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(Continued on inside of back cover)

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RIFFLE BEETLES IN THE GENUS *STENELMIS* (COLEOPTERA: ELMIDAE) FROM WARM SPRINGS IN SOUTHERN NEVADA: NEW SPECIES, NEW STATUS, AND A KEY[1]

Kurt L. Schmude[2,3]

ABSTRACT: *Stenelmis lariversi* sp. nov. is described from Ash Springs, Lincoln Co., Nevada, where it is apparently endemic. *Stenelmis moapa* is elevated to a species, separate from *Stenelmis calida*. Both species are endemic to southern Nevada. *Stenelmis calida* and *S. moapa* are closely related, but *S. lariversi* is more closely related to the widespread *S. occidentalis*, the only other species known from warm springs in southern Nevada.

I revised the North American species of the riffle beetle genus *Stenelmis* (Schmude 1992) as part of my doctoral dissertation, published descriptions of three new species (Schmude and Brown 1991, Schmude et al. 1992), and clarified the status of three others (Schmude and Hilsenhoff 1991). Recent studies of the benthic fauna in warm springs in southern Nevada have dealt, in part, with species of *Stenelmis* (W.D. Shepard, in litt.), but their taxonomic status needs to be updated so that valid names can be used. Thus, I describe in this paper one new species, elevate one previously described subspecies to specific level, and present a key to the species in the genus that occur in southern Nevada. Although I intend to publish a North American revision of *Stenelmis* as soon as possible, I wish to accommodate colleagues studying this group in Nevada by making the names available in a timely fashion.

Materials and methods, including abbreviations used for pronotal and elytral characters, are the same as those in Schmude and Brown (1991) and Schmude et al. (1992). A Wild M 400 Photomakroskop with Kodak TMAX 100 film at 25X magnification was used to obtain the habitus pictures (Figs. 1-3). The following institutions and individuals provided specimens for this study, while others are repositories: AMNH-American Museum of Natural History, New York, L.H. Herman; CASC-California Academy of Sciences, San Francisco, D.H. Kavanaugh, R. Brett; CNCI-Canadian National Collections, Ottawa; INHS-Illinois Natural History Survey, Champaign, K.C. McGiffen, K.R. Methven; LACM-Natural History Museum of Los Angeles County, Los Angeles, R.R. Snelling; LSUC-Louisiana State Univ., Baton Rouge, J.B. Chapin, C.B. Barr; MCZC-Museum of Comparative Zoology, Harvard Univ., Cambridge, S.R. Shaw, S. Pratt, D. Furth; NMNH-National Museum of Natural History, Smithsonian Institution, P.J. Spangler;

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NSDA-Nevada State Dept. of Agriculture, Reno, R.C. Bechtel; SEMC-Snow Entomological Museum, Univ. of Kansas, Lawrence, G.W. Byers, R.W. Brooks, J. Pakaluk, J.K. Gelhaus; UCRC-Univ. of California, Riverside, S.E. Frommer; UWIC-Univ. of Wisconsin, Madison; WSUC-Washington State Univ., Pullman, R.S. Zack; CBB-Cheryl B. Barr, Univ. of California, Berkeley; HPB-Harley P. Brown, Oklahoma Museum of Natural History, Norman; KLS-Kurt L. Schmude; WDS-William D. Shepard, California State Univ., Sacramento.

Stenelmis lariversi Schmude, NEW SPECIES

HOLOTYPE MALE. **Head:** Interocular width (IOW) 0.35 mm; dark medial stripe between eyes very narrow and short; light lateral stripes cover most of the area between the eyes and broadly connect posteriorly. Antennae and palpi testaceous.

Pronotum (Fig. 1): Pronotal length (PL) 0.93 mm, pronotal width (PW) 0.80 mm. Widest near midlength. Lateral margins sinuate basally, bisinuate apically; anterolateral angles narrow, deflexed, and divergent. Median sulcus (MS) shallow, narrow, and uniform in width. Median costae (MC) low and broad, more raised and mound-like posteriorly. MS and MC obsolete anterior 0.32 and posterior 0.07. Oblique lateral depression (OLD) moderate in depth. Lateral tubercles moderately prominent; posterior tubercle (PT) only slightly elongate. Area between anterior tubercle and anterolateral angles moderately raised and mound-like. Pronotal granules (PG) evenly scattered, not numerous, very small (as large as femoral granules), and difficult to discern anteriorly. Color dull gray-brown. Surface very pubescent, velvety in appearance.

Elytra (Fig. 1): Elytral length (EL) 1.95 mm, elytral width (EW) 0.96 mm. Background color brown; elytra immaculate. Discal costae 0.22 elytral length, low posteriorly, moderately raised and convergent anteriorly, reaching basal margin. Lateral carina indistinct, with only a low costa on interval 6. Surface very tomentose, but less so than pronotum. Punctures of elytral striae difficult to see amid tomentum. Scutellar granules not discernible.

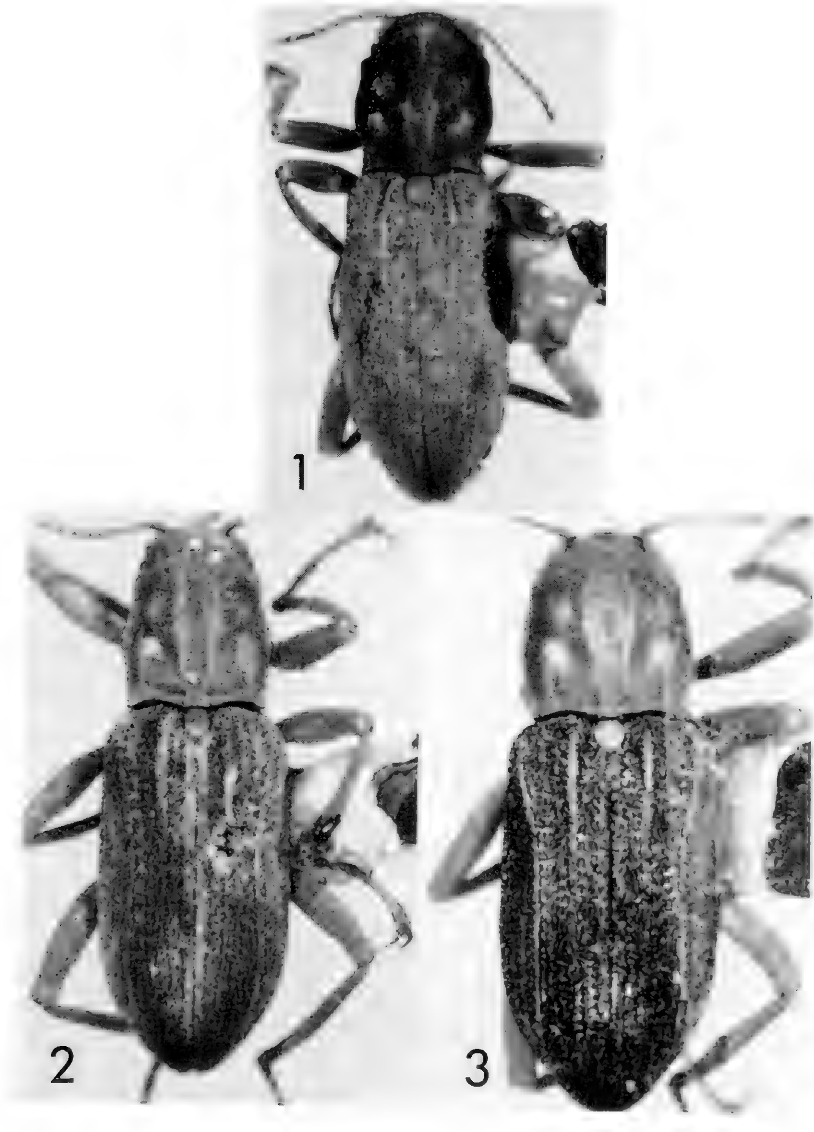
Venter: Apical emargination of last sternum slightly wider than apical width of tarsomere 5.

Legs: Femoral granules (FG) sparse, small, and of one size. Femora and tibiae pale gray; apices of femora, bases of tibiae, and tarsi testaceous. Mesotibial ridge low and elongate, located in distal half of segment; no metatibial ridge. Tarsomere 5 equal to or shorter than combined lengths of preceding four tarsomeres, and distinctly dilated in the apical half (not gradually widened from base to apex); tarsal claws short, narrow, and only slightly curved.

Genitalia (Fig. 4): Penis widest at base, progressively narrowed to middle where it is slightly bulbous for a short distance, gradually narrowed to its rounded apex. Parameres with inner dorsal margins slightly divergent, apices pointed and nearly at a 90 angle; outer margins subparallel basally, slightly sinuate and convergent apically; inner ventral margins slightly sinuate apically.

ALLOTYPE. IOW: 0.38 mm, PL: 0.96 mm, PW: 0.84 mm, EL: 2.00 mm, EW: 0.96 mm. Nearly identical to holotype. Pronotal MS and MC obsolete in anterior 0.39.

TYPE DATA. Holotype, allotype, and 110 paratypes: "NEVADA: Lincoln Co. Ash Springs, Hwy 93 30 May 1991 Coll'rs: C.B. Barr & W.D. Shepard"/ "Collected in Ash Springs, within warm springheads"/(red) "HOLOTYPE (or ALLOTYPE) STENELMIS LARIVERSI Schmude Det: K.L. Schmude"/(male genitalia in microvial). Holotype, allotype, and 12 paratypes are in the CASC. Paratypes are in the following collections: 12 NMNH, 8 INHS, 8 SEMC, 6 AMNH, 6 LSUC, 6 Monte L. Bean Museum, Brigham Young Univ., 2 CNCI, 2 UWIC, 14 CBB, 12 HPB, 9 KLS, 13 WDS. Nine additional paratypes (6 AMNH; 3 KLS) have the following label data: "Nev.; Lincoln Co. Ash Sprg.; warm May 4, 1973 Joe Schuh, Coll.". Twenty-two more paratypes (16 WSUC; 6 KLS) have the following label data: "NV: Lincoln Co., Ash Springs, Ash Spring 26 March 1992



Figs. 1-3. 1. *Stenelmis lariversi*, n. sp., paratype. 2. *S. moapa* La Rivers, paratype. 3. *S. calida* Chandler, paratype.

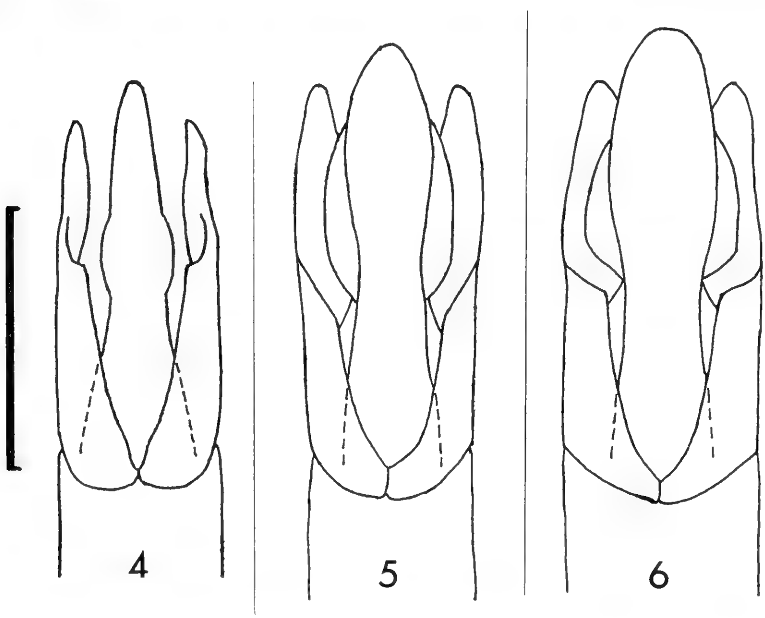
R.S. Zack & K.A. Rosema collectors". Three damaged specimens not designated as paratypes, but collected with the holotype, exist in the collections of CBB and WDS. Sixteen larvae and three pupae were also collected and are in the collections of CBB, WDS, and KLS. No additional specimens are known.

VARIATION (Table 1). All specimens in the type series are very similar. Pronotal MS and MC are obsolete in anterior 0.32-0.39. The pronotal OLD is shallow to deep. The length of tarsomere 5 varies from 0.03 mm shorter to 0.04 mm longer than the combined lengths of preceding four tarsomeres.

DIAGNOSIS. The uniquely shaped pronotum, which is widest near midlength and has narrow, deflexed, and divergent anterolateral angles, along with a densely pubescent, velvety appearance, is diagnostic. Adults are also easily recognized by their very tomentose elytra, and males by the shape of the penis.

ETYMOLOGY. Named in honor of Ira La Rivers for his extensive work on the fauna and flora of NV (Lugaski 1979).

DISTRIBUTION and ABUNDANCE. Presently this species is known only from the type locality. The population size is unknown, but it is probably relatively small; 116 adults were the most that were collected at one time.



Figs. 4-6. Male genitalia. 4. *Stenelmis lariversi*, n. sp., paratype. 5. *S. moapa* La Rivers. 6. *S. calida* Chandler, paratype. Scale bar = 0.25 mm.

HABITAT. Ash Springs is a series of warm springs (35.9° C) surrounding a man-made pool with a perennial outflow into a runoff stream (La Rivers 1948, Williams et al. 1985, Shepard 1993, C.B. Barr and W.D. Shepard, in litt.). C.B. Barr and W.D. Shepard collected the species in springheads around the pool's margin, with some adults as deep into the springhead as an arm could reach. Adults were not found in the pool's outflow stream despite extensive sampling, although *S. occidentalis* Schmude and Brown was found. R.S. Zack collected specimens from the same area, but about 50 m further away. He found adults only among small cobble and larger stones in a small riffle area that flowed from a pool. W.D. Shepard recently revisited Zack's site and found adults also inhabiting the springhead and submerged plants in still water areas. Several endangered or rare endemic desert fish, insects, and spring snails inhabit Ash Springs and nearby springs (Williams et al. 1985, C.B. Barr and W.D. Shepard, in litt.).

FLIGHT RECORDS. None, all specimens I examined were brachypterous.

STATUS. *Stenelmis lariversi* is likely endemic to warm springs in southern NV, and perhaps even to the type locality. Consequently, protection of the species and its habitat should be seriously considered.

Stenelmis moapa La Rivers, NEW STATUS

Stenelmis calida moapa La Rivers 1949:218. La Rivers 1950a:105, 1956:157, 1962:509; Brown 1972:20, 1983:10; Williams et al. 1985:47; U.S. Fish and Wildlife Service 1991:58828 (and as Moapa warm springs riffle beetle); Shepard 1992:380.

NEOTYPE MALE. The holotype of *S. moapa* is lost (see Remarks). **Head:** IOW 0.40 mm. Medial dark stripe narrowed posteriorly and narrower than each of the light stripes, which nearly cover entire area between eyes. Antennae and palpi testaceous.

Pronotum (Fig. 2): PL 1.11 mm, PW 0.94 mm. Lateral margins sinuate basally, convergent and bisinuate apically. MS relatively wide, widest anteriorly, narrowed basally. MC relatively low and narrow, most raised and narrowest posteriorly, slightly interrupted medially. MS and MC obsolete anterior 0.18 and posterior 0.10. OLD deep, clearly separating prominent lateral tubercles. PT nearly round, only barely longer than wide. PG medium size, not dense, uniformly distributed, and difficult to see. Color reddish gray. Surface covered with dense white tomentum and thin mineral deposit.

Elytra (Fig. 2): EL 2.34 mm, EW 1.16 mm. Discal costae moderately raised for 0.16 elytral length, broad, nearly reaching basal margin, which is raised between discal costae and anterior macula. Background color brown. Each elytron narrowly and faintly maculate; anterior macula confined to interval 5, longer than discal costa; posterior macula narrow anteriorly (interval 5), expanded posteriorly (striae 4-5), ending beyond lateral carina. Color pattern difficult to discern beneath tomentum, best seen when 95% ethanol is applied to surface (portion of white pubescence and mineral deposit scraped away medially). Lateral carina not sharply elevated; bowed inward medially. Fourteen scutellar granules, same size as PG.

Legs: FG numerous, moderately dense, and of two sizes, largest twice the size of smallest. Femora and tibiae reddish gray, tarsi testaceous. Mesotibial ridge low and elongate; metatibial ridge very low and short. Tarsomere 5 much longer than combined lengths of preceding four tarsomeres; basal portion elongate (0.60 length), dilated next 0.17 length, uniformly wide apical 0.23.

Genitalia (Fig. 5): Penis widest in apical half, narrowed from base to midlength, widened in apical half with margins arcuate; lateral flange distinct and abruptly expanded with basolateral angle rounded and obtusely subangular, narrowed apically, and becoming flush with sides of penis before a line drawn between apices of parameres. Parameres with inner dorsal margins moderately divergent, apices obtusely rounded; outer margins slightly convergent from base to middle where they are briefly convex, then margins convergent to apices.

TYPE DATA. Neotype and 12 paratypes: "Warm Spgs. Nev. XII-26-27-1948 LaRivers - Banta"/ (blue) "PARATYPE Stenelmis calida moapa Ira LaRivers"/ (red) "NEOHOLOTYPE"/ (red) "STENELMIS MOAPA La Rivers det: K. Schmude" (male genitalia in microvial). Three additional paratypes have the following labels: "NEVADA: Clark Co., Warm Springs, Pelocoris Meadow 26-27 December 1948 I. LaRivers, BHBanta Cal. Acad. Sci. Coll."/"IRA LA RIVERS COLLECTION Bequeathed to the CALIFORNIA ACADEMY of SCIENCES -1978"/(brown) STENELMIS CALIDA MOAPA La Rivers 1949 TOPOTYPE"/ (yellow) "STENELMIS MOAPA La Rivers det: K. Schmude". The neotype and nine paratypes are in the SEMC where they originated, three paratypes are in the CASC, and two paratypes are in the author's collection.
ADDITIONAL SPECIMENS EXAMINED. NEVADA: *Clark Co.* W Glendale [or NW Moapa], Big Pool & outflow streams (8 CBB; 8 KLS; 51 WDS), Muddy River (1 CBB; 7 WDS), Warm Springs (36 AMNH; 5 CASC; 6 NCST; 85 NMNH; 14 WSUC; 56 KLS; 181 WDS).

VARIATION (Table 1). Variation within the type series is minimal. MS, MC, and lateral tubercles are more pronounced in some specimens. Elytra appear less maculate to immaculate due to different amounts of tomentum and mineral deposits. Lateral carinae on elytra are not as bowed inward medially on a few beetles.

DIAGNOSIS. Adults are most similar to those of *S. calida* Chandler, an endemic species that occurs in springs in the Death Valley National Park; the two are likely sister species. The pronotum of *S. moapa* is narrower and not hump-like in lateral view; the elytra are also narrower (Table 1). Tarsomere 5 is much longer than combined lengths of preceding four tarsomeres. Additional characters are discussed under *S. calida*. Adults of *S. occidentalis* occur with *S. moapa*, but the combination of narrower elytra, tomentose pronotum, long tarsomere 5, and male genitalia will separate adults of *S. moapa*.

DISTRIBUTION and ABUNDANCE. This species was previously known only from the type locality, Big Pool, and its outlet streams in the Warm Springs Area, which are part of the headwater sources of the Muddy (or Moapa) R.; the general area was described by La Rivers (1950b) and Williams et al. (1985). In 1986, W.D. Shepard and C.B. Barr found adults to be also abundant in Warm Springs (within Warm Springs Resort) south of Big Pool, and uncommon in the Muddy R. north of Big Pool. All other specimens I have examined were merely labeled from the general area. Apparently, *S. moapa* is endemic to the Warm

Springs Area, but see Remarks. As with *S. calida* and *S.lariversi*, the population size is unknown, with as many as 149 collected at one time at the Warm Springs site.

HABITAT. Big Pool is a warmwater (32° C), limestone spring, and its outlet streams become progressively cooler away from the source (24 -32 C); La Rivers (1949, 1950b,c) described the Pool and outlets. La Rivers (1949) found the majority of adults in the outlet streams only a few feet downstream from Big Pool where they occurred on gravel, vegetation, and particularly bare tree roots in the swift, shallow water. Specimens have also been collected on roots and algal covered rocks on a sand-gravel substrate in the nearby Warm Springs and Muddy River. Endangered or vulnerable endemic desert fish, insects, and springsnails occur with *S. moapa* (Williams et al. 1985, C.B. Barr and W.D. Shepard, in litt.).

REMARKS. After La Rivers' death, his insect collection (except Naucoridae) was donated to the Nevada State Department of Agriculture in Reno (Lugaski 1979). The transfer of insects from the Biology Department at the University of Nevada-Reno was made by then curator R.C. Bechtel (and others). I received a loan of La Rivers' collection of *Stenelmis*, but no adults of *S. moapa* were present, even though the holotype, paratypes and other specimens were stated to be "in the author's collection" (La Rivers 1949). Upon my request, R.C. Bechtel conducted a thorough, but unsuccessful, search through La Rivers' insect collection. Since the types of other species of insects described by La Rivers were present in the collection (R.C. Bechtel, pers. comm.), including a synoptic collection of *Stenelmis* that featured 40 paratypes of *S. calida* among other paratypes, I was mystified by the absence of *S. moapa*. Furthermore, paratypes were not present at the AMNH, NMNH, or the British Museum of Natural History, as stated by La Rivers (1949); the Paris Museum, also mentioned by La Rivers (1949), was not contacted. Fortunately, three specimens from the type series were sent to the CASC less than a year after La Rivers' death, which would suggest at least part of the series existed in 1978. Also, 13 paratypes were found in the SEMC, which were sent by La Rivers to M.W. Sanderson (M.W. Sanderson, in litt.). These 16 paratypes are the remains of what was likely a large type series, based on La Rivers' collecting habits. La Rivers probably kept at least some of his material in alcohol (La Rivers 1949:218, footnote), but no alcoholic material now exists in his collection (R.C. Bechtel, pers. comm.). Based upon this information, and upon the careful gathering of La Rivers' collection at the time of its transfer, R.C. Bechtel believes the remainder of the type series is lost, and I agree. To stabilize nomenclature among the growing number of species of *Stenelmis* found in southern Nevada, I designated a neotype from among the remaining 16 paratypes.

La Rivers (1949, 1950a) stated he found *S. moapa* at Ash Springs and in Hiko Spring in Lincoln Co., north of Warm Springs. These specimens (likely preserved in alcohol) have also disappeared, which is unfortunate because *S. moapa* has not been collected at Ash Springs, though *S. lariversi* and *S. occidentalis* have been found; I am unaware of any existing specimens of *Stenelmis* from Hiko Spring. It is also possible that some of La Rivers' type series of *S. moapa* included *S. occidentalis* since this species also occurs in the Warm Springs Area.

STATUS. This species is considered a federal species of concern, formerly designated as C2 (USFWS 1991).

Stenelmis calida Chandler

Stenelmis calida Chandler 1949:133. La Rivers 1949:220, 1956:157; 1962:509.

Stenelmis calida calida Chandler. La Rivers 1949:221, 1950a:105, 1956:157; Leech and Chandler 1956:361; Brown 1972:20, 1983:10; Williams et al. 1985:43; U.S. Fish and Wildlife Service 1991:58828.

Stenelmis calidae Chandler and *Stenelmis c. calidae* Chandler. Minckley and Deacon 1975:107, 108 (incorrect subsequent spellings).

Devil's Hole Warm Spring riffle beetle—Hershler and Sada 1987:841; U.S. Fish and Wildlife Service 1991:58828.

DIAGNOSIS. Because of its endemism, identification of *calida* can be based solely on its distribution. Adults are most similar to *moapa* but have a wider pronotum that appears humped in lateral view (Fig. 3). They also have wider elytra (Table 1), and the length of tarsomere 5 compared to the combined lengths of preceding four tarsomeres is much less. The penis is wider with the enlarged apical portion longer and wider; the lateral flange is more angular basolaterally (Fig. 6). Apices of the inner dorsal margins of the parameres are more sharply angled.

DISTRIBUTION and ABUNDANCE. Prior to Schmude (1992), verifiable records of *S. calida* were known only from Devil's Hole in Ash Meadows. The species is now known from the following nearby warm springs: Indian, Point of Rock, North and South Scruggs, Marsh, Bloody Gulch, and possibly Mexican (Schmude 1992, Shepard 1992, Shepard and Threloff 1997). A series of adults was found in the NMNH with locality labels that read "NV:Mercury N.T.S." (Nevada Test Site). These beetles were collected during a study for the Atomic Energy Commission, but were apparently not collected in Mercury, NV; Mercury refers to the project name (P.J. Spangler, pers. comm.), and the exact site location is unknown. La Rivers (1962) reported that adults occurred at several places in addition to Devil's Hole, and he stated this species was a "common part of the fauna of hardscrabble creeks...in Ash Meadows," but adults he or others may have collected have not been located and probably do not exist anymore (see Remarks under *S. moapa*). The size of the population in Devil's Hole is unknown, but the largest known series is the type series, which consists of at least 131 specimens; La Rivers (1950a) stated this species "occurs in large numbers." In the other

Table 1. Variation of six mensural characters (mm) and their ratios for adults of *Stenelmis lariversi, S. calida*, and *S. moapa*. Measurements taken at 72X magnification. PL: pronotal length, PW: greatest pronotal width, EL: elytral length, EW: greatest elytral width, PE Length: summed individual lengths of pronotum and elytra, IOW: interocular width.

n	PL	PW	PW/PL	EL	EW	EL/EW	PE Length	IOW
Stenelmis lariversi								
♂ 40	0.83-1.06	0.68-0.89	0.77-0.89	1.68-2.23	0.84-1.08	1.96-2.23	2.51-3.29	0.31-0.40
♀ 40	0.84-1.10	0.73-0.95	0.81-0.89	1.75-2.23	0.85-1.05	1.95-2.23	2.59-3.31	0.33-0.40
Stenelmis calida								
♂ 70	1.01-1.28	0.94-1.26	0.86-0.99	2.13-2.63	1.16-1.48	1.71-1.96	3.14-3.88	0.40-0.49
♀ 78	1.04-1.25	0.94-1.18	0.87-0.96	2.18-2.60	1.13-1.43	1.76-2.00	3.24-3.85	0.39-0.50
Stenelmis moapa								
♂ 31	0.91-1.18	0.74-1.00	0.79-0.87	1.95-2.50	0.95-1.24	1.95-2.07	2.88-3.68	0.36-0.44
♀ 37	0.91-1.23	0.75-1.06	0.80-0.87	1.91-2.59	0.91-1.28	1.99-2.15	2.83-3.81	0.36-0.45

springs, many fewer adults were collected (maximum = 29, Indian Springs), mainly due to the fragile habitat (W.D. Shepard & R.S. Zack, pers. comm.). Sizes of the populations are assumed to be relatively small, but W.D. Shepard (in litt.) believes, "the populations are more abundant than previously suspected. However, due to the difficulty of working in the area, we have located only a few [populations]. But, the area is loaded with hard-to-find springs, many of them unnamed." W.D. Shepard (in litt.) is currently studying the ecology of *S. calida.*

HABITAT. Devil's Hole is a warm-water (32.8-33.9° C) pool within a limestone cavern that has been well described (Miller 1948, Chandler 1949, La Rivers 1950a, Dudley and Larson 1976, Williams et al. 1985, Hershler and Sada 1987). The beetles live among rocks on a shallowly submerged shelf, and apparently feed on the abundant algae. Water depths varied from a few inches to three feet (La Rivers 1950a), but due to groundwater pumping (Dudley and Larson 1976), recent depths varied from zero to several inches (W.D. Shepard, in litt.). The beetles share this habitat with the endemic and endangered (USFWS 1996) Devil's Hole pupfish, *Cyprinodon diabolis* Wales, which occasionally feeds on adults and larvae of the riffle beetle (Minckley and Deacon 1975). Adults from the other springs were collected in the outflow streams, which are extremely narrow and deeply incised into the desert floor (La Rivers 1953, Hershler and Sada 1987, Shepard 1992 and in litt.). Point of Rocks Springs was also described by La Rivers (1953); it harbors the federally endangered naucorid *Ambrysus amargosus* La Rivers (USFWS 1996).

SPECIMENS EXAMINED. NEVADA: *Nye* Bloody Gulch (2 KLS). Devil's Hole (65 CASC; 12 INHS; 5 LACM; 52 MCZC; 13 NMNH; 40 NSDA; 9 SEMC; 3 UCRC; 2 HPB; 6 KLS; 25 WDS). Indian Springs (6 KLS; 23 WDS). Marsh Spring (10 WSUC; 6 KLS). "Mercury" (see text: 46 NMNH; 5 KLS). North Scruggs Spring (11 WSUC; 10 KLS). Point of Rocks Springs (6 WDS). South Scruggs Spring (10 WSUC; 4 KLS).

STATUS. Unlike its neighbors, *Cyprinodon diabolis* and *Ambrysus amargosus*, *Stenelmis calida* is considered as a federal species of concern, formerly designated as C2 (USFWS 1991). Fortunately, the U.S. Fish and Wildlife Service manages Devil's Hole and the immediately surrounding land in Ash Meadows National Wildlife Refuge, which furnishes considerable protection for all its inhabitants.

Stenelmis occidentalis Schmude and Brown

Schmude and Brown (1991) described and illustrated this species, and provided measurements for specimens collected in southern Nevada. They also included comments on its diagnosis, distribution, abundance, and habitat.

Key to adults of *Stenelmis* in southern Nevada

1. Pronotum very pubescent, velvety in appearance, with anterolateral angles narrow, divergent, and deflexed; elytra very tomentose; penis without lateral flange; PE length 2.52-3.31 mm; Ash Springs .... *lariversi*
   Pronotum at most tomentose, not velvety in appearance, with anterolateral angles wider, most commonly subparallel, and not deflexed; elytra at most moderately tomentose; penis with or without lateral flange 2
2. Pronotum tomentose; tarsomere 5 elongate, 0.06-0.14 mm longer than combined lengths of preceding four tarsomeres; penis with lateral flange; PE length 2.83-3.81 mm; Warm Springs Area .... *moapa*
   Pronotum not tomentose; tarsomere 5 shorter, 0.04 mm shorter to 0.06 mm longer than combined lengths of preceding four tarsomeres; penis with or without a lateral flange 3
3. Anterior portion of pronotum appearing humped, deflexed; penis with lateral flange; PE length 3.14-3.88 mm; Devil's Hole and nearby springs .... *calida*
   Pronotum not noticeably deflexed or hump-like; penis without lateral flange; PE length 3.19-3.84 mm; Muddy R. and outflow streams of Warm and Ash Springs .... *occidentalis*

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NOTES ON THE INTRODUCED ANT *QUADRISTRUMA EMMAE* (HYMENOPTERA: FORMICIDAE) IN FLORIDA[1]

Mark Deyrup[2], Stephen Deyrup[3]

ABSTRACT: The Old World tropical ant *Quadristruma emmae* is reported from 28 counties in southern and central Florida, where it occurs in a variety of man-modified and natural, xeric and mesic habitats. Based on its habitat requirements, it is expected to colonize sheltered urban habitats in the southwestern United States. A captive colony caught and consumed entomobryid Collembola. This species, along with the neotropical exotic *Strumigenys eggersi*, are common throughout southern Florida, and may have had local effects on some northern species of dacetines of the genus *Smithistruma* whose ranges extend into central and southern Florida, but these exotic dacetines are not expected to endanger native species of ants. Three males collected in flight traps are believed to represent this species, based on size, and the structure of the mandible and forewing.

The ant *Quadristruma emmae* (Emery) (Fig. 1) is a tramp species known from Florida, the West Indies (specimens reported from the Bahamas: San Salvador, North Andros, New Providence; Cuba; Puerto Rico; and U.S. Virgin Islands: St. Thomas), Africa, India, the Seychelles, Malaysia, Indonesia, New Guinea, Australia, New Hebrides, the Philippines, Guam, and Hawaii (Bolton 1983). It is clearly native to the Old World tropics, where its only congener occurs. Brown (1954) suggested that the species originated in Africa as a lineage derived from the *Strumigenys rogeri* Emery species group. *Quadristruma emmae* is the only ant in Florida (or the United States) whose antennae have only four segments. Other character states useful for identification are the bowed jaws with two apical teeth, the large spoon-shaped hairs with discoid tips on the head (Fig. 1), and the small size (length of worker about 1.4 mm, length of female about 1.7 mm). Outside the U.S., the distinction between *Quadristruma* and the large, diverse genus *Strumigenys* depends primarily on the reduced number of antennal segments in the former genus, and *Quadristruma* may eventually be subsumed into *Strumigenys* (Brown 1954). There is no possibility of confusing *Q. emmae* with any Florida species of *Strumigenys*.

The purpose of this note is to describe the range and habitat preferences of *Q. emmae* in Florida, present some information on its diet and colony composition, consider its possible ecological impact on native species, and describe specimens that are believed to be the previously unknown male.

DISTRIBUTION AND ECOLOGY

Quadristruma emmae is presently confined to southern and central penin-

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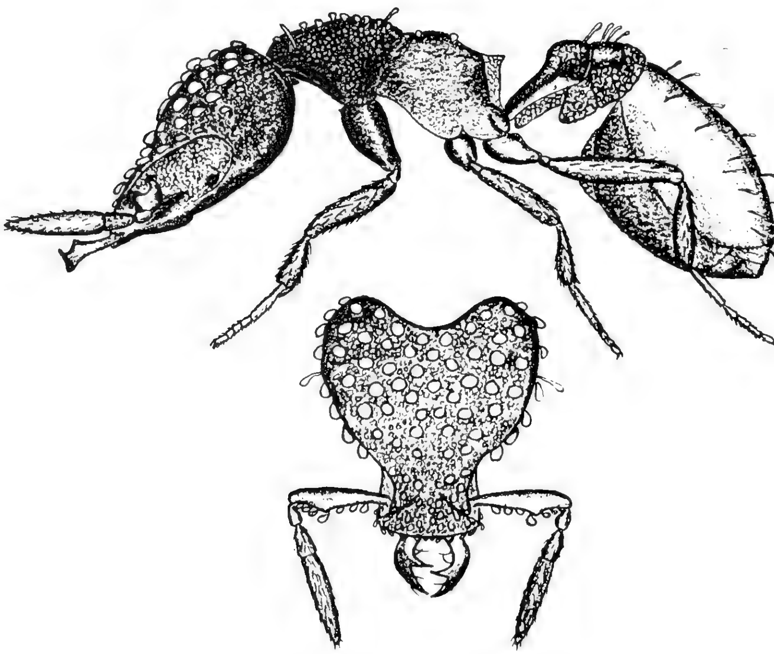

Figure 1. *Quadristruma emmae*, worker.

sular Florida. The site records in Fig. 2 are from a study of litter-inhabiting ants from throughout Florida, including hundreds of Tulgren funnel extractions from sites north of the sites shown in Fig. 2. *Quadristruma emmae* was not found by Johnson in his exhaustive study (1986) of the ants of Alachua County. The distribution of this species in Florida, as well as its world distribution (Bolton 1983), suggest that it will not become a common species in the colder parts of Florida, or elsewhere in the U.S. It is, however, an abundant species in southern Florida areas that are centers of the nursery trade, and it is likely to be transported all over the southeastern U.S. and eventually into the Southwest, where it might establish populations in protected microclimates, especially in urban areas. It may already occur in cities in southern Texas, Arizona, New Mexico, and California, all states with such varied and exciting natural habitats for ants that their anthropogenic habitats may receive less attention. In southern Florida, it has been found in most xeric and mesic sites that have been intensively sampled. Gaps in the distribution map are primarily due to extensive wetlands or problems of access for collecting litter samples.

Quadristruma emmae was first reported in Florida by Brown in 1949. There is a specimen from Homestead (Dade County), Florida, dated 25 June 1945, in the Florida State Collection of Arthropods. It is next reported forty years later at a site in south-central Florida (Deyrup and Trager 1986), soon after from several sites in the Florida keys (Deyrup et al. 1988), then from 15 Florida counties (Deyrup et al. 1989), and now from 28 counties. Although this history gives the impression of an exotic species that has had a recent, almost explosive increase through southern and central Florida, this impression is probably wrong. The increase in records is probably due to the survey of ants in leaf litter that has been going on over the last 12 years.

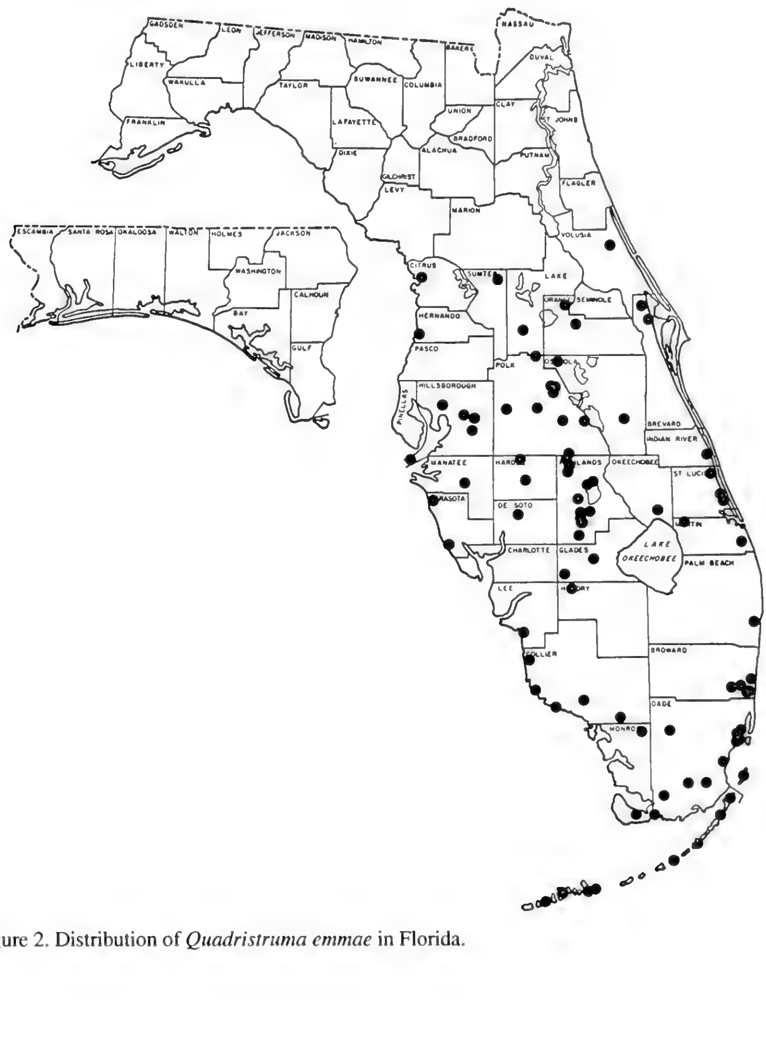

Figure 2. Distribution of *Quadristruma emmae* in Florida.

In this survey of litter-inhabiting ants, using standardized, unsifted, approximately 2-liter samples of litter, we found *Q. emmae* in 227 samples at 99 sites. The sites were roughly categorized as xeric, mesic, or wet. Of the sites that had *Q. emmae,* 39 were xeric, 49 were mesic, 11 were wet. The sites were also roughly categorized as highly modified by human activity, somewhat modified, and unmodified. Highly modified areas included planted areas, such as mulched hedges along shopping malls, avocado groves, dense stands of exotic trees, and all urban sites. Somewhat modified areas include those that are adjacent to large roads, or have some soil disturbance, or an admixture of large exotic plants, and most suburban sites. Unmodified areas are natural plant communities, including some unburned Florida scrub and sandhill sites; even though fire suppression might be considered a type of modification of natural habitats, there were probably always some patches of these xeric forest types that went an unusually long time between fires. Of the sites that had *Q. emmae*, 28 were highly modified, 29 were somewhat modified, and 42 were unmodified.

Habitat types were also assigned to these collecting sites. The sites with *Q. emmae* were distributed among the following habitats:

39 – xeric forest (old growth, long unburned Florida scrub and sandhill)
22 – mesic forest (oaks, often with pines; plantings of large exotic trees; riparian forest)
13 – tropical hardwood hammock
10 – shrub plantings and landscape trees; mulched areas near buildings and lawns
5 – wet hardwood hammocks that do not flood regularly
3 – open, recently burned sandhill
2 – swamp forest
2 – pine flatwoods
2 – tropical pine rocklands
1 – marsh tussocks

The litter samples used in this study were indexed by site and date. Out of 908 samples that were collected at a site and date where *Q. emmae* was found, 227 (exactly 25%) contained *Q. emmae*. The percentage at particular sites and dates varies, but overall where *Q. emmae* occurs it is a common species.

We made a list of ants for each of the 227 litter samples that contained *Q. emmae.* This list shows that *Q. emmae* almost always occurs with other species of ants, with which it must be compatible and with which it must share microhabitat requirements. There were 15 samples with no other ant species; 40 with 1 other ant species; 64 with 2 other ant species; 45 with 3 other ant species; 33 with 4 other ant species; 21 with 5 other ant species; 8 with 6 other ant species; and 1 with 7 other ant species. The list of species and the number of times that they occurred together with *Q. emmae* is in Table 1; included in this table is an indication of which species are exotics and which are dacetine ants.

Two colonies of *Q. emmae* were examined. One was in a hollow acorn in leaf litter in a mesic forest at Spruce Creek Preserve, Volusia Co.; this nest had one

Table 1. Species of ants found together with *Q. emmae* in 227 small litter samples. Exotics denoted by asterisk (*). Other dacetines denoted by plus sign (+).

No. of Co-occurrences	Species
99	*Solenopsis abdita* Thompson
74	*+*Strumigenys eggersi* Emery
70	*Solenopsis tennesseensis* Smith
53	*Hypoponera opacior* (Forel)
40	*Brachymyrmex depilis* Emery
31	**Wasmannia auropunctata* (Roger)
26	*Pheidole dentigula* Smith **P. moerens* Wheeler
21	*Pheidole floridana* Emery
14	*Paratrechina wojciki* Trager
13	*Cyphomyrmex minutus* Mayr +*Strumigenys louisianae* Roger
10	*Solenopsis nickersoni* Thompson
9	**Pheidole flavens* Roger
8	**Odontomachus ruginodis* Smith
7	*Odontomachus brunneus* (Patton)
5	+*Smithistruma talpa* (Weber), *+*Strumigenys rogeri* Emery
4	*Aphaenogaster miamiana* Wheeler, *Eurhopalothrix floridana* Brown & Kempf, **Paratrechina guatemalensis* (Forel), *Pheidole dentata* Mayr,*+*Strumigenys gundlachi* (Roger)
3	**Hypoponera punctatissima* (Roger), *Paratrechina faisonensis* (Forel), *Pheidole metallescens* Emery, +*Smithistruma ornata* (Mayr), *Solenopsis geminata* (Fabricius), *+*Trichoscapa membranifera* (Emery)
2	*Aphaenogaster treatae* Forel, *Hypoponera opaciceps* (Mayr), *Monomorium floricola* (Jerdon), +*Smithistruma creightoni* (Smith), +*S. dietrichi* (Smith), *Solenopsis carolinensis* (Forel),**Solenopsis invicta* Buren, **Tapinoma melanocephalum* (Fabricius).
1	*Amblyopone pallipes* (Haldeman), *Aphaenogaster ashmeadi* (Emery), *A.fulva* Roger, *Camponotus floridanus* (Buckley), **Cardiocondyla emeryi* Forel, **C. wroughtonii* (Forel), *Crematogaster lineolata* (Say), **Cyphomyrmex rimosus* (Spinola), *Discothyrea testacea* Roger, *Hypoponera inexorata* (Wheeler), *Leptothorax torrei* (Aguayo), *Monomorium viride* Brown, *Myrmecina americana* Emery, *Odontomachus clarus* Roger, **Paratrechina bourbonica* (Forel), *P. concinna* Trager, **P. longicornis* (Latreille), **Tetramorium caldarium* (Roger), **T. simillimum* (Smith), *Trachymyrmex septentrionalis* (McCook)

queen, 14 workers, and brood. A second colony was found in a hollow, buried acorn of *Quercus chapmanii* in xeric scrub forest at the Archbold Biological Station, Highlands Co. This colony had one queen, 42 workers, and brood. When the acorn from Highlands Co. was opened, there was one dead, white mite with one leg detached, and a shriveled entombryid collembolan that was being eaten by a larva. This colony was offered a wide variety of living soil organisms sifted from leaf litter, and the next day there were 7 dead entomobryids in the colony inside the acorn, including one collembolan that was being eaten by a larva. The next day two larvae were seen feeding on entomobryids. It appears that entomobryid Collembola are a preferred prey of *Q. emmae*.

SUMMARY OF POSSIBLE ECOLOGICAL IMPACTS OF *Q. EMMAE*

Quadristruma emmae has colonized all of southern and south-central Florida, where it is a common species in a variety of xeric and mesic habitats. To those of us who are concerned about the integrity of southern Florida's natural communities, it should be particularly disturbing that *Q. emmae* seems to regularly invade natural communities. In these natural communities *Q. emmae* could be having two undesirable effects: 1) changing the population structure of native prey species, and 2) displacing native species, especially other species of dacetine ants, that feed on Collembola. For the first, there is no evidence of any sort; we do not even know whether the prey are themselves native species; for all we know *Q. emmae* could be helping to restore a balance between exotic and native Collembola. For the second, we have the evidence of co-occurring species (Table 1), from which it can be seen that *Q. emmae* seldom occurs with any other species of dacetine ant, except for *Strumigenys eggersi* Emery, which is itself an even more pervasive exotic, originating in the Neotropics. The known native dacetine ants of Florida consist of *Strumigenys louisianae* Roger and at least 21 species of *Smithistruma*. There is excellent evidence from our unpublished collecting data that most species of *Smithistruma* are more northern, and become scarce well before the northern edge of the range of *Q. emmae* or *S. eggersi*. There are several species of *Smithistruma* that have ranges that extend into south-central Florida in swamp forest and wet hammock areas, but these are not favored habitats for *Q. emmae* (though they have been invaded by another exotic dacetine, *Strumigenys rogeri* Emery). The species most likely to have been affected in south-central Florida are *Smithistruma talpa* (Weber), *S. creightoni* (Smith), and *S. dietrichi* (Smith), all of which occur in xeric forest. In more mesic sites, *S. ornata* (Mayr) and *Strumigenys louisianae* might be displaced by *Q. emmae*, in combination with *S. eggersi*. In tropical Florida there is no evidence that there were ever any native dacetines other than *Strumigenys louisianae* and *Smithistruma dietrichi*. There are records of these species from the 1960's, and both species still occur in the Florida keys (Deyrup et al. 1988), although they are rare. To summarize, *Q. emmae* and other exotic dacetine ants have invaded south and south-central Florida on a grand scale, and there is a good chance that they have displaced, or are displacing, native species of dacetines that are northern in origin and less well adapted to tropical and subtropical conditions. At this point, however, we do not seem to be facing the prospect of the displacement of any Florida species of dacetine ant throughout or beyond its range in Florida.

Although one might go to almost any ecological preserve in southern Florida and immediately find large numbers of *Q. emmae* or other exotic dacetines polluting what appear to be natural communities, there is no reason to suspect that these natural communities are about to collapse, beginning with the soil microfauna. Our samples show that many native litter-inhabiting ants seem to be compatible with *Q. emmae* (Table 1). Moreover, although the litter fauna is an important component of natural ecosystems, the soil community itself can be considered a mass of subsystems, and the dacetine-collembolan interaction is only part of one subsystem. One of the features of highly complex biological systems is their resilience in the face of minor pollutants; another feature, however, is that the limitations of this resilience are usually unknown, and we are none too sure of what we can legitimately characterize as a "minor" pollutant.

THE MALE OF *Q. EMMAE*

The male of *Q. emmae* is undescribed. We did not find males in the nests that we have examined. We found, however, three males in flight traps at the Archbold Biological Station that we believe represent this species (Fig. 3) for the following reasons. 1). Morphological correlates with the female. The mandibles of these males are strongly bowed, notched at the base, and tilted upward, as in the female and the worker (Fig. 1); these are not character states known from other North American dacetines. The rare exotic *Epitritus hexamerus* Brown (not known from the Archbold Biological Station) also has bowed mandibles in the worker, but the males that we take to be *Q. emmae* are considerably smaller (total length 1.45 mm; length of forewing 1.85 mm) than one would expect for *E. hexamerus* males (the male of this species is unknown). The forewings closely resemble those of the female, including the development of the stigma, the length and width of the radial spur and the development of its distal knob, and the density of setation on various parts of the wing. 2). There are no other dacetines that can be associated with these males at the Archbold Biological Station, a site that has probably been more intensively sampled for dacetines than any other site of comparable size in Florida. Of the dacetines known from the Station, we have seen Florida specimens with associated males of *Strumigenys louisianae*, *Smithistruma dietrichi*, *S. ornata*, and *S. talpa*. The male of *S. clypeata* is described by Brown (1953); males of *S. creightoni* were examined by Brown (1964), who probably would have mentioned any aberrant development of the mandibles; and we have seen some large, unassociated

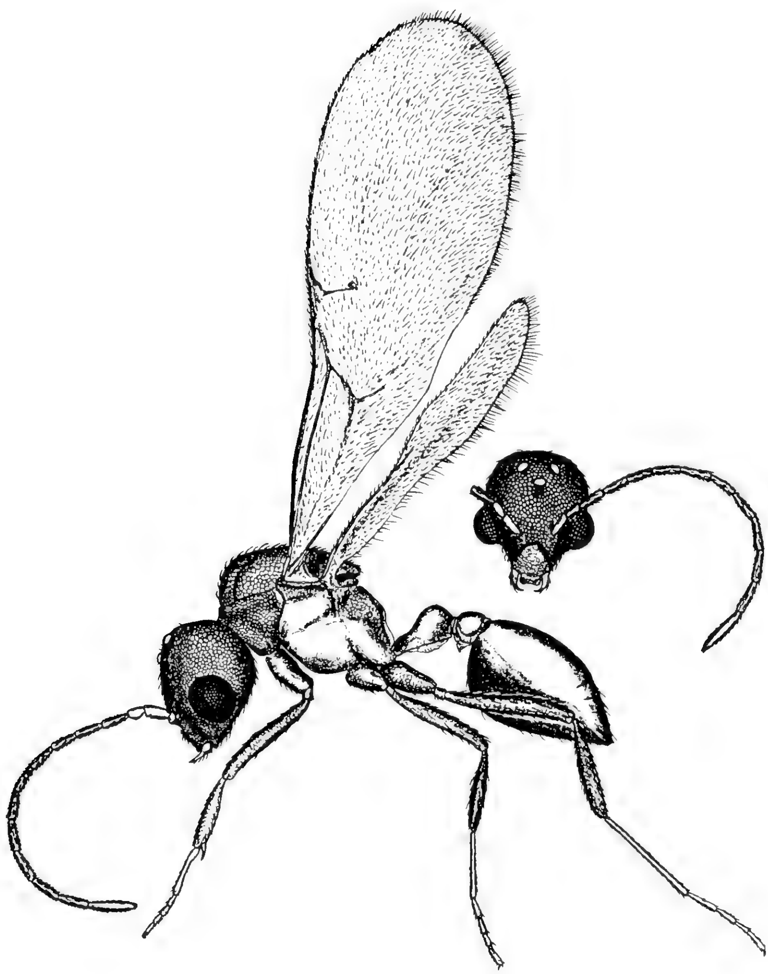

Figure 3. Presumed male (unassociated) of *Quadristruma emmae*.

males that are probably the males of *Strumigenys rogeri*. The males of the two remaining species, *Strumigenys eggersi* and *Trichoscapa membranifera* (Emery), are unknown, but if these specimens were males of either of those species we would be forced to assume that the male mandibles had evolved in a divergent and specialized way, rather than being feeble and probably functionally insignificant reflections of female and worker mandibular development (e.g., the male mandibles of *Smithistuma rostrata* (Emery), illustrated in Brown 1953).

The three males were collected in 1986 on July 25, 28, and Dec. 29, in Townes-style Malaise traps set up on a trail in dense sand pine scrub habitat. Over a period of three years, seven alate females were collected in these same traps, and four of these females were collected on July 14, 24, and 28 in 1986, so there is some coincidence in the flight activity of female *Q. emmae* and the presumed male of the species.

ACKNOWLEDGMENTS

We thank Zachary Prusak and Lloyd Davis for collection records from the northern part of the range of *Q. emmae*, and Clifford Johnson, Lloyd Davis, Zachary Prusak, and Walter Suter for surveys of litter ants in north Florida that help establish its absence in the northern part of the state. We thank Stefan Cover and Lloyd Davis for reviewing the manuscript, and an anonymous reviewer for meticulous and knowledgeable comments and corrections.

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OCCURRENCE OF *ONTHOPHAGUS NUCHICORNIS* (COLEOPTERA: SCARABAEIDAE) IN NORTH DAKOTA.[1]

Paul P. Tinerella, Gerald M. Fauske[2]

ABSTRACT: The present distribution of *Onthophagus nuchicornis* in North Dakota and historical information on its spread through the state is presented. An identification key to the *Onthophagus* sp. of the Dakotas is provided.

Introduction of select saprophagous Scarabaeidae took place in North America for livestock fecal reduction in pasture lands (Fincher 1981). In most cases, introductions were intentional, however, in the case of *Onthophagus nuchicornis* (Linnaeus) this introduction is believed to have been accidental. Documentation of the early introduction and subsequent spread of *O. nuchicornis* is recounted by Brown (1940). He noted that it was described as *O. rhinoceros* Melsheimer in 1844 from Pennsylvania and that it was also reported in 1881 by Henshaw from the Magdalen Islands. This dual eastern and western introductions and the subsequent distribution of *O. nuchicornis* were mapped by Howden (1966). A recent review of the spread of adventive scarabs in North America was provided by Hoebeke and Beucke (1997). This review documented the inland dispersal of *O. nuchicornis* from its points of introduction; however, no records were provided from the northern Great Plains, yet specimens of *O. nuchicornis* were present in the North Dakota State Insect Reference Collection (NDSIRC).

This report is based on 198 specimens of *O. nuchicornis* collected from 1981 through 1996. These records represent new distribution points for North Dakota. Discussed below are the chronology of these records and the inferred spread of *O. nuchicornis* in the northern Great Plains. Because existing regional keys omit one or more species of *Onthophagus* Latreille known from North and South Dakota (Helgesen and Post 1967, Ratcliffe 1991), a key is provided for the identification of *Onthophagus* from the Dakotas.

ESTABLISHMENT OF *ONTHOPHAGUS NUCHICORNIS* IN THE DAKOTAS.

Two historical markers exist as starting points in this investigation: Helgesen and Post (1967) and Kirk and Balsbaugh (1975). Helgesen and Post provided an identification guide to the saprophagous Scarabaeidae of North Dakota, and included three species of *Onthophagus* – *hecate* (Panzer), *orpheus* (Panzer), and *pennsylvanicus* Harold. Kirk and Balsbaugh compiled a list of South Dakota

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beetles, and recorded five species of *Onthophagus* – *cynomysi* Brown, *hecate*, *orpheus* , *pennsylvanicus*, and *striatulus* (Beauvois)[3]. Neither work listed *O. nuchicornis*.

Helgesen and Post (1967) targeted the scarabs, their publication being the culmination of a statewide two year survey combined with NDSIRC and literature records. Their work can be taken as evidence lending support to the idea that *O. nuchicornis* was not present in North Dakota prior to 1967. Little active scarab beetle collecting was done in North Dakota from 1974 through 1992. However, during that time period the first known North Dakota specimen of *O. nuchicornis* was collected from Cass County in 1981.

Use of the Balsbaugh and Kirk (1975) list as a benchmark is more problematic as there was no statewide survey of the Scarabaeidae. Records given in that work were based upon the literature, specimens present in the collection of the senior author of that work, and those from the Severin-McDaniel [formerly H.C. Severin] Insect Research Museum (SMIM) at South Dakota State University.

With respect to scarab beetles, collection records for South Dakota were sporadic from 1956 through the late 1980's; *O. nuchicornis* was not reported by Kirk and Balsbaugh (1975), nor are there specimens in the SMIM. Another species, *O. cynomysi*, was reported in the Kirk and Balsbaugh list and probably collected in the '60's or early '70's – just prior to the time when we would expect the first records of *O. nuchicornis* from South Dakota. Unfortunately these specimens have not been located in either the SMIM or USNM insect collections. Data for the *O. cynomysi* specimens are as follows. Specimens were taken at Chamberlain, South Dakota, in September – no year of collection was given by Balsbaugh and Kirk (1975). Those specimens were identified by Cartwright. Howden and Cartwright (1963) revised the North American species of *Onthophagus*, but gave only New Mexico and Oklahoma localities for *O. cynomysi*.[4] This is supporting, but not conclusive, evidence that *Onthophagus cynomysi* was collected between 1963 (Howden and Cartwright revision) and 1975 (Balsbaugh and Kirk list). Relating back to the use of the Kirk and Balsbaugh list as a benchmark: *O. nuchicornis* was not reported from South Dakota by 1975, there are no specimens in the SMIM, *O. cynomysi* was reported from the state – probably in the 1960's or early 1970's – just prior to the expected appearance of *O. nuchicornis*, and Paul Johnson (personal comm.) informs us that he has seen *O. nuchicornis* from South Dakota – 1990's, but this is after the crucial time of its spread into the Northern Great Plains.

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[3] Reported by Kirk and Balsbaugh (1975) as "*Onthophagus janus* Panzer." This name, original combination *Scarabaeus janus* Panzer 1794, is a primary homonym of *Scarabaeus janus* Olivier 1789. *Onthophagus* [*Copris*] *striatulus* (Beauvois) 1809 is the oldest available replacement name (Howden & Cartwright 1963).

[4] Note that *O. cynomysi* was not listed by Ratcliffe (1991) from Nebraska or by McNamara (1991) from Canada.

SPREAD OF *ONTHOPHAGUS NUCHICORNIS* ACROSS NORTH DAKOTA

Based on chronological sequence and collection history of the state, we believe the records contained in the NDSIRC can be used to reconstruct the westward expansion of *O. nuchicornis* across North Dakota. The presence of *O. nuchicornis* in Minnesota was established with records reported by Hoebeke and Beucke (1997). We report here two specimens collected in 1975 from Ottertail County, Minnesota. These collections predate other published records by four years, and thus serve to confirm the presence of *O. nuchicornis* in western Minnesota prior to the first North Dakota records. The earliest known North Dakota records are two specimens collected in a sunflower extract trap from Cass County, during 1981.

The westward expansion of *O. nuchicornis* (fig. 1) can be inferred from subsequent North Dakota records. In 1982, one specimen was collected from a fecal pat in Ransom County. In 1983 and 1984, small series' were taken again in fecal pats collected from Ransom County (see below for chronological collection data). In 1984, the first records were collected from Richland County by the

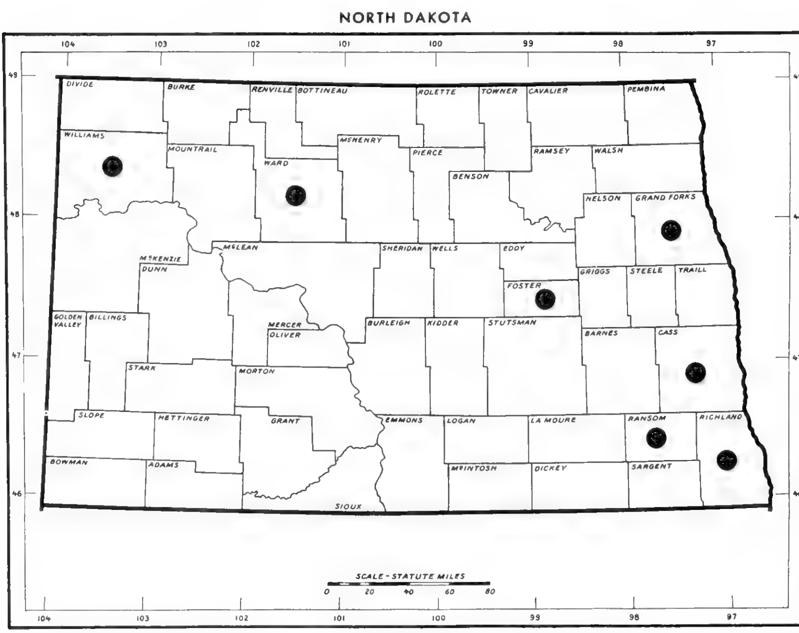

Figure 1. Known distribution of *Onthophagus nuchicornis* in North Dakota.

same means (this series yielded the greatest number of specimens of *O. nuchicornis* collected in the state prior to 1990). In 1987, Ward and Williams County specimens were collected in pitfall traps from agricultural study plots near Minot and Williston, respectively. These far western locality records were obtained over the span of a single field season. Low numbers collected from these sites probably indicate the recent arrival of *O. nuchicornis* and may be analogous to the pre-1990 low numbers from southeastern North Dakota. Though active collecting in the state at that time was highly sporadic, specimens were still recorded from various locations.

The continued westward expansion of *O. nuchicornis* is indicated by the eastern Montana collection data furnished by Mike Ivie (personal comm.) from the Montana Entomology Collection (MTEC). Specimens have been reported from Richland and Roosevelt counties in northeastern Montana. These records, from 1992 and 1994, respectively, mesh well with the 1987 data from Ward and Williston counties of North Dakota. There are numerous records of *O. nuchicornis* from western Montana which are apparently disjunct from the eastern records. This data correlates well with the hypothesized dual introduction of *O. nuchicornis* into North America.

NORTH DAKOTA RECORDS (Fig. 1): Cass Co.: 9-VII-1981, (2); Foster Co.: [10-17]-VI-1994, (2), [10-17]-X-1994 (2); Grand Forks Co.: 31-V-1993, (3); Ransom Co.: 31-VIII-1982, (1), 16-VIII-1983, (2), 16-V-1984, (3), 17-IX-1984, (1), 9-IV-1993, (5); Richland Co.: 30-V-1984, (10), 11-VIII-1992, (33), 12-VIII-1992, (74), 13-VIII-1992, (1), 17-VIII-1992, (9), 21-VIII-1992, (15), 27-VIII-1992, (18), 21-V-1993, (1), 28-V-1993, (2), 24-IX-1994, (1), 16-IX-1996, (4); Ward Co.: 14-VI-1987, (1); Williams Co.: 26-VI-1987, (2), 28-VI-1987, (4), 10-VIII-1987, (2).

Key to the species of *Onthophagus* recorded from the Dakotas.

1. Disc of pronotum granulate-tuberculate 2
1.' Disc of pronotum punctate 3

2. Elytral intervals and spaces between tubercles alutaceous and opaque, tubercles and elytral striae shining. Pastures throughout the Dakotas .... *O. hecate* (Panzer)
2.' Elytral intervals and spaces between tubercles shining black to aeneous, concolorous with tubercles and elytral striae. Prairie-dog burrows, SD only .... *O. cynomysi* Brown

3. Disc of pronotum and elytra shining metallic green, length > 5.2 mm .... *O. orpheus* (Panzer)
3.' Disc of pronotum and elytra not shining metallic green, length variable 4

4. Elytra yellow-brown mottled with black, contrasting with black pronotum, major male with median cephalic horn ...... *O. nuchicornis* (Linnaeus)
4.' Elytra may be pale at humeri, never mottled and not contrasting with pronotum when latter is black, major males with supra-orbital horns or without cephalic horns. 5

5. Shining; Second and third elytral intervals with three rows of setae, major male with supra-orbital horns, female with supra-orbital ridge distinctly elevated; pronotum in both sexes elevated dorsally, length (usually) >5.1mm ....*O. striatulus* (Beauvois)
5.' Alutaceous; Three rows of setae present at base of second elytral interval only, major male without horns, both sexes with reduced supraorbital carina; pronotum completely rounded; length < 5.1 mm .... *O. pennsylvanicus* Harold

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We wish to thank David A. Rider and Robert B. Carlson, (North Dakota State University), for their helpful review comments. We thank Paul Johnson, (South Dakota State University), for assistance in searching for additional records and for his review of the manuscript. Appreciation is also extended to Michael A. Ivie, (Montana State University) for providing collection records from Montana. Finally, thanks are extended to Paul K. Lago (Mississippi State University), for helpful comments and review of the manuscript.

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TWO NEW SPECIES OF *PROCLOEON* (EPHEMEROPTERA: BAETIDAE) FROM TEXAS[1]

N. A. Wiersema[2]

ABSTRACT: *Procloeon nelsoni*, new species, and *P. distinctum*, new species, are described from larvae and from male and female adults. Both species were collected from cool, alkaline waters of creeks and rivers in the hill country region of Texas. *Procloeon nelsoni* is most closely related to *P. diabolum*, also recently described from Texas, and probably represents a sister species. *Procloeon distinctum* is similar in both the larval and adult male stage to *P. rubropictum*, and probably represents a sister species.

Larvae of the small minnow mayfly genus *Procloeon* were recently characterized in the key to Nearctic genera by Edmunds and Waltz (1996) as having species with a truncate third segment of the labial palpi, incisors fused above the base or to the apex of at least one mandible, maxillary palpi segment three, if present, much shorter than segment two, all gills simple or with a single dorsal flap on all or some abdominal segments, and caudal filaments with lateral bristles to the apices. Adults were characterized as having single marginal intercalaries in the forewings, hindwings, if present, with a hooked costal process, a rounded or truncate penes cover between the basal segments of the male forceps, and lack of a spine shaped process between the basal segments of the male forceps.

While making collections in the spring of 1997, as part of my ongoing comprehensive study of the mayfly fauna of Texas, I discovered two previously undescribed species of *Procloeon* cohabiting the Blanco River in Hays County along with populations of *P. rufostrigatum* (McDunnough) and *P. viridoculare* (Berner). After subsequent collections it became evident that one species (*P. nelsoni* n. sp.) had previously been collected by C. R. Nelson and myself from the Devils River, Texas, where again it can be found to cooccur with *P. rufostrigatum*. The two new species are described here from larvae and male and female adults as *P. nelsoni*, new species, and *P. distinctum*, new species.

Collections and their abbreviations housing the material used in this study are as follows: The author's personal collection (NAW), Brackenridge Field Laboratory of the University of Texas at Austin (BFL), and the Purdue Entomological Research Collection (PERC).

Procloeon nelsoni, NEW SPECIES

(Figs. 1, 3-9)

Larva. Lengths: body 5.0-6.0 mm; caudal filaments 1.8-2.2 mm. Head: Coloration pale, without distinct patterning. Antennae pale, extending to or beyond midcoxae. Labrum (Fig. 3) sclerotized posterolaterally, slightly wider than long, with rounded anterior margin and

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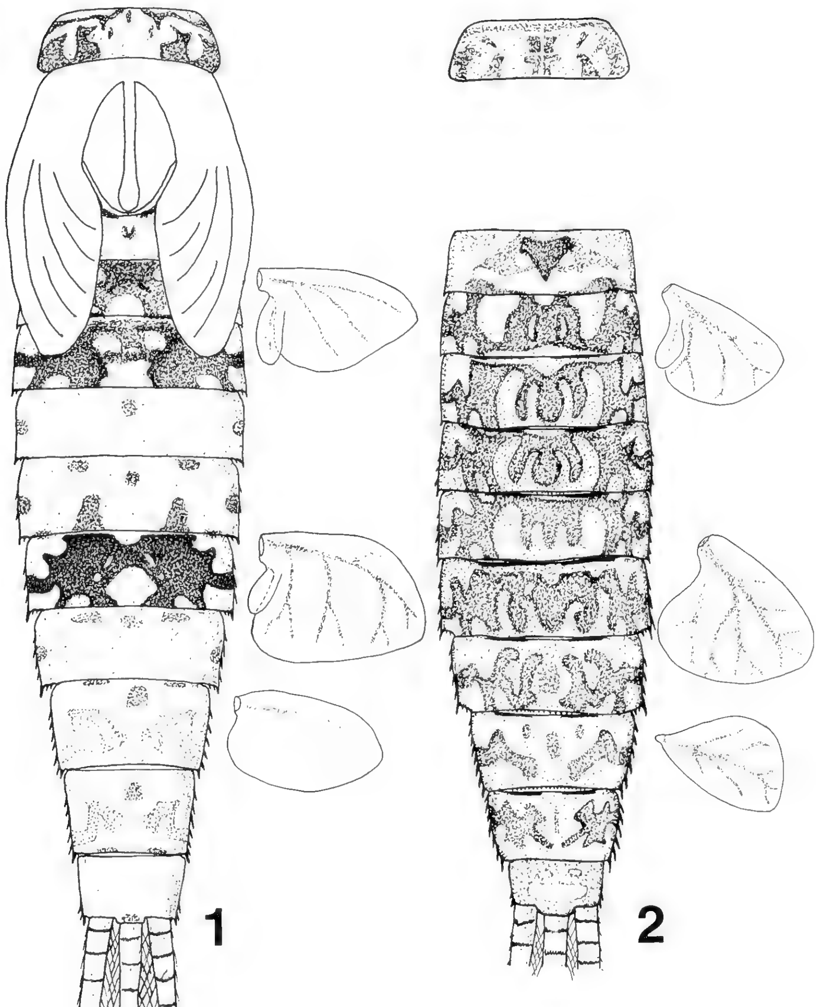


Figs. 1-2. 1. *Procloeon nelsoni*, n. sp., larval thorax, abdomen and gills 1, 5 and 7 (gills enlarged with respect to body, all figures dorsal). 2. *Procloeon distinctum*, n. sp., larval prothorax, abdomen and gills 1, 5 and 7 (gills enlarged with respect to body, all figures dorsal).

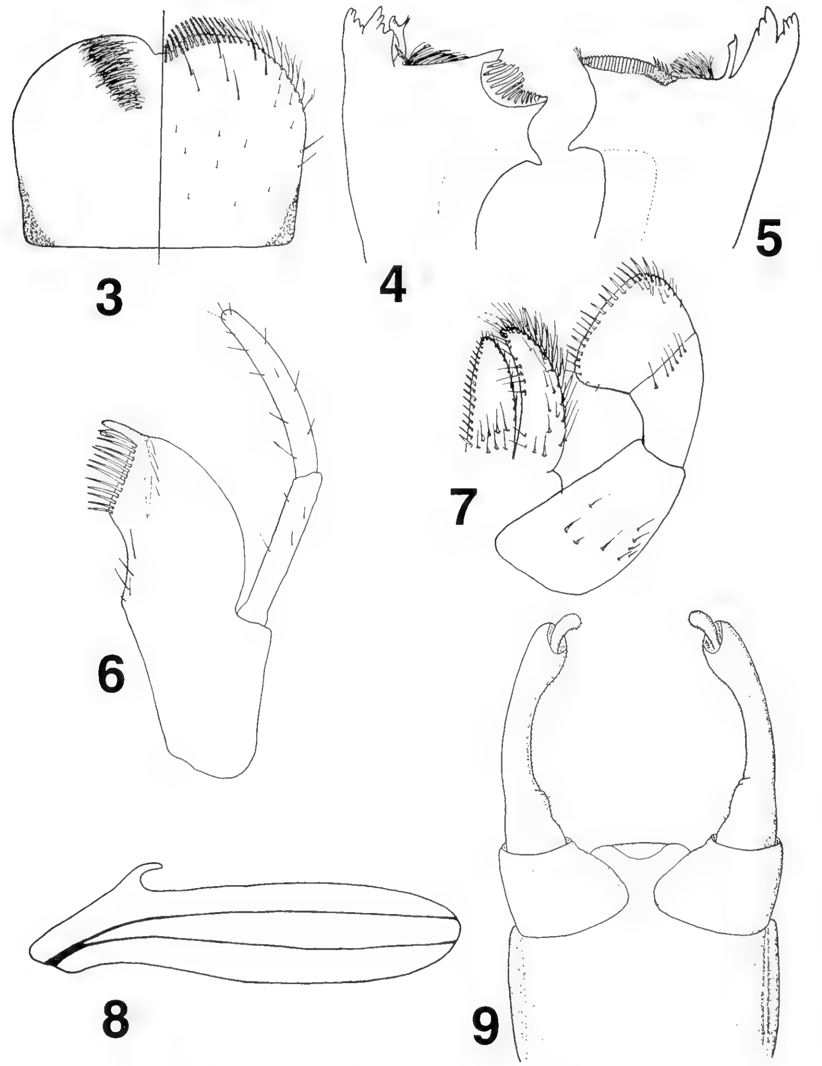
moderately deep medial emargination; anterior margin with bifurcate setae laterally and more robust, finely serrate setae medially. Left mandible (Fig. 4) with row of simple, fine setae between inner incisor and molar region. Right mandible (Fig. 5) with row of simple, fine setae between prostheca and molar region. Maxillae as in Fig. 6, with palpi two segmented and extending well beyond galealaciniae; palpal segment one about 3/4 to subequal to segment 2. Labium as in Fig. 7, with apically pointed glossae and paraglossae; palpi segment 3 truncate and medially expanded. Thorax: Prothorax as in Fig. 1, with distinct patterning of light and dark areas. Hindwingpads present. Legs: Femora with large, round, dark area distally, armored dorsally and ventrally with short, stout, simple setae and short, stout, finely, serrate setae; tarsi bare dorsally; tarsal claws without denticles and about 2/3 length of respective tarsi. Abdomen: Tergal patterning variable, but most similar to Fig. 1 [some individuals may have a wide, dorsomedial, black line running from the head to the posterior end of segment 10]; gills 1-5 with recurved dorsal lamella, those on 6 and 7 simple; gills with simple margins and only fine, simple setae. Posterior margins of terga 3-9 with regular arrangement of long and short spines, similar to Fig. 15. Lateral spines reduced in number and size posterior to segment 8; absent on segments 1-3 or 1-4. Paraprocts with 8-10 marginal spines. Caudal filaments with darkened intersegmental areas and dark band subdistally and often apically; lateral setae to apices.

Adult male. Lengths: body 4.6-5.2 mm; forewings 4.2-4.6 mm; hindwings 0.6-0.7 mm; cerci 8.0-10.0 mm. Head: Coloration light brown darkest around lateral ocelli. Turbinate eyes bright yellow; upper portion of eyes large and divergent anteriorly. Antennae pale. Thorax: Coloration light yellowish brown with darker areas bordering sutures; pro- and metathoracic nota with distinct red marks along medial and pleural sutures; sterna paler than nota. Forewings with membrane and venation hyaline; marginal intercalaries single and elongate, those posterior to R_3 longer than respective distal crossveins. Hindwings (Fig. 8) relatively narrow, ca. 4.5 times as long as wide, with nearly straight anterior and slightly convex posterior margins, two longitudinal veins and hooked costal process. Legs pale, darkest distally. Abdomen: Terga 1-6 translucent white with yellowish overcast dorsally in fresh material and paired, submedial, transverse red dashes posteriorly, difficult to discern on segment 1, 7-9; faint traces of median reddish line on some terga, usually appearing as red medial dot anteriorly; pleura with small, longitudinal, dark dashes either faint or absent on segments 1-9, when present, generally localized in anterior half of segment; terga 7 and 8 or tergum 8 only, with black dash at 45° angle laterally; terga 7-10 golden yellow in fresh material. Sterna entirely pale. Genitalia as in Fig. 9. Cerci entirely pale, whitish.

Female adult. Lengths: body 4.5-5.0 mm; forewings 4.5-5.0 mm; hindwings 0.7-0.8 mm; cerci 6.5-7.5 mm. Coloration similar to male. No prominent dorsal and lateral, black branching tracheation marks present. Pleura occasionally with faint logitudinal dashes on some segments.

Diagnosis. Larvae of *P. nelsoni* are most similar to those of *P. diabolum* Baumgardner and Kennedy (1998), recently described from Texas. However, the two species are at once distinguished by gill morphology (i.e. gills 1-5 with dorsal lamella in *P. nelsoni* and gills 1-3 only with dorsal lamella in *P. diabolum*). Larvae of *P. rivulare* (Traver) vary in having dorsal lamellae on gills 1-4 or 1-5, small when present on gill 5, but are otherwise easily distinguished from the above species by the lack of lateral spines anterior to segment 8, shorter antennae, shorter, more robust, tarsal claws, three segmented maxillary palpi, and different tergal patterning.

Adult males are also most similar to those described for *P. diabolum*. However, *P. nelsoni* males are distinguishable by the presence of paired, submedial



Figs. 3-9. *Procloeon nelsoni*, n. sp., 3-7 Larva. 3. Labrum (right: dorsal, left: ventral). 4. Left mandible. 5. Right mandible. 6. Right maxillae. 7. labium (half, dorsal view). 8-9 Male adult. 8. Hindwing. 9. Genitalia (ventral).

red dashes posteriorly on most abdominal terga, presence of distinct red markings on thoracic nota, turbinate eyes that are divergent anteriorly, and the presence of yellowish overcast on abdominal terga.

Baumgardner and Kennedy (1998) felt that their field associated adults described as *P. diabolum* were most similar to the species *Centroptilum album* McDunnough, *C. convexum* Ide, and *C. walshi* McDunnough which are all clearly members of *Centroptilum s. s.*, and in fact the two latter species (*C. convexum* and *C. walshi*), are probably conspecific with the widespread and variable species *C. album*.

Adult females of *P. nelsoni* are separated from other Nearctic *Procloeon* species with hindwings by the complete absence of branching, black tracheation lines laterally and dorsally on some abdominal segments and the presence of paired, submedial red dashes posteriorly on most abdominal terga.

Material examined. HOLOTYPE: Male adult with larval and subimaginal exuviae, USA: TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 05 May 1997 N.A. Wiersema (PERC). ALLOTYPE: Female adult with larval and subimaginal exuviae, same data and deposition as holotype. PARATYPES: Ten male and ten female adults with larval and subimaginal exuviae, same data, but 5 males and 5 females at BFL.

Other material examined. I collected all specimens listed below and they reside in my personal collection unless otherwise indicated. Seven male and seven female adults with larval and subimaginal exuviae, same data as holotype. TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 14, 16, 24 and 29 April 1997 (larvae); 05 May 1997 (larvae). Blanco Co., Miller Creek at Hwy 290/281 interchange; 30°12'24N, 098°22'24W; 16 July 1997 (larvae). Kimble Co., South Llano State Park, South Llano River at low water crossing on park road 73; 30°27'01N, 099°48'48W; 14 April 1998 (larvae). Val Verde Co., Devils River riffles upstream of Dolan Falls, 28 October 1996, N.A. Wiersema & C.R. Nelson, EPA 100 sample (larvae, BFL). Val Verde Co., Dolan Creek, 17 October 1993, C.R. Nelson & S.M. Stringer (larva, BFL).

Etymology. This species is named after Charles Riley Nelson (Austin, Texas) in recognition of all the assistance he has provided me.

Remarks. The larvae of *P. nelsoni* have only been collected from a few creeks and rivers in the hill country region of Texas, but because it is commonly found in the creeks and springs associated with the Devils River drainage in West Texas it is highly probable that it will eventually be found in northeastern state of Coahuila, Mexico as well. Larvae are most commonly found in association with thick submerged stands of Water Willow (*Justica americana*), as well as other aquatic macrophytes at the edge of riffles or in the slower reaches of runs. The Blanco River and other collection sites originate and flow over the Balconian Escarpment of central Texas and are characterized as having relatively clear, cool, and alkaline waters. An account of the specific physicochemical parameters of the type locality of both new species can be found in Davis (1987).

Proclоeon distinctum, NEW SPECIES

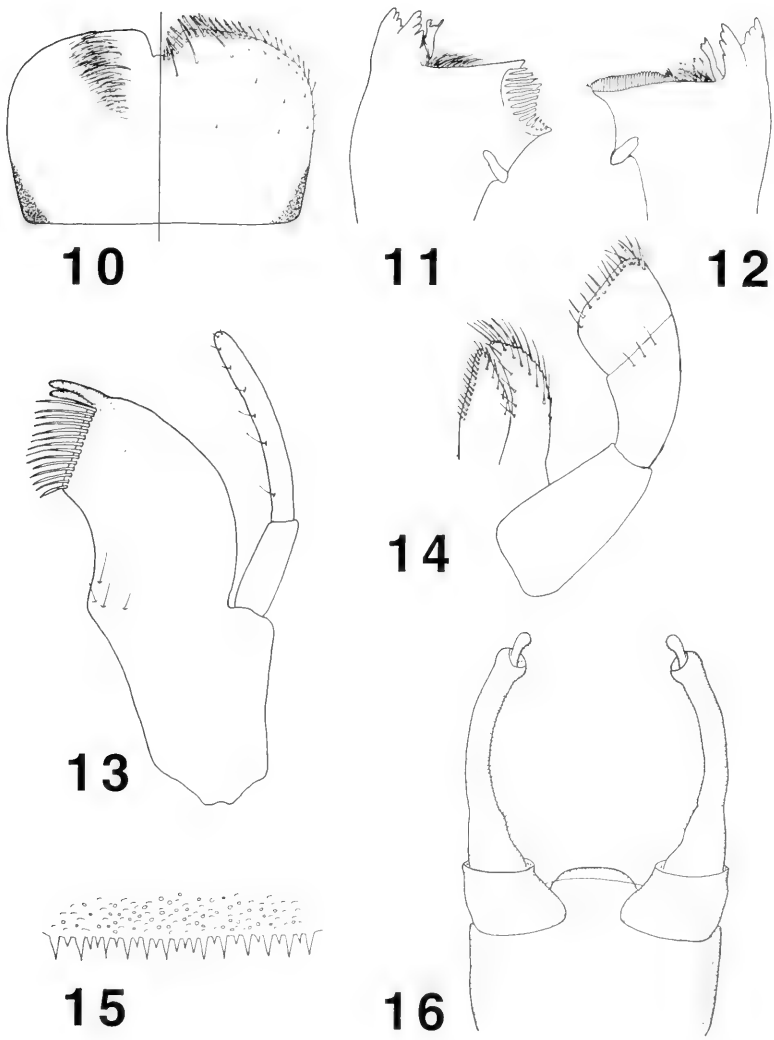
(Figs. 2, 10-16)

Larva. Lengths: body 4.8-5.5 mm; caudal filaments 2.0- 2.5 mm. Head: Coloration light to medium brown with fairly distinct, dark pattern bordering the coronal suture. Antennae extending to at least midcoxae. Labrum (Fig. 10) sclerotized posterolaterally, wider than long, with anterior margin nearly straight and deep medial emargination; anterior margin with bifurcate setae laterally and finely serrate setae medially. Left mandible (Figs. 11) with row of simple fine setae from base of inner incisor to molar region. Right mandible (Fig. 12) with row of simple fine setae between prostheca and molar region and tuft of more robust setae adjacent to molae. Maxillae as in Fig. 13, with palpi two segmented and extending to galealaciniae; palpal segment 1 about 1/2 as long as segment 2. Labium (Fig. 14) robust and elongate with glossae and paraglossae apically pointed; palpal segment three obliquely truncate. Thorax: Prothorax as in Fig. 2, with distinct patterning of light and dark areas. Hindwingpads absent. Legs pale to yellowish; femora with nearly straight margins and dark areas distally; tarsi heavily armored with many robust, finely serrate setae and few robust, simple setae ventrally; tarsal claws about 1/2 as long as respective tarsi with two rows of 6-8 large denticles, increasing in length distally. Abdomen: Terga usually with patterning similar to Fig. 2 [some mature specimens will show emerald green area medially near the posterior margin of segment 2, as in the adults (see below)]; gill 1 only with recurved dorsal lamella, gills on 2-7 simple; gills with simple margins and only scattered fine, simple setae; some gills may have reddish pigmentation basally. Posterior margins of terga 3-9 with regular arrangement of longer and short spines similar to Fig. 15, more basal terga with spines reduced in size. Sterna entirely pale or with broad, transverse brown lines on the anterior margin of segments 2-9. Lateral spines prominent on segments eight and nine, reduced in number and size on 3-7. Paraprocts with 11-13 marginal spines. Caudal filaments darker every fourth intersegmental areas and dark band subdistally, with lateral setae present to apices or occasionally absent distally.

Male adult. Lengths: body 4.0 mm; forewings 3.8 mm; cerci 7.8 mm. Head: Coloration reddish brown, darkest area around lateral ocelli. Turbinate portion of compound eyes kidney shaped, widely separated and divergent anteriorly; upper portion reddish-orange, lower portion reddish brown. Antennae pale, with flagellum darker than scape and pedicel. Thorax: Pronotum dark reddish brown; meso and metanota medium reddish brown with darker areas bordering sutures, sterna paler. Wings with membrane and venation hyaline; faint, brownish staining bordering attachment areas; marginal intercalaries single and elongate, those posterior to R_3 as long as respective distal crossveins. Hindwings absent. Legs pale, (missing or damaged on left side). Abdomen: Terga 1-6 translucent white with paired, submedial, red dashes posteriorly and small, very faint traces of a reddish median line on some terga; tergum 2 with a large emerald green area medially in the posterior half of the segment; terga 7-10 bright reddish brown with paired reddish posterior dashes obscured on segments 7-9; segment 1 with black pigmentation laterally and segments 2-7 with black, longitudinal dashes laterally; segment 8 with black dash at 45° angle; Sterna whitish. Genitalia as in Fig. 16, with penes cover broadly rounded. Cerci whitish.

Female adult. Lengths: body 3.8-4.2 mm; forewings 3.8-4.0 mm; cerci 7.0-7.5 mm. Body entirely bright greenish yellow. No distinct markings except an emerald green mark posteriorly on tergum 2.

Diagnosis. Larvae of *P. distinctum* are similar to *P. rubropictum*, but are separable by having a more robust labium (Fig. 14), with palpi segment 3 obliquely truncate, maxillary palpi with segment 1 about 1/2 as long as segment 2 (Fig. 13), tergal patterning similar to Fig. 2, leg setation, and shorter more robust,



Figs. 10-16. *Procloeon distinctum*, n. sp., 10-15 Larva. 10. Labrum (right: dorsal, left: ventral). 11. Left mandible. 12. Right mandible. 13. Right maxillae. 14. Labium (half, dorsal view). 15. Posterior margin of 4th abdominal tergite. 16. Male genitalia (ventral).

distinctly denticulate tarsal claws. *Procloeon rubropictum* larvae tend to have labial palpi segment 3 medially expanded more similar to *P. nelsoni* (Fig. 7), maxillary palpi with segment 1 subequal-equal to segment 2, tergal patterning not as above (although some individuals may exhibit a similar patterning on some segments), relatively sparse leg setation, and longer, thinner, poorly denticulate tarsal claws. Some individuals of *P. distinctum* may be further separated by the presence of broad, transverse, brown lines on the anterior margins of abdominal sternites 2-9, which are absent in *P. rubropictum.*

Adult males of *P. distinctum* are also similar to *P. rubropictum*, but are separable by the presence of an emerald green area medially near the posterior margin of abdominal segment 2 and a broadly rounded penes cover between the basal segments of the genital forceps as opposed to a more or less rectangular-shaped penes cover in *P. rubropictum.* Lowen and Flannagan (1992) stated that an emerald green spot may be present on abdominal segment 1 of live larvae of *P. rubropictum*, but gave no mention of it in the adults, nor have I ever observed it in any adults of *P. rubropictum.* Similar emerald green spots are often found in the closely related *P. rufostrigatum* as well, but are generally found on all abdominal terga. Based on the one adult male available *P. distinctum* also has far less extensive red markings on abdominal tergites 2-6 and particularly lacks the inverted "y-shaped" red mark often found on tergite 2 of *P. rubropictum* males.

Procloeon insignificans (McDunnough) also has similar genitalia to those of *P. distinctum* and *P. rubropictum*, but was described as lacking the paired, submedial red dashes found in the former species as well as black, longitudinal lines laterally. I have found these characteristics to be variable among some other species of the genus (unpublished). Further paired, submedial red dashes are very susceptible to fading in alcohol preserved specimens and are equally as hard to observe in pinned specimens. Based on the variation I have seen in *P. rubropictum* adult males, it appears *P. insignificans* may be conspecific with it, but until the larva of *P. insignificans* can be associated, its status will remain unclear.

Procloeon texanum McCafferty & Provonsha was essentially described from one male adult apparently reared from larvae collected from the Navasota River in Grimes County in southeastern Texas (McCafferty and Provonsha 1993). Based on the genitalia, size and lack of hindwings *P. texanum* is also similar to *P. distinctum*, but is separable by its light golden brown thoracic nota, pale abdominal terga 7-10, pale eyes, complete lack of any reddish or purplish markings dorsally or ventrally on abdominal segments 1-6 and male genitalia with a much more rounded almost subconical penes cover. Due to its proximity it is possible that *P. distinctum* and *P. texanum* will be found to be conspecific. However, repeated trips to the type locality of *P. texanum* have yielded no further specimens or possible larvae, thus any association is uncertain at this time.

Adult females of *P. distinctum* are clearly separated from females of *P. rubropictum* and all other known Nearctic *Procloeon* species that lack hindwings by their bright greenish yellow coloration, emerald green spot on abdominal tergum 2 (as in the male), and the complete absence of any black tracheation lines laterally and dorsally. Females of the northern species *P. simplex* also tend to be bright greenish yellow in color and lack dark tracheation lines. However, *P. simplex* is restricted to the Northeast and upper Midwest in North America, lacks an emerald green spot on tergum 2, and is also considerably larger.

Material examined. HOLOTYPE: Male adult with larval and subimaginal exuviae, USA: TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 05 May 1997 N.A. Wiersema (PERC).
PARATYPES: Four female adults with larval and subimaginal exuviae, same data and deposition as holotype.

Other material examined. TEXAS: Hays Co., Blanco River at Post Road, near Kyle; 29°56'08N, 097°53'40W; 14, 16, 20, 24 and 29 April 1997 N.A. Wiersema (larvae, NAW). Williamson Co., Georgetown, San Gabriel River at San Gabriel Park, blue pool above little dam, 28 April 1997 N.A. Wiersema (larvae, NAW).

Etymology. The specific epithet is a Latin word meaning separate or different. It is a reference to the unique and ornate nature of the tergal patterning of mature larvae.

Remarks. *Procloeon distinctum* is known from only two locations in the hill country region of central Texas and is possibly endemic to Texas. The larvae are most commonly found in association with submerged stands of Water Willow (*Justica americana*), as well as other aquatic macrophytes at the slower reaches of riffles and or runs.

ACKNOWLEDGMENTS

I would like to thank Boris C. Kondratieff (Colorado State University) and Charles R. Nelson (University of Texas at Austin) for loan of some of the material used in this study. I also wish to thank David Riskind (Texas Parks and Wildlife) for providing me with collecting permit # 54-97. I would finally like to express my appreciation to W. P. McCafferty (Purdue University) for his thoughts and editorial advice.

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AMERICABAETIS (EPHEMEROPTERA: BAETIDAE) FROM TEXAS: FIRST USA RECORD AND ADULT DESCRIPTION OF *A. PLETURUS* [1]

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

ABSTRACT: *Americabaetis pleturus* was collected and reared from south Texas. This represents the first known occurrence of the Neotropical genus *Americabaetis* north of Mexico. The first adult description of *A. pleturus* is provided, based on both males and females. Adult characterization is compared to that of other species of *Americabaetis* known as adults. *Americabaetis pleturus* co-occurs with the parthenogenetic *A. lugoi* in Central America; however, the two species are clearly distinguishable as both larvae and adults.

Eleven species have been considered in the Neotropical small minnow mayfly genus *Americabaetis* Kluge (Lugo-Ortiz and McCafferty 1996a, Waltz and McCafferty 1998). The known northern limits of the genus have been represented by the occurrence of the Central American and Mexican species *A. pleturus* (Lugo-Ortiz and McCafferty) in the northeastern Mexican states of Nuevo León and Tamaulipas (Lugo-Ortiz and McCafferty 1994, 1996b).

During the summer of 1997 one of us (NAW) collected and reared *A. pleturus* from the Guadalupe River in the coastal plains of south Texas. This significant new record is given here, and the adults of *A. pleturus* are described and compared for the first time. The materials upon which this report is based are held in the private collection of NAW (Houston, TX), or deposited in the Purdue Entomological Research Collection (PERC) (West Lafayette, IN) as indicated.

Americabaetis pleturus (Lugo-Ortiz and McCafferty)

Male adult. Lengths: body 4.2-5.0 mm, forewings 4.0-4.5 mm, cerci 8.0-10.0 mm. Head: Coloration dark brown, often with a distinct V-shaped darker patterning between lateral ocelli (Fig. 4). Turbinate eyes large, widely divergent anteriorly, and almost touching posteriorly (Fig. 4), in some contiguous posteriorly; upper surface orange-red; lower portion of stalks distinctly darkened (Fig. 3). Antennae with scapes, pedicels and flagella light brown; length at least 0.5x head width. Thorax: Nota medium to dark brown with darker and lighter areas around sutures; anterior half of metanotum distinctly white. Pleura and sterna slightly paler. Narrow-anterior portion of mesocutum rounded in lateral view, as in Figure 3. Forewings with paired marginal intercalaries posterior to R_2; wing veins pale; base of wings with small stain of light reddish brown; marginal intercalaries longer in anterior half of wing. Legs: Forelegs with light brown femora, slightly paler distally; mid- and hindlegs paler. Abdomen: Segments 1-5 somewhat translucent with faint orange-red shading; posterior half of terga 6 and 7-10 orange-red in freshly preserved specimens; terga 7-10 opaque; segments 1-7 with branching spiracular lines laterally and extending dorsally, darker in anterior half of segments. Genitalia as in Figure 1, with basal segment large and cylindrical with distinct medioapical constriction. Cerci pale.

Female adult. Lengths: body 4.5-5.0 mm, forewings 4.2-4.5 mm, cerci 6.0-7.0 mm. Body reddish brown. Forelegs with femora reddish brown, tibiae and tarsi slightly paler; mid- and hindlegs paler than forelegs. Forewings with light brown venation and very small pale brown stain basally on membrane. Abdomen (Fig. 2) distinctly darker laterally than dorsally and ventrally (with broad, median pale longitudinal area both dorsally and ventrally). Prominent dark, branching tracheation lines laterally and dorsally. Cerci light brown.

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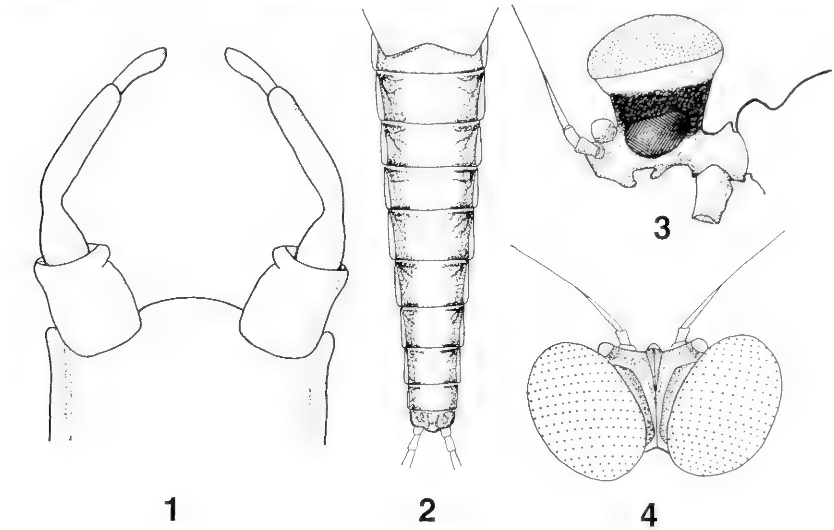
Material examined. Four larvae, one male adult, and one female adult, TEXAS, Victoria Co., Guadalupe River at Riverside Park in Victoria, 28°48'32"N, 97°01'45"W, VIII-20-1997, N. A. Wiersema; 33 larvae, 22 adult males (12 reared), and 20 female adults (4 reared), same data as above, except VIII-24-1997 (15 larvae, eight male adults, and six female adults deposited in PERC).



Figs. 1-4. *Americabaetis pleturus* adult. 1. Male genital forceps (ventral view). 2. Female abdomen (dorsal). 3. Male head and partial thorax (lateral view). 4. Male head (dorsal view).

DISCUSSION

All nominal species of *Americabaetis* are known in the larval stage, and a comprehensive identification key was provided by Waltz and McCafferty (1998). However, only *A. alphus* Lugo-Ortiz and McCafferty, *A. lugoi* Waltz and McCafferty, *A. naranjoi* (Kluge), *A. pleturus*, and *A. robacki* (Lugo-Ortiz and McCafferty) are known as adults. *Americabaetis naranjoi* is known only from Cuba. We have not seen material of this species and cannot comment on its characterization; however, it is highly unlikely to be found outside of the Antilles. *Americabaetis alphus* and *A. robacki* are known only from tropical South America and were extensively compared to each other by Waltz and McCafferty (1998). Male adults of *A. alphus* can be distinguished from those of *A. pleturus* by their widely separated, ellipsoidal turbinate eyes and their genitalia, which lack a distinct medioapical constriction on forceps segment 1. Although the turbinate eyes are quite similar in *A. pleturus* and *A. robacki*, the latter lacks the basal wing staining and the medioapical constriction of the forceps segment 1, in addition to having a much different abdominal color pattern. The parthenogenetic species *A. lugoi* (Waltz and McCafferty 1998) is present in Costa Rica along with *A. pleturus*. Female adults of *A. lugoi* are distinguishable from female adults of *A. pleturus* by the former's deeper and darker red-brown body coloration; abdominal segments which have only a narrow light longitudinal line dorsally and which lack prominent dark branching tracheation lines laterally; distinctly contrasting pale yellowish legs; and a much darker and more extensive staining of the membrane of the forewing basally.

The larvae of *A. pleturus* were collected from the lower reaches of the Guadalupe River, where they were found clinging to cobble heavily covered with periphyton in a relatively shallow (20-40 cm), swiftly flowing riffle. This region of the river is characterized by high clay banks, shallow flat riffle areas offset from the main channel with a substrate of mixed cobble, gravel, and sand, and a deep (3-5 m) main channel having shifting sand substrate. During normal flow periods the water tends to be relatively clear and cool.

Other mayflies collected as adults and or larvae along with *A. pleturus* were *Callibaetis punctilusus* McCafferty and Provonsha, *Caenis hilaris* (Say), *C. latipennis* Banks, *Camelobaetidius waltzi* McCafferty, *Campsurus decoloratus* (Hagen), *Fallceon quilleri* (Dodds), *Isonychia sicca* (Walsh), *Labiobaetis dardanus* (McDunnough), *Leptohyphes apache* Allen, *Stenonema exiguum* Traver, *S. mexicanum integrum* (McDunnough), *Thraulodes gonzalesi* Traver and Edmunds, *Tortopus circumfluus* Ulmer, *Traverella presidiana* (Traver), and *Tricorythodes curvatus* Allen. The stonefly *Neoperla clymene* (Newman) was very common among the non-mayfly benthic insects that were taken with *A. pleturus*.

As indicated by McCafferty (1998), *Americabaetis* clearly has a South American center of origin, and has dispersed northward relatively recently. Although occurring in northeastern Mexico and south Texas, *A. pleturus* was not reported from New Mexico based on the comprehensive faunistic data presented by McCafferty et al. (1997). From this we conclude that *Americabaetis* is highly limited in the Nearctic, where it is apparently warm-water sublimited and humid restricted (see McCafferty et al. 1992).

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ADDITIONS TO THE TAXONOMY OF *AMERICABAETIS* (EPHEMEROPTERA: BAETIDAE): *A. LUGOI*, N. SP., ADULT OF *A. ROBACKI*, AND KEY TO LARVAE[1]

R.D. Waltz[2], W.P. McCafferty[3]

ABSTRACT: *Americabaetis lugoi* is a distinctive new species of the small minnow mayfly family Baetidae and is described from female larvae and adults collected in Costa Rica. Extensive samples of the new species indicate that it is parthenogenetic. Larvae of *A. lugoi* share a frontal keel with certain other species of *Americabaetis*, but *A. lugoi* larvae differ from all other known species of the genus in mouthpart, paraproct, and other characteristics. Adults of *A. robacki* are described for the first time, based on reared material from Uruguay. They are diagnostically compared with *A. alphus*, the only other South American species known as an adult. A key to the larvae of all known *Americabaetis* species is provided.

Lugo-Ortiz and McCafferty (1996) gave generic status to *Americabaetis* Kluge, and in that revision reviewed or described 10 nominal species from Latin America as follows: *A. alphus* Lugo-Ortiz and McCafferty, from South America; *A. boriquensis* (Lugo-Ortiz and McCafferty), from the Antilles; *A. intermedius* (Lugo-Ortiz and McCafferty), from Central America; *A. labiosus* Lugo-Ortiz and McCafferty, from South America; *A. longetron* Lugo-Ortiz and McCafferty, from South America; *A. maxifolium* Lugo-Ortiz and McCafferty, from South America; *A. naranjoi* (Kluge), from the Antilles; *A. pleturus* (Lugo-Ortiz and McCafferty), from Central America and North America (see also Wiersema and McCafferty [1998]); *A. robacki* (Lugo-Ortiz and McCafferty), from South America; and *A. titthion* Lugo-Ortiz and McCafferty, from South America. McCafferty (1998) indicated that the genus was clearly of South American origin.

We herein describe a new species of *Americabaetis* based on female larvae and adults discovered in Costa Rica. In addition, we give the first description of male and female adults of *A. robacki*, and provide a key to all known species based on the larval stage. We are honored to name the new species after our colleague, Carlos Lugo-Ortiz.

Americabaetis lugoi, NEW SPECIES

Larva. Size: Body length 5 mm; cerci, 3.0-3.5 mm. Antennal scapes and pedicels subequal in length, with scattered fine setae, and scales; segments of the flagella each with distal row of moderately large scales. Frontal keel present and narrow (Fig. 1). Labrum (Fig.

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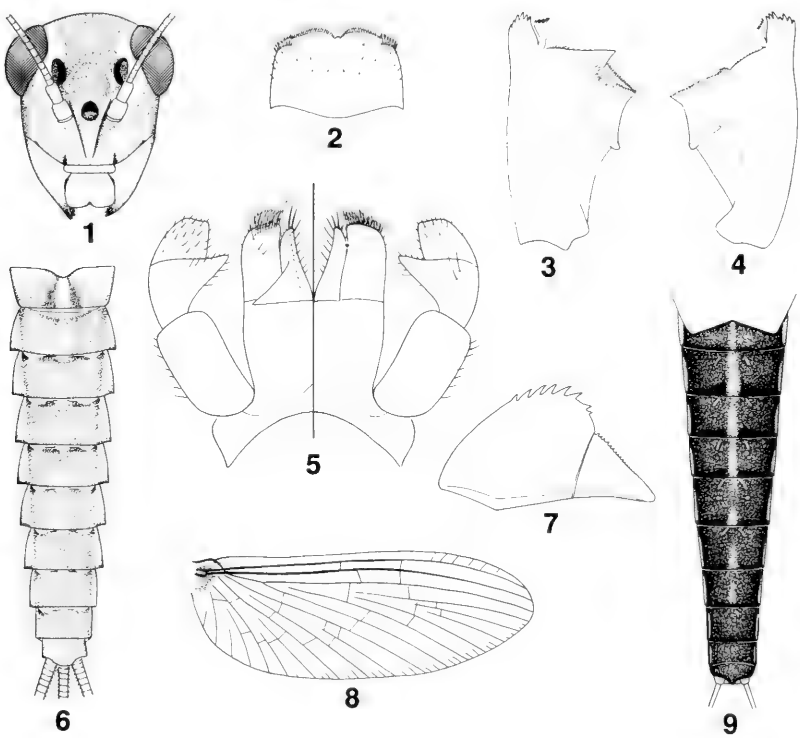
2) with anterior margin subparallel to hind margin and with median notch, prominent medial seta absent, few scattered fine setae dorsally, 6-7 bladelike submarginal setae at anterolateral corners. Right mandible (Fig. 3) with four or five denticles on outer incisor (third or fourth very small), one on middle incisor, and three on inner incisor, each incisor with vertical row of short, fine setae; prostheca stout, digitate; tuft (row) of setae present between base of incisors and mola. Left mandible (Fig. 4) with three denticles on outer incisor, one on middle incisor, and three on inner incisor; prostheca stout, digitate; scattered bristlelike setae present between base of incisors and mola. Maxillae elongate; maxillary palp two segmented, reaching apex of galealacinia; basal setae of galealacinia 5+1. Labium (Fig. 5) elongate and robust; palps with segment 1 subequal to 2 and 3 combined, segment 2 with anteriorly projecting apically setate lobe and 2-3 dorsal setae, segment 3 apically setate and with scattered fine setae on surface; glossae broad at base, tapering distally, with seven or eight setae on medial margin, and submarginal ventral row of 10-12 finer setae extending to near base; paraglossae broad, with three rows of pectinate setae at apex. Thorax: Nota yellowish-brown, without distinct pattern. Legs pale yellow-brown with numerous short bristles ventrally; femora dorsally with 18-20 blunt bristles, and distally with brown spot (seen on exuviae); tibiae with few scattered bristles dorsally, and with brown bands (seen in exuviae); tarsi with few scattered bristles dorsally; tarsal claws with 12-15 denticles.
Abdomen (Fig. 6): Color yellow-brown (ochre in alcohol) with broken dorsal median stripe; exuviae light brown with pale medial stripe dorsally; last instar with thoracic and abdominal color of subimagos and adults (see below). Terga and sterna with scales and few scattered fine setae; posterior margins of terga and sterna with sharp spines with length 1-2 times basal width. Gills platelike, poorly tracheated, with few marginal serrations, and with fine setae on anterior and posterior margins, not over 2.0 times length of respective segment. Paraprocts (Fig. 7) with 8-10 sharp spines. Caudal filaments pale, without banding; terminal filament ca. 0.8 times length of cerci.
Female adult. Body size 3.0-3.5 mm; body color brick-red to dark reddish brown, darker at intersegmental areas laterally and dorsally, medial two-thirds of sterna relatively pale, cream in some. Legs pale, yellow and contrasting strongly with dorsal body coloration; femora unmarked. Forewings (Fig. 8) with distinct dark brown stain at base of wing; apical intercostal area slightly opaque. Abdomen (Fig. 9) of some specimens dorsally with thin pale median longitudinal stripe; abdominal terga additionally with fine white lines and dots as shown in Figure 9.

Material examined. HOLOTYPE: female larva (exuviae): COSTA RICA, Guanacaste Prov., Estacion Maritza, Río Tempisquito, B.W. Sweeney, lab reared, VI-5-1992, slide-mounted in Euparol, deposited in the Purdue University Entomological Research Collection, West Lafayette, Indiana. PARATYPES: four female larvae and four adult females, same data and deposition as holotype.

Remarks. *Americabaetis lugoi* is apparently related to those *Americabaetis* species that possess a frontal keel on the head as larvae. These include *A. alphus*, *A. intermedius*, *A. longetron*, and *A. maxifolium*. Precise relationships within this grouping have not been ascertained, and those relationships are further complicated by the fact that, of this grouping, only *A. alphus* has also been described in the adult stage. *Americabaetis lugoi* larvae can easily be distinguished from all other species by characteristics given in the key below. Little can be said about adult diagnosis since it must be based entirely on female comparisons and at present only a few species of *Americabaetis* are known as



Figs. 1-6. *Americabaetis lugoi* larva. 1. Head capsule (frontal view). 2. Labrum. 3. Left mandible. 4 Right mandible. 5. Labium. 6. Abdomen (dorsal). 7. paraproct. 8-9. *A. lugoi* female adult. 8. Forewing. 9. Abdomen (dorsal).

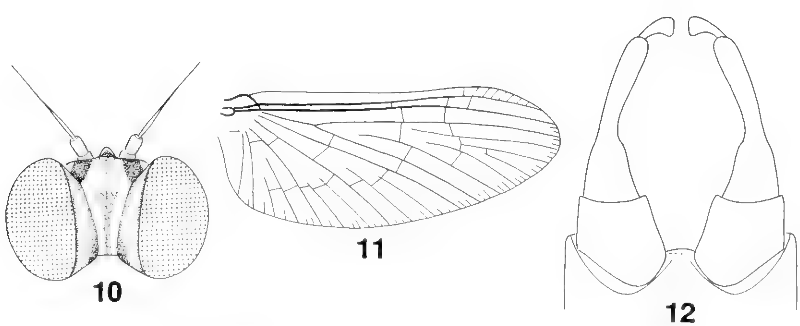
female adults. Adults comparisons of *Americabaetis* are treated by Wiersema and McCafferty (1998).

Jackson and Sweeney (1995) discussed the known biology of *A. lugoi* (as *Acerpenna* sp.). They showed that in the laboratory, eggs had a median developmental time of 23 days, and larvae completed development in 28 days (median period). Larvae were classified as gatherers since they could successfully complete development on an algal diet. Males were not represented in a sample of 86 reared specimens, and we consider *A. lugoi* to be parthenogenetic. As such it represents the first tropical species of Baetidae that we know to be parthenogenetic. In the Western Hemisphere, certain far-northern baetid species, such as *Baetis foemina* McDunnough and *B. hudsonicus* Ide, are strictly parthenogenetic, and other species of Baetidae have been shown to be parthenogenetic in some far-northern fringe populations. These latter include *Acerpenna* *macdunnoughi* (Ide), *B. bicaudatus* Dodds, and *Diphetor hageni* (Eaton) (see discussion in McCafferty and Morihara [1979]). *Americabaetis lugoi* would appear unusual in this respect in that its parthenogenesis is not associated with a cold regime. We do not know what adaptive significance parthenogenesis would be to this Costa Rican population, or if *A. lugoi* will prove to be parthenogenetic throughout its range, if indeed it occurs elsewhere.

Americabaetis robacki (Lugo-Ortiz and McCafferty)

Larva. Originally described by Lugo-Ortiz and McCafferty (1994) as *Acerpenna*; descriptions were slightly modified when transferred to *Americabaetis* (Lugo-Ortiz and McCafferty 1996), particularly regarding its possession of six rather than seven pairs of gills as had been incorrectly reported earlier.
Male adult (in alcohol). Body 2.5-3.0 mm long; forewings 3.3-3.5 mm long. Tubinate eyes (Fig. 10) ellipsoidal, longer than broad dorally, well separated anteriorly, but more approximate posteriorly, pale yellow dorsally and basally. Thorax medium to light brown, solid dorsally. Legs pale yellow, unmarked (fore- and midfemora dusky yellow). Forewings as in Figure 11, with base of subcosta shaded with reddish-brown, strongly opaque in intercostal area, otherwise membrane and venation colorless. Abdomen light to medium brown dorsally, tan to pale yellow ventrally; terga without distinct markings, although pigment sometimes granular, and terga with dark pencil line at posterior margin in specimens with relatively light abdomens; terga 7-10 slightly darker; sterna without markings, sterna 7-10 slightly more shaded. Male genitalia as in Figure 12. Cerci grayish white.
Female adult. Body 2.5-3.0 mm long; forewings 3.3-3.5 mm long. Coloration generally similar to male, except thorax yellow-brown; forewings lacking basal shading of subcosta and lacking strongly opaque intercostal area; and posterior terga brownish gray.

Material examined. URUGUAY: one male subimago and exuviae, Depto Maldonado, Arroyo de la Quinta, II-10-1984, N482. M. Gillies; one female adult and exuviae, same data as previous, II-15-1984, N335; 34 larvae, same data as previous, I-9-1984, N443-476; one female subimago and exuviae, Depto Maldonado, Branch of R. Maldonado Abra del Perdonna-Mistas, I-15-1984, N334, M. Gillies; one female adult and exuviae, Depto Maldonado, Laguna del Sauce, I-1-1984, N336, M. Gillies; one male adult and exuviae, same data as



Figs. 10-12. *Americabaetis robacki* male adult: 10. Eyes (dorsal). 11. Forewing. 12. Genitalia (ventral).

previous, N401; five adult males, one adult female, same data as previous, by dam, XII-15-1983, N351-357. All material deposited at Purdue Entomological Research Collection, West Lafayette, Indiana. In addition, *A. alphus* material cited by Lugo-Ortiz and McCafferty (1996) was re-examined for comparative purposes.

Remarks. The only other South American *Americabaetis* known in the adult stage is *A. alphus*. *Americabaetis robacki* and *A. alphus* adults are quite similar; however, males of *A. alphus* have a distinctive dorsal pattern on the abdominal terga, with terga 2-6 being unpigmented in a posterior band that gradually expands anteriorly towards the middle. Both sexes of *A. alphus* tend to be lighter colored than *A. robacki* and somewhat smaller in size. The turbinate eyes of *A. alphus* are uniformly separated from each other, whereas those of *A. robacki* are much closer posteriorly than they are anteriorly. Also, the intercostal area of the male wings is even more opaque in *A. alphus*. For a more complete comparison of known adults of *Americabaetis*, see Wiersema and McCafferty (1998).

Key to *Americabaetis* larvae

1 Frontal keel present (Fig. 1) **2**
1' Frontal keel absent **6**
2 Second segment of labial palp not developed mediodistally (Fig. 10 [Lugo-Ortiz and McCafferty 1994]); paraproct with numerous minute marginal spines (Fig. 11 [Lugo-Ortiz and McCafferty 1994]) .... ***A. intermedius***
2' Second segment of labial palp developed mediodistally (Figs. 5; 4 [Lugo-Ortiz and McCafferty 1994]; Figs. 6, 21, 31, 40, 50 [Lugo-Ortiz and McCafferty 1996]); paraprocts without numerous minute marginal spines **3**
3 Gills (Figs. 43, 44 [Lugo-Ortiz and McCafferty 1996]) 2.5-3.0 times length of respective tergum, with margins sparsely serrate .... ***A. maxifolium***
3' Gills (Figs. 11, 12, 33, 34 [Lugo-Ortiz and McCafferty 1996]) 1.5-2.0 times length of respective tergum, with margins densely or sparsely serrate **4**
4 Paraprocts with 6-7 elongate, sharp spines; abdominal terga either with distinctive white areas on 1, 4, and 7 (males) (Fig. 7 [Lugo-Ortiz and McCafferty 1996]) or white laterally on 2-8 (females) .... ***A. alphus***
4' Paraprocts with 8-13 spines; abdominal terga either nondescript or with median stripe (Fig. 6) **5**
5 Paraprocts with 8-10 irregular, sharp, marginal spines (Fig. 7); dorsal margin of femora with 18-20 blunt bristles .... ***A. lugoi***
5' Paraprocts with 11-13 slender spines increasing in length distally (Fig. 35 [Lugo-Ortiz and McCafferty 1996]); dorsal margin of femora with 22-25 long, acute setae .... ***A. longetron***
6 Labial palp segment 2 (Figs. 21, 50 [Lugo-Ortiz and McCafferty 1996]) narrow-elongate and weakly developed mediodistally **7**
6' Labial palp segment 2 (Fig. 4 [Lugo-Ortiz and McCafferty 1994]) not as above **8**
7 Meso- and metasternum (Fig. 51 [Lugo-Ortiz and McCafferty 1996]) with paired setose protuberances .... ***A. titthion***
7' Meso- and metasternum without paired setose protuberances .... ***A. labiosus***
8 Caudal filaments without dark bands; paraprocts with 5-6 spines (Fig. 5 [Lugo-Ortiz and McCafferty 1994]) .... ***A. boriquensis***

8' Caudal filaments variously banded; paraprocts variable **9**
9 Cerci with single dark broad band medially; paraproct with 11- 13 spines followed by numerous minute serrations (Fig. 14 [Lugo-Ortiz and McCafferty 1994]); Central and North American .... ***A. pleturus***
9' Cerci with both median and subapical banding; paraprocts not as above; South American and Antillean **10**
10 Labial palp segment 2 with six dorsal setae; South American .... ***A. robacki***
10' Labial palp segment 2 with four dorsal setae; Cuban .... ***A. naranjoi***

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MACROSIPHONIELLA LEUCANTHEMI (HOMOPTERA: APHIDIDAE): NEW RECORDS AND REDESCRIPTIONS OF THE APTEROUS AND ALATE VIVPAROUS FEMALES[1]

Manya B. Stoetzel, Gary L. Miller[2]

ABSTRACT: The known North American distribution of *Macrosiphoniella leucanthemi* is expanded from Pennsylvania and Oregon to include Maryland. Redescriptions of apterous and alate viviparous females are provided along with illustrations. A key to the aphids on chrysanthemums in the United States is modified to include *M. leucanthemi.*

The genus *Macrosiphoniella* Del Guercio (sensu stricto) is comprised of 87 species worldwide (Remaudière and Remaudière 1997). The number of North American species referable to the genus is much less (Russell 1967, Smith and Parron 1978, Robinson 1987). Of the 16 species known from North America (Robinson 1987), ten also occur in Europe. Members of the North American *Macrosiphoniella* are distinguished from other similar genera (e.g. *Dactynotus*, *Macrosiphum*, and *Sitobion*) by the presence of three setae on tarsal segment I, an ultimate rostral segment that is often stiletto shaped with the longest hairs on the basal half, scleroites that are often developed around the dorsal abdominal setae, a presiphuncular sclerite that is usually present, and apical reticulations that usually occur on more than one third of the length of the cornicles (Robinson 1987). Additional recognition characters include an elongate, blunt cauda in some species and the aphid's association with Asteraceae (= Compositae) (Foottit and Richards 1993).

Macrosiphoniella leucanthemi (Ferrari) was originally described in 1872 from Europe, but there apparently were no subsequent collections of the aphid for nearly 70 years (Hille Ris Lambers1939). Hille Ris Lambers (1939) provided a brief redescription and a modified key of the European *Macrosiphoniella* to include *M. leucanthemi*. Known distribution of *M. leucanthemi* in North America was previously limited to two counties in north-central Pennsylvania (Pepper 1965) and one site in western Oregon (Jensen 1992). Although abbreviated descriptions of *M. leucanthemi* have been provided (Ferrari 1872, Hille Ris Lambers 1939), corresponding morphological illustrations have not been published.

In this paper, we include an additional distribution record for *M. leucanthemi* and provide illustrations and redescriptions of the apterous and alate vivipa-

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rous females. Annotated keys based on Miller and Stoetzel's (1997) work on aphids associated with chrysanthemums in the United States are also included herein.

MATERIALS AND METHODS

Synoptic descriptions are based on original and subsequent descriptions, material from the Aphidoidea portion of the National Collection of Insects (USNM), Beltsville, Maryland, and the personal collection of Andrew S. Jensen (ASJC), Greenbelt, Maryland. Measurements are presented in microns (μ) as minimum and maximum ranges of representative specimens.

In **Specimens Examined**, alates and apterous adults are abbreviated as "al." and "ap. ad." respectively. For specimens collected at the same locality, on the same date, and from same host plant as previously listed, the duplicate information is not repeated. Unless otherwise noted, voucher material consists of a single slide (sl.). Information included within brackets ([ ]) has been added by the present authors for clarification purposes.

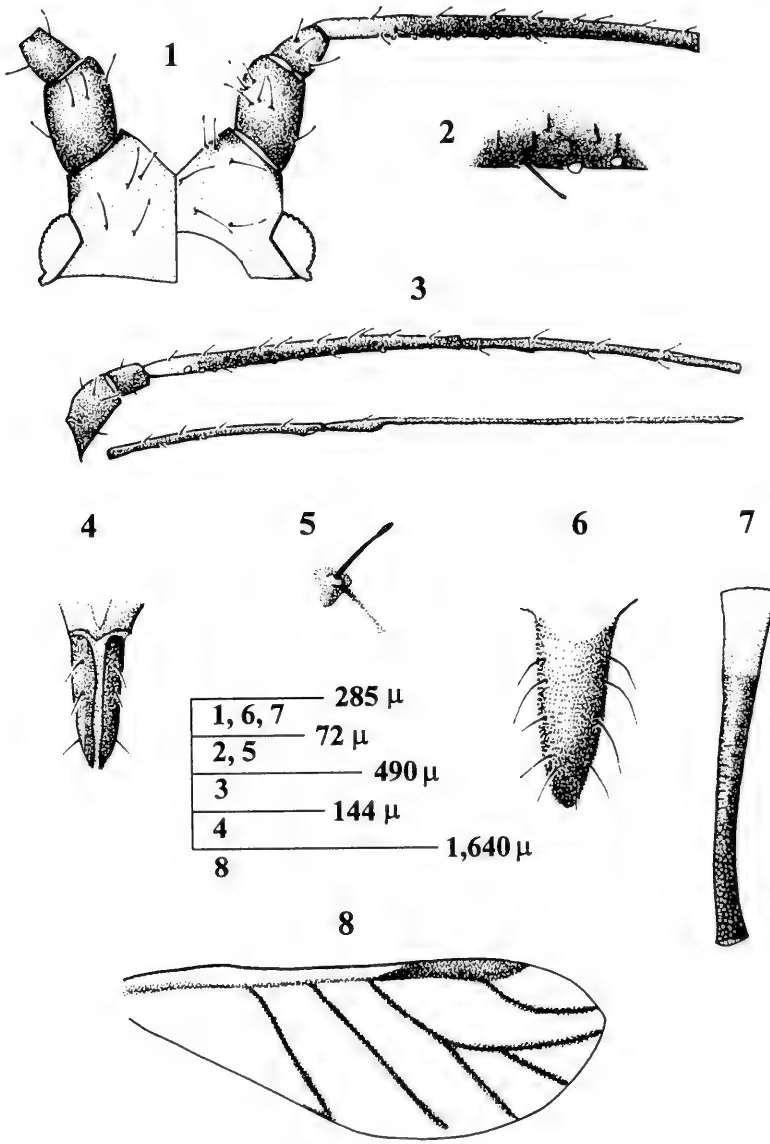
Macrosiphoniella leucanthemi (Ferrari)

Figs. 1-8

Siphonophora leucanthemi Ferrari, 1872:214.
Macrosiphoniella leucanthemi (Ferrari); Hille Ris Lambers, 1939:115-117.
Macrosiphoniella leucanthemi (Ferrari); Pepper, 1965:205.
Macrosiphoniella leucanthemi (Ferrari); Robinson, 1987:916.
Macrosiphoniella leucanthemi (Ferrari); Jensen, 1992:218.

Field Characters.- Apterous viviparous females, green with dark bands through eyes to "dark cream green" or "green - black dots" (USNM slide data) to yellowish green with darker green to reddish brown bar between the cornicles (Hille Ris Lambers 1939). Ferrari (1872, in Latin) described the "apterous female" as yellowish-green with red eyes; antennae dark with basal third pale, antennal tubercles dark; cornicles dark; cauda pale yellow; legs pale but femora, apex, and basal third of the tibiae dark. We add from observations of living specimens that the lateral margins of head and prothorax are deeper green and the last rostral segment is dark. Alate viviparous females similar in coloration to apterous viviparous female except green with red eyes (USNM slide data) and abdomen with small, distinctive marginal scleroites (Hille Ris Lambers 1939); abdomen of the "alate female" in Ferrari's (1872) description differs from the apterous female by having the head brownish-black, the thorax dark, and the wing veins dark with "first and second oblique" veins with dark margins.

Recognition Characters from Slide-mounted Specimens.- Apterous viviparous female (Figs. 1-2, 4-7): Body length 2,220-3,924; width through eyes, 492-624. Antennae longer than body, dark except base of III pale; length segment III, 492-624 with 10-21 secondary sensoria on basal 2/3, sensoria restricted to approximately half the circumference of the segment; length of IV, 816-1,044; V, 528-624; length of base of VI, 156-192; length of terminal process, 852-948. Setae capitate; head capsule setae nearly twice as long as basal width of antennal segment III. Rostrum extending to hind coxae; rostral segment III usually with 6 pairs of setae; length of ultimate segment (Fig. 4), 132-156, with 6 accessory setae, subequal to hind tarsal segment II. Length of hind tibia, 1,716-2,244; hind tarsus II, 120-144. Abdomen smooth with small spicules, dorsal abdominal setae usu-



Figures 1-8. 1, dorsal and ventral aspects of head capsule of apterous adult female; 2, enlargement of antennal sculpturing, seta, and secondary sensoria; 3, antenna of alate adult female; 4, ultimate rostral segment; 5, dorsal abdominal seta with basal scleroite; 6, dorsum of cauda; 7, cornicle; 8, forewing.

ally associated with a basal scleroite (Fig. 5); setae of abdominal tergite VIII nearly twice the basal width of antennal segment III. Cornicles (Fig. 7) dark, pale basally, gradually tapering then slightly expanded apically, apical $^1/_3$ with polygonal reticulation; length, 780-960. Length of cauda (Fig. 6), 336-468, pale, spinulose, elongate triangular, usually with 4-5 pairs of lateral setae and 1-3 preapical setae.

Alate viviparous female differing from apterous viviparous female as follows: Body length, 2,460-3,000; width through eyes, 516-564. Length of antennal (Fig. 3) segment III, 840-1,092, with 42-55 secondary sensoria; IV, 672-888; V, 576-708; length of base of VI, 168-204; terminal process, 924-1,080. Length of ultimate rostral segment 132-156. Length of hind tibia, 1,720-2,340; hind tarsus II, 120-156. Lateral sclerite large, subequal to basal width of cornicles. Length of cornicles, 768-936; cauda, 324-360, with 3-5 pairs of lateral setae and 2-3 preapical setae. Length of forewings, 3,240-3,360; hindwings 1,740-1,980; wing veins dark with fuscous border (Fig. 8).

Remarks.- The most recent collections of *M. leucanthemi* were from sites that included a concentration of ox-eye daisies, *Leucanthemum vulgare* Lam. (=*Chrysanthemum leucanthemum* L.), in the western Oregon Cascade Mountains (Jensen, 1992 and pers. com.) and from *L. vulgare* in a wildflower demonstration plot in Beltsville, Maryland. The initial collection of *M. leucanthemi* in Oregon came from heavily infested plants with aphids covering the stems (Jensen, pers. com.); however, additional collecting trips in subsequent years did not produce *M. leucanthemi* from areas adjacent to the original collection site (Jensen, pers. com.). Maryland specimens of *M. leucanthemi* also were not abundant or readily observable on their host plants. Specimens were detected only after host plants were tapped over a wooden collecting board (Jensen, pers. com.) or after of the bases of numerous flowers were examined carefully.

Specimens Examined.-U.S.A.: MARYLAND, Beltsville, on *C. leucanthemum* [=*L. vulgare*], A. Jensen collector, USNM: IV-29-1997 (2 ap. ad.), V-5-1997 (1 ap. ad.), V-14-1997 (1 al. ad.), V-20-1997 (1 al. ad. and 6 ap. ad. on 2 sl.), VI-17-1997 (8 ap. ad. on 2 sl.); G.L. Miller collector, USNM: V-4-1998 (1 al. ad.), V-13-1998 (2 ap. ad. on 2 sl.).

OREGON: Linn Co., Andrew's Forest, on *C. leucanthemum* [=*L. vulgare*], A. Jensen collector, ASJC: VI-19-1991 (1 al. ad. and 1 ap. ad. on 2 sl.).

PENNSYLVANIA: State College, on shasta daisy (Pepper's (1965) paper listed "*Chrysanthemum leucanthemum* var. *pinnatifidum*" as the host. It is possible that the identification "Shasta Daisy," as recorded on the microscope slide, was mistaken for ox-eye daisy and corrected in the publication.), J. O. Pepper collector, USNM: X-8-1948 (6 ap. ad. ♀ on 2 sl.); Red Rock, Rickett's Glen, on *C. leucanthemum* [=*L. vulgare*], J. O. Pepper collector, USNM: VIII-30-1950 (1 al. ad. ♀); State College, on *C. leucanthemum* [=*L. vulgare*], J. O. Pepper collector, USNM: VII-21-1962 (9 ap. ad. ♀ on 2 sl.).

The key included in Miller and Stoetzel's (1997) paper to apterae (= wingless adult females) colonizing chrysanthemums in the United States can be modified as follows to include *M. leucanthemi*:

11. Cornicle either completely pale, pale with dark tips, pale basally with remainder dark, or completely dark; cauda pale 12
Cornicle dark; cauda dark or dusky 14
12. Dorsal abdominal setae pointed or capitate; cornicle with rows of reticulations or striations below apex 12A
Dorsal abdominal setae fan shaped; cornicle without rows of reticulations or striations below apex . . . . *Pleotrichophorus chrysanthemi* (Theobald)
12A. Most dorsal abdominal setae associated with basal scleroite; cornicle with approximately 1/3 polygonally reticulated apically . . . *Macrosiphoniella leucanthemi* (Ferrari)
Dorsal abdominal setae not associated with basal scleroite; cornicle with much less than 1/3 polygonally reticulated apically . . . . (continue at 13 in Miller and Stoetzel's 1997 key)

The key included in Miller and Stoetzel's (1997) paper to alatae (= winged adult females) colonizing chrysanthemums in the United States can be modified as follows to include *M. leucanthemi*:

7. Cornicle with apical reticulations less than 1/3 of length, slightly constricted in region of apical reticulation . . . . *Macrosiphum euphorbiae* (Thomas)
Cornicle with apical reticulations more than 1/3 of length, reticulated region not constricted 7A
7A. Wing veins bordered with fuscous pigmentation; cornicle pale basally . . . . *Macrosiphoniella leucanthemi* (Ferrari)
Wing veins not bordered with fuscous pigmentation; cornicle completely dark . . . . (continue at 8 in Miller and Stoetzel's 1997 key)

DISCUSSION

The ox-eye daisy, *L. vulgare*, native to Eurasia, originally came to America sometime after the first Europeans arrived. With the deforestation of eastern North America and subsequent clearing of the land for agricultural use, the daisy spread and eventually become a nuisance in open fields (Sanders 1993). At the height of the American agricultural era, "spring fields were as white as after a midwinter's blizzard" (Sanders 1993); hence its other common names, white weed or May weed (Durant 1976). Since its initial introduction, ox-eye daisy has become widely naturalized in North America. Although it is classified as a regional noxious weed in selected areas of British Columbia, Canada (Cranston et. al. 1996), it is not on the U. S. Federal noxious weed list (Anonymous 1995). Land development and the succession of many old fields to wooded habitats has resulted in the ox-eye daisy's becoming much less common in parts of the eastern United States (Sanders 1993). More recently, the ox-eye daisy has been used in plantings of wildflower meadows and is offered for sale in several seed catalogs for gardeners.

Recent collections of *M. leucanthemi* indicate that it is more widespread than previously reported (Pepper 1965, Jensen 1992). Because ox-eye daisy may represent the only recorded host of *M. leucanthemi* in North America (Pepper 1965, Robinson 1987, Jensen 1992), and because this host is prevalent across much of the North America, *M. leucanthemi* might have a broader North American distribution. This aphid, however, may be variably abundant and heavy infestations encountered irregularly.

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We especially thank A. Jensen (USDA-ARS, Systematic Entomology Laboratory) for the loan of Oregon specimens of *M. leucanthemi* and comments regarding the Oregon collection site, bringing our attention to *M. leucanthemi* in Maryland, and reviewing the paper. We appreciate R. L. Blackman (Department of Entomology, British Museum (Natural History)) for forwarding a copy of Ferrari's original description of *M. leucanthemi*. We are also grateful to D. Miller (USDA-ARS, Systematic Entomology Laboratory, Beltsville, MD), S. McKamey (USDA-ARS, Systematic Entomology Laboratory, Washington, DC), D. Voegtlin (Illinois Natural History Survey, Champaign, IL), and A. G. Wheeler, Jr. (Clemson University, SC) for their reviews and helpful suggestions on early drafts of the manuscript.

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NEW WEST VIRGINIA RECORD FOR *FABRIA INORNATA* (TRICHOPTERA: PHRYGANEIDAE)[1]

Donald C. Tarter, Jennifer L. Wykle, Jason A. Morgan[2]

ABSTRACT: The phryganeid caddisfly *Fabria inornata* is reported for the first time in West Virginia. This record represents a southeastern extension of the known range which was previously reported from northern and central United States and a few Canadian provinces. Larvae (5) were collected from the Meadow River wetland complex (Greenbrier County) in dense beds of *Ceratophyllum* using a standard D-frame dip net. The number of caddisfly species now known for West Virginia is 193.

The family Phryganeidae, numbering about 75 species and 15 genera, is distributed in the Holarctic and Oriental regions (Wiggins, 1996). In North America, there are 10 genera with 28 species (Wiggins, 1996). Prior to this record, *Fabria inornata* (Banks) was known from Illinois, Iowa, Indiana, Minnesota, Michigan, Wisconsin in the United States, and the Canadian provinces of Ontario, Quebec, Northwest Territories, Manitoba, and Alberta (Banks, 1907; Neave, 1934; Leonard and Leonard, 1949; Etnier, 1965; Roy and Harper 1975, 1979; Schmid, 1980; Hilsenhoff, 1981; Flannagan and Flannagan, 1982; Waltz and McCafferty, 1983; and Wiggins, 1977, 1996). According to Wiggins (1996), the species is rare and highly localized. The larva was first identified from specimens reared in Ontario (Wiggins, 1977).

Larval collections were made in the Meadow River wetland complex on 29 October 1997 from dense beds of *Ceratophyllum* using a standard D-frame dip net (700 micron mesh). The following water quality parameters were recorded at the time of collection: temperature 9.5C; pH=7.0; dissolved oxygen 4.0 mg/L; alkalinity 51.3 mg/L $CaCO_3$; hardness 68.4 mg/L $CaCO_3$; acidity 0.0 mg/L; and free carbon dioxide 25 mg/L.

The Meadow River wetlands complex (latitude 37 3'41" N, longitude 80 24'39" W) comprises the second largest wetland in West Virginia, containing approximately 1393 ha (3131 acres) of swamp and wet meadow (Evans et al., 1982). The wetlands are situated in the western end of Greenbrier County at the southern boundary of the Allegheny Mountains physiographic section of West Virginia (Strausbaugh and Core, 1978). Strata of Mississippian age abut and underlie the alluvium of the Meadow River and its tributaries within the study area (Price and Heck, 1939).

Following the addition of *Fabria inornata* to the state checklist, 193 species of caddisflies, representing 16 families and 63 genera, are known from West Virginia (Stout and Stout, 1989; Tarter, 1990; Tarter and Sykora, 1990; Tarter and Kirchner, 1991; Griffith and Perry, 1992; and Tarter et al., 1996).

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A NEW SPECIES OF *SENDAPHNE* (HYMENOPTERA, BRACONIDAE) FROM BRAZIL[1]

D. Scatolini[2], A. M. Penteado-Dias[3]

ABSTRACT: A new species of *Sendaphne, S. paranaensis*, n.sp., (Hymenoptera: Braconidae: Microgastrinae) from Brazil is described and compared with allied species of the genus.

The members of the genus *Sendaphne* are predominantly yellow, with slender body, smooth propodeum and glossa especially long and bifid (Mason, 1981). The genus contains *S. olearus* Nixon, 1965, *S. sulmo* Nixon, 1965, *S. brasilianus* Penteado-Dias, 1995, *S. jatai* Penteado-Dias, 1995, and several undescribed species, all Neotropical. Since the treatment of Brazilian species by Penteado-Dias (1995), an additional new species from Paraná has been discovered, which is described below.

Terms for body morphology and wing venation follow Achterberg (1993).

Sendaphne paranaensis, NEW SPECIES

(Figs. 1-4)

Holotype, female. Head yellowish brown, mouth parts yellowish, mandibles with apex dark brown; antennae dark brown, with scape largely yellow. Mesosoma yellowish brown, with dark brown patterns as in figures 1, 2. Wings hyaline, with pterostigma dark brown. Legs pale yellow except apex of hind tibiae and the hind tarsal segments which are dark brown. Metasoma yellow, with dark brown areas in posterior region of tergites III and VIII; tergites IV-VII completely dark brown (fig. 1). Ovipositor sheaths dark brown.

Antennae with 16 flagellomeres; flagellomere XVI 2.6 times longer than its width, XV 2.1 times its width, XIV 3.1 times its width, XIII and XII 3.7 times the width. Fore wing: transverse cubito-anal vein postfurcal; distance from that to basal vein shorter than its length; first and second abscissae of the cubitus nearly equal in length (fig. 3).

Body covered by pale hair; mesosoma with uniform pubescence with exception of dorsal area of mesopleuron and metapleuron (fig. 2). Hind coxa longer than hind femur (fig. 4).

Hypopygium acute, not extending beyond the apex of the metasoma.

Body length: 3.1-3.9mm. First tergite 2.9 times longer than wide apically; second tergite longer than half of first tergite. Ovipositor sheaths as long as metasoma.

Male: Similar to female but with the extent of dark brown color in metasoma variable.

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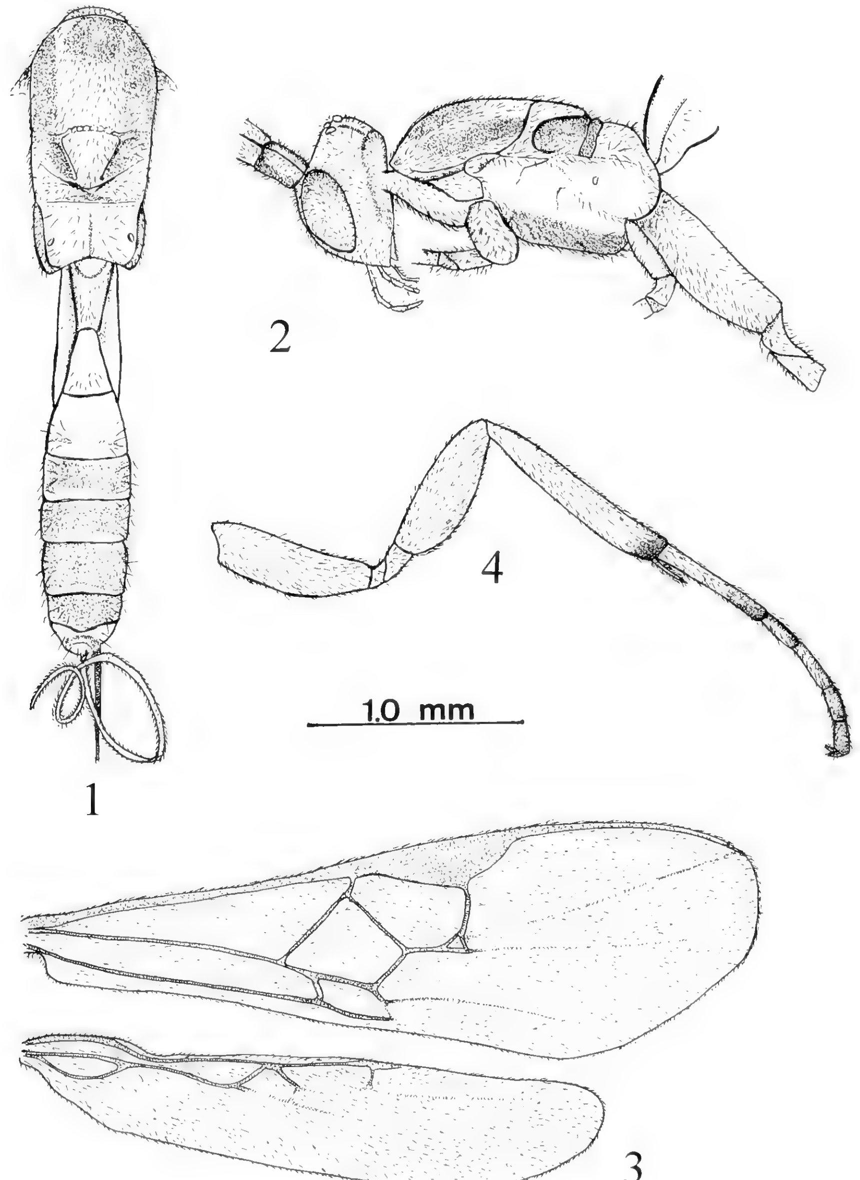

Figs. 1-4. *Sendaphne paranaensis* n. sp., female, holotype. 1, mesosoma and metasoma, dorsal view; 2, head, mesosoma and part of metasoma, lateral view; 3, wings; 4, hind leg.

(Reserva Biológica Samuel Klabin), Malaise trap. Paratypes: Brazil, Paraná: Telêmaco Borba, 11-VIII-1986: 1♀; 8-IX-1986: 1♀; 15-IX-1986: 1♂ and 2♀; 29-IX-1986: 2♂ and 1♀; 6-X-1986: 10♂ and 1♀; 13-X-1986: 2♂ and 1♀; 3-XI-1986: 5♂ and 1♀; 10-XI-1986: 6♂; 17-XI-1986: 10♂ and 1♀; 24-XI-1986: 6♂ and 1♀; 1-XII-1986: 3♂ and 1♀; 8-XII-1986: 1♂; 15-XII-1986: 1♂; 22-XII-1986: 2♂ and 1♀; 19-I-1987: 1♂; 30-III-1987: 2♂; 20-IV-1987: 2♂; 4-V-1987: 1♀; 27-VII-1987: 1♂. Holotype and 45 paratypes deposited in the Coleção de Entomologia "Pe. J. S. Moure" of Departamento de Zoologia, Universidade Federal do Paraná (UFPR), Curitiba, Paraná; 23 paratypes deposited in the Coleção Entomológica do Departamento de Ecologia e Biologia Evolutiva (DCBU), Universidade Federal de São Carlos , São Carlos, São Paulo.

Etymology. Specific name refers to the Brazilian state of the Paraná.

DISCUSSION

Sendaphne paranaensis resembles *S. olearus* in head coloration, but has dark brown areas on the mesosoma and only tergites III and VIII with posterior dark brown areas. *Sendaphne paranaensis*, *S. olearus* and *S. jatai* have the two abscissae of the cubitus of the fore wing the same length.

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SLIDE-MOUNTING TECHNIQUES FOR *TRICHOGRAMMA* (TRICHOGRAMMATIDAE) AND OTHER MINUTE PARASITIC HYMENOPTERA[1]

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ABSTRACT: Methods for preparing Canada balsam slides of *Trichogramma* and similarly-sized parasitic Hymenoptera are presented. Included are procedures for transferring to balsam, specimens that were originally mounted in temporary, water soluble media, such as Hoyer's medium.

The primary factor responsible for our poor understanding of the systematics of minute parasitic Hymenoptera such as the Trichogrammatidae is the absence of adequate study collections. Certainly this can be attributed, in part, to difficulty in collecting which usually involves searching for hosts, or, more commonly, carefully sorting through bulk collections such as Malaise trap or sweep samples. However, once specimens are found the problem of preparing them for study perhaps is even more daunting. For detailed study most parasitic Hymenoptera with a body length of 1 mm or less must be placed on slides. This includes species of *Trichogramma* and those of virtually all other trichogrammatid genera. Unfortunately, there has been a tradition of mounting such wasps in water soluble media such as Hoyer's (e.g. Rosen and Debach 1979) or Liquid Faure (e.g. Doutt and Viggiani 1968) which, unless carefully monitored, eventually dehydrate and damage specimens (Upton 1993). The argument against using temporary media for small chalcidoids has been well made by Noyes (1982). Additional problems with earlier collections of micro-Hymenoptera are that specimens frequently were mounted uncleared and in a lateral rather than dorsoventral position, both practices precluding adequate examination of important characters, particularly the male genitalia, which in the Trichogrammatidae are important for classification and often identification as well (Nagarkatti and Nagaraja 1971, Viggiani 1971).

This paper presents the techniques developed over several years at the University of California, Riverside, primarily for preparing permanent Canada balsam mounts of *Trichogramma*. The methods also have been applied to other genera of Trichogrammatidae and are appropriate for other small, lightly-sclerotized wasps such as Aphelinidae. Because these groups are frequently placed in Hoyers we also describe our techniques for transferring such specimens to Canada balsam.

Publication of these methods is motivated by the large number of lots of *Trichogramma* received from biological control workers for identification and

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the frequent requests for mounting procedures. The continued popularity of this group for inundative biological control (Smith 1996) coupled with its taxonomic complexity (Pinto and Stouthamer 1994) requires authoritative species identifications. The chances of obtaining such identifications are enhanced if taxonomists are provided with slide-mounted specimens, as they generally have neither the time nor the resources for specimen preparation.

MATERIALS

The materials listed here are optimal for mounting lightly-to moderately-sclerotized small wasps the size of *Trichogramma* (< 1 mm).

a). Hooked probes. Useful for moving and orienting specimens. These are made using 0.10 mm & 0.20 mm diameter minuten pins. Pins are placed in the end of small wooden dowels and cemented in place with epoxy. The tips then are bent at right angles.

b). Chisel-tipped probes. These tools are useful for the optional removal of wings and antennae. They are made by using minuten pins (as above), hammering them into a flattened spatula (<1.0 mm wide) and then honing the edge on a very fine wet stone or emery paper.

c). Balsam applicators. Made with #1, nylon-headed, black insect pins inserted (head out) into wooden holders (old "00000" artist spotting brush handles work well). A hole is made in the end of the wooden holder with a #2 insect pin, the tip of the #1 pin is coated with epoxy cement and inserted into the holder.

d). Glass pipettes (12.5-15 cm), fitted with latex bulbs.

e). Forceps (fine-tipped jeweler's type); 2 pair.

f). Ceramic depression plate. Optimum size is ca. 9.0 x 11.5 cm with 12 depressions each 5.0 mm deep and 21 mm in diameter.

g). Rectangular plastic sealable food containers. Used for storing the depression plate during specimen clearing and dehydration.

h). Clear glass depression slide. Useful if specimens are to be dissected (see below).

i). Glass coverslips. 5 mm diameter, for specimen positioning. If difficult to obtain, 6 mm coverslips may be used instead. With the larger coverslips a ceramic plate with slightly larger depressions (item f) should be used. 6 mm diameter glass coverslips for specimen mounting. Small round coverslips are easier to use than the larger round or square varieties, require less mountant, and are less subject to entrapment of air bubbles. The 6 mm coverslips are available from D. J. and D. Henshaw; 34, Rounton Rd., Waltham Abbey; Essex, EN9 3AR; England. We currently are unaware of a source for the 5 mm coverslips.

j). Dehydrating, mounting and clearing solutions. Canada balsam (filtered-neutral); clove oil; ethyl alcohol dehydration series (10, 20, 40, 60, 80, 95, & 100% solutions); 10% potassium hydroxide (KOH) solution; Triton X-100®; xylene. The Triton X-100 is added to the 10% ethanol solution (6 drops/500 ml). The

Canada balsam is mixed in small batches (15-20 ml) with 15% clove oil by volume. This conditions the mountant and retards the rapid "skinning" of the balsam during mounting; it is critical for remounting specimens out of Hoyer's (see below).

MOUNTING PROCEDURE

The following method is recommended for dried specimens (either air dried or critical-point dried). It is followed by modifications necessary if working with live or alcohol-preserved specimens. Most of the procedures detailed below require a great deal of practice and patience before proficiency is attained. We suggest that preparators begin with expendable specimens.

Before mounting, it is important to have a comfortable work area and a stereo-microscope allowing magnifications up to ca. 100x. The work area under the microscope should have sufficient surface to accommodate the 9 x 11.5 cm depression plate through all of its movements, without the possibility of tipping or falling. Additionally, on either side of the magnifying field under the microscope and about 1 in. lower than the work surface, there should be room to support one's hands while making small, controlled movements during specimen positioning and mounting. Hand stability while manipulating specimens with the forceps or probes is critical. The microscope stage should be clear glass and elevated ca. 1 in. so light can be directed through the stage onto a white background to provide backlighting for the specimen. A twin-pipe, fiber optic illuminator with focusing tubes is an ideal light source. One pipe can be used for backlighting while the other provides direct illumination.

a). Preparation. Prepare a ceramic depression plate by adding two, 5 (or 6) mm coverslips and 80% ethanol to each depression. For this and all other procedures depressions should be filled to the top with liquids. Place one dry specimen in each depression and submerge in the ethanol. Using forceps, lift the coverslips and place the specimen beneath both. Place the plate in a container with a tight fitting lid and 95% ethanol in the bottom. The depression plate should be on a platform elevating it above the ethanol.

b). Clearing and softening. After ca. 12 hr, remove the 80% ethanol with a pipette and replace with 10% KOH (for this and all other exchanges liquid should be removed only to the level of the coverslip to insure that the specimen remains submerged). Sufficient clearing with KOH is important so that internal structures, particularly the male genitalia, will be visible. Most specimens can be left in KOH for 16-20 hrs at room temperature depending on the degree of sclerotization. This should be extended to ca. 30 hr for the most highly sclerotized specimens; less time is required for lightly sclerotized specimens. During clearing with KOH place the depression plate in a container with a tight fitting lid and distilled water in the bottom.

To accelerate clearing, specimens can be placed in a 30-40 C. warming oven for 1.0-4.0 hrs, again, depending on the degree of sclerotization. 1.0-2.0 hrs is sufficient for most *Trichogramma*. After the first hour, warmed material should be checked every 30 min to prevent overclearing. Experience eventually allows one to estimate clearing time based on degree of sclerotization.

It is important that the specimen be under the two coverslips when the KOH is added. Otherwise it will float and is difficult to resubmerge. If floating occurs, resubmerging can be accomplished by lifting the coverslips with forceps and placing them above the specimen and gently coaxing it down to the bottom of the depression plate. If air bubbles become attached to the specimen during this process the KOH can be removed and replaced with 80% ethanol. This allows repositioning under the coverslips, while dissipating the air bubbles. The ethanol is then again replaced with KOH.

c). Specimen positioning. After material has cleared adequately, the KOH is removed with a pipette and replaced with 10% ethanol (with Triton X-100®). The specimen now is ready for positioning. Occasionally (particularly in *Trichogramma*) specimens will be adequately cleared except for gut contents in the abdominal area. When this occurs, the positioning should be carried out in KOH before the ethanol is substituted, thus allowing the KOH to penetrate the abdomen and complete the clearing process. This is especially important in taxa where an unhindered view of the genitalia is critical.

Positioning is the most critical and difficult step in the mounting process; it insures that the body and, most importantly, the genitalia are in the proper position for study. To a large extent, this step dictates the quality of the final preparation. The positioned specimen should end up somewhat dorsoventrally flattened, with dorsum adjacent to the coverslip, the legs and wings at roughly right angles to the body, and the antennae directed forward or laterally. The procedure used is as follows:

With two pair of forceps, move the uppermost coverslip to the side of the depression while holding the other in place over the specimen. Next, lift the second coverslip to free the specimen beneath. Hold the coverslip in a tilted position with the lower leg of the forceps resting on the bottom of the depression plate. The coverslip held in this position can be manipulated like the hinged lid of a box. With the coverslip in a slightly tilted position begin backing the specimen under its edge with the second pair of forceps, abdomen first and dorsum up (Fig. 1). As the specimen is pushed under, apply downward pressure with the coverslip at intervals to assure a slight dorsoventral flattening. The ability to manipulate the coverslip depends on adequate and comfortable hand support adjacent to the work area. The specimen can be moved under the coverslip by pushing on the front of the head with the tip of the closed forceps. Ideally, the legs and antennae move laterally during this process. As the specimen is backed under it is important to keep it in as perfect a dorsoventral plane as possible. This is especially important for males to provide optimum viewing of the genitalia. If adequately cleared, the genital capsule itself will be visible during positioning and slight adjustments can be made as necessary. The fore-

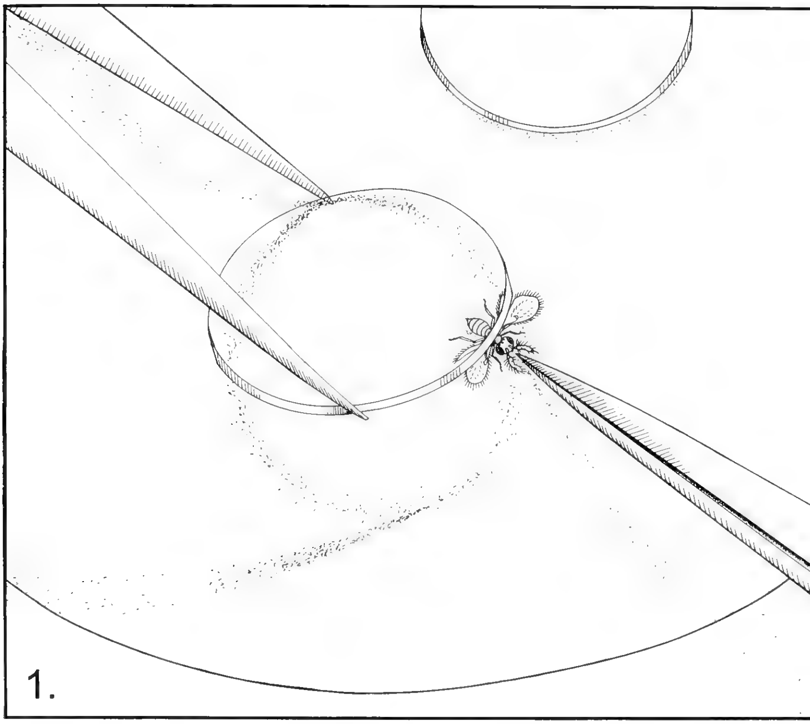

Figure 1. Positioning of a *Trichogramma* specimen (dorsum up) under a coverslip prior to dehydration and mounting (tilt of coverslip exaggerated).

wings normally reverse during this procedure, but this does not require correction because the location of the venation along the anterior border indicates that reversal has taken place. After positioning, the second coverslip is replaced on top of the first.

When working with dried individuals the legs sometimes extend directly below the body making it impossible to position specimens dorsoventally before movement under the coverslip. Such specimens, lying on their side, can be pushed, dorsum first, against the tilted coverslip and rolled into the correct position as the legs fold beneath the body. The specimen can then be pushed under as slight pressure is applied at intervals with the coverslip as indicated above.

d). Dehydration. After positioning is complete in 10% ethanol or KOH, the specimen is run through a series of higher ethanol concentrations (20, 40, 60, 80, & 95%) to absolute, keeping it at each concentration for 30-45 min. After the change to 40% the specimen should be repositioned from **under** to

between the two coverslips. This allows more rapid penetration by the ethanol and aids in dorsoventral positioning. If necessary, it is possible to manipulate specimens and adjust positioning up to the 60% concentration. Specimens become brittle and fragile in the higher concentrations.

Depression plates should remain in a tightly closed container during both the clearing and dehydration processes to prevent evaporation of liquids in the cells. During clearing and dehydration in 10 and 20% ethanol, the container should have distilled water in the bottom; 95% ethanol is used for the higher alcohol concentrations. The plates can be kept sealed for extended periods without liquid loss except at the 95% and absolute ethanol changes. At these levels the alcohol evaporates and specimens can dry out and be damaged if left for more than 1 hr.

e). Transfer to clove oil. After completing dehydration in absolute ethanol, the top coverslip is lifted, and the specimen is removed with a hooked probe (carefully hooking a wing or both antennae), gently transferred to clove oil and submerged. Material should remain in clove oil for at least 2 hr and can be stored for as long as 2 wks before mounting if kept in a closed, dust free container.

f). Modifications for ethanol-stored or live specimens. Excellent slides can be produced with dried material. However, live material or specimens stored in 70-80% ethanol can also be prepared directly for mounting. For ethanol-stored specimens, place individuals directly into 10% KOH for clearing. The procedure then follows that for dried specimens. If working with cultures or collecting parasitized eggs in the field, it may be desirable to prepare slides directly from live material. In this case, specimens should be killed once they are fully sclerotized by placing them in 75-80% ethanol for 12-24 hrs, and then treated the same as ethanol-stored material.

g). Mounting. Specimens can be mounted on slides either whole or after dissection. We find that *Trichogramma* and other relatively small trichogrammatids ($\leq$ 0.60 mm) are conveniently mounted whole. For larger specimens body depth may prevent the antennae and wings from being in an even plane for optimum viewing or photography. For these we routinely remove the antenna and wings from one side of the body, and mount them under a second coverslip with considerably less balsam. Some may prefer to dissect the head, both antennae, all wings and genitalia from the body, and mount them separately on the same slide. We do not do this because of time constraints. Furthermore, we find that mounting the male genitalia separately frequently distorts them and that they best retain their shape if left within the body.

1). Whole mounts. Before mounting, prepare a template to assist in placing the specimen at the center of the slide. Next, using the balsam applicator, pick up a small drop of mountant, dip it once in xylene, and gently "mix" it at the desired position on a clean slide. A dot of mountant ca. 3-4 mm in diameter is optimum. The specimen now can be placed in the mountant. Remove it from clove oil with the hooked probe and submerge it, dorsum up, in the balsam drop.

At this point the specimen can be oriented and some minor repositioning of body parts is possible. If the balsam is too tacky, a small drop of xylene can be added. After the balsam dries for 25-45 min (preferably covered to protect from dust), a coverslip (precleaned with 80% ethanol and lens tissue) is prepared. While holding the coverslip with forceps use the balsam applicator to lift another small dot of balsam, then dip the applicator in xylene and "mix" on the coverslip. Dip the applicator a second time in xylene and complete "mixing" before the coverslip is placed on the specimen. The area covered by the balsam dot should be ca. half that of the coverslip. The coverslip then is placed immediately on the specimen. For placement, it should approach the specimen from behind and at an angle, lowering it until the lower edge of the "coverslip balsam" contacts the "slide balsam". At this point the coverslip is released and allowed to settle. The coverslip and specimen can be manipulated slightly by gently touching and moving the coverslip with forceps during or immediately after settling.

It is important that the correct amount of balsam be used, which, of course, depends somewhat on the size of the specimen. Too little may crush it as the slide dries; too much usually results in too thick a mount and body parts settling off horizontal, precluding proper focusing or measuring.

2). Dissected specimens. We typically mount the right antenna, and the fore and hind wings from the same side of the body under one coverslip above the specimen they are taken from. For dissection, transfer the specimen from clove oil to a clear glass depression slide to which one drop of clove oil has been added. It is best to have backlighting for this procedure as it allows optimum tracking of dissected parts, which are difficult to see when cleared. Using a hooked probe and chisel-tipped probe, orient the specimen dorsum up with the head directed toward or away from you, depending on the side to be dissected. To remove the forewing, pin it at its base against the bottom of the depression slide with the chisel-tipped probe and gently move the specimen away with the hooked probe. The same procedure is used for the hind wing and the antenna. After removal from the body, the structures are stacked upon one another (forewing at bottom) and transferred with a hooked probe to a balsam dot (1.0 - 2.0 mm in diam.) on the slide. Once submerged in the balsam, the structures are separated and oriented. Wing orientation should be the same as if still attached to the body. The body with parts still attached is mounted under a separate coverslip below. Preparation of balsam dots and coverslips are the same as indicated for whole mounts.

Some taxa are deep bodied and difficult to keep in a dorsoventral plane after mounting. For these it may be necessary to add pieces of broken coverslip to either side of the specimen or to add additional balsam in layers over a period of time.

h). Drying. Completed slides must be kept flat until the balsam sets. They can be placed either in a slide folder for 1-2 wks, or on a tray in a drying oven at 30-40 C for 3-5 da.

REMOUNTING PROCEDURE

This procedure allows specimens originally mounted in Hoyer's medium to be transferred to Canada balsam with minimal damage. A significant problem in remounting is that the antennae and head frequently collapse after contacting the balsam. The following method, while not completely successful, prevents major collapsing in 80-95% of the specimens. The avoidance of xylene is the primary difference from the previous procedure.

a). Coverslips of Hoyer's mounts frequently have been sealed with various compounds to reduce desiccation. This material should be removed with the tip of a razor blade or Exacto® knife before processing.

b). Place slide in a Petri dish and soak in distilled water for ca. 60 hrs. After soaking, the coverslip can be lifted free of the specimen(s).

c). Transfer specimen with a hooked probe to a ceramic depression plate supplied with 10% ethanol (and Triton X-100®). Cover it with a 6 mm coverslip.

d). Replace ethanol with 10% KOH for 30-40 min at room temperature. KOH not only is a clearing and softening agent but also reduces head and antennal collapse. Consequently, specimens should be treated with KOH even if they had previously been cleared for the Hoyer's mount. Because of flattening from the previous mount it is very difficult to reposition specimens during the remounting process.

e). Remove the KOH with a pipette and replace with 10% ethanol for 30 min. Repeat with 20%, 40%, 60%, 80%, 95%, and twice with 100% ethanol. If necessary, specimens can be held longer (e.g. overnight) at concentrations of 80% or lower.

f). Replace the absolute ethanol with a 1:1 mixture of absolute ethanol and clove oil. Place the depression plate into a partly opened container for 2-3 wks to allow for slow, complete evaporation of the alcohol and any remaining water. The presence of the smallest amount of ethanol or water at this point results in partial or complete collapsing of the antennae and head during mounting. Once evaporation is complete only clove oil will remain and the specimen is ready for mounting.

g). The mounting procedure is similar to that used for new material but with the following differences. i) Xylene should never be used; using it at this stage results in structure collapse. If the balsam (with 15% clove oil) becomes too tacky, a drop or two of additional clove oil can be added. ii) The balsam dot placed on the slide should not be mixed or spread significantly, nor should it be allowed to dry after specimen placement. iii) Coverslips are placed immediately after specimen placement and are dry (i.e. no balsam is added to the coverslip first). iv) When placed on the specimen, the coverslip is not tilted but released parallel with the slide. This allows it to contact the balsam drop near its center and forces air bubbles out when pressure is applied with the forceps. v) Specimen transfer should be made as quickly as possible. Delays at this point can result in the balsam losing its working consistency and will damage the specimen.

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EDMUNDSIOPS INSTIGATUS: A NEW GENUS AND SPECIES OF SMALL MINNOW MAYFLIES (EPHEMEROPTERA: BAETIDAE) FROM AUSTRALIA[1,2]

C. R. Lugo-Ortiz, W. P. McCafferty[3]

ABSTRACT: *Edmundsiops instigatus* (Ephemeroptera: Baetidae), n. gen. and sp., is described for larvae collected from eastern Australia. The new genus is distinguished by the basally bulbous and apically bifid right prostheca, apically acute segment 2 of the maxillary palps, and bulbous segment 3 of the labial palps. The considerable intraspecific variation in body coloration, body size, leg setation, and paraproct spination in larvae of *E. instigatus* is discussed.

As is generally the case throughout the Southern Hemisphere, small minnow mayflies (Ephemeroptera: Baetidae) are poorly known in Australia. Only 16 species in the genera *Baetis* Leach (3 spp.), *Bungona* Harker (1 sp.), *Centroptilum* Eaton (2 spp.), *Cloeodes* Traver (2 spp.), *Cloeon* Leach (5 spp.), *Offadens* Lugo-Ortiz and McCafferty (2 spp.), and *Pseudocloeon* Klapálek (1 spp.) have been reported from Australia (Ulmer 1908, 1916, 1920; Tillyard 1936; Harker 1950, 1957; Suter 1986; Lugo-Ortiz and McCafferty 1998 ab). The taxonomic status of those Australian species assigned to *Baetis* and *Pseudocloeon* should be considered provisional because the concepts of both genera have been significantly modified recently as a result of worldwide revisionary studies (e.g., Waltz and McCafferty 1985, 1987 ab, 1997; McCafferty and Waltz 1990, 1995; Waltz et al. 1994). Baetidae have historically been poorly studied and understood mainly because only relatively recently 1) have comparative collections been amassed for study, 2) has it been realized that ultramorphology of larvae holds the key to delineating taxonomic diversity, and 3) has it become clear that a world perspective is necessary to formulate natural generic concepts.

Herein, we describe a new genus and species of Baetidae based on larvae collected from eastern Australia. Except where otherwise noted, the specimens studied are housed in the Purdue Entomological Research Collection, West Lafayette, IN.

Edmundsiops Lugo-Ortiz and McCafferty, NEW GENUS

Larva. Head: Capsule longer than broad. Labrum (Fig. 1) wider than long, broadly rounded anteriorly, with narrow anteromedial emargination. Hypopharynx (Fig. 2) with lingua apically acute and superlinguae apicolaterally narrow. Left mandible (Fig. 3) with

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incisors fused; prostheca robust, apically denticulate. Right mandible (Fig. 4) with incisors apically separated; prostheca basally bulbous, apically bifid. Maxillae (Fig. 5) with four short, blunt denticles on crown of galealaciniae; palps two segmented, reaching apex of galealaciniae; palp segment 2 apically acute. Labium (Fig. 6) not compact; palps three segmented; palp segment 3 bulbous. Thorax: Nota without setae medially. Legs (Fig. 7) robust; femora without villopore; tarsal claws (Fig. 8) with one row of denticles. Abdomen: Slightly dorsoventrally flattened. Terga (Fig. 9) with abundant scale bases and few scales scattered over surface; creases absent; posterior margin with triangular spines. Sterna with anterolateral friction pads. Gills (Figs. 10, 11) on segments 1-7, platelike, relatively broad, marginally with small serrations, well tracheated, held dorsolaterally. Paraprocts (Fig. 12) with marginal spines. Cerci with abundant setae laterally and medially; medial caudal filament 0.95-1.0 x cerci length, with abundant fine, simple setae laterally.

Adult. Unknown.

Included species. *Edmundsiops instigatus* Lugo-Ortiz and McCafferty, new species (type species).

Distribution. Australia: New South Wales, Queensland, Tasmania, Victoria.

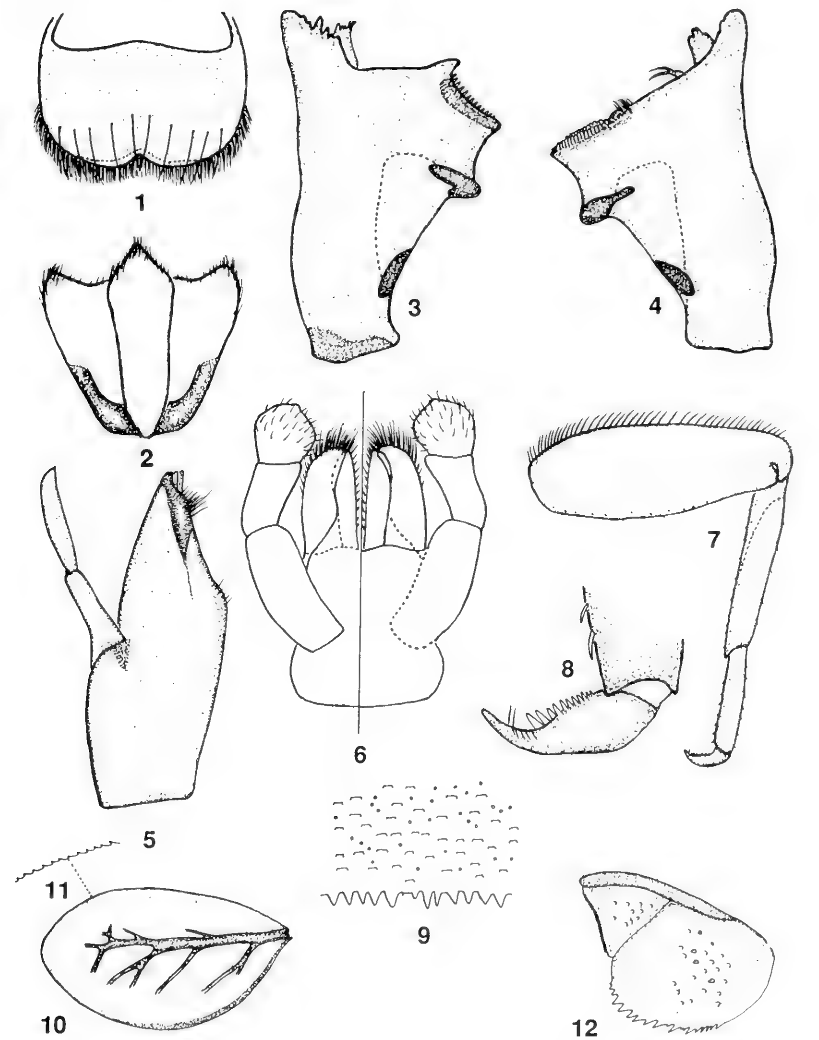
Etymology. The generic name is a combination of letters incorporating the surname of G. F. Edmunds, who collected the type material, and the Greek word *iops* (small fish). The gender is masculine.

Discussion. Larvae of *Edmundsiops* are distinguished from other known Australian and Southeast Asian baetids by the basally bulbous and apically bifid right prostheca (Fig. 4), apically acute segment 2 of the maxillary palps (Fig. 5), and bulbous segment 3 of the labial palps (Fig. 6).

Because the Australian and Southeast Asian baetid faunal composition is so poorly understood, we cannot at this time appropriately ascertain the phylogenetic relationships of *Edmundsiops.* We have not seen any other Australian or Southeast Asian baetids with morphological characteristics similar to those of *Edmundsiops,* and we therefore may assume that *Edmundsiops* represents a taxon with affinities elsewhere in the Southern Hemisphere, or alternatively that it represents an ancient insular lineage.

Edmundsiops instigatus Lugo-Ortiz and McCafferty, NEW SPECIES

Larva. Body length: 4.8-7.5 mm. Caudal filaments length: 2.0-4.0 mm. Head: Coloration pale to medium yellow-brown, without distinct pattern. Antennae approximately 3.0x length of head capsule. Labrum (Fig. 1) dorsally with submedial pair of long, fine, simple setae and anterior submarginal row of 4-5 long, fine, simple setae. Hypopharynx as in Fig. 2. Left mandible (Fig. 3) with incisors with five denticles. Right mandible (Fig. 4) with outer set of incisors consisting of broad, apically blunt denticle, inner set with three small denticles. Maxillae (Fig. 5) with four to five minute, fine, simple setae near medial hump; palp segments equal in length. Labium (Fig. 6) with glossae with abundant short, robust, simple setae medially; paraglossae with abundant long, robust, simple setae apically; palp segment 1 slightly longer than segments 2 and 3 combined; palp segment 2 with minute distomedial projection; palp segment 3 subequal in length to segment 2, with abundant long, robust, simple setae scattered over surface. Thorax: Coloration pale to medium yellow-brown, with medium brown markings. Hindwingpads present. Legs (Fig. 7) pale to medium yellow-brown; femora with row of long, robust, simple setae dorsally and few minute, fine, simple setae ventrally; tibiae with minute, fine, simple setae dorsally (sometimes with subdorsal row of



Figs. 1-12. *Edmundsiops instigatus* Lugo-Ortiz and McCafferty, new genus and species, larva. 1. Labrum (dorsal). 2. Hypopharynx. 3. Left mandible. 4. Right mandible. 5. Right maxilla. 6. Labium (left-ventral; right-dorsal). 7. Left foreleg. 8. Tarsal claw. 9. Detail of tergum 4. 10. Gill 4. 11. Detail of gill margin. 12. Paraproct.

relatively long, robust, simple setae) and few minute, simple setae ventrally; tarsi with few minute, fine, simple setae dorsally (sometimes with subdorsal row of relatively long, robust, simple setae) and row of 4-5 relatively short, robust, simple setae ventrally; tarsal claws (Fig. 8) with 10-11 denticles, increasing in length apically, with subapical pair of minute, fine, simple setae. Abdomen: Coloration pale to medium yellow-brown; tergum 1 with no distinct markings; terga 1-4, 6, and 7 sometimes with large oblong sublateral faint to pale yellow-brown markings; tergum 5 sometimes with faint to pale yellow-brown crownlike marking; terga 8-10 usually paler than other terga, with no distinct markings. Sterna cream to pale yellow-brown. Terga (Fig. 9) with abundant relatively large scale bases; posterior marginal spination irregular. Gills (Figs. 10, 11) with margin usually tinged with brown. Paraprocts (Fig. 12) with 4-15 irregular marginal spines; few scales and scale bases scattered over surface. Caudal filaments pale yellow-brown to medium brown.

Adult. Unknown.

Material examined. Holotype: Larva, AUSTRALIA, New South Wales, Commissioner's Water, 4 mi E of Armidale, 19-II-1966, G. F. Edmunds. Paratypes: AUSTRALIA, New South Wales: Two larvae, Mongarlowe R, nr Monga, Clyde Mtn, 25-I-1966, G. F. Edmunds (National Museum of Natural History, Smithsonian Institution, Washington, D. C.); two larvae, stream at Wilsons Valley, Mt Kosciusko, 10-II-1966, G. F. Edmunds (Australian National Collection, Canberra); three larvae, tributary of Piper Cr, nr jct with Piper Cr, Mt. Kosciusko, 5250 ft, 10-II-1966, G. F. Edmunds (mouthparts, forelegs, tergum 4, gill 4, and paraproct of one larva mounted on slide [medium: Euparal]); two larvae, small stream nr Pt Lookout, New England Natl Pk, 5000 ft, 20-II-1966, G. F. Edmunds; larva, Chandler R, 26 mi E of Armidale, no date, G. F. Edmunds; Tasmania: Three larvae, Derwent R, 4 mi S of Ouse, 27-I-1966, G. F. Edmunds. Additional material: AUSTRALIA, Australian Capital Territory: Five larvae, Lees Spring, nr Canberra, 1200 m, 16-X-1966, J. Illies; New South Wales: Four larvae, Eucumbene R, 4 mi S of Kiandra, 20-I-1966, G. F. Edmunds; two larvae, Alpine Cr, 11 mi E of Kiandra, 20-I-1966, G. F. Edmunds; three larvae, Bobundara Cr, 3 mi N of Maffra, 22-I-1966, G. F. Edmunds; larva, Maclaughlin R, 10 mi SE of Maffra, 22-I-1966, G. F. Edmunds; six larvae, Mongarlowe R, nr Monga, Clyde Mtn, 25-I-1966, G. F. Edmunds; three larvae, Spencers Cr, Mt Kosciusko, 5700 ft, 9-II-1966, G. F. Edmunds; three larvae, tributary of Piper Cr, nr jct with Piper Cr, Mt Kosciusko, 5250 ft, 10-II-1966, G. F. Edmunds; three larvae, Guthrie Cr, at Mt Kosciusko Rd, 10-II-1966, G. F. Edmunds; six larvae [mouthparts, forelegs, tergum 4, and paraproct of one larva mounted on slide (medium: Euparal)], Threbdo R, on Mt Kosciusko Rd, 4 mi N of Jindabyne, 11-II-1966, G. F. Edmunds; larva, Serpentine R, New England Natl Pk, 19-II-1966, G. F. Edmunds; six larvae, small stream nr entrance, New England Natl Pk, 20-II-1966, G. F. Edmunds; five larvae, Coutts Water, 15 mi W of Dorrigo, 4150 ft, 22-II-1966, G. F. Edmunds; four larvae, Newell Falls, 5 mi SE of Dorrigo, 22-II-1966, G. F. Edmunds; three larvae, Majors Cr, 4 mi E of Ebor, 4150 ft, 22-II-1966, G. F. Edmunds; six larvae, Bellinger R, at Bellinger, 23-II-1966, G. F. Edmunds; larva, Crakenback R, above mouth, Mt Kosciusko, 1100 m, 23-IX-1966, J. Illies; two larvae, creek, Mt Kosciusko, 1100 m, 23-IX-1966, J. Illies; four larvae, Guy Fawkes R, above Ebor Falls, 1.5 km NW of Ebor, 8-VIII-1975, M. N. Winokur; three larvae, Chandler R, 26 mi E of Armidale, no date, G. F. Edmunds; Queensland: Three larvae, Jourama Falls Natl Pk, 13-VIII-1983, D. A. and J. T. Polhemus; 13 larvae, Emerald Cr, nr Cairns, 800 m, 13-X-1966, J. Illies; Tasmania: Twelve larvae, Derwent R, 4 mi S of Ouse, 27-I-1966, G. F. Edmunds; 34 larvae, Styx R, Bushy Pk, 400 ft, 27-I-1966, G. F. Edmunds; 13 larvae, Clarence Pipeline, spillway into Bronte Lagoon, 31-I-1966, G. F. Edmunds; larva, Clarence R, at highway, 1-II-1966, G. F. Edmunds; larva, Clarence R, below Clarence Lagoon, 1-II-1966, G. F. Edmunds; nine larvae, Tyenna R, nr Mt Field Natl Pk, 3-II-1966, G. F. Edmunds; two larvae, Lake Dobson, Mt Field Natl Pk, 3382 ft, 3-II-1966, G. F. Edmunds; larva, Forth Falls, 26-XI-1966, J. Illies; Victoria: Larva, Ovens R, nr Harrietsville, 2-XII-1966, J. Illies.

Etymology. The specific name is Latin for entice.

Discussion. *Edmundsiops instigatus* shows considerable variation in general body coloration, body size, leg setation, and paraproct spination. Some populations consist of relatively large individuals with faint body markings and numerous paraproct spines, and lack a subdorsal row of robust setae on the tibiae and tarsi. Other populations consist of relatively small individuals with conspicuous body markings, few paraproct spines, and a subdorsal row of robust setae on the tibiae and tarsi. There are, however, some populations that show different combinations of those characteristics, and thus are morphologically intermediate. Consequently the possible recognition of two species, rather than one, based on the two morphological extremes, cannot be justified.

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SCIENTIFIC NOTE:

ADDITIONS TO THE INVENTORY OF TEXAS MAYFLIES (EPHEMEROPTERA)[1]

D.E. Baumgardner[2], N.A. Wiersema[3]

Although the mayfly fauna of Texas has been historically neglected, it has recieved considerable attention recently. New records by McCafferty and Davis (1992), Lugo-Ortiz and McCafferty (1995), Baumgardner et al. (1997), and Wiersema (1998a), as well as new species and stage descriptions by McCafferty and Provonsha (1993), Wiersema (1998b, 1999), and Wiersema and McCafferty (1998, 1999) have greatly expanded the known fauna of Texas. Currently 110 nominal species of mayflies are reported for Texas, distributed in 12 families and 40 genera. We herein report an additional four species and one genus in Texas. The new reports are as follows:

Baetodes deficiens Cohen & Allen, COMAL CO., Guadalupe River ca. 11mi, below Canyon Dam, 29°49'08N, 098°09'24W, 09 XI 1996 N.A. Wiersema, larva (pers. coll. of NAW). This widespread Central American and Mexican species was previously reported only from New Mexico in the USA (McCafferty et al. 1997).

Camelobaetidius waltzi McCafferty, VICTORIA CO., Guadalupe River at Riverside Park in Victoria, 28°48'32N, 097°01'45W, 24 VIII 1997 N.A.Wiersema, 4 larvae (NAW). BASTROP CO., McKinney Roughs, Colorado River at Wilbarger Bend, 19 IX 1997 N.A.Wiersema & C.R. Nelson, 20 larvae, 2 reared males (NAW). BLANCO CO., Pedernales Falls State Park, Pedernales River 05-06 IX 1997 N.A. Wiersema & C.R. Nelson, 8 larvae (NAW). *Camelobaetidius waltzi* in the hill country region and coastal plains of south Texas indicates a more widespread distribution throughout the central United States.

Cloeodes excogitatus Waltz & McCafferty, BREWSTER CO., Calamity Creek at Hwy 188, 18 mi S. of Alpine, 24 VII 1996 D.E. Baumgardner & D.E. Bowles, larva, (Texas A&M Univ. Coll.). The presence of this species in west Texas and the recent report of this species from northern California (Waltz et al. 1998), indicates a much more widespread distribution than previously documented.

Tricorythodes curvatus Allen, MONTGOMERY CO., New Caney, Caney Creek at US 59, 30°09'43N, 095°12'42W, 27 XII 1996 N.A. Wiersema, 17 larvae (NAW); same but 08 III 1997, 3 larvae (NAW). This species has not been reported in the literature since it was described by Allen (1977) as larvae from the Ozark Mountains of Arkansas.

We thank David Bowles (Texas Parks and Wildlife) and Charles R. Nelson (University of Texas at Austin) for assisting with field collections. We also wish to thank Boris C. Kondratieff (Colorado State University) and Charles R. Nelson for their critical reviews of an earlier manuscript. Thanks are also extended to Don Azuma (Academy of Natural Sciences of Philadelphia) for providing the holotype and paratypes of *T. curvatus* for comparative study.

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SARAH WRIGHT RECEIVES THE AMERICAN ENTOMOLOGICAL SOCIETY'S 1998 CALVERT AWARD

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.

This year the twelfth Calvert Award was presented to Sarah Wright, a ninth grade student at North Penn High School in Lansdale, PA, who is interested in butterflies and what they see. Her project, conducted over the past year, was entitled, "How do butterflies see each other?" Butterflies andother insects can see ultraviolet light that is invisible to humans. By taking pictures of a variety of butterflies using UV-sensitive film, Sarah showed that in addition to the beautiful colors we see, butterflies see patterns we do not see. For example, two species that look very similar to us have strikingly different appearances in the ultraviolet. Over half of the 114 species she photographed showed these differences. There were also noticeable differences between males and females. She says that these· distinctive ultraviolet reflectance and absorption patterns probably help butterflies recognize mates of their own species.

As the winner of the Calvert Award, Sarah Wright received memberships in the American Entomological Society as well as a $50 check. Jonathan K. Gelhaus, President of the Society, made the presentation at the membership meeting on April 22 at the Academy of Natural Sciences in Philadelphia.

Two other students were honored at the meeting. Ross Lang, an eighth grade home-schooled student from Yardley received first runner up for his project, "Is it time for lunch? Temporal learning in yellow jackets." Abigail Kochanik, an eleventh grade student from Cherokee High School in Marlton, New Jersey, received an honorable mention for her study, "To kill or not to kill? The insect vs. the pesticide." Ross and Abigail participated in the annual Delaware Valley Science Fairs held in Fort Washington, PA on April 8.

Harold G. White
Chair, Education Committee

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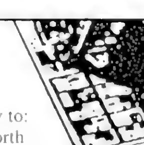

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EXOTIC LADY BEETLE SURVEY IN NORTHEASTERN UNITED STATES: *HIPPODAMIA VARIEGATA* AND *PROPYLEA QUATUORDECIMPUNCTATA* (COLEOPTERA: COCCINELLIDAE)[1]

D.R. Ellis[2], D.R. Prokrym[3], R.G. Adams[4]

ABSTRACT: A multistate survey coordinated through the USDA APHIS Cooperative Agricultural Pest Survey (CAPS) Program to detect the exotic coccinellids *Hippodamia variegata* (Goeze) and *Propylea quatuordecimpunctata* (L.) was conducted in the northeastern United States in 1993. We provide 34 new collection records for *H. variegata*. The surveys demonstrated an expanded distribution and defined the leading edge of expansion for *H. variegata* and *P. quatuordecimpunctata* in the northeastern United States. We also provide information on the displacement of native coccinellids by these two exotic species.

Hippodamia variegata (Goeze) and *Propylea quatuordecimpunctata* (L.) are two exotic coccinellids that have recently become established in the northeastern United States. *H. variegata* is a biological control agent that attacks aphid pests in its home range of Eurasia, Africa, and India (Gordon 1987). Michels and Bateman (1986) considered this coccinellid to be useful in helping suppress populations of the greenbug, *Schizaphis graminum* (Rondani), a grain pest in the Plains States. In 1986, the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) mass-produced and released *H. variegata* in midwestern and western states for biological control of the Russian wheat aphid, *Diuraphis noxia* (Mordvilko), a serious pest of small grains. Establishment in the midwestern and western regions was unsuccessful (Flanders et al. 1991, Prokrym et al. 1992).

Gordon (1987) reported that the first established population of *H. variegata* in North America was observed in 1984 near Montreal in eastern Canada. *H. variegata* may have become established through accidental introduction by European vessels in the St. Lawrence Seaway (Gordon 1987, Schaefer and Dysart 1988, Day et al. 1994) or through intentional releases. The USDA released this coccinellid from 1957 to 1983 and 1987 to 1993 in eastern and midwestern states (Gordon 1985, Gordon 1987, Dysart 1988, Flanders 1990, Wheeler 1993). As *H. variegata* had never been intentionally released in Canada, its establishment there was most likely a result of accidental introduction via shipping (Day

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et al. 1994). By 1989, *H. variegata*'s distribution had expanded from Montreal to Ottawa, Canada, and by 1992, Wheeler (1993) reported the first U.S. occurrences from CT, MA, NH, NJ, NY, PA, RI and VT.

Propylea quatuordecimpunctata is also a common aphid predator throughout Europe. The USDA introduced *P. quatuordecimpunctata* in 1968 to help control greenbugs (Rogers et al. 1972). It was reared and released in DE, NJ, OK and WA from 1970 to 1982 (Gordon 1985). Like *H. variegata*, it also was not recovered at these locations (Flanders et al. 1991, Prokrym et al. 1992).

Researchers in the United States and Canada have monitored the expansion of *H. variegata* and *P. quatuordecimpunctata* in North America. Day et al. (1994) and Wheeler (1990) discussed the distributional history of *P. quatuordecimpunctata* in the northeastern United States. Day et al. (1994) described the known distribution for *P. quatuordecimpunctata* using existing collection records for nine northeastern states and information from our survey. Wheeler (1993) reported the establishment of *H. variegata* in eight states, and Hoebeke and Wheeler (1996) built on this effort with new collection records from Canada.

The objectives of this paper are to 1) document information from a coordinated, 11-state survey that employed standardized sampling methods to track exotic coccinellids, specifically *H. variegata* and *P. quatuordecimpunctata*; 2) expand on studies by Wheeler (1993) and Day et al. (1994) by providing the most current distribution of *H. variegata* and *P. quatuordecimpunctata*; 3) note habitat preferences for both beetles; and, 4) provide additional insight on displacement of native coccinellids by exotic species.

METHODS

Cooperators from universities, departments of agriculture, and Cooperative Extension Systems in 11 states (CT, DE, MA, MD, ME, NH, NY, PA, RI, VT, VA) surveyed for *H. variegata* and *P. quatuordecimpunctata* between mid-June and the end of August, 1993 (Table 1). The lead author served as survey coordinator; provided the site-selection protocol, survey methodology, guidelines for specimen identification, and other appropriate references (e.g., Gordon 1985, Gordon and Vandenberg 1991); and prepared the final report. The APHIS Niles

Table 1. Participants in the CAPS Exotic Coccinellid Multistate Survey

CT: Donna Ellis, University of Connecticut
DE: Joanne Whalen, University of Delaware
MA: Craig Hollingsworth, University of Massachusetts
MD: Dick Bean, Charles Staines, Maryland Department of Agriculture
ME: Ron Mack, University of Maine
NH: John Weaver, University of New Hampshire
NY: Janet Knodel, Cornell University
PA: Nancy Hill Richwine, Jim Stimmel, Al Wheeler, Pennsylvania Department of Agriculture
RI: Lisa Tewksbury, University of Rhode Island
VT: Jon Turmel, Vermont Department of Agriculture
VA: Eric Day, Virginia Polytechnic Institute and State University

Plant Protection Center provided reference specimens to the survey participants.

Survey participants selected fields that were greater than three acres; that were planted to alfalfa, clover, vetch or cereals; and which did not receive insecticides for 30 days before sampling. At least one field in each of three counties per state was surveyed biweekly for a total of six visits to each field. Participants timed survey activities to coincide with the highest aphid populations in their state as determined by field observations and personal knowledge. Only adult lady beetles were collected.

Two methods of sweep-net collecting of adult coccinellids were used to provide more information on habitats in the northeastern region where these predators were found. In the first method, participants in ME, NH, NY and VT swept insects from host plants by making 500 sweeps in each of three locations within the same field (1,500 total sweeps per survey site). In the second method, participants in CT, DE, MA, MD, PA, RI and VA combined 100 sweeps in each of four diverse adjacent habitats at one site. It was recommended that participants sample diverse habitats such as agricultural crops (e.g., alfalfa, clover, or vetch fields), weedy field borders and woodland edges.

The unsorted insect material collected from the field was placed in a labeled bag and returned to the state laboratory for sorting. State cooperators examined the coccinellids from each sample for *H. variegata* and *P. quatuordecimpunctata* adults. Suspect coccinellids were sent to the APHIS Niles Center for confirmation of the identification, with voucher specimens retained at Niles.

The participants handled recovery data in several ways. Information on first-of-season captures of *H. variegata* or *P. quatuordecimpunctata* and new state or county records confirmed by the Niles Center were posted via electronic mail to CAPS cooperators. Positive and negative survey data from each participating state were submitted to the CAPS National Agricultural Pest Identification System (NAPIS) database, a national database for the distributions of pest and beneficial species.

RESULTS AND DISCUSSION

State cooperators surveyed for *H. variegata* and *P. quatuordecimpunctata* in 100 counties in the 11-state region during 1993, more than three times the number of survey sites required by the survey protocol. The overwhelming response by the cooperators resulted in far more survey and distribution data collected than had originally been requested.

H. variegata was found in 45 counties (45% of the total counties surveyed), which included 34 new county records, or 76% of the total number of counties where this coccinellid was collected (Table 2). A specimen of *H. variegata* collected from Cumberland County, Maine, in 1991 was discovered in a personal collection (R. Mack, pers. commun., 1993). This specimen represented a

Table 2. First recoveries of *Hippodamia variegata* (Goeze) from the northeastern United States from 1993 CAPS regional and related surveys.[1]

State	County	Date	Collector
Connecticut	Litchfield	09/16/93	D. Ellis
	Middlesex	07/08/93	D. Ellis
	New London	06/10/93	D. Ellis
Maine[2]	Androscoggin	09/13/93	R. Mack
	Aroostook	09/07/93	R. Mack
	Franklin	09/16/93	R. Mack
	Hancock	09/02/93	R. Mack
	Kennebec	09/15/93	R. Mack
	Lincoln	09/13/93	R. Mack
	Oxford	09/16/93	R. Mack
	Penobscot	09/10/93	R. Mack
	Piscataquis	09/08/93	R. Mack
	Sagadahoc	09/13/93	R. Mack
	Somerset	09/08/93	R. Mack
	Washington	09/07/93	R. Mack
Massachusetts	Essex	09/07/93	R. Mytkowicz
	Norfolk	07/01/93	R. Mytkowicz
	Plymouth	07/22/93	D.Fernandes
New Hampshire	Hillsborough	08/09/93	S. Reynolds
	Rockingham	09/21/93	S. Reynolds
	Strafford	08/03/93	J.S.Weaver/S. Reynolds
New Jersey[3]	Burlington	08/12/93	W. Peasley
	Essex	07/15/93	J. VonderHorst
	Hunterdon	08/04/93	H. Crowley
	Morris	07/12/93	H. Crowley
	Passaic	07/16/93	J. VonderHorst
	Union	07/26/93	J. VonderHorst
New York	Monroe	09/08/93	J. Knodel
	Ontario	08/05/93	J. Knodel
	Seneca	09/22/93	J. Knodel
	Tioga	09/19/93	R. Hoebeke
	Yates	08/06/93	J. Knodel
Pennsylvania	Delaware	08/19/93	R.L. Stewart
	Monroe	08/20/93	R.L. Stewart
	Northhampton	08/16/93	R.L. Stewart
Rhode Island	Newport	09/22/93	L. Tewksbury
	Washington	09/15/93	L. Tewksbury
Vermont	Orange	09/09/93	J. Turmel

[1] *Propylea quatuordecimpunctata* collection records from the CAPS survey reported by Day et al. 1994.

[2] D. Barry collected the first two *H. variegata* specimens from Maine in Cumberland Co. on 15 July 1991 and York Co. on 25 July 1991. The Cumberland Co. specimen represents the earliest known U.S. collection, although it was reported subsequently to Wheeler (1993). These earlier collection records were uncovered as part of the CAPS regional survey effort.

[3] R. Chianese, unpub. data, 1994.

new state record for Maine.

Propylea quatuordecimpunctata was found in 66 counties (66% of the total counties surveyed), with 46 of these occurrences representing new county records. New county records were obtained in 70% of the counties where this beneficial coccinellid was surveyed and found during 1993. Collection records for *P. quatuordecimpunctata* have been reported by Day et al. (1994).

Survey results illustrate the expanding range of both *H. variegata* (Fig. 1) and *P. quatuordecimpunctata* (Fig. 2). Following the CAPS multistate survey in 1993, additional new state and county records for the two species have been collected by many individuals in the northeast region, including most of New Jersey and parts of eastern Pennsylvania and New York (R. Chianese, pers. commun., 1994; A. Wheeler, pers. commun., 1996; Wheeler and Stoops 1996). In New Castle County, Delaware, a single *H. variegata* was collected from alfalfa by J. Tropp in 1994 and a *P. quatuordecimpunctata* adult was collected by W. Day in 1997, representing new state records for these coccinellids (W. Day, unpubl. data, 1997). To date, *H. variegata* and *P. quatuordecimpunctata* have not been collected in Maryland, Virginia, or states west of the survey region. We expect that the coccinellids will continue to expand from their current distribution, however, as recently reported for *H. variegata* by Hoebeke and Wheeler (1996).

Propylea quatuordecimpunctata adults were generally observed earlier in the season (Figs. 3A-3C) and in greater abundance than *H. variegata* (Figs. 4A-4C) during the 1993 survey. *P. quatuordecimpunctata* was found by mid-May in Connecticut (Fig. 3A), early June in Massachusetts (Fig. 3B), and mid-June in Pennsylvania (Fig. 3C) and Rhode Island (Fig. 3A). This coccinellid continued to be collected throughout the summer and early fall in locations where it was present early in the growing season. Although *H. variegata* was collected by mid-June in Connecticut (Fig. 4A) and by late June in New Hampshire (Fig. 4B) and Pennsylvania (Fig. 4C), adults were usually captured during the survey from mid-August through September. In Vermont, *H. variegata* was found only in September on flowering alfalfa (Ellis and Adams 1993, J. Turmel, pers. commun., 1993). With a similar response of *H. variegata* and *P. quatuordecimpunctata* occurring across all states, researchers are encouraged to time future surveys for these coccinellids during peak abundance. The seasonal occurrences of *H. variegata* and *P. quatuordecimpunctata* were fairly consistent from state to state. Lack of collection data from a particular location surveyed during a period when the coccinellids have previously been found in other northeastern states (Figs. 1 and 2) suggests that *H. variegata* and *P. quatuordecimpunctata* may have failed to become established thus far in that location.

In several states, the survey participants periodically collected high numbers of the exotic coccinellids from host plants. For example, 187 *P. quatuordecimpunctata* adults were captured in 400 sweeps in Newport County, Rhode Island, in a 3-acre alfalfa field in July (L. Tewksbury, pers. commun.,

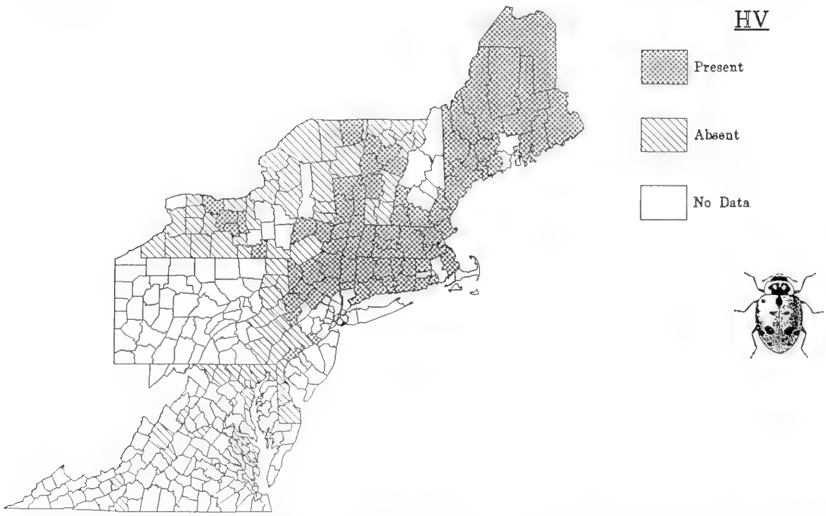


Figure 1. *Hippodamia variegata* (HV) distribution in the northeastern United States from 1984 to 1993. The map shows current distribution of HV and includes new state and county occurrences from the 1993 CAPS regional survey.

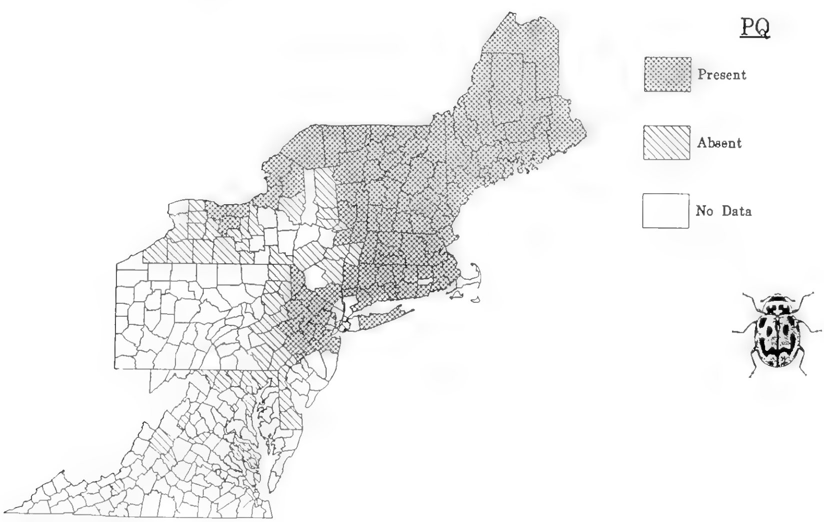


Figure 2. *Propylea quatuordecimpunctata* (PQ) distribution in the northeastern United States from 1984 to 1993. The map shows current distribution of PQ and includes new state and county occurrences from the 1993 CAPS regional survey.

[Note: Figs. 1and 2: Counties are designated as "present" if the coccinellid was found in any year listed in the caption. Data include information from Dysart 1987; Dysart 1988; Wheeler 1993; Chianese (pers. commun., 1994); Day et al. 1994; and the NAPIS database, CAPS Program, USDA. Maps generated by D. Ellis, CAPS Program, on 6 January 1994.]

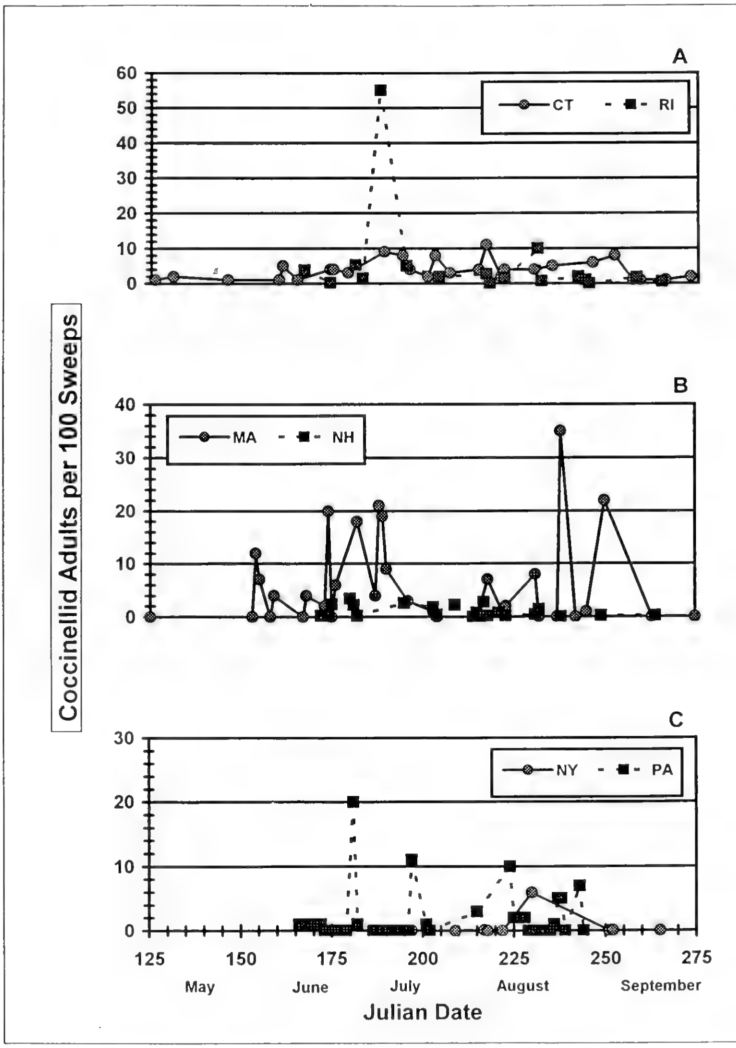
1993). In New Hampshire, 69 *H. variegata* adults were collected from 250 sweeps in an alfalfa field in September.

Several cooperators observed lower numbers of aphids on host plants during the hot, dry 1993 summer, likely resulting in lower coccinellid captures at some locations. For example, *P. quatuordecimpunctata* adults were common in Connecticut strawberry fields in late spring and were even found in fields where aphid populations were low but populations of twospotted spider mites, *Tetranychus urticae* Koch, were high. In general terms, aphids were not consistently found in high populations at all survey sites.

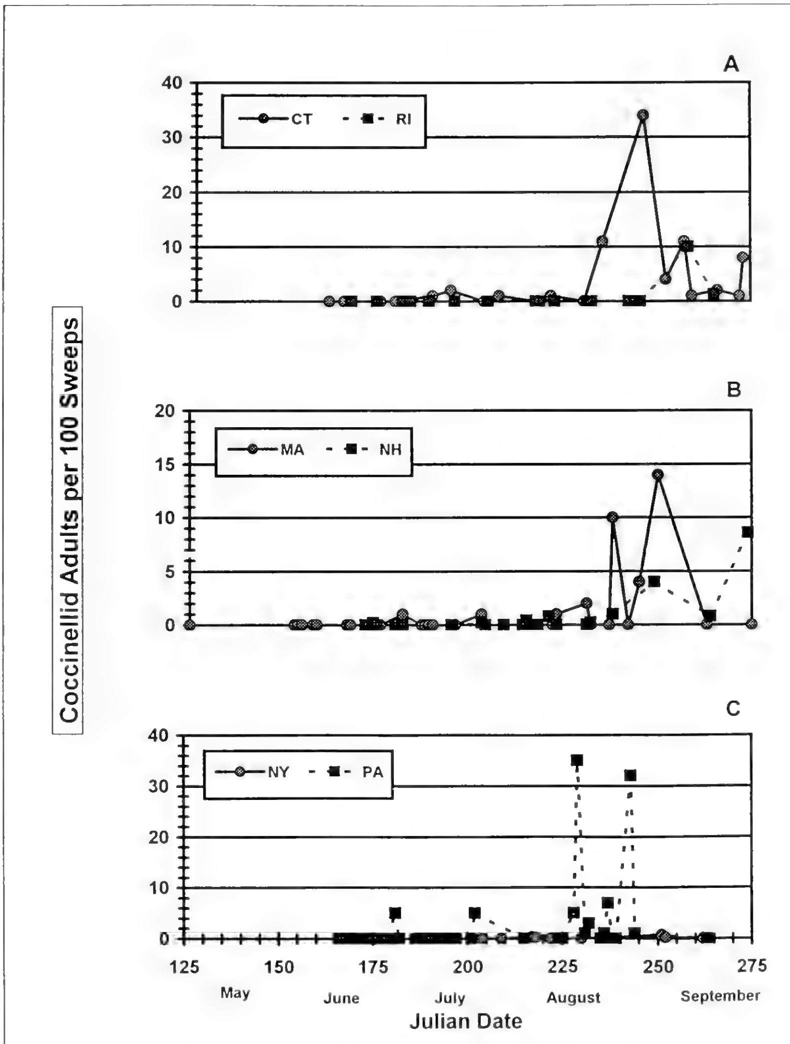
In the 11-state region, plant species that served as hosts for aphids, the preferred prey of the beneficial lady beetles, included agronomic crops such as alfalfa (*Medicago sativa L.*), clover (*Trifolium* spp.), rye (*Secale cereale* L.), and vetch (*Vicia* spp.), as well as many weed species, including Canada thistle [*Cirsium arvense* (L.) Scopoli], goldenrod (*Solidago* spp.), horseweed [*Conyza canadensis* (L.) Cronquist], and ragweed (*Ambrosia artemisiifolia* L.). Cooperators in several states observed *H. variegata* and *P. quatuordecimpunctata* adults on other host crops (e.g., apple, blueberries, broccoli, strawberries, and sweet corn) in addition to the crops recommended in the survey protocol. The coccinellids were observed on the crop or were captured on sticky traps placed within the crop canopy. In an apple orchard in New Haven County, Connecticut, 71 *P. quatuordecimpunctata* adults were captured on Ladd apple maggot traps between 23 June and 4 August 1993. During the previous year, 134 adults were captured on Ladd traps in the same orchard during a four-week period.

The diversity of host plants and habitats where *H. variegata* and *P. quatuordecimpunctata* were found during this survey might be a key to the successful establishment of these coccinellids in the northeast and the failure of the lady beetles to survive in major wheat-growing areas where Russian wheat aphids are found. Survey participants observed *H. variegata* and *P. quatuordecimpunctata* larvae and adults on weeds growing along the edge of crops that were periodically disturbed, such as an alfalfa field harvested for hay, and in weedy areas along roadsides. It is possible that weedy field borders, serving as alternative hosts for aphids, contribute to the survival of the coccinellids in areas where the primary host crop is disturbed. By contrast, the cultural and harvest practices used in the expansive wheat fields in the midwestern and western United States may negatively affect aphid numbers and habitat, leaving few alternative habitats for *H. variegata* and *P. quatuordecimpunctata*. In the northeast, weedy field borders or woodland edges surrounding the smaller fields of alfalfa and other crops may function as alternative habitats for lady beetles and aphids, providing host plants and areas for overwintering and reproduction when the crop is disturbed.

In addition to collecting *H. variegata* and *P. quatuordecimpunctata* adults during the multistate survey, cooperators recorded information on other beneficial coccinellids captured in sweep nets or observed in the field. A total of 17



Figures 3A-3C. Total daily sweep trap captures in Connecticut and Rhode Island (Fig. 3A), Massachusetts and New Hampshire (Fig. 3B), and New York and Pennsylvania (Fig. 3C) for *Propylea quatuordecimpunctata* (PQ) in 1993 (Note: each data point may represent a total of 1 to 12 samples taken on that day. Figures generated from NAPIS data).



Figures 4A-4C. Total daily sweep trap captures in Connecticut and Rhode Island (Fig. 4A), Massachusetts and New Hampshire (Fig. 4B), and New York and Pennsylvania (Fig. 4C) for *Hippodamia variegata* (HV) in 1993 (Note: each data point may represent a total of 1 to 8 samples taken on that day. Figures generated from NAPIS data).

coccinellid species were collected during the survey period, including other introduced coccinellids, such as *Coccinella septempunctata* L., the sevenspotted lady beetle, and native coccinellid species (Table 3). *C. septempunctata* was found in high numbers (e.g., up to 33 adults collected per 100 sweeps) at survey sites in the northeast during 1993. These results reveal the diversity of native and introduced beneficial coccinellids that are available for biological control of aphids and other plant pests.

Our survey results may provide additional data to document the displacement of native aphidophagous coccinellids by introduced species. For example, Wheeler (1993) and Wheeler and Hoebeke (1995) commented on the possible displacement of *Coccinella novemnotata* Herbst by the introduced *C. septempunctata* in the northeastern U.S. During this survey, the participants did not collect any *C. novemnotata* specimens. Similarly, Wheeler (1993) did not detect *C. novemnotata* at any of the 62 sites surveyed in the northeastern United States in September 1992 but collected 66 *C. septempunctata* adults at 23 sites during that period. Wheeler discussed variations in coccinellid abundance due to the time of year in which the survey was conducted.

We noted a similar trend for *Hippodamia convergens* Guerin. Survey participants detected this coccinellid in unusually low numbers during the survey period, recovering only two *H. convergens* from 29 Connecticut and Pennsylvania survey sites. In addition, 15 *H. convergens* adults were swept from host plants in Virginia from 9 June through 26 September 1993, in comparison with 426 *C. septempunctata* adults that were collected during the same time period. These results are consistent with those reported by Wheeler (1993), who collected 66 *C. septempunctata* adults but only one *H. convergens* during a 1992 survey. Overall, our results provide additional information to the coccinellid historical database for the northeastern United States, and we encourage other

Table 3. Native and introduced aphidophagous coccinellids collected in 11 states in the northeastern United States during 1993.

Native species	**Introduced species**
Adalia bipunctata (L.)	*Coccinella septempunctata* L.
Anisosticta bitriangularis (Say)	*Harmonia axyridis* (Pallas)
Brachiacantha felina (F.)	*Hippodamia variegata* (Goeze)
Brachiacantha ursina (F.)	*Propylea quatuordecimpunctata* (L.)
Calvia quatuordecimguttata (L.)	
Chilocorus stigma (Say)	
Coccinella trifasciata Mulsant	
Coleomegilla maculata lengi Timberlake	
Cycloneda munda (Say)	
Hippodamia convergens Guerin	
Hippodamia glacialis glacialis (F.)	
Hippodamia parenthesis (Say)	
Hyperaspis proba (Say)	

researchers to continue investigating this area of study.

Results from the 1993 CAPS multistate survey, together with historical records beginning in 1984, document the establishment of *H. variegata* and *P. quatuordecimpunctata* throughout New England, in many northern and eastern counties in New York, in northern New Jersey, and in eastern Pennsylvania (NAPIS database, CAPS Program, USDA 1993, Wheeler 1993, Day et al. 1994, Wheeler and Stoops 1996). It seems that these beneficial coccinellids have become well established and have readily adapted to the many diverse habitats found in the northeastern United States. Day et al. (1994) attributed this successful establishment to the accidental introduction and natural dispersal of *H. variegata* and *P. quatuordecimpunctata* from Canada, rather than intentional releases.

The CAPS multistate survey has contributed significantly to the expanded knowledge base and current distribution of *H. variegata* and *P. quatuordecimpunctata* in the northeastern United States and has provided pertinent information on habitat requirements and preferences of these exotic coccinellids. These findings may help researchers better understand the conditions required for establishment of *H. variegata* and *P. quatuordecimpunctata* in regions where Russian wheat aphid biological control is needed. Future studies should address the distribution of *H. variegata* and *P. quatuordecimpunctata* populations as they expand into southern New York, western Pennsylvania, Ohio, and through New Jersey, Delaware, Maryland, and Virginia. Further research on habitats of exotic coccinellids may provide additional information on the ability of these species to: 1) further extend their current distribution in the northeast; and, 2) become established in western and midwestern states where the Russian wheat aphid occurs.

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THE FEMALE OF *LEPIDOSTOMA LESCHENI* (TRICHOPTERA: LEPIDOSTOMATIDAE), WITH NEW DISTRIBUTIONAL RECORDS FOR THE SPECIES[1]

Stephen R. Moulton II[2], Henry W. Robison[3], Betty G. Crump[4]

ABSTRACT: The female of *Lepidostoma lescheni* is described and illustrated for the first time and a female allotype specimen designated. Several new collection records are presented to help clarify its distribution and endemism in the Interior Highlands of North America.

While surveying the insect fauna inhabiting springs and seeps of the Ouachita Mountains in south-central Arkansas, we collected several males and females of the caddisfly *Lepidostoma lescheni* Bowles, Mathis, and Weaver. This species was recently described on the basis of a single male specimen collected from Slocum Spring on Mt. Magazine, Logan Co., Arkansas (Bowles et al. 1994). Moulton and Stewart (1996) studied the diversity and distribution of caddisflies in the Ozark and Ouachita Mountains (collectively referred to as the Interior Highlands). Their study did not yield any additional specimens of this species.

Bowles et al. (1994) suggested that *L. lescheni* was related to *L. griseum* (Banks) and *L. morsei* Weaver of the *L. griseum* Group. In addition to *L. lescheni*, five other species [*L. carrolli* Flint, *L. griseum*, *L. libum* Ross, *L. ozarkense* Flint and Harp, and *L. togatum* (Hagen)] are found in the Interior Highlands (Bowles et al. 1994, Moulton and Stewart 1996). Moulton and Stewart (1996) presented an illustrated key to the males of the six regional species. Descriptions and figures of females for the other regional species can be found in the works by Ross (1946), Flint and Wiggins (1961), Schmid (1980), Weaver (1988), and Flint and Harp (1990). The identity of the *L. lescheni* female is supported for two reasons. First, no males of other *Lepidostoma* species were found in our collections that contained males of *L. lescheni*. Second, the genitalia of *Lepidostoma* females in our collections did not agree with descriptions and figures of female genitalia for the other five *Lepidostoma* species found in the Interior Highlands. Herein, we describe for the first time the female of *L. lescheni* and present new collection records to reveal more about its distribution and endemism in the Interior Highlands. No allotype female specimen was desig-

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nated before now for *L. lescheni.*

Adults of *L. lescheni* were collected using an 8-watt ultraviolet light trap. Morphological terminology follows that of Weaver (1988). Material examined in this study is deposited in the collections of the Clemson University Arthropod Collection (CUAC), the Illinois Natural History Survey (INHS), the National Museum of Natural History (NMNH), Southern Arkansas University (SAU), the University of Minnesota (UM), and the research collections of the senior author (SRM) and John S. Weaver (JSW).

Lepidostoma lescheni Bowles, Mathis, and Weaver

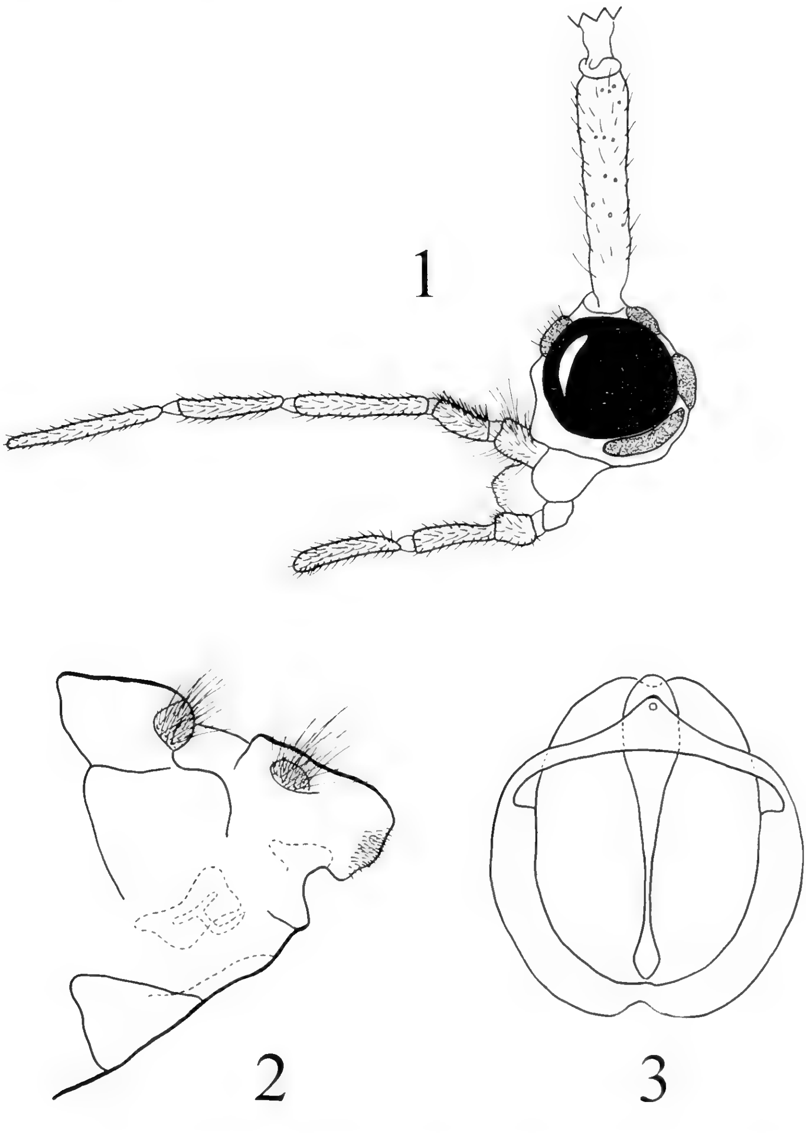
Figs. 1-3

Lepidostoma (Mormomyia) lescheni Bowles, Mathis, and Weaver 1994:249.
Lepidostoma lescheni: Moulton and Stewart 1996:133.
Lepidostoma species B: Bowles and Mathis 1989:240.

Material Examined.—Allotype, female, U.S.A, ARKANSAS, Montgomery Co., Collier Springs, 8.4 km NE of Norman, W of Road 177, T3S, R24W, Sec17, 17-X-1996, H.W. Robison (NMNH); same but 5 males, 4 females (NMNH); same but 6 km SW Black Springs, S of Road 10, T4S, R26W, SE 1/4 of Sec3, 8-VIII-1996, 1 male, 1 female (SAU); same but Blue Springs, 11.3 km NW Bonnerdale, S of Road 44, T3S, R23W, Sec14, 17-X-1996, 10 males, 13 females (SRM); same but 11.3 km NE Norman, N of Road 208, T3S, R24W, Sec22, 2 males, 9 females (UM); same but Rattlesnake Spring, 6.5 km NW, Caddo Gap, T3S, R24W, Sec33, 6 males, 5 females (CUAC); same but Tea Creek Springs, 10.5 km NW Bonnerdale, S of Road 476, T3S, R23W, Sec23, 8 females (INHS); same but Slatington Spring, 8.5 km SE of Big Fork, W of Road 1, 6 males, 2 females (JSW).

Female Description.—Head (Fig. 1): Antennal scape 0.7 – 0.8 mm long, parallel-sided, entire surface rugose with dense short setae; antennae as long as forewings. Maxillary palpi each five-segmented, segment 2 with setae longer than those on segments 3–5, segment 1 with numerous long, silky setae; labial palpi each three-segmented. Head and pronotum brown. Meso- and metascuta dark brown except for pale areas centrally and on posterior corners; meso- and metascutella pale. Wings brown with scattered pale spots in membrane; forewings each 7.2 – 7.8 mm long, hindwings each 6.5 – 7.0 mm long; frenulum of each hindwing with 6 - 8 long, stiff setae. Legs straw-colored; tibial spurs 2-4-4. Abdominal tergites brown, terga VI – IX with paired, oblong warts, with long slender setae. Genitalia (Figs. 2, 3): Spermathecal sclerite in lateral view with posterodorsal margin strongly arched; anterior margin lobate; anteroventral margin bowed ventrad; arcuate bridge (= "lateral pair of bands fusing ventrally," Weaver 1988) projecting ventrad from posterolateral margins and angled posterodorsad, extending only to posterior apex; in ventral view with inner portion ovoid; medially with elongate, keyhole-shaped posteroventral process, posterior portion of this process large with small central spermathecal duct opening, tapering anterally to narrow middle, and enlarging slightly on anterior end; anterior one-half of spermathecal sclerite with outer sclerotized border, emarginate anteromesally, posteriorly with transverse arcuate bridge, anterior margin of bridge gently curved, posterior margin with prominent posteromedial triangular extension. Ventral plate on segment VIII smooth, tongue-like.

Discussion.—Like many species of *Lepidostoma*, females of *L. lescheni* differ strikingly from the males in the shape of the antennal scape. The anterior margin in lateral view is markedly convex in males and straight in females. The female of *L. lescheni* is similar to females of other species in the *Mormomyia*



Figs. 1–3. Female of *Lepidostoma lescheni*. 1. head, left lateral. 2. genitalia, left lateral. 3. spermathecal sclerite, ventral, oriented with posterior end upward.

subgenus, but most closely resembles the female of *L. griseum*. The genitalia of *L. lescheni* differs from those of *L. griseum* by having much broader anterior and posterodorsal margins of the spermathecal sclerite, in lateral view. Also, the posteroventral arcuate bridge of the spermathecal sclerite has a posteromedial triangular extension (convex and without extension in *L. griseum*), but does not possess a ventral lobe which is present in *L. griseum* (see Weaver 1988, Figs. 142A, B).

The collection records listed above increase the number of known males and females of *L. lescheni* to 30 and 43, respectively. All records are from Montgomery County, Arkansas, which is located centrally in the Ouachita Mountains and about 80 km south of the type locality in Logan County, Arkansas. The type locality, Mt. Magazine, is south of the Arkansas River and is considered to represent a biogeographic transition zone between the Ozark and Ouachita Mountains. These new distributional records suggest that *L. lescheni* is restricted to springs and seeps in the Ouachita Mountains, making it the only lepidostomatid caddisfly that may be endemic to this mountainous region. Interestingly, *L. griseum* has been collected from small springs in the Ozark physiographic province (Moulton and Stewart 1996), thereby suggesting a local parapatric distribution.

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We thank Brian Pounds and Terry McKay of the U.S. Forest Service (USFS) for assisting with field collections. The USFS Ouachita National Forest provided a grant for coauthor Henry W. Robison to survey the insect fauna of spring seeps in the Ouachita Mountains. Gregg Easley, Brady Richards, Jon W. Raese (all with the U.S. Geological Survey), and John S. Weaver (University of New Hampshire) reviewed early drafts of the manuscript. The comments of two anonymous reviewers are greatly appreciated.

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TAXONOMIC NOTES ON *EUSAPYGA* (HYMENOPTERA: SAPYGIDAE) AND DESCRIPTION OF *EUSAPYGA NORDENAE* N. SP.[1]

Karl V. Krombein[2]

ABSTRACT: Variation is reported in the number of ocellar calli in *Eusapyga* and linear tyloids are noted ventrally on the terminal flagellomeres of males. *Eusapyga nordenae*, n. sp., is described from south central Florida sand scrub.

Cresson (1880) described *Eusapyga* as a new subgenus in a brief key to the species of *Sapyga* Latreille. He based it on the presence of six smooth, raised areas on the vertex, small indistinct ocelli, a raised line along the upper inner eye orbits and the similarly shaped terminal antennal segment in both sexes compared with a lack of calli and sexual dimorphism of the last antennal segment in *Sapyga*. Pate (1947) confirmed these differences in his tentative reclassification of the New World Sapygidae but noted in his key to the genera of Sapyginae that *Eusapyga* had four[3] impunctate calli in the ocellar area. In his key to the Nearctic and Palearctic genera of Sapygidae Kurzenko (1997) confirmed Cresson's criteria for separation of *Eusapyga*. His figure 15 shows six rounded calli in the ocellar area, small ocelli and a narrow callus along the upper inner eye orbits.

The rounded calli (Fig. 4) in and around the ocellar triangle consist of a larger pair between and extending posterad of the posterior ocelli, a smaller lateral pair each beneath and mostly laterad of the small posterior ocelli and a small pair each almost touching the lower side of the small anterior ocellus. There is, however, intraspecific variation in the development of the two smaller pairs of ocellar calli. Both pairs may be absent (Figs. 1, 3) or the lower pair may be absent and the lateral pair present but smaller (Fig. 2). The narrow callus along the upper inner eye orbits is shaped like an elongate teardrop (Figs. 5, 6); it is not known to vary intraspecifically.

The apical 8-10 flagellomeres of *Eusapyga* males each have a linear tyloid on the ventral surface, a character not noted in the genus previously.

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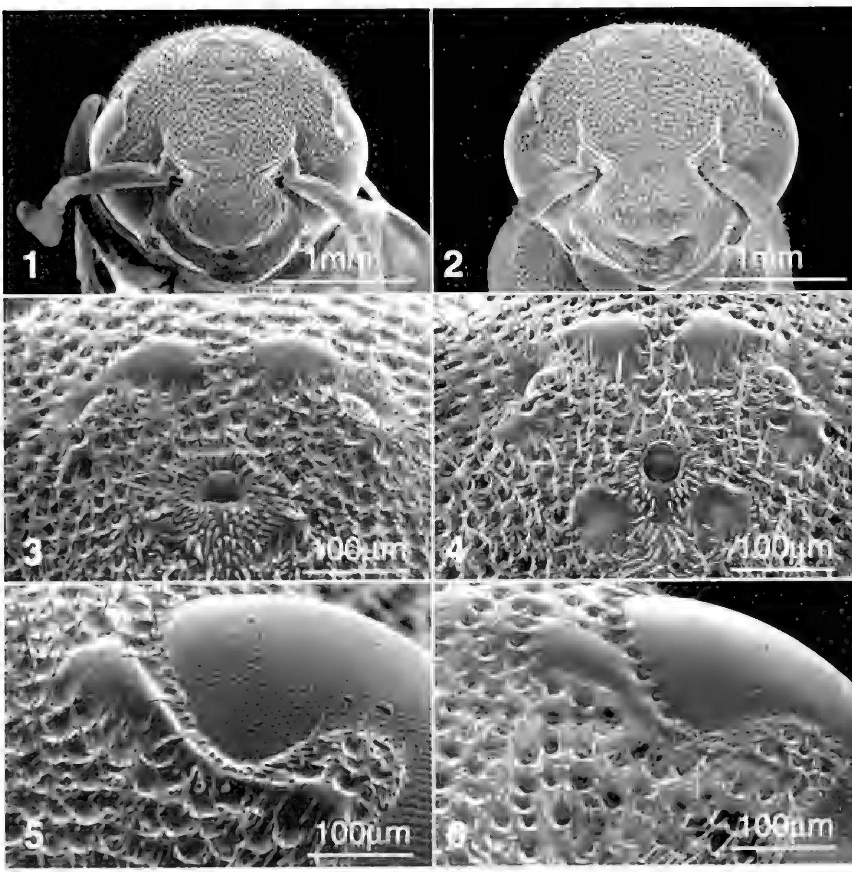
[3] This is either a *lapsus* or Pate may have based his key on an aberrant specimen lacking a pair of calli.

Eusapyga nordenae Krombein, NEW SPECIES

(Figures 1, 3, 5)

Female Description. Length 11.3 mm, forewing 8.0 mm. Head in frontal view rounded (Fig. 1), lateral angles of median clypeal lobe obtuse, ocellar area (Fig. 3) with a pair of large, rounded posterior calli, lateral and anterior pairs of calli lacking, tear-drop shaped callus along upper inner eye margin (Fig. 5) more strongly raised than in other species (cf Fig. 6).

Black, pale markings red to orange; scape, pedicel and first flagellomere light red; clypeus with a pair of small red spots laterally, front above clypeus with anchor-shaped, reddish orange spot, narrow orange stripe along inner eye margin and small red streak along upper outer eye



Figs. 1-6, *Eusapyga* females. 1. *E. nordenae* n. sp., head in frontal view. 2. *E. rubripes* (Cresson), head in frontal view, Dallas, TX. 3. *E. nordenae*, ocellar area. 4. *E. verticalis* (Cresson), ocellar area, Mt. Shasta City, CA. 5. *E. nordenae*, ocular callus. 6. *E. rubripes*, ocular callus.

margin; pronotum dorsally with narrow orange stripe anteriorly, rest of dorsum light red; scutum with a posterolateral spot darker red; scutellum and metanotum each with a pair of lateral orange spots, more narrowly separated on metanotum; upper mesopleuron with a small orange spot beneath wings; propodeum with a pair of large, light red spots posteriorly extending onto lateral surface; legs light red except coxae in part black; wings strongly infuscated, costal lamella and base of costa orange, stigma light brown; first metasomal segment dorsally with an anterior light red band shading to orange laterally; second dorsal segment with a broad light red band shading to orange posteriorly; fourth dorsal segment with a pair of narrow subapical orange stripes narrowly separated near midline; second ventral segment with large posterolateral spots light red; third ventral segment with a short posterolateral red stripe, and fourth with a small posterolateral red spot.

Male. Unknown.

Holotype. Female; FLORIDA, Highlands Co., Archbold Biol. Station, 27° 10'N, 81° 21'W, 8 April 1998, B.B. Norden, on flowers of *Ilex glabra*. Deposited in National Museum of Natural History (USNM).

Host. Unknown, but it is possibly the megachilid bee *Dianthidium floridiense* Schwarz, several females of which were collected on flowers of *Ilex glabra* on the same date. Bees of this genus are the only recorded hosts of *Eusapyga* and they have been reported as hosts for four other taxa in the genus (Krombein, 1979).

Etymology. The species is named for its collector, Beth B. Norden, a specialist in pollination ecology.

Diagnosis. *Eusapyga nordenae* is distinguished from its congeners by a combination of the infuscated wings and in having the pale markings ranging from light red to orange. Other species of *Eusapyga* are slightly infumated on the anterior third of the forewings and the pale markings are bright yellow to white except *E. rubripes* which has light red legs with some bright yellow markings rather than black legs with bright yellow or black areas.

ACKNOWLEDGMENTS

I am grateful to Donald Azuma, Academy of Natural Sciences, Philadelphia, for the loan of type and non-type specimens of *E. rubripes* (Cresson), and to Philip Perkins, Museum of Comparative Zoology, Cambridge for the loan of the type of *E. carolina* Banks. Within the Smithsonian I am indebted to Beth Norden for mounting specimens for uncoated SEM study, Susann Braden for preparation of the micrographs and George Venable for preparation of the figures.

Finally, I thank two anonymous reviewers for their thoughtful and helpful comments.

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RHOPALUS (BRACHYCARENUS) TIGRINUS (HEMIPTERA: RHOPALIDAE): FIRST WESTERN U.S. RECORDS OF A EURASIAN SCENTLESS PLANT BUG[1]

A.G. Wheeler, Jr.[2], E. Richard Hoebeke[3]

ABSTRACT: *Rhopalus* (*Brachycarenus*) *tigrinus*, a Palearctic rhopalid known previously in North America from Maryland, Michigan, New Jersey, New York, and Pennsylvania, is newly recorded from six states in the western United States: Arizona, California, Colorado, Nebraska, Oregon, and Wyoming. This specialist on crucifers (Brassicaceae) was collected along highways and railroads, mainly from naturalized Eurasian plants such as flixweed (*Descurainia sophia*), perennial peppergrass (*Lepidium latifolium*), short-pod mustard (*Hirschfeldia incana*), and tumble mustard (*Sisymbrium altissimum*).

Rhopalus (*Brachycarenus*) *tigrinus* (Schilling) is a widespread Eurasian rhopalid that develops mainly on low-growing crucifers (Brassicaceae) whose seeds ripen early (Aukema 1993, Stehlík and Vavřínová 1995). The first Nearctic record was New Jersey (Hoebeke 1977), with subsequent collections from Maryland, Michigan, New York, and Pennsylvania (Hoebeke and Wheeler 1982; Wheeler 1984, 1992; Wheeler and Hoebeke 1988) (Fig. 1). Diagnostic characters, descriptions of the immature stages, and life-history information for this adventive rhopalid were provided by Hoebeke and Wheeler (1982), Wheeler (1984), and Wheeler and Hoebeke (1988).

Here, we give the first records of *R. tigrinus* from the western United States (Fig. 2). The following records are based on material submitted to E.R. Hoebeke (ERH) for identification or donated to the Cornell University Insect Collection (CUIC); material submitted for identification through the USDA's Systematic Entomology Laboratory, Beltsville, MD, and determined by T.J. Henry; and specimens collected by A.G. Wheeler (AGW) and T.J. Henry. Numbers of adults collected are in parentheses. Voucher specimens have been deposited in the CUIC and National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.

New U.S. records (Fig. 2): ARIZONA: Pima Co., Tuscon, Tanque Verde, 22 Feb. 1992, G.C. Eickwort (1). CALIFORNIA: Colusa Co., Williams, 9 Aug. 1998, AGW, ex *Lepidium latifolium* (5); Lake Co., Middletown, 10 Aug. 1998, AGW, ex *Hirschfeldia incana* (2); Mariposa Co., Lake McClure, 21 June 1998 (2) and Red Hill Rec. Area, June 1997 (2), W.A. Wall, ex *Streptanthus polygaloides*; Merced Co., Santa Nella (37°05'N, 121°00'W), 14 Aug. 1998, AGW & T.J. Henry, ex crucifers; San Benito Co., Rt. 156, 7.5 mi. N. of Hollister (36°57'N, 121°23'W), 14 Aug. 1998, AGW & T.J. Henry (1); San Joaquin Co., Rough and Ready Island (37°96'N, 121°36'W) (1) and Stockton (37°58'N, 121°18'W) (4), 12 Aug. 1998, AGW & T.J. Henry, ex *Raphanus* sp.; Santa

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Clara Co., Rt. 152, W. of Pacheco Pass (37°03'N, 121°13'W), 14 Aug. 1998, AGW & T.J. Henry, ex *Hirschfeldia incana* (2); Stanislaus Co., Westley (37°32'N, 121°15'W), 14 Aug. 1998, AGW & T.J. Henry, ex *Hirschfeldia incana* (4); Tehama Co., Red Bluff, Samson Slough, 29 Apr.-9 May 1984, D.S. Chandler, sweeping vetch (1); Yolo Co., Rt. 16, 0.8 km NNW. of Guinde, 10 Aug. 1998, AGW, ex *Hirschfeldia incana* (12) and Rd. 99W, 0.8 km S. of Zamora, 9 Aug. 1998, AGW, ex *Lepidium latifolium* (6). COLORADO: Douglas Co., Castle Rock, 21-22 Aug. 1994, M.H. Evans, sweeping mixed forbs (30); Sedgwick Co., Julesburg, 14 June 1998, AGW, ex *Sisymbrium altissimum* (1). NEBRASKA: Cheyenne Co., Sidney, 14 June 1998, AGW, ex *Descurainia sophia* (2); Dawes Co., Rt. 20, 0.8 km E. of Crawford, 17 June 1998, AGW, ex *Sisymbrium altissimum* (2); Deuel Co., Big Springs, 14 June 1998, AGW, ex *Descurainia sophia* (1) and Chappell, 14 June 1998, AGW, sweeping crucifers (1); Garden Co., Oshkosh, 18 June 1998, AGW, ex *Descurainia sophia* (1); Keith Co., Cedar Point Biological Station, 13 km N. of Ogallala, 12 June 1998, AGW, ex inflorescence of *Conium maculatum* (1) and Ogallala, 9-10 June 1998, AGW, ex *Descurainia sophia* (15) and *Sisymbrium altissimum* (3); Kimball Co., Kimball, 19 June 1998, AGW, ex *Descurainia sophia* and *Sisymbrium altissimum* (3); Lincoln Co., Hershey, 18 June 1998, AGW, ex *Descurainia sophia* (1); Morrill Co., Broadwater, 16 June 1998, AGW, sweeping weeds (1); Perkins Co., Rt. 23, 4 mi. E. of Madrid (40°51'N, 101°27"W), 21 Aug. 1998, AGW & T.J. Henry, ex *Sisymbrium altissimum* (1); Sioux Co., Rt. 29, 18 km N. of Mitchell, 17 June 1998, AGW, ex *Sisymbrium altissimum* (6). OREGON: Harney Co., Steens Mtn., Pike Creek (42°34'9"N, 118°32'8"W; 1,555 m), 10 May 1996 (1), 22 June 1996 (1), 7 June 1997 (1), J.D. McIver, ex *Lupinus argenteus*. WYOMING: Goshen Co., Torrington, 17 June 1998, AGW, ex *Descurainia sophia* (4); Laramie Co., Pine Bluffs, 19 June 1998, AGW, ex *Descurainia sophia* (6).

Collections of *R. tigrinus* in the western United States range in elevation from sea level in California's San Joaquin Valley (Rough and Ready Island) to more than 1,500 m above sea level in Oregon. Surveys in the western states were most extensive in Nebraska, where crucifers were sampled along railroads and highways. This rhopalid was found at all six sites sampled near the Union Pacific Railroad and Interstate Highway 80, from Kimball in the southwestern part of the panhandle east to Hershey (about 265 km) in west-central Nebraska. It was not found at four sites near Rt. 80 east of Hershey (North Platte to Cozad). Adults were found sporadically (4 of ca. 10 sites) north of Rt. 80 in the panhandle and were present near Crawford in the northwest, about 210 km north of the collection site at Kimball. In Nebraska, adults were collected mainly on the naturalized crucifers *Descurainia sophia* (L.) Webb ex Prantl and *Sisymbrium altissimum* L. Nymphs, present only at Big Springs and Sidney, were observed on *D. sophia*.

In California, *R. tigrinus* was found mainly in the Central Valley (with a few records from the eastern portion of the South Coast Ranges and Sierra Nevada foothills) from Tehama County in the north to San Benito County in the south, a distance of about 370 km. The late-season (August) host plants were perennial peppergrass (*Lepidium latifolium* L.) and short-pod mustard (*Hirschfeldia incana* (L.) Lag.-Foss.), which are both naturalized Old World crucifers.

The importation of nursery stock or other plant material likely was responsible for this rhopalid's unintentional introduction into North America. Once *R. tigrinus* became established, its spread might have been aided by the railroad

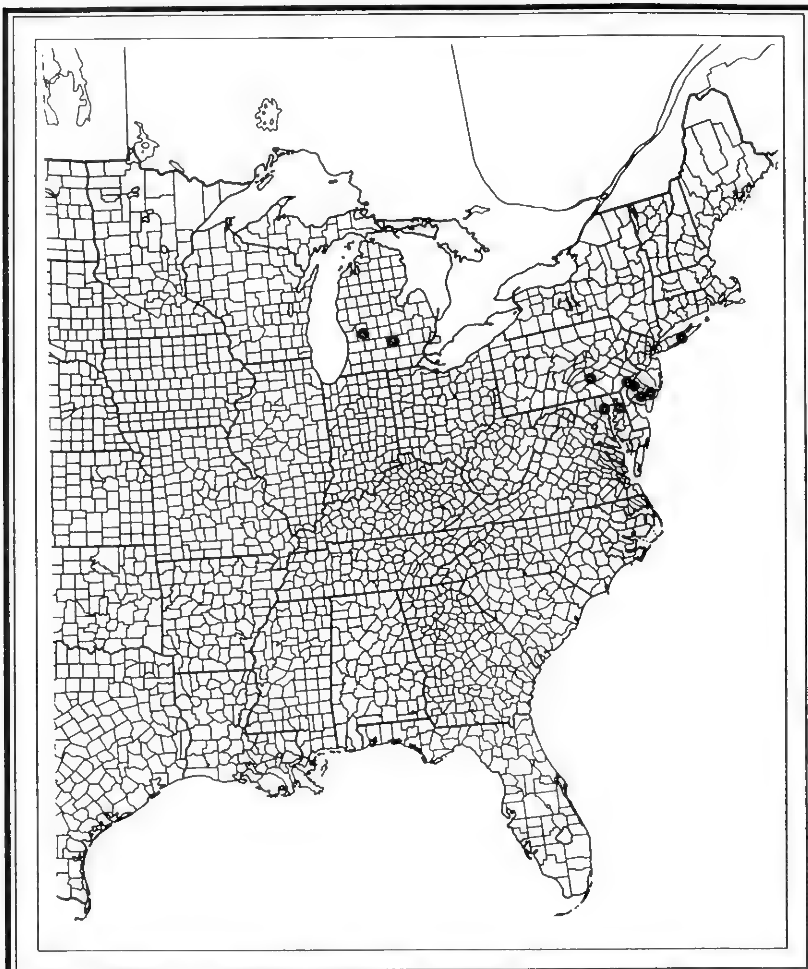

Figure 1. Known distribution of *Rhopalus (Brachycarenus) tigrinus* in the eastern United States, based on examined specimens (dots). Note: The record from Kent Co., Michigan (Wyoming, 11 August 1995, E.R. Hoebeke, ex *Lepidium* sp., 2 adults) represents unpublished data.

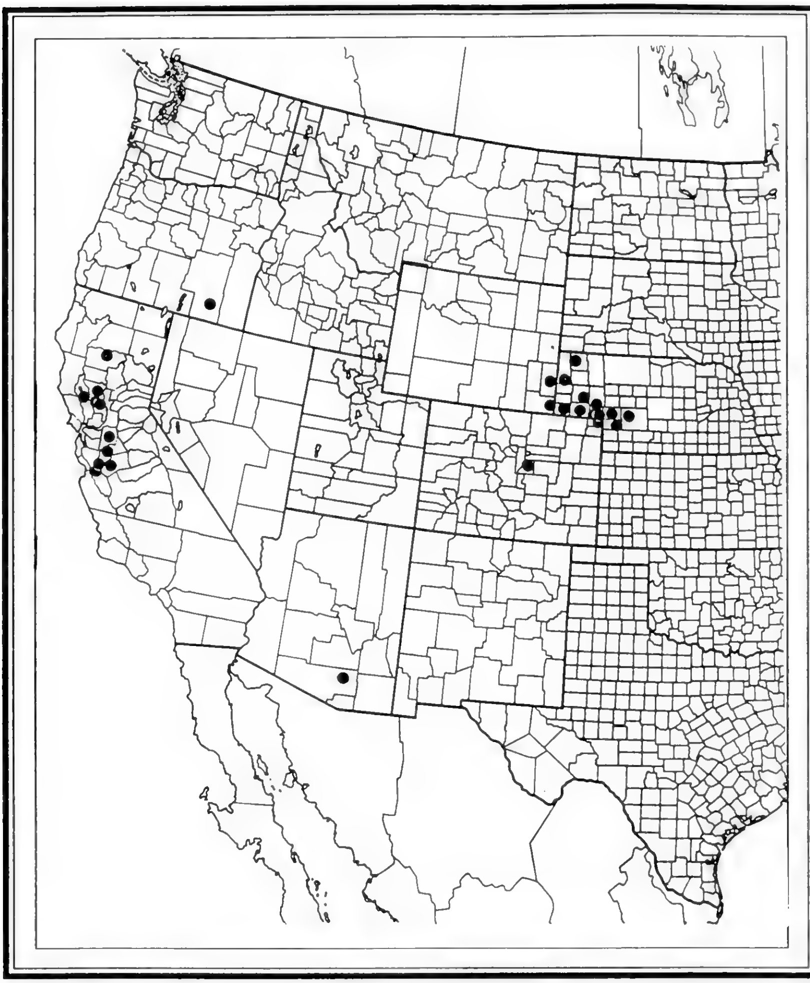

Figure 2. Known distribution of *Rhopalus* (*Brachycarenus*) *tigrinus* in the western United States, based on examined specimens (dots) reported herein.

(Hoebeke and Wheeler 1982), although we have no evidence that individuals are transported in or on railroad cars. Its occurrence in railroad yards and along rights-of-way in the eastern and western United States might simply reflect the abundance of preferred Old World crucifers that are naturalized in railroad ballast and in other ruderal sites near railroads. Railroad lines, as well as highways, probably serve as corridors that facilitate the spread of this adventive species.

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SOUTHERN RANGE EXTENSION OF A PALEARCTIC STINK BUG, *PICROMERUS BIDENS* (HEMIPTERA: PENTATOMIDAE), IN NORTH AMERICA[1]

A.G. Wheeler, Jr.[2]

ABSTRACT: The Palearctic *Picromerus bidens* is a predacious stink bug (Pentatomidae: Asopinae) that was first collected in North America in 1932 (Maine) but not reported until 1967 (Maine and Vermont). Other published North American records are Ontario, Quebec, and the Maritime Provinces in Canada; all other New England states (except Connecticut); and northern New York. Pennsylvania is given as a new state record, and additional New York records extend the range in that state to the south-central region.

Picromerus bidens (L.) is a common Palearctic pentatomid whose bionomics are well known. This asopine is univoltine, overwinters in the egg stage, and preys mainly on coleopteran, hymenopteran, and lepidopteran larvae that feed on herbaceous and woody plants; adults are most often collected from mid-July to early October (e.g., Javahery 1986, Stehlík 1987, Larivière and Larochelle 1989). Although *P. bidens* was collected in Maine in 1932, it was not recorded from North America until Cooper (1967) reported collecting adults at Union Village, Vermont, during 1962-1966, and mentioned a specimen from Lincoln, Maine, found among undetermined material in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Perhaps because this potentially important predator might help suppress densities of certain crop pests, its spread has been followed more closely than that of many other insects that are adventive in North America. It has since been reported from New Hampshire (Lattin and Donahue 1969), Quebec (Kelton 1972), Massachusetts and New York (Larochelle and Larivière 1980), and New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Rhode Island (Larivière and Larochelle 1989). North American populations of *P. bidens* probably have resulted from the importation of nursery stock or other horticultural products rather than an intentional introduction for biological control (Javahery 1986, Larivière and Larochelle 1989).

Previously, the southernmost record of *P. bidens* in North America was Chepachet, Rhode Island (Larivière and Larochelle 1989). The following records of adults extend the known Nearctic distribution of *P. bidens*, with the record from Pennsylvania about 330 km from the Rhode Island locality and about 120 km south. Voucher specimens have been deposited in the Cornell University Insect Collection, Ithaca, NY (CUIC), and the USNM.

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NEW YORK: Cortland Co., Cortland, 16 September 1995, S. Berry (1♀); Tompkins Co., Ithaca, 8 September 1997, C. McDonald (1♀) and 29 September 1997, T. Clark (1♂). PENNSYLVANIA: Monroe Co., S. of Long Pond, 41°01'N, 75°28'W, 600 m, 19 July 1998, A.G. Wheeler, Jr., ex *Aronia* sp. (1♂).

The Pennsylvania specimen, from pitch pine-scrub oak barrens, was beaten from *Aronia* sp. (Rosaceae) in a hedgerow of predominantly scrub oak, *Quercus ilicifolia* Wangenh., along a gas pipeline right-of-way. New York specimens, from collections of Cornell University students, lack habitat information.

The occurrence of *P. bidens* in south-central New York and northeastern Pennsylvania likely is quite recent. Specimens have been found only since 1995 in collections made by Cornell students. In Pennsylvania, *P. bidens* was collected within a kilometer of pine-barrens sites where I inventoried Miridae associated with scrub oak (Wheeler 1991) and Fulgoroidea of scrub oak and pitch pine, *Pinus rigida* Mill. (Wheeler and Wilson 1996). *Picromerus bidens* was not encountered in those surveys.

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FIRST RECORDS OF THE FAMILY NOTONECTIDAE (INSECTA : HEMIPTERA) FROM WEST VIRGINIA[1]

Stephen W. Chordas III[2], Richard L. Stewart Jr.[3], Linda Butler[4]

ABSTRACT: Notonectidae are common and widespread insects throughout the United States and Canada, but no notonectids have been reported from West Virginia. We now report this family to be represented in the state by four species in two genera, *Buenoa margaritacea*, *Notonecta indica*, *Notonecta irrorata* and *Notonecta undulata*. Additionally, we provide a list of other Notonectidae species that may occur in West Virginia.

The family Notonectidae Latreille, 1802 is a generally common and widespread family of predaceous aquatic insects in North America. It has been reported from every Canadian province and territory and most of the United States. With our report of this family from West Virginia, only three of the 48 contiguous states (Delaware, New Hampshire and North Dakota) lack published records (Hungerford, 1934; Polhemus and Polhemus, 1988; Truxal, 1953). Since species of this family have been reported from all areas surrounding these three states, it seems the lack of records for these areas is due to a lack of published accounts of this family rather than their absence. The purposes of this paper are to document the occurrence of the family Notonectidae in West Virginia, report one *Buenoa* and three *Notonecta* species as new state records and to provide a list of species that may occur in West Virginia.

METHODS

Adult backswimmers were collected during the summer of 1998 with dip nets and preserved in 70% ethanol. Museum specimens from the University of West Virginia were also examined. Identifications were made using keys, illustrations and descriptions by Hungerford (1934). Chordas and Harp (1991), Hilsenhoff (1984), Hungerford (1934), Polhemus and Polhemus (1988), Polhemus (1997), Truxal (1953) and Yeakel and Larsen (1997) provided species distribution. Voucher specimens were deposited in the Ohio Biological Survey's Aquatic Insect Collection (Museum of Biological Diversity at The Ohio State University, Columbus, Ohio) and in the first author's personal collection.

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RESULTS AND DISCUSSION

Four species of Notonectidae, three belonging to the genus *Notonecta* Linnaeus, 1758 and one to the genus *Buenoa* Kirkaldy, 1908, were identified from several localities throughout West Virginia. These species, *Buenoa margaritacea* Torre-Bueno, 1908, *Notonecta indica* Linnaeus, 1771, *Notonecta irrorata* Uhler, 1879 and *Notonecta undulata* Say, 1832, are the first Notonectidae reported from West Virginia.

Buenoa margaritacea: A single male specimen, collected in Monongalia county in July, 1974, was identified from the University of West Virginia collection. This species is common in the midwest and eastern United States (Polhemus and Polhemus, 1988) and probably occurs throughout West Virginia.

Notonecta indica: A single female specimen, collected in Putnam county in September, 1978, was identified from the University of West Virginia collection. This is a common species in the southern half of the United States with scattered records encroaching the northeast (Steve Chordas, unpublished data; Polhemus and Polhemus, 1988). West Virginia lies at the very northern edge of its known range.

Notonecta irrorata: This species is common throughout the eastern portions of the United States and Canada. It has now been reported for every state east of the Mississippi River except Georgia, New Hampshire, Vermont and Delaware (Steve Chordas, unpublished data; Polhemus and Polhemus, 1988). It most commonly occurs in woodland ponds and pools in addition to other lentic habitats that are at least in part shaded (Chordas and Harp, 1991; Hungerford, 1934).

We recently collected this species from three northern counties in West Virginia. One male and four females were found on July 18, 1998 in a small road side pool along State Route 2 in Hancock county approximately three km west of Newell. One male and three females were found on June 15, 1998 in a small, apparently fishless, partly wooded pool along the Ohio River in Ohio county approximately 1.5 km south of the Ohio/Brooke county line north of Warwood. Seven males and one female were taken on June 16, 1998 from a small, apparently fishless, partly wooded road side pond off State Route 2 in Pleasants county just southwest of the Willow Island locks and dam of the Ohio River. Six specimens, five from Monongalia county and one from Taylor county, collected during May, August and September (labels lacked year of collection), were identified from the University of West Virginia collection. This species probably occurs throughout the State and is likely to be one of the most common backswimmers in West Virginia.

Notonecta undulata: This species is the most common and widespread species in the United States and Canada. Including West Virginia, it has been reported from 38 of the 48 contiguous states in the U.S. and for every province and territory in Canada except the Yukon (Polhemus and Polhemus, 1988). This species occurs in almost any lentic habitat but is most abundant in smaller fishless lentic habitats (Chordas and Harp, 1991; Hungerford, 1934).

We recently collected this species from two northern counties. Two females were taken from Ohio county and three females were taken from Pleasants county (same dates and localities as described for *N. irrorata* above). A total of 19 specimens, collected from Berkeley, Greenbrier, Hampshire, Mercer, Monongalia and Preston counties during the months of May through September (various years), were identified from the University of West Virginia collection. This species probably occurs throughout the State and may be the most common and widespread notonectid species in West Virginia.

In addition to the four species reported in this paper, four additional *Notonecta* species and three additional *Buenoa* species may occur in West Virginia (Table 1). Investigators are encouraged to report any Hemiptera records, not just from West Virginia but throughout the United States and Canada, as a contribution to the ongoing effort to document the Hemiptera fauna of this region (Polhemus and Polhemus, 1988; Yeakel and Larsen, 1997).

Table 1. Notonectidae species known or likely to occur in West Virginia

Genus	***Notonecta***	***Buenoa***
Species	*N. indica* Linnaeus, 1771 * *N. insulata* Kirby, 1837 *N. irrorata* Uhler, 1879 * *N. petrunkevitchi* Hutchinson, 1945 *N. raleighi lunata* Hungerford, 1926 *N. uhleri* Kirkaldy, 1897 *N. undulata* Say, 1832 *	*B. confusa* Truxal, 1953 *B. limnocastoris* Hungerford, 1923 *B. margaritacea* Torre-Bueno, 1908 * *B. scimitra* Bare, 1925

* = Species newly reported for West Virginia in this paper.

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ENHANCING BIOLOGICAL CONTROL, 1998. C.H. Pickett and R.L. Bugg, eds. Univ. California Press. 433 pgs; 6 b/w illus., 75 figs., 48 tables. $50.00 hdbk.

The subtitle of this book, "Habitat Management to Promote Natural Enemies of Agricultural Pests" pretty well covers the thrust of this book. The authors claim this is the first comprehensive summary of recent findings on habitat manipulation to control pests.

PARASITES IN SOCIAL INSECTS. 1998. P. Schmid-Hempel. Princeton University Press. 409 pp. $85.00 cloth, $35.00 paper.

This book provides an overview of existing knowledge of parasites of social insects and analyzes how parasites shape the biology of social insects: ants, wasps, bees, and termites. Appendix 2 provides a comprehensive listing of the parasites of social insects, including references, and thus is a superb guide to current research and relevant literature.

CONSERVATION AND BIODIVERSITY. 1998. A.P. Dobson. Scientific American Library. 264 pp. 8" x 9" format. $19.95 paper.

As species disappear at an unprecedented rate, scientists work to conserve the Earth's biodiversity. In this book, the author explores the management of endangered species, the economics of different conservation techniques, and the practical possibilities for using the environment while sustaining it. Case studies describe the changes in animal populations before and after management attempts.

THE INSECTS: STRUCTURE AND FUNCTION, 4th ed. 1998. R.F. Chapman. Cambridge University Press. 770 pp. $130.00 hard, $54.95 paper.

A completely rewritten update of a well established standard text and reference work for students and researchers in zoology, entomology, and physiology.

THYSANOPTERA, AN IDENTIFICATION GUIDE, 2nd ed. 1998. L.A. Mound and G. Kibby. CAB International/Oxford University Press. 70 pp. 8-1/2 x 12 format. Spiral bound. Cloth $35.00.

Because of difficulties in using the first edition of this identification guide, this second edition has been entirely redrafted into a visual key to genera so as to make it easier to recognize the character states necessary to identification.

DISTRIBUTION AND CLASSIFICATION OF AQUATIC WEEVILS (COLEOPTERA: CURCULIONIDAE) IN THE GENUS *EUHRYCHIOPSIS* IN WASHINGTON STATE[1]

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ABSTRACT: During the summers of 1993, 1996 and 1997, we surveyed a total of 66 sites in Washington State to determine the presence and distribution of the aquatic weevil *Euhrychiopsis lecontei*. *E. lecontei* was found in 8 sites in 1993, all in eastern Washington. In 1996 the weevil was found in 9 lakes, 2 of which where located in western Washington. During 1997, we found weevils in 14 sites, all except one were located east of the Cascade Mountains. Previously, the genus *Euhrychiopsis* was considered to have 2 species, *lecontei* and *albertanus*. However, examination of the male genitalia from specimens of both species in this genus from 20 populations across North America showed no differences within or between populations. Therefore, there is only one valid species in the genus *Euhrychiopsis*, namely *lecontei*. *E. albertanus* is a junior synonym [NEW SYNONYMY].

In recent years, the aquatic weevil *Euhrychiopsis lecontei* (Dietz) has been receiving a great deal of attention from both researchers and resource managers as a potential biological control agent of Eurasian watermilfoil (*Myriophyllum spicatum* L.), an aquatic macrophyte native to Europe, Asia and northern Africa (Couch and Nelson 1986). This weevil is native to North America and has been associated with declines of *M. spicatum* in the continent (Creed and Sheldon 1995, Lillie 1996, Jester et al. 1997, Creed 1998). In addition, most of the unexplained declines of *M. spicatum* in North America have occurred within *E. lecontei*'s original range (Creed 1998). Laboratory and field studies conducted in Vermont and Minnesota have concluded that this weevil is a watermilfoil specialist and that it can have a negative impact on Eurasian watermilfoil (e.g. Creed and Sheldon 1995, Sheldon and Creed 1995, Newman et al. 1996, Solarz and Newman 1996).

Given the promising results seen in Vermont and Minnesota and that Eurasian watermilfoil is currently found in 86 lakes and rivers throughout Washington State (Parsons 1997), *E. lecontei* may be an alternative for controlling

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Eurasian watermilfoil in this state. However, several questions about the distribution of *E. lecontei* need to be determined before implementing a biological control program that uses this weevil in Washington State. Prior to our study, it was not known if the weevil occurred throughout Washington or was limited to certain regions. For example, if the weevil is present only in eastern Washington it may not be possible to use it as a biological control agent in the western part of the state. We were also interested in determining which watermilfoil species are serving as host plants for *E. lecontei*. In addition to determining the geographic distribution and host plant usage of *E. lecontei* in Washington, we also resolved the confusion that existed with regards to the taxonomy and classification of weevils in the genus *Euhrychiopsis*. Dietz erected this genus in 1896 as a subgenus of *Phytobius* Schoenherr and based it upon a single species, *lecontei* Dietz. Subsequently in 1932, Brown added a second species, *albertanus* to the genus *Phytobius*. Brown considered *E. lecontei* to be a junior synonym of the European *Eubrychius velatus* Beck, following the consensus of other American weevil specialists. Buchanan (1937) corrected this error and pointed out that *Eubrychius* was restricted to Europe. A previous examination by the second author (CWOB), of specimens identified as *Eubrychius* from numerous museums in the United States, showed that all such North American specimens were misidentified *Euhrychiopsis lecontei*. In Colonnelli's (1986) World Checklist of Phytobiini, *Eubrychius* was considered to be Holarctic. However, Colonnelli did not list any actual localities in the United States or Canada. In addition, he recognized *Euhrychiopsis* as having two species, *lecontei* and *albertanus*. This classification was based on differences in coloration, but it was unclear if these were two separate species or only one. To determine if these color differences are indicative of two species, CWOB examined numerous individuals from across North America within the genus *Euhrychiopsis*, including those collected in the present study.

METHODS

1993 Surveys

The third author (RPC) surveyed 20 lake and riverine sites in Washington for *Euhrychiopsis*. Three of the 20 sites were located west of the Cascade Mountains and 17 were in eastern Washington. Surveys were conducted in late July and early August and specimens were collected by either wading or snorkeling. Eurasian and northern watermilfoil (*M. sibiricum* Komarov = *M. exalbescens* Fernald) were examined for adult weevils and larval damage. Watermilfoil species were distinguished by morphological differences (Aiken et al. 1979). Larval damage, unique to *E. lecontei*, was identified by examining plant stems for holes and burrowing created by late instar larvae (Creed and Sheldon 1994a, 1995; Sheldon and O'Bryan 1996a; Jester et al. 1997). Sites in addition to those listed in Table 1 were visited, but no attempt was made to collect at these sites as no watermilfoil was observed from shore.

1996-97 Surveys

Thirty-seven lakes (2 from 1993, Lakes Pateros and Curlew) and a section of the Columbia River by the city of Maryhill were surveyed from mid-July to the end of August, 1996. In 1997, 37 of these sites and an additional 13 (3 from 1993, Okanogan River at Oroville, Whitestone Lake, and the Columbia River at Brewster) were surveyed from early June to early September. Aquatic plant data previously collated by Sharon Walton (1996) and Jenifer Parsons (1997) were used to select survey sites each year. Based on their data, most sites visited were reported previously to have either Eurasian and/or native northern watermilfoil. We tried to avoid sites where Eurasian watermilfoil was being controlled as this can reduce weevil abundance (Sheldon and O'Bryan 1996b). Of the 38 sites we visited in 1996, 16 were located in western Washington, while the remaining 22 were east of the Cascades. In 1997, 24 sites were in western Washington and 26 were east of the Cascades (Table 1).

We surveyed the shoreline of each lake and river site to locate and map watermilfoil beds. Whenever possible, 5 locations within the watermilfoil beds (monotypic and/or mixed species, including plants other than watermilfoils) of each waterbody were selected randomly in 1996. These same locations were surveyed again in 1997. If we did not find any watermilfoil in a location in 1997, we selected a new one randomly. Three snorkel surveys were conducted in each of the 5 locations in both years. Each survey consisted of snorkeling for 5 minutes, examining the top 0.50 m of watermilfoil plants for adult weevils and larval damage; this is the same method used in Vermont (H. Crosson, Vermont Department of Environmental Conservation, Waterbury, VT, pers. comm.). Any adults that were found were collected and larval damage observed was recorded. Representative samples of larval damage were collected in 1996 and 1997. If the survey site consisted of a mixed species bed, plants other than watermilfoils were briefly checked; however our surveys focused primarily on watermilfoil species.

Two plant specimens were collected at each watermilfoil survey site within each waterbody. One plant sample from each site was pressed, while the other specimen was identified. Since most of the collected plants did not have flowers, differentiation of the watermilfoil species was based on stem and leaf morphology (Aiken et al. 1979). If the classification of any specimen was uncertain the plants were identified only to genus.

Weevil Classification

During all 3 survey years, adult weevils were collected when found and the plants they were associated with were noted. Voucher specimens were deposited in CWOB's collection, at the School of Fisheries, University of Washington, Seattle, WA and in RPC's personal collection. To determine if the genus *Euhrychiopsis* truly consists of 2 species, *lecontei* Dietz and *albertanus* Brown, CWOB compared the coloration and morphology (male genitalia) of the weevils we collected to that of weevils of the same genus from more than 20 populations from Canada (Alberta, Saskatchewan, British Columbia) and the United States (MN, WA, WI, UT, VT, IA, CO, and IL).

RESULTS AND DISCUSSION

Classification

Based on close examination of numerous specimens of *E. lecontei* and *E. albertanus* by CWOB, there is only one valid species in the genus *Euhrychiopsis*, namely *lecontei* Dietz. *E. albertanus* Brown is a junior synonym of the latter [**new synonymy**]. Dissections of male genitalia showed that there are no differences within or between populations. The specimens examined represent a single species with a wide range of color forms which vary so greatly that they should not be treated even as subspecies. In fact, multiple color forms have been collected within the same waterbody in at least Washington and Wisconsin (R. Lillie, Wisconsin Department of Natural Resources, Monona, WI; pers. comm.). Consequently, any specimens which key to *Euhrychiopsis* using Colonnelli's key (1986) can be treated as *E. lecontei* Dietz.

Typically, eastern North American populations of *E. lecontei* are distinctly mottled. Their dorsal surface ranges from pale yellowish brown to greenish brown, mixed with dark brown to black maculae and a yellowish venter. Westward populations tend to become darker in a clinal fashion, with the maculations becoming larger and more predominant. Typical *E. albertanus* were nearly black with a distinct whitish postcutellar sutural vitta and a whitish venter. However, in all the series of *albertanus* from the western prairie (including the type locality) that were examined by CWOB, dark mottled specimens also occurred in addition to black specimens. West of the Rocky Mountains in Washington and British Columbia, dark mottled forms are present, and so far no solid black forms have been collected. Even though there is this great color variation, it is clear that this is a single species. Hence, *Euhrychiopsis* is a monotypic genus. The latter is encouraging because future control efforts involving weevils from this genus need only to focus on one species, *lecontei* Dietz.

Distribution of *E. lecontei*

In 1993, we found *E. lecontei* in 8 of the 20 sites surveyed; all sites were in eastern Washington. During the 1996 surveys, *E. lecontei* was present in 9 of the 38 sites. Two of the lakes, Sawyer and Meridian, were located in western Washington, while the other 7 were in eastern Washington. Only 2 of the 8 weevil sites from 1993, Lake Pateros and Curlew Lake, were surveyed in 1996. Both larval damage and 2 adults were collected in Curlew Lake in 1996. We did not find either in Lake Pateros, however only a section of the eastern shore of the lake was surveyed. In 1997, we found *E. lecontei* in 14 of the 50 sites surveyed. All sites except for Lake Sawyer were in eastern Washington. Only 3 weevil sites from 1993, Lake Pateros, Curlew Lake and the Okanogan River at Oroville, were surveyed in 1997. We found larval damage both in Curlew Lake and the Okanogan River at Oroville, while in Lake Pateros we did not detect any adults or larval damage. In addition, all of the weevil sites from 1996 had larval damage and/or adults in 1997, except for Lake Meridian where neither were detected.

To date, we have found *E. lecontei* in 21 lake and riverine sites around Washington (Table 1). Most of these sites were located in eastern Washington (19), however we did find *E. lecontei* in western Washington. West of the Cascades, the weevil was present only in King County, in Lakes Meridian and Sawyer. In eastern Washington, *E. lecontei* occurred in 7 counties, Chelan, Ferry, Grant, Lincoln, Okanogan, Pend Oreille and Spokane. Only 3 of the 19 sites with weevils east of the Cascades were located in the Columbia and Okanogan Rivers. We found the greatest number of adult weevils in Fish Lake (17) in 1996, followed by Sawyer Lake (9) in 1997. The presence of *E. lecontei* in eastern and western Washington is promising, as this would facilitate future biological control programs using this weevil in both regions. In addition, it is encouraging that we found *E. lecontei* in the Columbia and Okanogan Rivers as well as in King County, because Eurasian watermilfoil is a nuisance in these areas. In fact, the earliest herbarium specimen of Eurasian watermilfoil in Washington State was collected from Lake Meridian in the mid 1960's (Parsons 1997).

We also found that in Washington, *E. lecontei* is associated with both Eurasian and northern watermilfoil (Table 2), the latter being native to the state and North America. To date, *E. lecontei* has been found primarily on Eurasian watermilfoil in western Washington. In contrast, in eastern Washington weevils were found in more waterbodies with northern watermilfoil than Eurasian watermilfoil. Northern watermilfoil is widely distributed throughout Washington, particularly east of the Cascades. In 11 of the 19 weevil sites in eastern Washington, *E. lecontei* was associated with northern watermilfoil. Of the remaining 8 weevil sites in eastern Washington, weevils were present on Eurasian watermilfoil in 6 (Lake Pateros, Sacheen Lake, Evergreen Lake, Columbia River at Entiat, Okanogan River at Oroville and below Lake Osoyoos), while in the other 2 sites (Aeneas and Stan Coffin Lakes) *E. lecontei* occurred on both Eurasian and northern watermilfoil. Because our surveys focused primarily on watermilfoil species, we can not comment on the host specificity of *E. lecontei*. However, our data do provide further evidence that northern watermilfoil is a native host of *E. lecontei*. In at least 7 lakes with weevils, *M. sibiricum* has been the only watermilfoil species present. Our results corroborate those of Creed and Sheldon (1994b) who found *E. lecontei* in 10 lakes in Alberta, Canada where Eurasian watermilfoil was absent, but northern watermilfoil was present.

Table 1. Distribution of *Euhrychiopsis lecontei* in Washington State.

			Watermilfoil spp.[2]			*Euhrychiopsis lecontei*[3]		
Lake or river	**County**	**Location[1]**	**1993**	**1996**	**1997**	**1993**	**1996**	**1997**
Lake Chelan at Mill Bay Park	Chelan	T30N,R21E,S19	EWM	———	———	None	———	———
Columbia R. at Entiat	Chelan	T26N,R21E,S16	EWM	———	———	A(5)	———	———
Lake Pateros near Wells Dam	Chelan	T29N,R24E,S6	EWM	EWM	EWM	A(2)	None	None
Wapato Lake	Chelan	T28N,R21E,S23	NWM	———	———	LD	———	———
Beaver Lake	Clallam	T31N,R12W,S9	———	———	NWM	———	———	None
Lake Sutherland	Clallam	T30N,R8W,S22	———	———	NWM	———	———	None
Silver Lake	Cowlitz	T10N,R1W,S36	EWM	———	———	None	———	———
Curlew Lake	Ferry	T38N,R33E,S28	NWM	NWM	NWM	A(2)	A(2), LD	LD
Columbia R. at Pasco	Franklin	T9N,R30E,S3	EWM	———	———	None	———	———
Scooteney Res Lake	Franklin	T14N,R30E,S27	———	EWM	EWM	———	None	None
Babcock Ridge Lake	Grant	T20N,R23E,S10	———	EWM	EWM	———	None	None
Billy Clapp Lake	Grant	T23N,R28E,S36	———	EWM	None	———	None	None
Burke Lake	Grant	T19N,R23E,S15	———	NWM	NWM	———	None	None
Canal Lake	Grant	T17N,R29E,S33	———	NWM	NWM	———	LD	A(1), LD
Corral Lake	Grant	T17N,R28E,S15	———	NWM	NWM	———	LD	A(5), LD
Evergreen Lake	Grant	T19N,R23E,S22	———	———	EWM	———	———	LD
Stan Coffin Lake near Quincy	Grant	T19N,R23E,S10	———	NWM & EWM	NWM & EWM	———	None	A(4), LD
Warden Lake	Grant	T17N,R29E,S10	———	NWM	NWM	———	None	LD
Cranberry Lake in Whidbey Island	Island	T34N,R1E,S35	———	———	NWM	———	———	None
Bass Lake	King	T20N,R6E,S2	———	EWM	EWM	———	None	None
Lake Desire	King	T23N,R5E,S36	———	EWM	EWM	———	None	None
Lake Dollof	King	T21N,R4E,S10	———	EWM	EWM	———	None	None
Margaret Lake	King	T26N,R7E,S3	———	———	WESWM	———	———	None
Lake Meridian	King	T22N,R5E,S27	———	EWM	EWM	———	A(3), LD	None

			Watermilfoil spp.[2]			*Euhrychiopsis lecontei*[3]		
Lake or river	**County**	**Location[1]**	**1993**	**1996**	**1997**	**1993**	**1996**	**1997**
Neilson (Holm) Lake	King	T21N,R5E,S14	———	EWM	EWM	———	None	None
North Lake	King	T21N,R4E,S15	———	———	WWM	———	———	None
Lake Sawyer	King	T21N,R6E,S4	———	EWM[5]	EWM[5]	———	A(5), LD	A(9), LD
Shadow Lake	King	T22N,R6E,S7	———	None	None	———	None	None
Shady Lake	King	T22N,R5E,S1	———	None	EWM	———	None	None
Star Lake	King	T22N,R4E,S34	———	EWM	EWM	———	None	None
Lake Wilderness	King	T22N,R6E,S22	———	EWM	EWM	———	None	None
Columbia R. at Maryhill	Klickitat	T2N,R15E,S13	———	EWM	EWM	———	None	None
Horsethief Lake	Klickitat	T2N,R14E,S19	———	EWM	EWM	———	None	None
Swofford Pond	Lewis	T12N,R3E,S26	EWM	———	———	None	———	———
Fishtrap Lake	Lincoln	T21N,R39E,S12	———	NWM[6]	NWM[6]	———	A(2), LD	A(3), LD
Aeneas Lake near Tonasket	Okanogan	T37N,R26E,S25	———	NWM	NWM & EWM	———	A(3), LD	A(1), LD
Columbia R. at Pateros	Okanogan	T29N,R23E,S35	None	———	———	None	———	———
Columbia R. at Brewster	Okanogan	T30N,R24E,S23	EWM	———	EWM	None	———	None
Conconully Lake	Okanogan	T35N,R25E,S6	———	WS[7]	EWM	———	None	None
Fish Lake	Okanogan	T36N,R25E,S22	———	NWM	NWM	———	A(17), LD	LD
Little Twin Lake	Okanogan	T34N,R21E,S15	———	None	None	———	None	None
Okanogan R. at Oroville	Okanogan	T39N,R27E,S21	EWM	———	EWM	A(5)	———	LD
Okanogan R. 300 m below Lake Osoyoos	Okanogan	T39N,R27E,S28	EWM	———	———	LD	———	———
Lake Osoyoos	Okanogan	T40N,R27E,S22	EWM	———	———	None	———	———
Palmer Lake	Okanogan	T39N,R25E,S13	———	NWM	None	———	None	None
Spectacle Lake	Okanogan	T38N,R26E,S2	NWM	———	———	LD	———	———
Whitestone Lake	Okanogan	T38N,R27E,S17	EWM	———	EWM[5]	None	———	None
Fan Lake	Pend Oreille	T30N,R43E,S32	———	NWM	NWM	———	None	A(5), LD
Nile Lake	Pend Oreille	T37N,R42E,S35	———	———	EWM	———	———	None

			Watermilfoil spp.[2]			*Euhrychiopsis lecontei*[3]		
Lake or river	**County**	**Location[1]**	**1993**	**1996**	**1997**	**1993**	**1996**	**1997**
Pend Oreille R. near Newport	Pend Oreille	T55N,R45E,S18	EWM & NWM	———	———	None	———	———
Sacheen Lake	Pend Oreille	T31N,R44E,S30	EWM	———	———	A(6)	———	———
Egg Lake in San Juan Island	San Juan	T36N,R3W,S33	———	———	NWM[4]	———	———	None
Beaver Lake	Skagit	T34N,R5E,S7	———	NWM	NWM	———	None	None
Clear Lake	Skagit	T36N,R9E,S23	———	EWM	EWM	———	None	None
Lake Erie	Skagit	T34N,R1E,S11	———	———	NWM	———	———	None
Heart Lake	Skagit	T36N,R7E,S5	———	NWM	NWM	———	None	None
Lake McMurray	Skagit	T33N,R5E,S30	———	———	EWM	———	———	None
Sixteen Lake	Skagit	T33N,R4E,S15	———	EWM	EWM	———	None	None
Loma Lake	Snohomish	T31N,R4E,S35	———	NWM[8]	NWM[8]	———	None	None
Badger Lake	Spokane	T21N,R41E,S4	———	NWM[9]	NWM	———	None	A(1), LD
Long Lake (Refuge)	Spokane	T23N,R41E,S26	———	———	None	———	———	None
Williams Lake	Spokane	T21N,R40E,S13	———	NWM[6]	NWM[6]	———	A(1), LD	LD
Jumpoff Joe Lake	Stevens	T31N,R40E,S36	NWM	———	———	None	———	———
Waitts Lake	Stevens	T31N,R40E,S17	NWM	———	———	None	———	———
Hicks Lake	Thurston	T18N,R1W,S27	None	———	———	None	———	———
Whatcom Lake	Whatcom	T38N,R3E,S28	———	EWM	EWM	———	None	None

[1]The location of the waterbodies is reported as Township (T), Range (R), and Section (S). [2]Watermilfoil species found in the waterbody and where larval damage and/or adults were present. EWM=Eurasian watermilfoil; —— =sites that were not surveyed in a particular year; NWM=northern watermilfoil; WESWM=western watermilfoil; and WWM=whorled watermilfoil; WS=watermilfoil species. [3]A=adult weevils. The total number of adults collected is shown in parentheses. This number includes adults that were collected during weevils surveys and while mapping the watermilfoil. LD=larval damage. [4]Whorled watermilfoil might have been present also in Egg Lake. [5]Eurasian watermilfoil occurred throughout the littoral zone of Lakes Sawyer and Whitestone, but a few plants of northern watermilfoil were also present. [6]Northern watermilfoil was the predominant watermilfoil species in Fishtrap and Williams Lakes, however a few plants of Eurasian watermilfoil were found. [7]Unclear if some of the watermilfoil in Conconully Lake was Eurasian watermilfoil or another species. [8]A few scattered plants of western watermilfoil may have been present in Loma Lake. [9]Uncertain if some of the watermilfoil plants in Badger Lake were northern or another species.

There are several questions that still need to be answered before implementing a biological control program with *E. lecontei* in Washington State. For example, do differences exist in the life history of *E. lecontei* in eastern and western Washington since both regions have very different climatic conditions? Most, if not all of the lakes in eastern Washington where weevils have been collected freeze during the winter; this is not the case for the lakes with weevils in western Washington. Also, does the weevil interact with other native species of watermilfoil in Washington? We are uncertain if northern watermilfoil is the only native plant that is a host for *E. lecontei* in Washington. In addition, we do not know what impact the weevil may have on other native watermilfoils found in the state, such as western (*M. hippuroides* Nuttall) and whorled (*M. verticillatum* L.) watermilfoils. Finally, how do weevil densities in Washington State compare with those of other states where *E. lecontei* has been associated with declines of Eurasian watermilfoil (e.g., Illinois, Vermont, and Wisconsin [Jester et al. 1997])? The "low" numbers of weevils collected in our study do not necessarily imply low weevil densities. Similarly, the fact that weevils were not found in most of the waterbodies surveyed (60% in 1993, 76% in 1996 and 72 % in 1997) does not necessarily indicate that weevils are not present there. Local areas where weevils were present may not have been surveyed. In addition, lakes may have been surveyed too early or too late in the season, thus missing peak weevil densities.

Table 2. Number (%) of lakes surveyed in Washington State with *Euhrychiopsis lecontei* and the watermilfoil species present.[1]

	Eastern Washington	Western Washington
No. of waterbodies surveyed	39	27
No. of waterbodies with *E. lecontei*	19 (48.7%)	2 (7.4%)
No. of waterbodies with Eurasian watermilfoil	6 (31.6%)	2 (100%)
No. of waterbodies with northern watermilfoil	11 (57.9%)	0
No. of waterbodies with Eurasian & northern	2 (10.5%)	0

[1] Data from 1993, 1996 and 1997 are presented.

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STUDIES IN AQUATIC INSECTS XV: NEW SPECIES OF *NEOTRICHIA* AND FIRST RECORD OF *OXYETHIRA HILOSA* (TRICHOPTERA: HYDROPTILIDAE) FROM MEXICO[1]

Joaquín Bueno-Soria[2]

ABSTRACT: Two new species of the genus *Neotrichia*, from the tropical rain forest of Veracruz, Mexico, are described and the male genitalia illustrated. *Oxyethira hilosa*, described from Costa Rica, is recorded for the first time in Mexico.

The family Hydroptilidae is the most diverse of the Mexican caddisfly fauna so it is not surprising to find new species in this family. Harris and Bueno (1993), Bueno and Harris (1993), and Harris and Holzenthal (1992) have recently studied elements of the fauna.

In recent years, several species of *Neotrichia* from Central America and the Amazon region in South America have been described by Harris and Davenport (1992). Harris and Tiemann (1993) recorded the distribution for the *canixa* species group, which are distinguished on the basis of features of the ninth abdominal segment, including the thin bifid process on the posterolateral margin. The purpose of this paper is to describe another member of the *canixa* group and another species, probably belonging to the *anahua* group; both collected in the tropical rain forest near the Gulf of Mexico coast in Veracruz.

The terminology utilized here follows that of Marshall (1979). The holotypes will be deposited at the Colección Nacional de Insectos Instituto de Biología, UNAM (CNIN).

Neotrichia tuxtla, NEW SPECIES

Figs. 1-4

On the basis of the genitalia in ventral view, *Neotrichia tuxtla*, new species, is similar to *N. anahua* (Mosely). However, *N. tuxtla*, new species, differs from *N. anahua* in the rectangular shape of the inferior appendages which have the apex oblique in lateral view, the base slightly wider than the rounded apex in ventral view and the smooth apical margins of the bracteole in lateral view.

ADULT ♂: Length 1.5-1.8 mm. Color in alcohol stramineous.

Male genitalia: Ninth segment in ventral and lateral view anteriorly produced into a long

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process. Tenth tergum membranous appears to be fused to ninth dorsally, apical margin quadrate, apex with ventrolateral angles rounded in lateral aspect. Bracteole in lateral aspect ovate, apical margin evenly rounded, with a short, narrow stem; finger-like in ventral view. Inferior appendages in lateral view rectangular, with apex oblique and slightly rounded; in ventral view with the base slightly wider than the rounded apex, from dorsal surface, a pair of internal processes with truncate apex bearing a single bristle. Subgenital plate in ventral view a broad plate, apical margin truncate with a pair of lateral bristles; centrally produced in a short, downward directed process with apex bifurcate; in lateral view the central process appears bent downward with apex rounded. Phallus wide basally, tubular distally with a pair of heavy sclerotized spine-like processes; in lateral view preapical spine shortest and curved, longer spine almost straight; thin paramere encircling shaft at midlength.

Female: Unknown

Type material. - Holotype; ♂; MEXICO: Veracruz; Estación de Biología Tropical Los Tuxtlas, UNAM. Arroyo del Zoológico, 6. V. 1989, R. Barba (CNIN). Paratype with same data as holotype, 1 ♂ (CNIN).

Etymology: The species epithet, *tuxtla*, refers to the Los Tuxtlas region in Veracruz where the species was collected.

Remarks: This species was collected at an intermittent rivulet in the rain forest near the coast.

Neotrichia jarochita, NEW SPECIES

Figs. 5-8

In overall appearance the male genitalia of this species are similar to *Neotrichia juani* Harris & Tiemann and *N. malickyi* Harris. However, *N. jarochita*, new species, differs from them by having the inferior appendages narrow in ventral view with the inner process very thin and fused at midlength to a wider process.

ADULT ♂. Length 1.5mm. Color in alcohol stramineous.

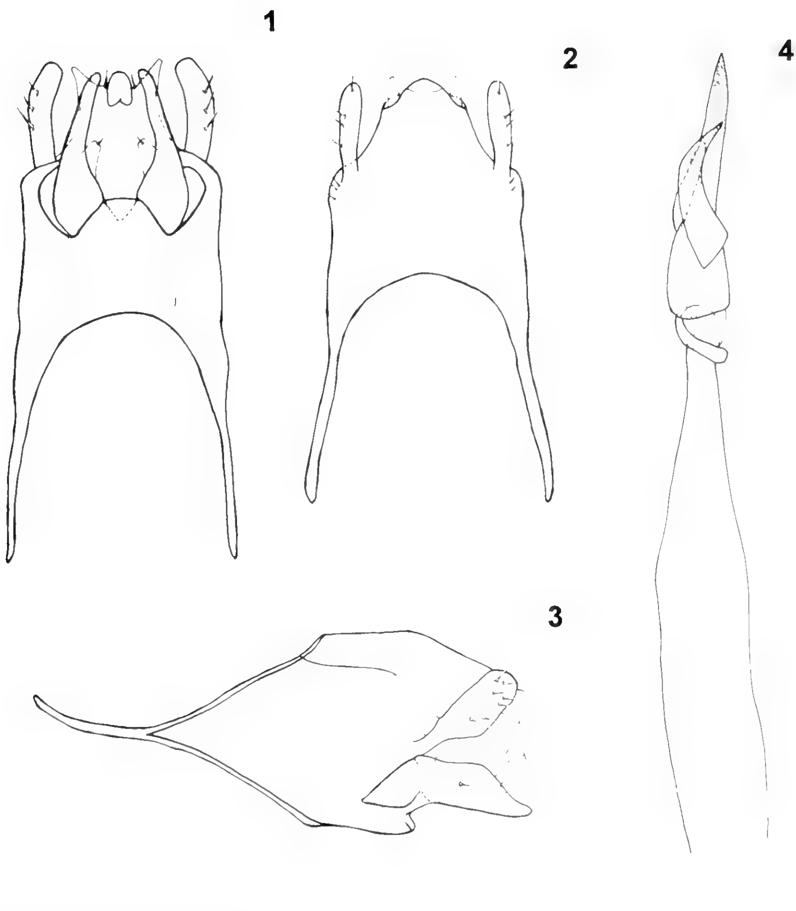
Male genitalia: Ninth segment in lateral view with anterior margin rounded, bracteola from posteroventral margin developed into a forked process, with dorsal arm thinner than ventral one; in ventral view posterolateral processes elongate and straight, anterior margin emarginate; dorsally with a pair of small setiferous lobes. Tenth segment fused with ninth segment, tergum developed as a pair of curved horn-like processses, sclerotized and distally acuminate. Inferior appendages bifid in lateral view, thin and narrowing distally; in ventral view bifid, with inner process thin and fused at midlength to a wider curved process. Subgenital plate a thin shelf in lateral view, curving ventrad to acute apex; in ventral view rectangular, with short mesal projection. Phallus wide basally, tubular distally, pair of sharply bent processes at apex, lower process curving downward; thin paramere encircling shaft at narrow midlength.

Female: Unknown.

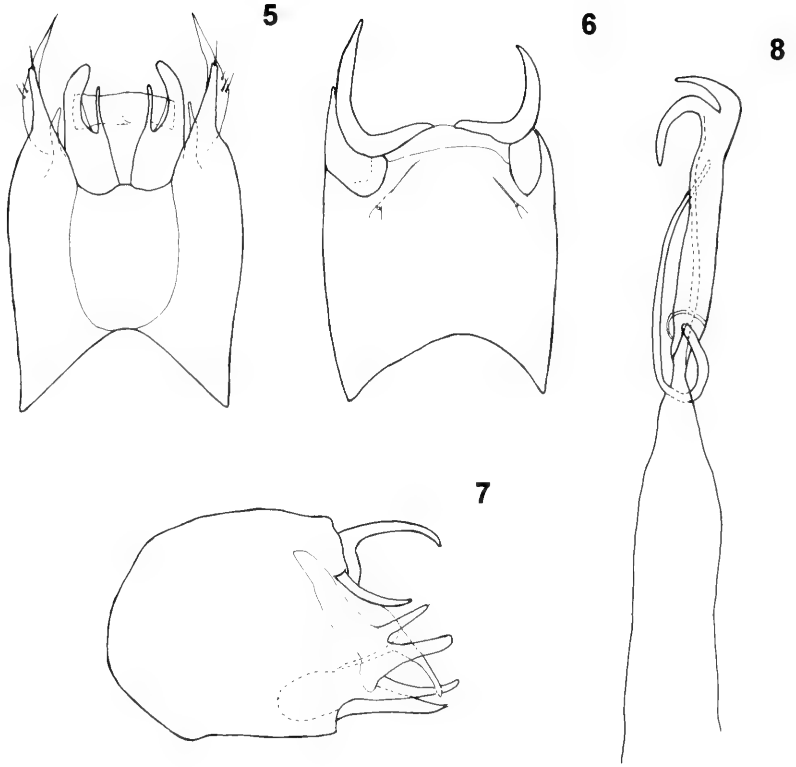
Type Material:. Holotype,♂. MEXICO: Veracruz: Estación de Biología Tropical Los Tuxtlas, UNAM. Arroyo del Zoológico, 2.VIII.1989, R. Barba (CNIN). Paratypes with same data as holotype, 10 ♂ (CNIN); 7♂.(USNM)

Etymology: The species epithet, *jarochita*, is the feminine diminutive of the vernacular name given to peasants of the coast of Veracruz, Mexico.

Remarks: This species was collected in an intermittent rivulet in the rain forest near the coast.



Figs.- 1-4. *Neotrichia tuxtla*, New Species. Male genitalia. 1. Ventral view. 2. Dorsal view. 3. Lateral view. 4. Phallus dorsal view.



Figs.- 5-8. *Neotrichia jarochita*, New Species. Male genitalia. 5. Ventral view. 6. Dorsal view. 7. Lateral view. 8. Phallus dorsal view.

Oxyethira hilosa Holzenthal & Harris

Holzenthal and Harris (1992) described this species from Costa Rica. In Mexico, this species was collected in a small clean water stream, near a lowland forest spring. Material studied: one ♂. MEXICO: Veracruz, San José del Carmen, Mpio. Agua Dulce Balneario San Antonio, 17°52'.291 N; 94°05'.042 W, el. 200 m, 11 June 1997, J Bueno, R. Barba (CNIN).

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STUDIES IN AQUATIC INSECTS XVI:TWO NEW SPECIES OF THE MICROCADDISFLY GENUS *MEJICANOTRICHIA* (TRICHOPTERA: HYDROPTILIDAE) FROM MEXICO, WITH A KEY TO THE SPECIES IN THE GENUS[1]

Joaquín Bueno-Soria, Rafael Barba-Alvarez[2]

ABSTRACT: The recently erected Mexican and Guatemalan microcaddisfly genus *Mejicanotrichia* contains five previously described species. In this paper, *M. harrisi* and *M. rara*, new species from Guerrero, Mexico, are described and their male genitalia illustrated. A key for adult males of all seven currently known species of *Mejicanotrichia* is included, with addition of new characters for the separation of *M. harrisi* and *M. rara*.

The genus *Mejicanotrichia* was erected by Harris and Holzenthal (1997) for species of the *Alisotrichia blantoni* species group (sensu Flint 1970) and for one species new to science.

With the exception of *Mejicanotrichia trifida* described from Guatemala, Dept. Izabal, the species described for the genus have been collected in Mexico: *M. estaquillosa*, Nuevo León; *M. blantoni*, San Luis Potosí; *M. tamaza*, Oaxaca; *M. tridentata*, Chiapas; *M. rara*, new species, Guerrero; and *M. harrisi*, new species, from Guerrero, México.

Individuals of the species we describe here lack the forewing modifications of *Mejicanotrichia* males mentioned by Harris and Holzenthal. However, other characters in the specimens studied, such as the presence of three ocelli, unmodified antennae, 0-2-4 tibial spurs, and the median notch on the ninth sternum are considered by us as strong characters supporting the inclusion of these two new species within *Mejicanotrichia*.

Morphological terminology used in the description follows that of Marshall (1979). Types and paratypes are deposited in the Colección Nacional de Insectos del Instituto de Biología, Universidad Nacional Autónoma de México. (CNIN) and National Museum of Natural History (NMNH).

Mejicanotrichia rara, Bueno & Barba, NEW SPECIES

Figs. 1-4

Mejicanotrichia rara, new species, appears to be related to *M. trifida* because the phallus bears apically a pair of lobules and subapically a pair of lateral spines. However, *M. rara* can be distinguished by the presence of an elon-

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gate sternal process on abdominal segment VII, and by the wider notch on the ventral portion of segment IX.

ADULT: Length of forewings 1.3 mm. Color in alcohol fuscous. Abdominal segment VII with an elongate sternal process. Segment VIII subdivided, ventral portion in lateral view slightly ellipsoid with posterior border rounded, anterior border straight; in dorsal view rectangular with fringe of elongate setae; in ventral view with posterior fringe of elongate setae.

Male genitalia: Segment IX in lateral view dorsoventrally compressed, narrowing dorsally; posteroventrally with short rounded projection; elongate sclerotized process directed ventrally, narrowing distally and curved ventrad; in ventral view posterior border with wide mesal excision, lateral margins of excision rectangular, laterally with elongate processes from dorsal margin, processes with elongate tips bending mesad; in dorsal view emarginated posteriorly. Tenth tergum an ellipsoidal membranous lobe with thin sclerotized bands laterally. Inferior appendages and subgenital plate absent. Phallus in ventral view constricted subbasally; mesally with a pair of stout, short spines; anteriorly subdivided into two elongate processes, each one with a subapically internal long and thin spine-like sclerite; ejaculatory duct long and threadlike.

Female: Unknown

Type material: Holotype: ♂, MEXICO: Guerrero: Municipio de Taxco, Teusisapan, Río Temascalapa. 18° 25.083' N: 99° 41.490' W, 1056 m, 28-II-1995, R. Barba and A. Rojas (CNIN). Paratypes: Same location as holotype but, 18° 25.56N: 99° 42.5W, 930m, 12- X-1994, R. Barba and D. Ocaña, 1 ♂, (CNIN); Same location as holotype but 21-X-1995, R. Barba and D. Ocaña, 1 ♂, (CNIN).

Etymology: The species epithet, *rara*, is the Spanish for feminine of rare or uncommon.

Mejicanotrichia harrisi, Bueno & Barba, NEW SPECIES

Figs. 5-8

Mejicanotrichia harrisi, new species, is similar to *M. tamaza* (Flint) by the presence of a pair of elongate lateroventral processes of the phallus. However, this new species can be easily recognized by the presence of two short, hook-like sclerites, situated subapically in the phallus, visible in both ventral and dorsal views.

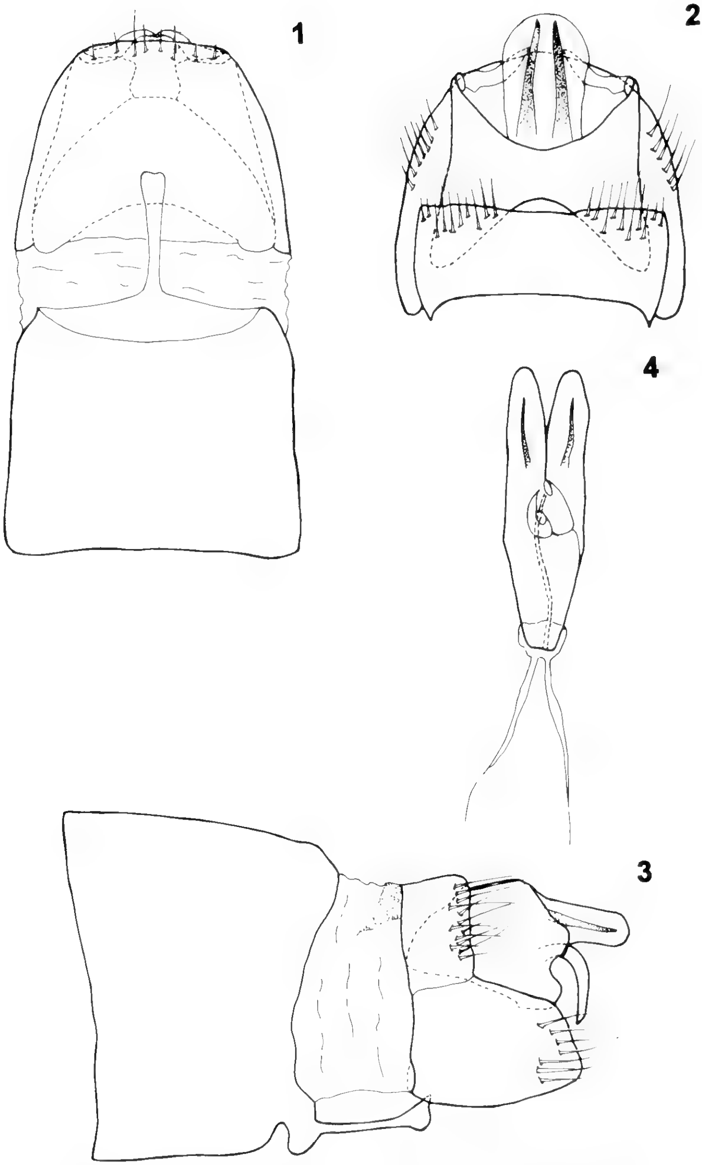
ADULT: Length of forewings 2 mm. Color in alcohol fuscous. Abdominal segment VII without sternal process. Segment VIII elongate posteroventrally, emarginated ventrally along posterior margin.

Male genitalia: Segment IX in lateral view, dorsoventrally compressed, narrowing dorsally, posteroventrally with triangular projection, elongate sclerotized process posteromesally, narrowing distally and curved ventrad; in ventral view with deep mesal excision on posterior border, lateral margins of excision rectangular; laterally with rounded plate bearing elongate processes from dorsal margin, processes with elongate tips bending mesad; in dorsal view deeply emarginated on posterior margin with fringe of elongate setae. Tergum X ellipsoidal membranous lobe. Inferior appendages and subgenital plate absent. Phallus in ventral view constricted subbasally; mesally with two pairs of short spines; apex with pair of elongate, sclerotized and straight lateral processes, with a membranous elongate, rectangular, mesal process, with truncate apex.

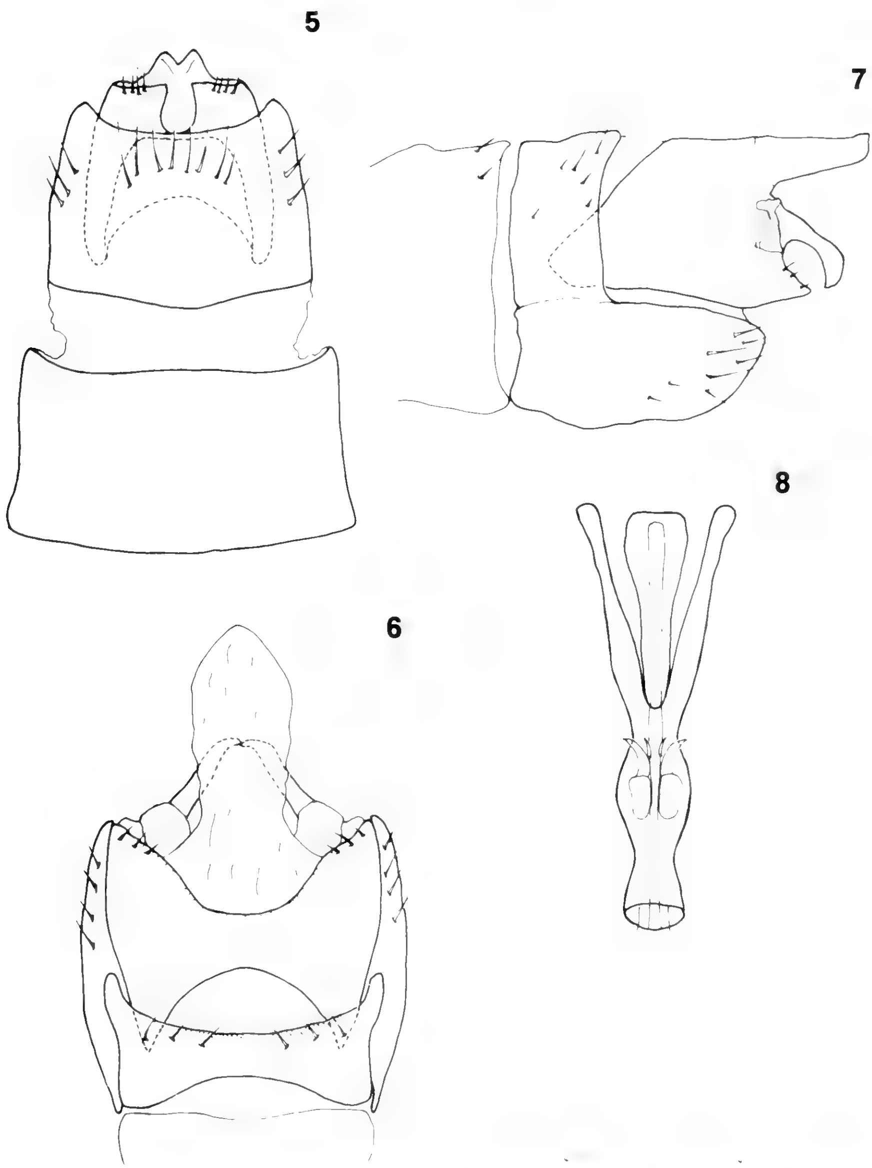
Female: Unknown

Type Material: Holotype. ♂: MEXICO: Guerrero: Municipio de Taxco, Teusisapan, Río Temascalapa, 18° 25.083' N: 99° 41.490' W 1056 m, 12-X-1994, R. Barba and D. Ocaña (CNIN). Paratypes.- Same location as holotype, but 12-X.-1994 1♂ (CNIN); 28-I-1995, R. Barba and R. Gaviño, 3 ♂ (CNIN); same but 28-II-1995 R. Barba and A. Rojas 5, ♂ (NMNH); same but 27-V-1995, R. Barba and D. Ocaña 7♂ (CNIN); same but 24-VI-1995, R. Barba 7♂ (CNIN).

Etymology: We dedicate this species to our colleague, Dr. Steve Harris, for his contributions to the knowledge of the Neotropical caddisfly fauna.



Figs.- 1-4. *Mejicanotrichia rara*, new species.1-4. Male genitalia. 1. Ventral view. 2. Dorsal view. 3. Lateral view. 4. Phallus dorsal view.



Figs.- 5-8. *Mejicanotrichia harrisi*, new species. 5-8. Male genitalia. 5. Ventral view. 6. Dorsal view. 7. Lateral view. 8. Phallus dorsal view.

Key to adult males of *Mejicanotrichia*

1. Phallus with apical or subapical spines. 2
   Phallus without apical or subapical spines (Fig. 8) .... *M. harrisi new species*

2. - Phallus with three pairs of spines apically (Harris and Holzenthal 1997, figs.10 D, E) ... 3
   Phallus with two pairs or less of apically or subapically spines (Harris and Holzenthal 1997, figs. 8. D, E) 4

3. Phallus apically with three pairs of elongate lateral spines and central spine (Harris and Holzenthal 1997, fig. 10 D, E) .... *M. estaquillosa*
   Phallus apically with three pair of short spines and a pair of short lateral spines subapically (Harris and Holzenthal 1997, fig. 3 D, E). .... *M. blantoni*

4. Phallus apically with two pairs of elongate spines 5
   Phallus apically without spines (Harris and Holzenthal 1997, figs. 6. D, E), (Fig. 8) 6

5. Phallus apically with a pair of elongate, weak spines laterally, pair of thin spines mesally and subapically with a pair of spicule bearing sclerites (Harris and Holzenthal 1997, figs. 5. D, E) .... *M tamaza;*
   Phallus apically with two pair of elongate spines, without subapically pair of spicule bearing sclerites (Harris and Holzenthal 1997, figs. 8. D, E) .... *M. tridentata*

6. Phallus subapically with a pair of lateral spines, with ejaculatory duct emerging between spines (Harris and Holzenthal 1997, fig.6. E) .... *M. trifida*
   Phallus subapically with a pair of thin, elongate spines laterally, without ejaculatory duct emerging between spines (Fig. 4) .... *M. rara*

DISCUSSION

The new species were collected at a permanent mountain stream, north of the basin of the large Balsas River, with vegetation typical of a deciduous tropical forest (Rzedowsky 1986). The climate for this area is hot and dry most of the year, with a rainy season from June throughout September.

ACKNOWLEDGMENTS

We thank P. J. Spangler (NMNH), Atilano Contreras-Ramos, and Harry Brailovsky (IBUNAM), for revisions and suggestions to the manuscript and to the anonymous reviewers, for their time and effort to improve the manuscript

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SCIENTIFIC NOTE

OESTROPHASIA CLAUSA (DIPTERA: TACHINIDAE), A PARASITE OF ADULT *DIPLOTAXIS MOERENS* (COLEOPTERA: SCARABAEIDAE)[1]

Hayward G. Spangler[2], John F. Burger[3]

Very little host information has been published for tachinid flies in the tribe Oestrophasiini in North America. Guimarães (1971) erected the tribe Oestrophasiini for 4 genera, 2 of which occurred in North America (*Cenosoma* van der Wulp and *Oestrophasia* Brauer & Bergenstamm). Wood (1987) subsequently synonymized *Cenosoma* in North America with *Oestrophasia*. This tribe now contains only the genus *Oestrophasia* in North America, with 4 species described.

Guimarães (1971, 1977) cited one record of *Cenosoma signiferum* van der Wulp parasitizing *Colaspis pini* Barber (Coleoptera: Chrysomelidae) in Louisiana, and indicated that it was the only host record for the entire tribe in the Nearctic Region. There are no host records cited for Oestrophasiini by Arnaud (1978). Townsend (1936) stated that tachinids in the genus *Oestrophasia* place their eggs, each containing a fully developed maggot, on the host food plant so that it will be swallowed by the host. However, it seems more likely that the female fly oviposits on the host food plant, and the larva waits for a host after hatching from the egg.

The only other known host record for an oestrophasiine tachinid is a single adult *Euoestrophasia aperta* Brauer & Bergenstamm reared from an adult *Listroderes* sp. weevil (Curculionidae) in Argentina (Parker et al., 1950).

Relatively little information seems to be available for tachinid flies attacking adult Scarabaeidae in North America. Most records are from larvae, most notably *Phyllophaga* Harris (Arnaud, 1978). There are no published records of tachinid flies attacking larval or adult scarab beetles of the genus *Diplotaxis* Kirby, a genus with about 180 species occurring in North and Central America (Vaurie, 1958).

We report here the first record of a host for *Oestrophasia clausa* Brauer & Bergenstamm in North America, and the first record of a tachinid fly attacking the scarab genus *Diplotaxis*.

A *Diplotaxis moerens* LeConte adult was collected by HGS on May 5, 1996, from Tucson, Arizona. It was confined in a 5 dram plastic vial and placed in an office environment for daily observation (temp. 22° - 24°C). On May 9, the beetle had died and a fly puparium lay next to it in the vial. On May 28, an adult female of *Oestrophasia clausa* had emerged from the puparium. The specimen was sent to JFB for identification. Because no adequate description of the species or a key to species of North American *Oestrophasia* was available to us at the time, the specimen was sent to D. M. Wood, Ottawa, Canada, who identified it as *O. clausa*. This species has a relatively wide distribution in the western United States, from Idaho to California, south to Arizona and New Mexico.

Both host and parasite are deposited in the insect collection of the University of Arizona, Tucson.

ACKNOWLEDGMENTS

We thank D. M. Wood, Ottawa, Canada for identifying *Oestrophasia clausa*, Carl Olson, Department of Entomology, University of Arizona, Tucson for identifying the specimen of *Diplotaxis moerens*, and J. E. O'Hara, Eastern Cereal and Oilseed Research Centre, Ottawa, Canada, for information and references on the classification of *Oestrophasia*.

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Fasc. 61. TINEODIDAE. J.B. Heppner
Fasc. 93. HEDYLIDAE. M.J. Scoble

MATING BEHAVIOR OF *PLATYNEUROMUS* (MEGALOPTERA: CORYDALIDAE), WITH LIFE HISTORY NOTES ON DOBSONFLIES FROM MEXICO AND COSTA RICA[1]

Atilano Contreras-Ramos[2]

ABSTRACT: This paper provides observations on mating behavior, oviposition, pupation, and adult life span of *Platyneuromus* from northeastern Mexico, as well as on larval habitats of *Chloronia*, *Corydalus*, and *Platyneuromus* recorded in Mexico and Costa Rica. *Platyneuromus*' mating behavior differed from that of *Corydalus* in that males only displayed threatening positions but did not fight. Further, they did not rest their mandibles over female's body after mating but softly bit and touched female's wings and abdomen with their mandibles. *Platyneuromus* larvae in northeastern Mexico appear to prefer higher elevation streams and a narrower spectrum of ecological conditions than *Corydalus*. Currently stable New World dobsonfly taxonomy should facilitate research on the largely unstudied life history traits of Neotropical taxa.

Three genera of dobsonflies (Corydalidae: Corydalinae) occur in the New World: *Chloronia*, *Corydalus*, and *Platyneuromus*. Relatively recent taxonomic revisions (Penny and Flint 1982, Glorioso and Flint 1984, Contreras-Ramos 1995, 1998) now facilitate studies on subjects such as description of immature stages, larval habitat and habits, voltinism, secondary production, mating behavior, and more.

Adult morphological variation, distribution, time of emergence, and co-occurrence of *Platyneuromus* species were treated by Glorioso and Flint (1984). However, this paper presents the first observations of eggs, larval habitat, mating behavior, and adult life span of any species in the genus. General information on larval habitat and coexistence of dobsonfly species in other localities of Mexico and Costa Rica are included as well. Most observations were recorded during a taxonomic study on the immature stages of *Platyneuromus* in northeastern Mexico (Nuevo León), during the summers of 1988 and 1989. Descriptions of the immature stages and detailed locality records are being published elsewhere (Contreras-Ramos and Harris 1998).

MATERIALS AND METHODS

Study Sites. Life history observations of *Platyneuromus soror* (Hagen) were recorded during a taxonomic project (Contreras-Ramos and Harris 1998) in the area of Santiago (south from Monterrey), Nuevo León, northeastern Mexico. Field work was done especially at a site known as Potrero Redondo (25.258° N, 100.160° W, elevation approximately 1400 m a.s.l.), within an oak-pine forest

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in the Sierra Madre Oriental (Figs. 1, 2). Several adults were reared in Monterrey (from prepupae collected at Potrero Redondo) and additional observations of mating behavior were obtained from these specimens. Localities in Mexico and Costa Rica, where larval habitat of *Corydalus* and *Chloronia* were recorded, are mentioned below.

Rearing and Observations of Mating Behavior. Seven pitfall traps were set up on the stream banks (cf. Azam and Anderson 1969) for collection of *Platyneuromus* larvae leaving the water to pupate. No larvae were captured by the traps in a 5 day period (June 23–28, 1988). Nonetheless, prepupae and pupae were collected from chambers under stones and rocks along the stream margins. No attempt was made to rear *Platyneuromus* larvae, but several adults were obtained from prepupae and pupae. Plastic containers (250 cc) with perforated caps were filled with soil from the stream banks. Prepupae were placed in a furrow made in the soil within the containers and covered with a flat stone. Soon new chambers were built by the prepupae. Containers were inspected daily to record time of pupation and emergence. Mature larvae occasionally can be induced to pupate by transferring them to a soil container. I have successfully reared adult *Nigronia* and *Corydalus* in this fashion. However, some larvae do not pupate and eventually die after a few weeks. Adults of both sexes of *Platyneuromus*, either collected with blacklight or reared, were allowed to

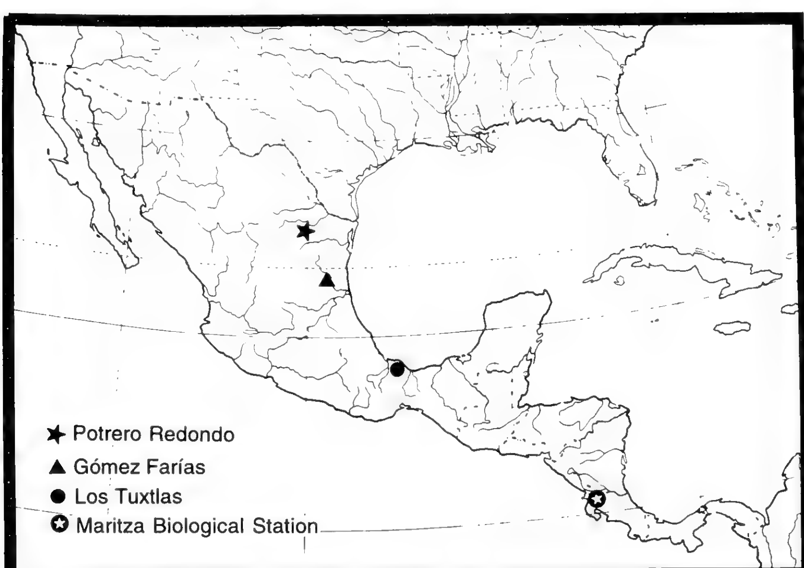

Fig. 1. Location of some study sites where life history observations were recorded.

Figs. 2–5. Some study sites where life history observations were recorded: 2 — Potrero Redondo (Santiago, Nuevo León); 3 — Las Adjuntas (Santiago, Nuevo León); 4 — La Poza Azul (Gómez Farías, Tamaulipas); 5 — Río Máquinas (Los Tuxtlas, Veracruz).

mate. In the field, adults were placed in a terrarium measuring approximately 76 x 30 x 30 cm. For simulating natural conditions, the terrarium bottom was covered with moss and liverworts and a couple of twigs were placed from bottom to sides. The terrarium top was covered with a finely meshed screen. Red light was used for illumination (Evans 1972), because other colors are disturbing to these insects (e.g., white and blue). Recorded times of activity are in local time. After mating and egg masses being laid, a small container with stream water was placed under them for capturing first instars upon hatching. One mature egg mass was preserved in 80% ethanol.

Biological and Ecological Observations. Throughout the study, observations on habitat, co-occurrence of megalopteran genera, and duration of life stages were recorded. Hellgrammites were collected from streams by disturbing substrates such as vegetation, rocks, and leaf packs, or from under bark of submerged logs. Standard aquatic nets, enamel pans, and forceps were used for capturing and sorting the larvae. Acid alcohol (9 parts 80% ethanol, 1 part glacial acetic acid; modified from Stehr 1987) served as the killing agent. Within a few hours from collection, larvae (length ≥ 20 mm), as well as prepupae and pupae were injected orally with the same acid alcohol solution in which they were kept. After approximately 24 hours specimens were transferred to 80% ethanol for final storage. Surgical gloves were used for handling specimens fixed with acid alcohol.

RESULTS AND DISCUSSION

Mating Behavior. Two females and two males collected with blacklight on June 24, 1988, were placed in a terrarium to observe their courtship and mating. Adults became active at dusk. Mating attempts were observed but copulation was not accomplished during the observation period. At about 2145 hours the following day (June 25), copulation occurred. Courtship began when the male held his wings straight and flat with the abdomen tip directed upright and the tenth tergites standing over the level of the wings ("arrogant" display posture). The male also fluttered his wings at short intervals (with no abdominal vibration). Following this display the female bent her abdomen forward by her left side, as the male did but in the opposite direction. Copulation was performed on the moss and liverworts (terrarium floor) and lasted about 30 seconds. At 0400 hours on June 26, the adults became inactive and two egg masses had been laid (cf. "eggs" below). Later, the first pair of males were replaced and two females were added. The adults became active around 1945 hours (June 26), just prior to sunset. At 2037 hours one copulation took place, after which the female proceeded immediately to drink water from the liverworts. The male briefly rubbed the female's wings with his mandibles (about 2 minutes), and her antennae with his antennae, perhaps as a mate guarding behavior. Then, he moved away. No additional direct contact was observed. Occasionally and apparently unconnected with mating, females were observed to flutter their wings without flying, moving the abdomen up and down quickly. Eventually, they would fly and hit the terrarium walls.

Mating behavior of adults reared from prepupae was also observed on July 3 and 5 in Monterrey (see "eggs" below). The first day, one of three males attempted to mate with the only female for a period of about 10 minutes. He followed the female continually, walking ventral side up on the screen covering the terrarium, attempting copulation constantly. At times, the female stopped and the male touched her abdomen (tip and middle) with his mandibles and antennae, also softly biting her wings. The male attempted copulation by bending his abdomen forward at either side, trying to grasp the female's abdomen with his tenth tergites. Every time the male's tenth tergites slid toward the tip of the female abdomen, contact was lost, so copulation did not occur. Wing fluttering behavior of the male was not observed during this pairing. On the second day, at about 0120 hours, one male displayed the wing fluttering behavior while walking on the screen covering the terrarium followed by several attempts to mate with the only female. A few minutes later, two males faced each other climbing a twig. They remained for a few seconds with their mandibles open in threatening position, but they did not fight.

During the observations a strong smell prevailed in the room. This smell, rather foul, was also evident in the alcohol in which males were preserved. This phenomenon has been reported previously for males of *Corydalus* and *Orohermes* (Evans 1972). Possibly, the membranous foldings behind the ninth sternum of males might be glandular and serve as scent glands. Internal, posterolateral pregenital sacs (on the eighth abdominal segment) in *Platyneuromus* and some *Corydalus* may have a similar function. Female *Chloronia*, *Platyneuromus*, and several phylogenetically basal *Corydalus* have an abdominal pouch posteroventrally on the 6th segment. The pouch's function is unknown. It appears to be eversible, as observed in some alcohol preserved specimens, and it might also be glandular. However, oberved female dobsonflies did not have a strong smell associated with them.

From these observations, it seems that the more active role during mating is performed by the male, who pursues the female while attempting copulation. A striking feature I observed, which suggests a discrete precopulatory courtship, was the male's behavior of keeping the wings straight, fluttering them intermittently, and holding the terminalia upright above the level of the wings (Fig. 6). A similar pattern was reported by Evans (1972: 80) for *Corydalus texanus* (as *C. cognatus*): "...the male became active, fluttering his wings and walking about with his abdomen held off the substrate..." However, Evans' description does not clearly indicate if the male's terminalia were held above the level of the wings. The precopulatory behavior mentioned by Evans (1972: 80) for *C. cornutus* and *C. texanus* consists "...of [1] touching their antennae in a head-to-head position, followed by [2] the male sometimes placing his head across the female's wings..." Parfin (1952: 430) described the second pattern in *Corydalus*

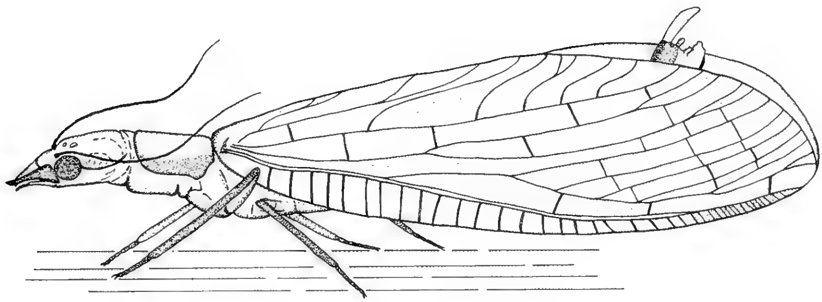

Fig. 6. Male *Platyneuromus soror* in pursuing behavior with genitalia upright.

cornutus: "...the male...placed his mandibles over the wings of the female and the two remained in that position during the next hour..." I observed the first behavior (head-to-head position) one time in *Platyneuromus*, but the males never rested their head on the female's wings. Such possibly mate-guarding behavior, presumably serving to assure paternal investment (Henry 1997), was not strictly observed in *Platyneuromus*, but I did observe a male that stayed with the female for a brief period after mating (about 2 minutes). Both Evans and Parfin observed mating of *Corydalus* to occur only on vertical surfaces. By comparison, I observed males of *Platyneuromus* attempt copulation on the bottom of the terrarium, ventral side up on the screen covering the terrarium, and on the twigs set diagonally inside the terrarium. Although large, gelatinous spermatophores have been reported to be attached externally to the female dobsonfly genitalia (Hayashi 1992, 1993), I did not observe this phenomenon here. Such behavior, probably overlooked, is most likely part of mating in *Platyneuromus*.

Mating behavior of Neotropical dobsonflies is poorly known. I suggest that detailed comparative studies of mating behavior should help unravel patterns across species and genera. In turn, such patterns may prove to be useful sources of characters for phylogenetic hypotheses.

Eggs. At Potrero Redondo, *P. soror* adults were collected with blacklight on June 24, 1988, and allowed to mate in a terrarium. The mean ambient temperature range was 18.3–23.3°C. Two days later, at approximately 0100 hours, two egg masses were laid. One of the egg masses was glued to the glass wall of the terrarium, the other to the sealant between the walls. The egg mass on the glass measured approximately 12 x 13 mm. Both egg masses were round, slightly convex, chalky white, and similar to those of *Corydalus* as described by Baker and Neunzig (1968), and to several others observed from Alabama and Mexico. The terrarium was then transported to Monterrey, Nuevo León, where the remaining development period took place, at a mean temperature range of 30.3–

32.7°C (high with respect to natural habitat conditions). Both egg masses hatched 16 days after being laid. A third, irregular (elongate) egg mass was laid on July 3, 1988, and was preserved after 9 days. The larvae, inside the eggs, were almost completely developed.

The only eggs of *Platyneuromus* available to me for study were almost fully developed, and therefore, no attempt is made here to give a formal description. However, under dissecting microscope, the chorion appeared smooth and translucent; also, the egg shape was elongate, subcylindrical, with a micropylar process. Eggs were glued to each other by a cementing matrix. Egg shape and micropylar process were similar to those of *Corydalus* illustrated by Baker and Neunzig (1968).

Pupation. At Potrero Redondo, seven pitfall traps were placed along the stream banks on June 23, 1988. The traps were inspected daily for five days, but no prepupae were captured. However, during the same period 21 prepupae and six pupae were collected from under stones, approximately 15 larvae were collected from the stream (all immature), and nine adults were captured with a blacklight trap. Based on these collections, peak emergence appears be around the dates of collection and larval migration from the stream had already occurred. My observations agree with Glorioso and Flint (1984), who reported that the peak of abundance for *P. soror* seemed to fall between May and early July throughout its distributional range.

I found prepupae and pupae as far as 20 m from the stream with specimens being collected from the stream bank and onto a forested hillside. However, most of them were found close to the stream. Pupation sites far from the water also have been indicated for *Corydalus* (Howard 1908, Parfin 1952). I found both life stages under rocks or stones, ranging in size from 20–45 cm long. Pupation substrates varied from dry to very humid and from gravel or sand to compact silt.

Eight prepupae, all collected on June 23, were allowed to pupate in containers with soil. Time spent as prepupae ranged from one to three days in four specimens and five to seven days in three specimens. The prepupae first were maintained at field temperature for three days (cf. "eggs" above), but they were held at city temperature (cf. "eggs" above) for the remaining days. Time spent as pupae was eight days for six specimens and 7 days for one specimen. Four of the pupae requiring eight days spent one or two days at field temperature, and the remaining three pupae spent the entire pupation period at city temperature. Time as prepupa and pupa was not recorded for one specimen. Two more specimens had a pupation period of nine days, with the first three days at field temperature. Based on five observations I made in the field, it appears that adult emergence occurs early in the morning while still dark, as early as between midnight and 0200 hours. These observations indicate that the prepupal period is at least seven days, and that pupation lasts at least another eight to nine days. Because temperatures in the city were considerably higher, it is likely that both periods are longer under natural conditions. Studies under constant natural conditions are still necessary to determine actual duration of prepupal and pupal periods.

Adult Life Span. Of the nine adults collected with black light (cf. "eggs" above) and kept in captivity, one died after three days, four after four days, three after five days, and one after six days; the first three days under field temperature. One adult that emerged in the city lived four days. Three adults collected on August 6, 1989, lived for one week kept under air-conditioned temperature. Parfin (1952) reported an average longevity of eight days for both sexes of *Corydalus cornutus* in captivity. The actual life span of adult *Platyneuromus* in nature may be longer, with a shorter observed period caused by high temperatures and confinement conditions as inferred from damage on their wings and antennae.

While kept in the terrarium, adults of *Platyneuromus* were observed to drink readily from the water spread over the moss and liverworts. They drank also from small containers filled with a commercial sweet solution. Adults of *Corydalus* also have been reported to drink water (Parfin 1952).

Habitat. According to observations during adult collections of *Platyneuromus soror* in several parts of Mexico, it appears this species prefers clean, cool, well oxygenated permanent streams. Information gathered from museum specimens also suggests occurrence of this species, generally, at fairly high elevations (e.g., 610–2200 m, Glorioso and Flint 1984). *Corydalus*, on the other hand, seems to have a wider range of habitat conditions including warm, intermittent streams in arid zones, and habitats similar to those described above for *Platyneuromus*. Larvae of *Platyneuromus* were found mostly under rocks and stones in moderate to fast flowing riffles, but also in slow flowing water and on moss subjected to very fast current below falls. Hellgrammites were commonly captured with *Anacroneuria* (Plecoptera), *Leptonema* (Trichoptera), and several mayfly nymphs, among other groups.

Although larvae, pupae, and adults of only *Platyneuromus* have been collected at Potrero Redondo (altitude ca. 1400 m), both *Corydalus* and *Platyneuromus* co-occur in a nearby, also forested site (Las Adjuntas, Fig. 3) at a lower altitude (750 m). Further below, in the same general area (at about 500 m altitude), only *Corydalus luteus* has been collected, in streams with semiarid conditions. On May 13, 1989, I collected 23 larvae of *Platyneuromus* and five larvae of *Corydalus* from a stream at Las Adjuntas. These collections suggest a possible segregation of habitat based on altitudinal zonation. However, more evidence is required to document any ecological preferences (e.g., feeding habits), in sympatry and in allopatry, of species of both genera. Habitat selectivity has been documented for other dobsonfly species. For instance, *Chloronia hieroglyphica* is never found near large streams and rivers in northern Brazil (Penny and Flint 1982), and in Suriname, *Corydalus affinis* and *C. nubilus* appear to be confined to large open rivers, whereas *C. batesii* and *Chloronia hyeroglyphica* are confined to shadowed small bush creeks (Geijskes 1984).

***Corydalus luteus* Hagen**. On June 10, 1988, 26 larvae were collected from Arroyo Dolores, a small stream besides El Cercado, Municipio de Santiago, Nuevo León, Mexico (25.258° N, 100.142° W, elevation 475 m a.s.l.). The riparian trees were mainly *Taxodium mucronatum*, surrounded by shrubby vegetation within a semiarid environment. The stream was under drought conditions and was completely dry in some portions. Stream width was approximately 0.5 m where water was flowing, and only a few centimeters, or less deep. Numerous (tens) mature and immature larvae were found under rocks in humid soil on the stream bed; others were found in the short portions of the stream where water was flowing. In both cases, larvae were under crowded conditions.

For 10 days nine mature larvae were kept in an aquarium and fed raw hamburger. A pan with soil was placed on top of large stones so larvae could leave the water and crawl into the soil for pupation, as described by Smith (1970). Several larvae crawled into the pan with soil, but always returned to the water within minutes. The larvae were then transferred into bowls with soil, placed in furrows made with a finger, and covered with a flat stone. Only three larvae pupated taking 13–22 days for pupation to begin as evidenced by the excavation of pupal chambers. Pupation lasted for one week and the adults lived only two to four days at a mean temperature range of 32.6–33.1°C. Such high temperatures may have accounted for the rather short period of pupation, the very brief life of the adults, and for the minimal mating attempts that were observed. Two larvae that did not pupate died after 10 days of having been placed in soil. However, hellgrammites are capable of living out of the water (or in the water, without food) for long periods of time. One larva collected from Schultz Creek, Alabama, was kept alive in soil for over two months, eventually dying without pupating.

In northeastern Mexico, *C. luteus* larvae were collected from different microhabitats, such as fast flowing riffles in shallow streams, moss under fast current below falls, cobbles in fast flowing rivers (about 1 m deep), as well as under bark in slow flowing and deeper rivers (about 1 m deep or more). Also, *Corydalus* larvae seem to do well under both moderately polluted and disturbed habitats.

***Chloronia* spp.** On August 6, 1988, one male and seven females of *Chloronia mexicana* Stitz were collected with blacklight at the headwaters of the Río Frío (near "La Playita"), Ejido San Pablo, Municipio de Gómez Farías, Tamaulipas, Mexico. The following day, further downstream at a nearby site ("La Poza Azul", Fig. 4), three larvae of *C. mexicana* were collected. The river at this location was about 7 m wide, and about 2.5 m deep. The larvae were found on submerged logs in a depositional zone about 1 m deep and with almost no current. The substrate was silty and the water turbid. *Triplectides* (Leptoceridae) caddisfly cases with larvae and pupae were attached to the logs, as well as mayfly nymphs and elmid beetles. On the evening of May 18, 1989, in "La Playita" area, two *C.*

mexicana larvae were collected. One *Chloronia* larva was found with a *Corydalus* larva under the bark of a small piece of wood. The other larva was found also under bark in another small piece of wood. Two adult females of *C. mexicana* were collected with blacklight at this location. Collecting benthic invertebrates was difficult in those localities because of a considerable river depth and dense terrestrial and riparian vegetation. I suggest artificial substrates as an alternative method for hellgrammite collecting in such a habitat. The Gómez Farías area is the northernmost eastern limit of the genus *Chloronia*, with only *C. mexicana* being present.

On June 3, 1989, two larvae of *Chloronia* (species unidentified) were collected from Río La Palma, above La Palma, near the National University's Biological Station "Los Tuxtlas", Veracruz, Mexico. Larvae were found in a leaf pack, anchored to the roots of marginal vegetation in the riffle zone of the stream (about 4 m wide and 40 cm deep). *Corydalus* larvae were common in Río La Palma and other streams in the area (Fig. 5). However, despite intense efforts, no more *Chloronia* larvae were found. Dr. Oliver S. Flint, Jr. (personal communication) visited the area in 1981 and found several *Chloronia* larvae especially under larger rocks that were embedded in the substrate. The tropical forest in the area of "Los Tuxtlas" is being reduced drastically because of cattle introductions and human settlements. Decreasing riparian vegetation, as well as pollutants such as detergents, fertilizers, and pesticides, may be having a deleterious impact on benthic insect populations.

By comparison, during a visit in the summer of 1991 to the Maritza Biological Station in Guanacaste Conservation Area (Fig. 1), Costa Rica, I found *Chloronia* (adults and larvae) to be fairly common, collecting several of them from Río Tempisquito (10.958° N, 85.497° W, 550 m). Larvae (unidentified species) were found under rocks, in riffles, by disturbing the substrate and capturing them with a dip net. The Río Tempisquito watershed in Costa Rica appeared minimally disturbed in comparison with streams at Los Tuxtlas, Mexico, suggesting that *Chloronia* larvae might be sensitive to anthropogenic perturbations.

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ANNOUNCEMENT

EXOTIC INSECT PEST COMMITTEE SEEKS SUGGESTIONS

The Entomological Society of America has entered into a contract with the US Department of Agriculture to identify a list of potentially serious exotic insect pests to United States agriculture. The ESA selected a team to coordinate the review and draft a final report to be presented to USDA.

Species Suggestions are Being Sought Now

The committee is currently soliciting input from researchers, taxonomists, forest entomologists, crop specialists, and others with knowledge of specific exotic insect pests which could become pests in the United States. Forms to suggest exotic pest species for the committee's consideration may be obtained by calling Robert D. Waltz, Chair, 317-232-4120, or by emailing bwaltz@dnr.state.in.us or faxing requests to 317-232-2649.

For purposes of this initial call, an exotic insect pest is any species not currently known to occur in the United States but which, if established, could become a serious pest. The committee is seeking seriously to list and consider as many as possible exotic insect pests that could become established on crops in the United States. Your knowledge and suggestions are needed.

SCIENTIFIC NOTE

REINSTATEMENT OF TWO JUNIOR SECONDARY HOMONYMS IN THE FAMILY BAETIDAE (EPHEMEROPTERA)[1,2]

W. P. McCafferty[3]

McCafferty and Waltz (1990) transferred the North American species originally described as *Pseudocloeon parvulum* McDunnough to the genus *Baetis* Leach. Because the combination *Baetis parvulus* had already been used by Crass for a South African species, secondary homonymy was created, and McCafferty and Waltz (1990) renamed the North American species *Baetis armillatus*. McCafferty and Waltz (1990) also transferred the North American species originally described as *Pseudocloeon cingulatum* McDunnough to *Baetis*. Because the combination *Baetis cingulatus* had already been used by Stephens and McDunnough for other species in Europe and North America, respectively, secondary homonymy was created, and McCafferty and Waltz (1990) renamed the species *Baetis cinctutus* McCafferty and Waltz.

Lugo-Ortiz and McCafferty (1998) transferred both *Baetis armillatus and Baetis cinctutus* along with numerous other North American species to the genus *Plauditus* Lugo-Ortiz and McCafferty. Article 59 (d) of the International Code of Zoological Nomenclature indicates that a species-group name rejected after 1960 on grounds of junior secondary homonymy is to be reinstated if the two species-group taxa are no longer considered congeneric. Therefore the proper names for the species become *Plauditus parvulus* (McDunnough) [with *Baetis armillatus* McCafferty and Waltz becoming a junior objective synonym of it], and *Plauditus cingulatus* (McDunnough) [with *Baetis cinctutus* McCafferty and Waltz becoming a junior objective synonym of it]. Of course, these original epithets will remain with any possible future generic combination except *Baetis*.

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[2] Purdue Agricultural Research Journal No. 15930.

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TWO NEW SPECIES OF *AMBLYDERUS* (COLEOPTERA: ANTHICIDAE) FROM GREAT SAND DUNES NATIONAL MONUMENT, COLORADO[1]

Michael J. Weissmann, Boris C. Kondratieff[2]

ABSTRACT: Two new species of antlike flower beetles, *Amblyderus triplehorni*, n. sp., and *A. werneri*, n. sp. are described from Great Sand Dunes National Monument in south-central Colorado. Biological notes are included on the mating behavior and feeding by *A. triplehorni*.

The species of *Amblyderus* from North America have been treated by LeConte (1850, 1852) and Casey (1895), resulting in eight names. Werner (1975), however, recognized only four species, *A. granularis* (LeConte), *A. obesus* Casey, *A. pallens* (LeConte), and *A. parviceps* Casey.

Casey (1895) considered *Amblyderus* to be "one of the most characteristic elements of the seabeach population." While typically associated with sea beaches, some members of the genus are likely to be found in any areas where there are sand dunes in the interior of North America. Blatchley (1910) noted that *A. pallens* "occurs beneath rubbish on the sand beach and dunes of Lake Michigan, its hues so blending with those of the sand that the insects are scarcely visible until they move." *A. pallens* is known from a good number of inland dunes and sandy river bank sites, while *A. granularis* is well known from the Great Lakes beach areas, as well as a few seashore dune sites on the east coast of the United States (Chandler, personal communication).

Two new species of *Amblyderus* were collected at Great Sand Dunes National Monument, and were originally determined as undescribed by the late Floyd G. Werner. Donald S. Chandler, University of New Hampshire, will be revising the genus (personal communication), but encouraged us to describe the following two new species. In addition to these two new species, the widespread *A. pallens* (LeConte) occurs at the Monument, but was not recorded in Weissmann and Kondratieff (1999).

Great Sand Dunes National Monument consists of spectacular dunes pushed up against the Sangre de Cristo Mountains. The dune mass covers 101 km^2 on the east side of the San Luis Valley in Alamosa and Saguache Counties of south-central Colorado. These dunes tower more than 200 m above the valley floor (over 2400 m elevation). Two additional endemic Coleoptera species have been described from the Great Sand Dunes area: *Cicindela theatina* Rotger (Rotger 1944) and *Eleodes hirtipennis* Triplehorn (Triplehorn 1964).

The terminology of the descriptions follows Chandler (1997).

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Amblyderus triplehorni Weissmann and Kondratieff, NEW SPECIES

Figs. 1, 2

Description. Length 4.5 - 5.0 mm. **Head** triangular, wider than long; posterior-lateral angles rounded with base slightly impressed; eyes black, large, oval, and separated from base of head by a distance equal to nearly their own; integument dark brown posteriorly with lighter integument anteriorly; surface coarsly tuberculate over entire disc except for median smooth line that is broader at apex and nearly half as broad but still distinct at base; antennae nearly twice as long as head, with last antennomere conical, pubescent on distal 2/3. **Thorax** with prothorax distinctly wider than head at base, tapering evenly to base which is approx. 2/3 the width of the pronotal apex; disc of pronotum covered with tubercles, each of which is anterior to a corresponding decumbent seta arising from a puncture; anterior margin more finely tuberculate with longer, erect hairs extending toward the head both dorsally from the pronotum and ventrally from the prosternum; integument darker posteriodorsally and usually lighter anteriorly and ventrally, especially in females. **Elytra** suboval, nearly twice as long as wide, and 1/3 wider than the basal margin of the prothorax; sides slightly convex and widest in the anterior 1/3, posteriorly tapering slightly to a subtruncate to slightly sinuate apex that is medially slightly prolonged posteriorly; disc somewhat rugose, with decumbent short pubescence, with darker integument, usually lighter colored at the anterior corners and on the narrow humeri. **Legs** lighter colored than abdomen and elytra, often pale or even yellow; anterior tibiae of male only slightly sinuate on distal portion and clothed with long pubescence; tibial spurs slightly longer in the females than in the males. **Abdomen** dull with dark integument, covered with dense recumbent hairs; last 1-1/2 tergites extending beyond the apex of the elytra. Aedeagus with tegmen elongate, tapering to apex, rounded distally (Fig. 2).

Diagnosis. *Amblyderus triplehorni* can be easily distinguished from all other North American *Amblyderus* by its larger size (4.5-5.0 mm long) and tapered tegmen of the aedeagus (Fig. 2).

Discussion. Color is variable in *A. triplehorni*, but males are generally darker than females. Males usually have most of the head, pronotum, and abdomen darker, with lighter regions in the very anterior portions on each of these areas. The integument is darkest, often black, on the ventral abdomen, and lightest on the antennae, legs, ventral region of prothorax, and anterior portion of the head. Pubescence is white to silvery. Females are overall lighter in color, often with the head uniform in color and the ventral thorax light colored (dark in males). Some individuals are light tan throughout, giving the appearance of *A. pallens* but almost twice the size. Also, *A. pallens* lacks the dense erect hairs on the anterior margin of the prothorax, and the pygidium is not fully exposed dorsally.

Specimens Examined. Holotype: ♂ Colorado, Alamosa Co., Great Sand Dunes National Monument, 16-VII-1974, C.A., W.E., and B.W. Triplehorn (deposited at the USNM collection, Smithsonian). **Paratypes:** Colorado: 214 ♀♀, 135 ♂♂ same data as holotype (OSUC, UAIC, USNM, CSUC and UNHC); 9 ♀♀, 1 ♂ Great Sand Dunes, Dr. Lenczy 6 [June?] 1964 (UAIC and UNHC); 3 ♀♀, 1 ♂ Great Sand Dunes Nat'l. Monument, 25 mi. NE Alamosa, Alamosa Co., 8 June, 18 June, and 13 July 1983, T.P. Sluss (GRSA); 1 ♀ Saguache Co., Gr. Sand Dunes Nat. Mon., E. part of dune mass, 8200-8400', 6 Aug. 1990,

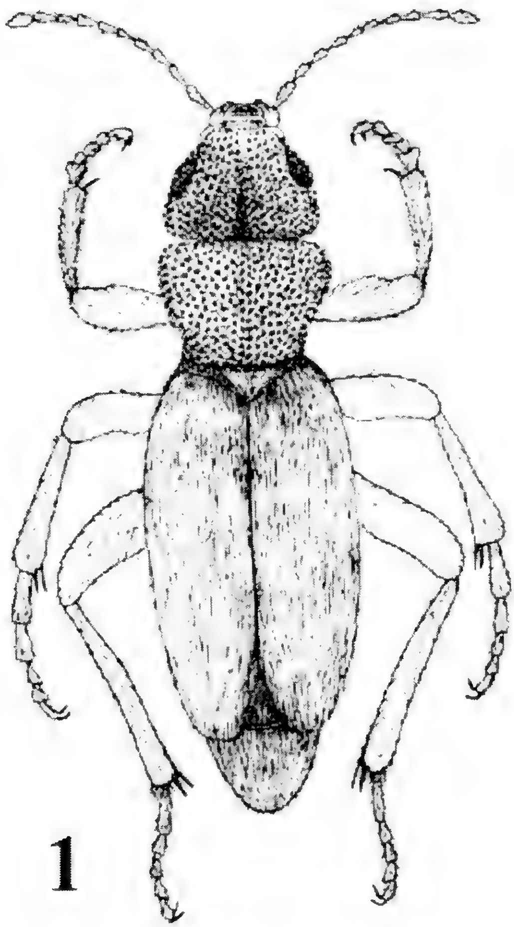
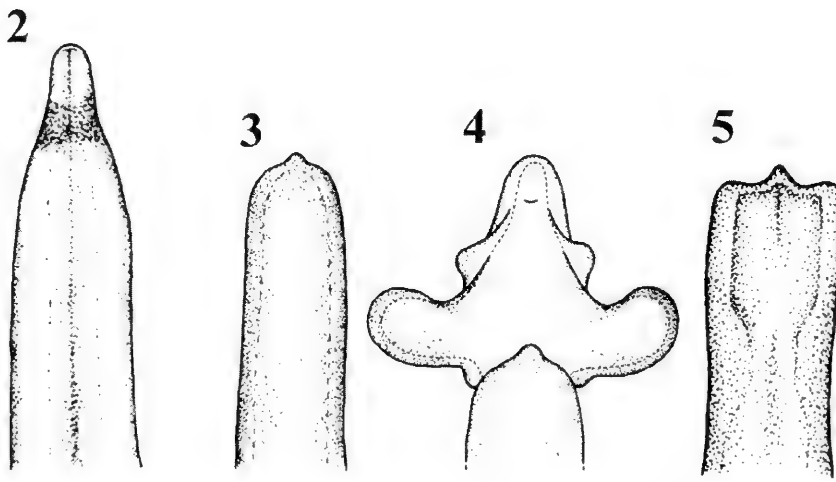


Fig. 1. Dorsal habitus of *Amblyderus triplehorni*.



Figs. 2 - 5. Dorsal view of tegmen of aedeagus. 2. *A. triplehorni*; 3. *A. werneri*; 4. *A. werneri*, extruded aedeagus; 5. *A. pallens*.

L. Clement & M. Weissmann, inside dead *Polyphylla* (CSUC); 5 œœ Saguache Co., Gr. Sand Dunes Nat. Mon., 7 June 1991, L. Clement, K. Darrow & M. Weissmann, on dune mass, 8200' (CSUC); 3 œœ Gt. Sand Dunes National Monument, 5 July 1958, Carol Whitney (CSUC). **Additional Records:** Colorado: 10 œœ Great Sand Dunes National Monument, Alamosa Co., IX-1-1974, D.S.Chandler.

Distribution. This species is currently known only from Great Sand Dunes National Monument, Alamosa and Saguache Counties, Colorado.

Biological and Collection Information. Individuals of *A. triplehorni* were observed between 5:00 and 7:30 pm on 8 July 1997 on the eastern dunes at Great Sand Dunes National Monument, approximately 1 km uphill from Medano Creek. They were encountered in large numbers in debris pockets on the south-east side of dunes (downwind), where bits of grass and dead insects are dropped by wind. Individuals would move rapidly across the dune surface in a circuitous pattern between wind gusts, scavenging for food and occasionally stopping to feed on a small dead insect (especially aphids) trapped in debris pockets by strong winds. During a strong wind gust, they would lie flat, thereby reducing their profile exposed to the wind. As the wind would pick up surrounding debris of live and dead material and blow it around, *A. triplehorni* would tend to remain immobile until the gust passed, and then would continue moving around.

As the wind died down, they would move up to the crest of the ridge and dozens to hundreds of individuals would be visible on just a few square meters of ridge. They would move around in seemingly random patterns, stopping at every dead insect part but only feeding on some—presumably skipping over parts that were too dessicated. One individual was observed to prefer tiny yellow cicadellids that were present in large numbers. Two methods of feeding were observed: 1) head down using the middle and hind legs to anchor the body with the forelegs and palps manipulating the food; and 2) turning over on the back and manipulating the food by using all six legs to rotate the food around and move it to the mouth. Occasionally one would catch and hold food with its mouth and forelegs and walk erradically posteriorly with it.

Mating pairs were observed and duration of copulation was variable, apparently interrupted by large wind gusts or the approach of another individual.

Etymology. This species is named in honor of Charles A. Triplehorn, Ohio State University, who, with W.A. and B.W. Triplehorn, collected the large type series from Great Sand Dunes National Monument in July, 1974.

Amblyderus werneri Weissmann and Kondratieff, NEW SPECIES

Figs. 3, 4

Description. Length 3.0 mm. **Head** very broadly triangular, nearly twice as wide as long; posterior-lateral angles rounded with base distinctly impressed; eyes large, oval, and separated from posterior margin of head by a distance nearly equal to their own length; integument light yellowish brown, sometimes darker posteriorly; surface indistinctly tuberculate over entire disc except for median smooth line; antennae nearly twice as long as head. **Thorax** with prothorax only slightly wider than head at base, tapering to base which is approx. 1/2 the width of apex; prothorax cylindrical near base; disc of pronotum covered with tubercles, each of which is anterior to a corresponding decumbent seta arising from a puncture; anterior margin more finely tuberculate with white to silvery erect hairs extending toward the head dorsally and with longer hairs extending laterally and ventrally from the prosternum; integument uniformly light yellowish brown. **Elytra** suboval, nearly twice as long as wide, and 1/3 wider than the basal margin of the prothorax; sides slightly convex and widest in the anterior 1/3, posteriorly tapering slightly to a subtruncate apex; disc somewhat rugose with decumbent short pubescence with darker integument, usually lighter colored at the anterior corners, on narrow humeri, and medially. **Legs** lighter colored than abdomen and elytra, often pale or even yellow; anterior tibiae of male only very slightly sinuate on distal portion; **Abdomen** dull with dark integument, covered with dense recumbent hairs; last tergite only slightly extending beyond the end of the elytra in most individuals, although fully exposed on some females. Aedeagus with tegmen broad and scoop-shaped with a nipple-like apex (Fig. 3). The extruded portion of the aedeagus with soft tissue as in Fig. 4.

Diagnosis. *Amblyderus werneri* is similar in size to the sympatric *A. pallens*, but darker in color, and the pygidium is visible dorsally. The aedeagus is similar to that of *A. pallens* (Fig. 5), except that the tegmen in *A. pallens* is broad with three distinct distal projections.

Discussion. The few specimens available are rather similar in size and coloration.

Specimens Examined. Holotype: ♂ Colorado, Saguache Co., Gr. Sand Dunes Nat. Mon., Sand Creek, 7900', T25S R73W Sec. 31, 12 July 1991, MV light, MJ Weissmann & LC Clement (deposited at the USNM collection, Smithsonian). **Paratypes:** Colorado: 2 ♀♀ same data as holotype (CSUC); 3 ♂♂, 4 ♀♀ Great Sand Dunes National Monument, 25 mi. NE Alamosa, Alamosa Co., 18 June 1983, T.P. Sluss (GRSA); 6 ♂♂, 6 ♀♀ Saguache Co., Baca Land Grant, 29 July 1997, in pitfall trap, P.M. Pineda (CSUC); 16 ♂♂, 25 ♀♀ Alamosa Co., Medano Ranch, Interdunal Wetland, 17-20 June 1998, in pitfall trap, P.M. Pineda & C. Cordova (OSUC, UAIC, USNM, CSUC and UNHC); 14 ♂♂, 7 ♀♀ Alamosa Co., Great Sand Dunes National Monument, Main Sand Mass, 23-25 (June?) 1998, P.M. Pineda (OSUC, UAIC, USNM, CSUC and UNHC).

Distribution. This species is currently known only from Great Sand Dunes National Monument, and surrounding similar habitats in Alamosa and Saguache Counties.

Biological and Collection Information. Three specimens were collected at a mercury vapor lamp on 12 July 1991. It is not clear whether they were actually attracted to the light or whether the placement of the light (on top of a dune peak) was on top of their night "roosting" location. These specimens were collected at the dunes on the far northwest portion of the dune mass along Sand Creek (Saguache County). It is unknown where in the monument the seven T.P. Sluss specimens (18 June 1983) were collected. Ten specimens of *A. pallens* were collected by Sluss with the same label data (GRSA). Pineda also collected 21 specimens of *A. pallens* on the Baca Land Grant (29 July 1997) in the same pitfall traps with *A. werneri*.

Etymology. This species is named in memory of Floyd G. Werner, University of Arizona, a prolific worker in the Anthicidae, who first determined that this species was undescribed.

ACKNOWLEDGMENTS

We would like to thank all who loaned us specimens, including Carl A. Olson, Dept. of Entomology, University of Arizona, Tucson, AZ (UAIC); the staff at Great Sand Dunes National Monument, Mosca, CO (GRSA), and Donald S. Chandler, Department of Zoology, University of New Hampshire, Durham, NH (UNHC). Additional specimens were collected for this study by Phyllis M. Pineda, Colorado Natural Heritage Program, Fort Collins, CO and have been deposited in the C.P. Gillette Entomological Museum at Colorado State University, Fort Collins, CO (CSUC). Donald Chandler and Charles A. Triplehorn, Museum of Biological Diversity, Ohio State University, Columbus, OH (OSUC) reviewed the manuscript and provided helpful suggestions. Illustrations were prepared by Lynn Bjork and Scott J. Fitzgerald, and Richard Cowan assisted with creating the plates.

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SOCIETY MEETING OF FEBRUARY 25, 1998

Dr. Jon Gelhaus
Biodiversity group, Academy of Natural Sciences, Philadelphia

Dr. Gelhaus discussed "Bug Hunting in Mongolia," in particular his entomological research at ancient lake Hovsgol Nuur. His slides illustrated the difficulties of travel in those remote areas as well as the impressive landscapes and remarkable insects. He emphasized in his talk the intense interest of the Mongolian scientists and their students in discovering and protecting their natural heritage.

Jon also reminded the audience of the hazards of fieldwork in areas far from the beaten track with an account of his almost-tragic injury sustained while playing softball. He was lucky that he could be adequately treated with the resources at hand.

He ended by pointing out that his studies have only begun and that there is a vast wealth of undiscovered entomological knowledge waiting in central Asia for those able to undertake such challenging expeditions.

William J. Cromartie,
Corresponding Secretary

FIRST RECORD OF THE PARASITOID *ARCHYTAS ATERRIMUS* (DIPTERA: TACHINIDAE) FROM *UTETHEISA ORNATRIX* (LEPIDOPTERA: ARCTIIDAE)[1]

V. K. Iyengar[2], C. Rossini[2], E. R. Hoebeke[3], W. E. Conner[4], T. Eisner[2]

ABSTRACT: A male of the tachinid fly, *Archytas aterrimus*, was noted to emerge from a pupa of *Utetheisa ornatrix*, an arctiid moth that sequesters pyrrolizidine alkaloids from its larval foodplants. Chemical analysis of the fly showed it to be free of pyrrolizidine alkaloids, indicating that it does not itself acquire the chemicals from its host. *A. aterrimus* is known to parasitize other lepidopteran species, including some that are also chemically protected.

A shipment that we received recently from Winston-Salem, North Carolina, of live, field-collected larvae of *Utetheisa ornatrix* (L.), included one larva that upon pupation gave rise to a single male of *Archytas aterrimus* (Robineau-Desvoidy) (Fig. 1). The tachinid had not formerly been reported from this host (Ravlin and Stehr 1984). *U. ornatrix* is a well protected insect. As a larva it feeds on plants of the genus *Crotalaria* (Fabaceae), which contain pyrrolizidine alkaloids. The larvae sequester these alkaloids, retain them into adulthood, and as adults transmit them in part to the eggs (Eisner and Meinwald 1995). All stages of *U. ornatrix* are protected as a result, the larvae and adults against spiders (Eisner and Eisner 1991, Eisner and Meinwald, 1995), the eggs against ants and ladybird beetles (Hare and Eisner 1993, Dussourd et al. 1988).

Development in a host that is chemically protected must be advantageous to a parasitoid, since the parasitoid is thereby itself protected against predation. One wonders whether *A. aterrimus* parasitizes *U. ornatrix* as a matter of routine, or whether it does so only under exceptional circumstances. Either way, it seems clear that the tachinid parasitizes other protected lepidopteran larvae as well. Its hosts include, for example, *Cerura* sp. and *Lochmaeus* (*Heterocampa*) *manteo* (Doubleday) (Ravlin and Stehr 1984), notodontid caterpillars that spray formic acid-containing secretions (Hintze 1969, Eisner et al. 1972), and *Cycnia tenera* Huebner (Ravlin and Stehr 1984), an aposematic arctiid larva that sequesters cardenolides from its foodplants (milkweeds) (Cohen and Brower 1983). It would be interesting to know whether *A. aterrimus* is in

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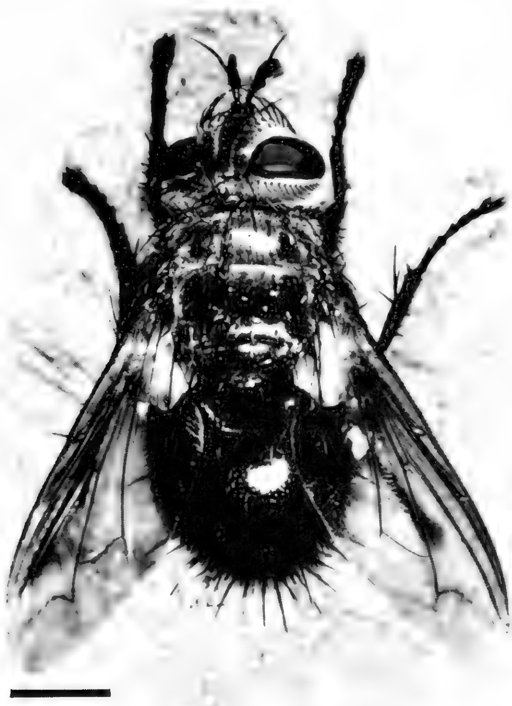

Fig. 1. The male of *A. aterrimus* that hatched from *U. ornatrix*, photographed live shortly after emergence. The specimen was triturated for chemical extraction and was therefore not preserved for voucher purposes. Bar = 2 mm.

some special way(s) adapted to seek out protected hosts and cope with their defenses. Even if so, however, the fly is known to parasitize a number of chemically unprotected lepidopterans as well (Ravlin and Stehr 1989).

To check whether *A. aterrimus* might itself incorporate some of the pyrrolizidine alkaloids from its host, we analyzed our single male for pyrrolizidine alkaloid content. To this end, the fly was extracted with phosphate buffer (pH = 3) and the extract analyzed by High Pressure Liquid Chromatography (C_{18} column, Keystone Sci. BDS Hypersil, 250 x 4.6 mm, 5 µm particle size, 120 Å phosphate acetonitrile 98:2). We found no detectable quantity of alkaloid in the fly (detection threshold=25 ng).

Note added in proof:

Since writing the above we have come upon a second specimen of *A. aterrimus* that emerged from a *U. ornatrix* pupa from Lake Placid, Highlands Co., FL. This fly also proved to lack detectable amounts of pyrrolizidine alkaloids.

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REILLUSTRATION OF *HYDROPTILA LLOGANAE*, WITH A NEW JUNIOR SYNONYM, *HYDROPTILA MORSEI* (TRICHOPTERA: HYDROPTILIDAE)[1]

David A. Etnier, John T. Baxter, Jr.[2]

ABSTRACT: *Hydroptila morsei* is identified as a subjective junior synonym of *H. lloganae*. The genital capsule from a male paratype of *H. lloganae* is illustrated. The species is known from 84 males from 11 localities from the Coastal Plain of Florida, Louisiana, South Carolina, and Texas. Emergence dates include all months except January, February, and November.

Hydroptila lloganae was described by Blickle (1961) based on males from four localities in north and central Florida. We have been unable to find any additional published records for this species. We found Blickle's (1961, 1979) illustrations of the male genitalia difficult to interpret, and in an effort to gain a better concept of this poorly known species, we examined three paratopotype males provided by Kathy R. Zeiders, Illinois Natural History Survey.

The paratopotypes of *Hydroptila lloganae* were found to be identical to 32 specimens (14 lots) of male *Hydroptila* in the University of Tennessee collection, originally identified as *Hydroptila* sp. cf. *strepha* Ross. We noted a great similarity between *H. lloganae* and *H. morsei* Sykora and Harris, 1994. This species was described from Dorchester Co., South Carolina, with additional paratypes from Hardin Co., Texas, and Highlands Co., Florida (paratypes of *H. lloganae* were also taken from Highlands Co., Florida). A paratopotype male of *H. morsei* was sent to us by J. L. Sykora, and we find this specimen to represent the same species, rendering *Hydroptila morsei* Sykora and Harris a junior synonym of *Hydroptila lloganae* Blickle.

Hydroptila lloganae Blickle

(Fig. 1a, b, c)

Hydroptila lloganae Blickle, 1961. Blickle (1961), new species, (Fig. 1b, c, d), type locality Chattahoochee, Gadsden Co., FL (holotype male, 13 paratype males), 15 March-21 May 1957, 13 June 1958. Additional paratype males: 1 from Goose Prairie, Jefferson Co., FL (= Goose Pasture, Morse, 1994), 9 May 1958; 14 from Highlands Hammock State Park, Highlands Co., FL, 13 Sept.-25 Oct. 1957, 22 March-13 June 1958; 4 from Temple Terrace, Hillsbrough Co., FL, 27 Dec. 1957, 11 April-13 June 1958. Blickle, 1962, listed, as above. Blickle, 1979, listed, as above, male illustrated, keyed. Morse, 1993, listed. Morse, 1994, Rare in FL, known only from types.

Hydroptila morsei Sykora and Harris, 1994 (**new subjective junior synonym**). Sykora

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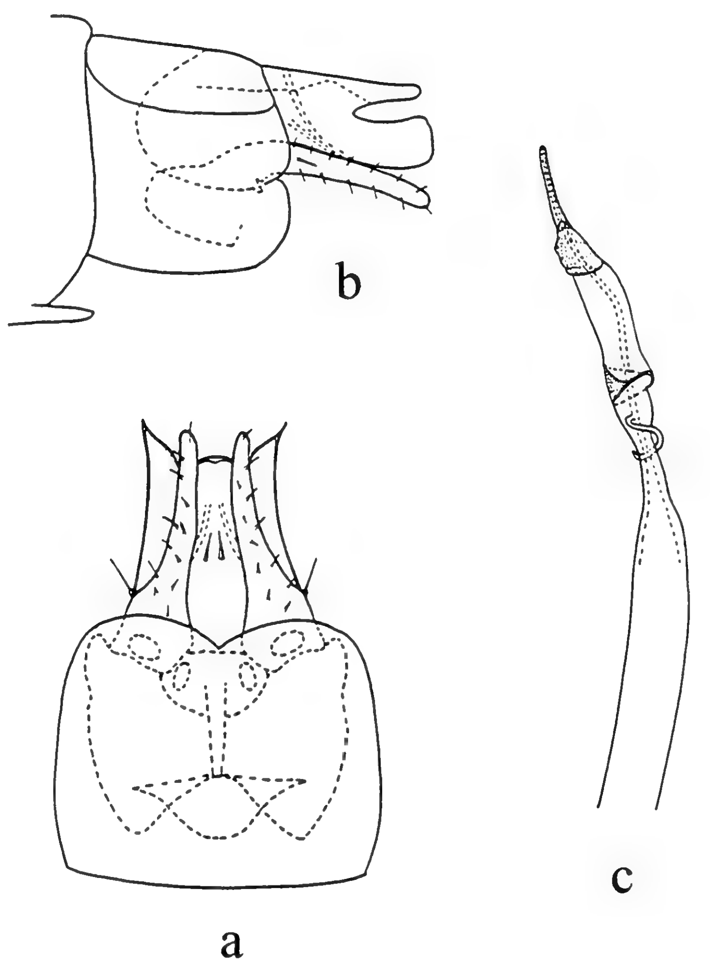

Figure 1. *Hydroptila lloganae* Blickle, genitalia of paratopotype male; a. ventral view. b. lateral view. c. phallus.

and Harris, 1994 (Fig. 14-17), type locality Four Holes Swamp, Goodsons Lake, Dorchester Co., SC, (holotype male, 4 paratype males), 13 Aug. 1976. Additional paratype males: 2 from Four Holes Swamp, Berkely Co., SC, 7 May 1976; 6 from Cypress Creek, Hardin Co., TX, 23 Oct. 1992; 1 from Hickory Creek, Hardin Co., TX, 23 Oct. 1992; 2 from Archbold Biological Station, Highlands Co., FL, 6 March 1964.

MATERIAL EXAMINED

In addition to paratype males of both *Hydroptila lloganae* and *H. morsei* mentioned above, we have examined the following:

LA—Little Bayou Pierre, Natchetoches Parish, 12 males, 27 March 1975.

SC—Upper Three Runs Creek, Savannah River Ecology Laboratory, Aiken Co., 30 June-3 Sept. 1975, 24 males.

DESCRIPTION

The description of the junior synonym, *Hydroptila morsei*, provided by Sykora and Harris (1994) is appropriate for *H. lloganae*, except for a minor point. We interpret the distal portion of the phallus to be lightly sclerotized except for a membranous area near its base and another membranous area just proximal to the tip of the phallus (Fig. 1C). This distal membranous area is separated from the sclerotized middle of the distal portion of the phallus by a slight flange that is not always visible. This is presumably the structure Blickle (1961) described as a "... transparent, alate-like structure on one side". Sykora and Harris (1994) interpreted the entire distal portion of the phallus surrounding the ejaculatory duct to be membranous, but their illustration and our examination of a paratopotype male of *H. morsei* are consistent with our interpretation. Figure 1 is a reillustration of the phallus and ventral and lateral views of the male genitalia of a paratopotype of *H. lloganae*.

Males of *Hydroptila lloganae* from the Aiken County, South Carolina locality formerly in the University of Tennessee collection have been redeposited at the Carnegie Museum, Clemson University, Illinois Natural History Survey, Royal Ontario Museum, the S. C. Harris collection, and United States Museum of Natural History.

ACKNOWLEDGMENTS

Thanks to Kathy Zeiders and Jan Sykora for providing paratype males of *Hydroptila lloganae* and *H. morsei*, respectively. Steve Harris and Jan Sykora graciously provided helpful input to the manuscript, as did two anonymous reviewers. Harvey Stirewalt and Jerry Louton, respectively, provided the light trap material containing the specimens from Aiken County, South Carolina, and Natchetoches Parish, Louisiana.

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BOOK REVIEW

DIVERSITY AND DISTRIBUTION OF THE MAYFLIES (EPHEMEROPTERA) OF ILLINOIS, INDIANA, KENTUCKY, MICHIGAN, OHIO, AND WISCONSIN. 1998. R. Patrick Randolph & W. Patrick McCafferty. Ohio Biological Survey Bulletin, New Series 13(1):vii+188pp. $25.00 plus shipping from Ohio Biol. Survey, 1315 Kinnear Rd., Columbus, OH 43213.

This volume presents results from a Herculean endeavor to document the diversity and distribution of mayflies of six Midwestern states. It is also a monument to the many biologists who collected, preserved, labeled, and curated the collections, and those who deposit voucher specimens of ecological studies. The study extended over a large enough area to include northern and southern species.

An introduction states the rationale of the study, reviews the appropriate literature for the region, the influence of natural physiography (Recent and Pleistocene) and notes the influence of man in degrading streams, rivers and lakes. Table one summarizes distribution patterns with regard to glaciation, water temperature and to five natural regions. Table two shows coefficients of similar species present in 40 regional drainages. These two tables, in conjunction with maps, are predictive of new records in the area and adjoining states. For some species with scattered distributions the existence of nature reserves may be critical. Figure six is valuable because it shows the counties from which no mayfly data are reported. Wisconsin, Indiana, and the Upper Peninsula of Michigan are thoroughly collected, while Kentucky has the lowest percentage of counties from which mayflies are recorded.

There are growing national concerns about biodiversity and the degradation of the environment, but how can we know if aquatic habitats are being degraded without studies such as this one? It is a model of the data needed worldwide.

The heart of the volume is 125 pages of distributional data, reviewing previously published records, and new state and county records. It is the first comprehensive work that treats an area large enough that many advances in species and generic classification of the last 25 years are featured.

I found very few errors and none that obscured meaning. One peculiarity is the citation of an unpublished record of *Pseudiron centralis* from the Platte River in Nebraska although there are published records for the locality. By some lapse the author of *Stenacron gildersleevei* (Traver) is cited as McDunnough.

The volume is concluded by a checklist of the mayfly species for each of the six states, the 36 river drainages, and the four great lakes. This publication will be highly valued for the study area, and will be used by most benthic biologists in North America.

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FIRST RECORD OF PARASITISM OF *MANOMERA TENUESCENS* (PHASMIDA: HETERONEMIIDAE) BY *PHASMOPHAGA ANTENNALIS* (DIPTERA: TACHINIDAE)[1]

Erich H. Tilgner, Joseph V. McHugh[2]

ABSTRACT: The first case of parasitism of *Manomera tenuescens* by *Phasmophaga antennalis* is reported. This record represents the third known phasmid host for *P. antennalis* and the first known parasite for *M. tenuescens*.

Flies in the family Tachinidae are the only known endoparasites of Phasmida (Arnaud 1978; Bedford 1978; Ferrar 1987). In North America five walking-stick species are known to be their hosts (Table 1). The tachinid fly *Phasmophaga antennalis* Townsend has been reported to parasitize two of these species: *Anisomorpha buprestoides* (Stoll) and *Diapheromera femorata* (Say). This article provides the first record of parasitism for a third host, *Manomera tenuescens* (Scudder).

Manomera tenuescens is a gracile phasmid well camouflaged in its habitat. The females are green and yellow, resembling blades of grass, while the males are smaller, purplish-brown, and have the appearance of slender twigs or grass stems. No parasites were previously known for this species.

On June 7, 1997 several adults of *M. tenuescens* were collected from a three acre grassy clearing in a pine and turkey oak scrub forest in Alachua County near Gainesville, Florida. Although Blatchley (1920) states that *M. tenuescens* is rarely found "in low damp places", all specimens observed were restricted to an area near the margin of a small creek.

The phasmids were transported to an insect rearing room at the University of Georgia and housed in a screened cage. On June 10, a fly larva was observed emerging from the anterior region of the abdomen of a female *M. tenuescens*. The larva was transferred to a sealed plastic box filled with moist sand, where it immediately buried itself and subsequently pupated. It was kept at 25° C until eclosion. On June 18, the formerly parasitized phasmid died. On the June 27, an adult male of *P. antennalis* eclosed. These observations are similar to those reported by Neff and Eisner (1960) for parasitized *A. buprestoides*.

Unfortunately, little is known about the biology of *P. antennalis* and many interesting questions remain unanswered. For example, its egg anatomy is consistent with a leaf-ovipositing habit whereby the host becomes parasitized by

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consuming leaves bearing the eggs (Townsend, 1909). Assuming that this type of oviposition occurs, do the female flies search for a likely host plant, or do they target feeding phasmids and oviposit on nearby vegetation? Are additional phasmid species or other folivorous insects parasitized? Are some hosts preferred over others?

More information is needed about the natural history of this fly. Questions regarding host specificity might best be studied in the Gainesville area, where all three known hosts occur sympatrically. The authors hope that these new observations stimulate study of the interactions between this interesting parasite and its hosts, so that these questions can be addressed.

Table 1. Tachinidae recorded from North American Phasmida. Arnaud (1978) provides complete literature citations for these records, with the exception of the new record presented here and that of Sandoval & Vickery (1996).

Tachinidae parasite	Phasmida host	Reported by
Euhalidaya genalis	*Diapheromera femorata*	Walton 1914
Phasmophaga antennalis	*D. femorata*	Townsend 1909
P. antennalis	*Manomera tenuescens*	*New Record
P. antennalis	*Anisomorpha buprestoides*	Neff & Eisner 1960
P. meridionalis	*A. buprestoides*	Russell 1912
Roeseliopsis americana	*A. buprestoides*	Neff & Eisner 1960
Tachina sp.	*D. femorata*	Osten Sacken 1877
Tachinidae	*Timema douglasi*	Sandoval & Vickery 1996
Tachinidae	*T. cristinae*	Sandoval & Vickery 1996
Tachinidae	*T. californicum*	Sandoval & Vickery 1996

ACKNOWLEDGMENTS

We would like to express our gratitude to Erica W. Chiao, Tatiana G. Kiselyova and Corey N. Lewis for providing critical reviews of the manuscript. Thanks are due to Dr. D. M. Wood for confirming the identification of the tachinids. This research was supported by Hatch project # GEO 00787 (to JVM).

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DRAGONFLIES AND DAMSELFLIES (ODONATA) OF THE NATIONAL FORESTS IN ALABAMA[1]

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ABSTRACT: Odonate surveys were conducted on National Forest lands in Alabama between 1994 and 1997. We collected 124 species representing all ten families and 71% of the species known to occur in the state. The number of species collected in any one National Forest ranged from 62 to 88. Seventy new county records were documented during this survey. National Forest lands in Alabama may serve as a refugium for odonate species with specialized larval habitat requirements or that are sensitive to habitat disturbances.

There are four National Forests in the state of Alabama, the Bankhead, Conecuh, Talladega, and Tuskegee (Fig. 1). These National Forest lands comprise over 267,000 hectares, or approximately 3% of the state's area (U. S. Forest Service, 1994), and are distributed in the state across four physiographic regions: the Cumberland Plateau, Alabama Valley and Ridge, Piedmont Upland and East Gulf Coastal Plain. Most of the freshwater habitat types in Alabama are represented in one or more of its National Forests, and these lands are semiprotected and relatively undisturbed.

The Bankhead National Forest covers about 72,800 hectares of Franklin, Lawrence, and Winston counties in northwest Alabama and is located in the Cumberlands Plateau physiographic region. The headwater tributaries and upper reaches of the Sipsey Fork, the major watercourse in the Bankhead, are protected under the National Wild and Scenic Rivers Act of 1963.

The Conecuh National Forest is located on approximately 34,000 hectares of the lower East Gulf Coastal Plain physiographic region in Covington and Escambia counties in extreme southern Alabama. This Forest contains several aquatic habitats which are very rare in Alabama, such as pitcher plant bogs and small, natural sand-bottomed ponds.

The Talladega National Forest is the largest forest in Alabama, encompassing about 157,800 hectares in two disjunct divisions. The Talladega/Shoal Creek Division is located in Calhoun, Clay, Cleburne, and Talladega counties in northeast Alabama. This division includes the southernmost foothills of the Appalachian Mountains and it lies within the Piedmont Upland and the Alabama Valley and Ridge physiographic regions. The Oakmulgee Division is located in west-central Alabama in Bibb, Chilton, Dallas, Hale, Perry, and Tuscaloosa counties and lies almost entirely within the East Gulf Coastal Plain

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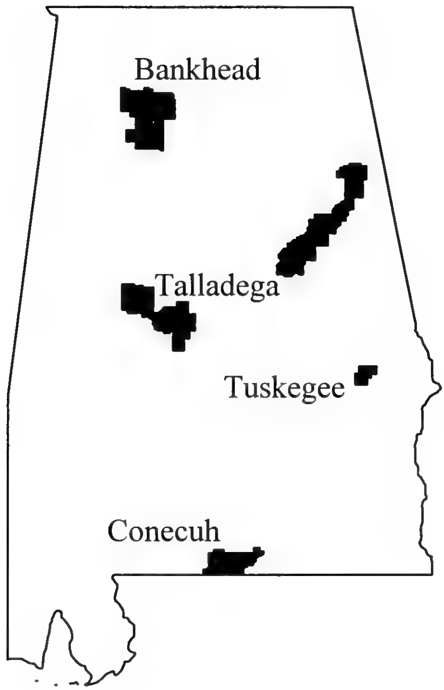

Figure 1. Map of Alabama showing the location of the National Forests.

physiographic region. A small portion of this division lies along the Fall Line Hills separating the Coastal Plain from the Alabama Valley and Ridge and is a "mixing zone" of northern and southern faunal elements.

The Tuskegee National Forest, Alabama's smallest forest, encompasses about 4,400 hectares in Macon County in southeast Alabama. All aquatic habitat within this forest lies in the East Gulf Coastal Plain physiographic region.

In recent years, Forest Service personnel in Alabama have begun to systematically document the aquatic resources on National Forest lands within the state (L. McDougal, pers. comm.). As part of this effort, and to supplement a publication on the distribution of odonates in Alabama (Tennessen et al., 1995), odonate surveys were conducted on National Forest lands in Alabama between 1994 and 1997. We present here a checklist of odonates from the four National Forests in the state of Alabama.

MATERIALS AND METHODS

Potential collection localities were identified by studying topographic maps, reviewing historical location data, and consulting with other biologists familiar with the National Forests. A wide variety of aquatic habitats was sampled including headwater seepage areas, small headwater streams, medium to large creeks, small rivers, large and small impoundments, and natural ponds. In addition, substantial time was spent searching along dirt roads and open fields to collect individuals that were foraging or had not yet returned to the breeding habitat. Adult odonate collections were made at approximately monthly intervals throughout the flight season (generally, March through October).

Adult odonates were collected using an aerial net; larvae were collected by kicknetting in appropriate habitat or by collecting exuviae (shed larval exoskeletons) by hand after emergence. Sight records were utilized for many of the more common or easily identifiable species. No sight records were included, however, if (1) voucher specimens of that species had not been collected from within the boundaries of the National Forest, and (2) identification to the species level with 100% certainty could not be made.

Larvae and exuviae were preserved and stored in 70% isopropanol. Adults were preserved by immersion in acetone and stored dry in envelopes. Voucher specimens are being maintained as part of the authors' permanent collection.

Nomenclature follows Garrison (1991) with the following exceptions from Tennessen et al. (1995): (1) *Stenogomphurus* Carle is treated as a subgenus of *Gomphus* Leach rather than being recognized as a separate genus; (2) *Gomphus brimleyi* Muttkowski is treated as a subspecies of *cavillaris* Needham; (3) the genera *Epicordulia* Selys and *Tetragoneuria* Hagen are treated as subgenera of the genus *Epitheca* Burmeister; and (4) *Ladona* Needham is treated as a genus separate from *Libellula* Linnaeus.

RESULTS AND DISCUSSION

Sampling on National Forest lands resulted in the collection of 124 species of odonates, representing all ten families and 71% of the 174 species known to occur in Alabama. The number of species collected per forest ranged from 62 in the Bankhead to 88 in the Talladega, or from 35% to 50% of the state's fauna. Thirty-nine species of damselflies were collected, mostly members of the family Coenagrionidae. Eighty-five species of dragonflies were collected; the families most commonly encountered included Libellulidae and Gomphidae. Seventy new county records were documented during the survey. The species collected, along with the National Forests in which they were found, the approximate flight season of the adults, and new county records are given in Table 1.

Fifty-seven of the odonate species collected during this survey are largely confined to lentic habitats such as ponds, lakes, and swamps within the National Forests; forty-three other species are usually restricted to flowing streams of various sizes. Eleven species are considered generalists that can exist in lentic or lotic habitats. The remaining twelve species are specialized to inhabit spring-fed seepage areas or sheet flow swamp thickets in the larval stage (Tennessen et al., 1995).

Seven of the species collected during this survey are, to date, restricted within Alabama to National Forest lands. These species are *Lestes vidua* Hagen, *Amphiagrion saucium* (Burmeister), *Gomphus australis* Needham, *Gomphus cavillaris brimleyi* Muttkowski, *Progomphus bellei* Knopf & Tennessen, *Didymops floridensis* Davis, and *Somatochlora calverti* Williamson & Gloyd. In addition, *Epitheca spinosa* (Hagen) and *Neurocordulia alabamensis* Hodges, two species not collected in Alabama in at least fifty years, were "rediscovered" on National Forest lands. Of these nine species, seven are known or believed to have specialized larval habitat requirements that are discussed below.

Amphiagrion saucium is a small red and black damselfly occurring from northern Georgia, Alabama, and Mississippi northward to Minnesota and eastward to Maine; the species also occurs in several Canadian provinces (Westfall & May, 1996). Populations of this species tend to be localized, probably due to a limited, scattered preferred habitat, which is usually spring fed, peaty bog margins or sphagnum-bordered spring seepage trickles. The only known Alabama population occurs at a sphagnum trickle near Blue Girth Creek, in the Talladega National Forest. This locality is just above the Fall Line and likely represents the southern terminus of the species' overall range.

Gomphus australis occurs in the southeastern coastal states from North Carolina to Mississippi (Dunkle, 1989), where the larval habitat is sand-bottomed natural lakes and ponds that are often fringed with water lilies (Tennessen et al., 1995). During this survey the species was collected at Otter Pond, Conecuh National Forest.

Gomphus cavillaris brimleyi, another inhabitant of natural sand-bottomed lakes or ponds on the Coastal Plain, has previously been reported from Florida and North Carolina (Dunkle, 1989). Several males were collected from Blue Pond and Open Pond, Conecuh National Forest, during April of 1993 and 1994.

Progomphus bellei was described based on specimens from Florida and North Carolina (Knopf & Tennessen, 1980). The typical habitat of this species is natural sand-bottomed ponds and tiny sandy seepage streams on the Coastal Plain (Tennessen et al., 1995). Three male specimens were collected at Little Creek, Conecuh National Forest, during this survey.

Didymops floridensis, a species which inhabits sand-bottomed lakes edged with emergent grasses and bald cypress (Dunkle, 1989), was thought to be endemic to Florida. A single male specimen collected in April 1994 at Blue Pond, Conecuh National Forest, represents the first record of this species from outside that state.

Epitheca spinosa is a rare early spring species which usually inhabits wooded swamps with little flow (Tennessen et al., 1995). A single male specimen was collected from Otter Pond, Conecuh National Forest, in March 1994.

Somatochlora calverti was previously known only from Florida and South Carolina. The breeding habitat of this Coastal Plain species is unknown but is thought to be boggy forest seepage trickles (Franz, 1982). Several adults of both sexes were collected along a Forest Service gravel road in the Conecuh National Forest in July 1995.

Thirty of the 123 species collected during this survey were found to be restricted to one specific National Forest. This may be in part due to limited collecting effort, and additional sampling should reveal the presence of some of these species in other National Forests in Alabama. However, some real differences among the odonate faunas of the individual forests in the state exist. The Conecuh National Forest contains unique coastal plain habitats, such as pitcher plant bogs and small natural ponds, not found in the other National Forests. Of the seventeen species collected only in the Conecuh National Forest, at least twelve are known to utilize these unique areas for breeding and larval habitats. Similarly, four of the nine species that were collected only in the Talladega National Forest occur in upland areas of the eastern United States and reach the southern limit of their range in Alabama in the foothills of the Appalachian Mountains, a portion of which lies within this forest.

The species collected during this survey represent approximately 71% of the total known Alabama odonate fauna, an impressive percentage in light of the fact that the National Forests comprise a mere 3% of the state's land area. In addition, the National Forest lands of Alabama may represent a refugium for those species that have specialized larval habitat requirements, as discussed previously, or that are especially sensitive to disturbance of their habitat. The

Gomphidae, for example, are primarily lotic obligates that require fairly pristine, undisturbed habitat, and the family contains a high percentage of species considered to be rare (Tennessen et al., 1995). Twenty-six of the forty gomphid species known to occur in Alabama were collected during this survey, indicating the presence of high quality lotic habitat within the National Forest lands of Alabama.

Table 1. Species list of Odonata from the National Forests in Alabama.

Species list	Bankhead	Conecuh	Talladega	Tuskegee	Adult Flight Dates
Suborder Zygoptera (39)					
Family Calopterygidae (5)					
Calopteryx angustipennis (Selys)	X		X		May - June
Calopteryx dimidiata Burmeister		X	X		April - September
Calopteryx maculata (Beauvois)	X	X	X	X	April - September
Hetaerina americana (Fabricius)[w]	X	X	X		August - September
Hetaerina titia (Drury)[p]		X	X	X	July - October
Family Lestidae (5)					
Lestes disjunctus australis Walker[h,l]	X	X	X	X	April - October
Lestes inaequalis Walsh [w]	X	X	X	X	April - June
Lestes rectangularis Say			X	X	April - September
Lestes vidua Hagen		X			January
Lestes vigilax Hagen *in* Selys[h,m,w]	X	X	X	X	April - October
Family Coenagrionidae (29)					
Amphiagrion saucium (Burmeister)			X		April - May
Argia apicalis (Say)	X		X	X	June - September
Argia bipunctulata (Hagen) [m,w]	X	X	X	X	April - September
Argia fumipennis fumipennis (Burmeister)		X			April - October
Argia fumipennis violacea (Hagen)	X		X	X	April - October
Argia moesta (Hagen)	X	X	X	X	June - October
Argia sedula (Hagen)		X	X	X	August - October
Argia tibialis (Rambur) [w]	X	X	X	X	June - August
Argia translata Hagen *in* Selys	X		X		August
Chromagrion conditum (Selys) [c]			X		May
Enallagma aspersum (Hagen)	X				June
Enallagma basidens Calvert [l]	X		X		June
Enallagma concisum Williamson		X			April - July
Enallagma daeckii (Calvert) [h]	X	X	X		April - July
Enallagma divagans Selys	X	X	X	X	April - June
Enallagma doubledayi (Selys) [m]		X		X	March - October
Enallagma dubium Root [m]		X		X	April - September
Enallagma exsulans (Hagen) [w]	X		X	X	May - September
Enallagma geminatum Kellicott [m,w]	X	X	X	X	March - October
Enallagma signatum (Hagen) [m]	X	X	X	X	March - September
Enallagma traviatum Selys [m]	X	X	X	X	April - July
Enallagma vesperum Calvert [m]		X	X	X	April - August

Species list	Bankhead	Conecuh	Talladega	Tuskegee	Adult Flight Dates
Ischnura hastata (Say) [b,m,w]	X	X	X	X	March - October
Ischnura kellicotti Williamson [m]		X	X	X	March - October
Ischnura posita posita (Hagen) [w]	X	X	X	X	March - October
Ischnura ramburii (Selys) [m]		X		X	April - October
Nehalennia gracilis Morse		X	X		May - June
Nehalennia integricollis Calvert [h,m,w]	X	X	X	X	April - September
Telebasis byersi Westfall [h,w]	X		X		June - July
Suborder Anisoptera (85)					
Family Aeshnidae (9)					
Anax junius (Drury) [w]	X	X	X	X	March - October
Anax longipes Hagen [m]		X		X	April - August
Basiaeschna janata (Say)	X		X	X	March - May
Boyeria vinosa (Say)	X	X	X	X	June - October
Coryphaeschna ingens (Rambur)		X			April
Epiaeschna heros (Fabricius) [m]	X	X	X	X	March - October
Gomphaeschna antilope (Hagen) [m]		X	X	X	April - May
Gomphaeschna furcillata (Say) [m,p]		X	X	X	March - May
Nasiaeschna pentacantha (Rambur)		X		X	April - July
Family Petaluridae (1)					
Tachopteryx thoreyi (Hagen *in* Selys)	X	X	X		April - June
Family Gomphidae (26)					
Aphylla williamsoni (Gloyd)		X	X		July - August
Arigomphus pallidus (Rambur)		X			April
Dromogomphus armatus Selys [p]		X	X		June - August
Dromogomphus spinosus Selys	X	X	X	X	May - August
Erpetogomphus designatus Hagen *in* Selys [m]				X	August - September
Gomphus apomyius Donnelly			X	X	May
Gomphus australis Needham		X			April
Gomphus cavillaris brimleyi Muttkowski		X			April
Gomphus dilatatus Rambur		X			July
Gomphus exilis Selys [m]	X	X	X	X	March - June
Gomphus geminatus Carle		X			April
Gomphus hodgesi Needham		X			April - May
Gomphus hybridus Williamson			X		April
Gomphus lineatifrons Calvert	X		X		May - June
Gomphus lividus Selys [w]	X		X	X	March - May
Gomphus parvidens Currie			X		May - June
Gomphus rogersi Gloyd			X		Larvae only[#]
Hagenius brevistylus Selys [w]	X	X	X	X	June - August
Ophiogomphus incurvatus alleghaniensis Carle			X		Larvae only[#]
Progomphus bellei Knopf & Tennessen		X			June - July
Progomphus obscurus (Rambur) [m]	X	X	X	X	May - August
Stylogomphus albistylus (Hagen *in* Selys)	X		X		May - June
Stylurus ivae (Williamson)		X	X		September
Stylurus laurae (Williamson)			X		August

Species list	Bankhead	Conecuh	Talladega	Tuskegee	Adult Flight Dates
Stylurus plagiatus (Selys) [w]	X	X			September
Stylurus townesi Gloyd		X			July
Family Cordulegastridae (3)					
Cordulegaster bilineata (Carle)		X	X		March - April
Cordulegaster maculata Selys [m]	X		X	X	March - May
Cordulegaster obliqua (Say)			X		July
Family Corduliidae (Macromiinae) (5)					
Didymops floridensis Davis		X			April
Didymops transversa (Say) [m]	X		X	X	March - May
Macromia alleghaniensis Williamson [w]	X		X		June - July
Macromia illinoiensis georgina (Selys)	X	X	X	X	June - October
Macromia taeniolata Rambur			X		August
Family Corduliidae (Corduliinae) (14)					
Epitheca costalis (Selys)		X	X	X	March - June
Epitheca cynosura (Say)	X	X	X	X	March - May
Epitheca princeps Hagen [w]	X		X		May - June
Epitheca spinosa (Hagen *in* Selys)		X			March
Helocordulia selysii (Hagen *in* Selys) [w]	X	X	X		March - April
Helocordulia uhleri (Selys) [w]	X		X		March - April
Neurocordulia alabamensis Hodges *in* Needham & Westfall		X	X		June
Neurocordulia molesta (Walsh)				X	Larvae only[#]
Neurocordulia obsoleta (Say)	X				Larvae only[#]
Somatochlora calverti Williamson & Gloyd		X			July
Somatochlora filosa (Hagen) [m]		X	X	X	July - October
Somatochlora linearis (Hagen) [m]			X	X	August
Somatochlora provocans Calvert [h]		X	X		June - August
Somatochlora tenebrosa (Say) [h]	X		X		June - October
Family Libellulidae (27)					
Celithemis amanda (Hagen)		X			June - October
Celithemis bertha Williamson		X			April - October
Celithemis elisa (Hagen) [m]		X		X	April - October
Celithemis fasciata Kirby [m,w]	X	X	X	X	April - September
Celithemis ornata (Rambur)		X			April
Celithemis verna Pritchard [h,m]		X	X	X	April - June
Dythemis velox Hagen [w]	X		X		June - September
Erythemis simplicicollis (Say) [w]	X	X	X	X	March - October
Erythrodiplax minuscula (Rambur)		X		X	April - October
Ladona deplanata (Rambur) [m,w]	X	X	X	X	March - May
Libellula auripennis Burmeister		X	X	X	April - October
Libellula axilena Westwood [m]		X		X	June - July
Libellula cyanea Fabricius	X		X	X	April - August
Libellula flavida Rambur	X	X	X	X	June - September
Libellula incesta Hagen	X	X	X	X	June - October
Libellula luctuosa Burmeister	X	X	X	X	June - September
Libellula lydia Drury	X	X	X	X	March - October
Libellula pulchella Drury [1]	X	X			May - September

Species list	Bankhead	Conecuh	Talladega	Tuskegee	Adult Flight Dates
Libellula semifasciata Burmeister		X		X	March - July
Libellula vibrans Fabricius	X	X	X	X	June - October
Pachydiplax longipennis (Burmeister)	X	X	X	X	March - October
Pantala flavescens (Fabricius)	X	X			July - October
Perithemis tenera (Say) [w]	X	X	X	X	May - September
Sympetrum ambiguum (Rambur)			X	X	September - October
Sympetrum vicinum (Hagen) [w]	X		X		June - October
Tramea carolina (Linnaeus) [h]		X	X	X	March - October
Tramea lacerata Hagen		X		X	April - October
Total	62	87	88	68	

[a] - No adult specimens were collected for these species; therefore, no adult flight dates are given.
[b] - New county record for Bibb County, Alabama
[c] - New county record for Chilton County, Alabama
[h] - New county record for Hale County, Alabama
[m] - New county record for Macon County, Alabama
[l] - New county record for Lawrence County, Alabama
[p] - New county record for Perry County, Alabama
[w] - New county record for Winston County, Alabama

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A PRELIMINARY REVIEW OF COLOMBIAN ANTS (HYMENOPTERA: FORMICIDAE) PRESERVED IN COPAL[1]

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ABSTRACT: Ants preserved in copal are reported from localities in Colombia, South America. Representatives of 21 genera (5 subfamilies) are reported from Boyaca Department; representatives of 24 genera (6 subfamilies) are reported from Santander Department. Comparisons between the faunas were made using presence / absence measures and alpha diversity measures. Of the genera encountered in Santander Department, a significant number were typically terrestrial foragers rather than arboreal foragers. It is theorized that the majority of resin trapped specimens were foraging at or near the soil surface. Of the genera encountered in Boyaca Department, a high percentage was typically arboreal foragers. It is theorized that resins trapped these specimens as they foraged well above the soil surface. Comparisons were also made to the fossil ants found in amber from the Dominican Republic and to the extant ant fauna of Colombia. The ants preserved in copal are more similar to those found in amber from the Dominican Republic than to those presently known from Colombia. It is theorized that this is due to the method of collection (resin trapped specimens) which may exclude a large number of genera.

Although ants dominate many terrestrial ecosystems, they are relatively uncommon as fossils and sub-fossils. Many ant wing fragments are represented in shales (from Eocene to more recent deposits). Specimens typically represent reproductives which flew over a body of water and were drowned and buried in volcanic ash or mud (Carpenter, 1930). Worker ants are typically encountered as fossils preserved in hardened plant resins (amber and copal). The former have been extensively studied (for example, Wheeler, 1915 reviewed the ant fauna of the Baltic amber; Wilson, 1985 reviewed the ant fauna of the Dominican Republic amber). Many new species (and some new genera) have been described from amber (for example, Baroni-Urbani, 1980a described the first Attini and Baroni-Urbani, 1980b described the first Odontomachini; Ward, 1992 described new species of *Pseudomyrmex*).

Poinar (1996) indicated that resin is the viscous stage (sticky and pliable) when it emerges from plants. After the resin dries and can not be molded (pressure results in fractures instead of an impression), the material is called copal. The change from resin to copal varies but can be as short as a month. Within copal the molecules have started to polymerize (however, the surface can be-

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come sticky when copal is subjected to organic solvents). Copal is softer than amber and melts at lower temperatures. The material continues to polymerize over time. When the melting point is between 200 and 380 degrees Celsius, the hardness is between 2 and 3 (Mohs scale), and the surface does not become sticky when subjected to organic solvents, the material is called amber. Poinar (1996) estimated the time for copal to become amber probably takes between 2 and 4 million years.

Specimens preserved in copal have been relatively overlooked. Exceptions include Schluter and Von Gnielinski, 1987 and DuBois, 1998. Part of the reason for this neglect is that the species and genera represented in copal all appear to be modern forms. Most copal is thought to be of Recent, Pleistocene, or Pliocene origin (Poinar, 1992). Analyses using C_{14} methods on Colombian copal yielded age ranges from 10 to 500 years old (one sample was between 380 and 500 years old, another 210 and 310 years old, and a third between 10 and 80 years old) (Poinar, 1996). A number of arguments supporting both Recent and Tertiary ages for this material were presented by Stinchcomb (1998). Regardless of the age, we believe that this material is worthy of further study. It can provide a link (historically) with older material and can shed light on the ant fauna of a region prior to intensive human activities. Such material may also be used to document distributional changes of genera and species within an ecosystem. The purpose of this paper is to quantify some of the ant biodiversity contained in copal from two departments in Colombia (Boyaca and Santander).

METHODS AND MATERIALS

Ant specimens preserved in copal were directly examined and identified with a Wild dissecting stereomicroscope. Specimens were identified to genus using Bolton, 1994 and Hölldobler and Wilson, 1990, and directly compared with recent specimens in the collection of the senior author. Many specimens were oriented in such a manner that identification to species was difficult without significant re-cutting and re-polishing of the matrix. Tools were not readily available for this work, thus specimens were grouped into morphospecies. All analyses were then done at the generic level. All data was included in a presence / absence matrix (by genus) and was analyzed using the Biodiv program version 4.1 (Baev and Penev, 1993). Jaccard's coefficient (weighted for species richness) was selected to quantify biodiversity. With presence / absence data, additional comparisons were made with the known extant Colombian ant fauna and with the ant fauna reported from amber of the Dominican Republic.

Quantitative analyses were also conducted for comparisons between the two sites. As with presence / absence data, the Biodiv program formed the basis for this analysis. A suite of indices was selected since calculation of different indices causes some loss of information (Magurran, 1988). The selected suite follows that used by DuBois (1995): Margalef Index, Reciprocal of Simpson's Index, Shannon Diversity Index, Q Statistic, Berger-Parker Dominance Index, Alpha Diversity Index and Pielou Evenness Index. Since comparisons were made at the level of genus, some information regarding species diversity was undoubtedly lost. However, a number of genera were represented by a single morpho-species (sometimes a single specimen).

GEOLOGICAL DETAILS

Specimens were obtained from Allan Graffham (Ardmore, Oklahoma). Duplicate material has been returned to him. All material originated from localities in Colombia: Boyaca or Santander Departments. Schlee (1984) attributed the Santander locality to the vicinity of "Peña Blanca." It is presumed this locality is within Santander Department. Santander and Boyaca are adjacent departments in the Colombian Andes. Poinar and Poinar (1994: 187) indicated these localities are probably near the Magdalena River (which forms the western boundary of parts of Boyaca and Santander Departments). Poinar (1996) indicated the bulk of this material "...comes from the Departments of Santander, Boyaca, and Bolivar; more specifically, near the cities or villages of Bucaramanga, Giron, Bonda, Medellin, Peñablanca, Mariquita, and Valle de Jesus." It should be noted that Medellin is in Dept. Antioquia. Although the actual localities have not been personally examined, the general habitus of the amber deposits is a layer (containing copal) covered by a layer of volcanic ash. Initial discovery of copal deposits is along road cuts. Depth of the copal bearing layer ranges between 1 and 3 meters beneath the soil surface (in Santander) and up to 10 meters beneath the soil surface (in Boyaca). Efforts are presently underway to obtain a sample of this ash so its age can be determined (Allen Graffham, pers. comm.). Copal is presumed to be of Recent, Pleistocene, or Pliocene age. Since it floats, it can readily be re-deposited. Landslides may also re-deposit this material. Therefore, ages of copal are difficult to determine. $Carbon_{14}$ analysis has yielded dates ranging from mid-1700's through mid-1900's. However, the oils used to polish the material (and subsequent heat generated during polishing) may significantly alter the matrix and may not allow for proper $carbon_{14}$ dating. Ken Anderson (pers. comm.) indicated this material is of "resins of undetermined geological age, but probably not of great antiquity." Poinar (1992) indicated that all known Colombian material is of Pleistocene age. However, Poinar (1996) indicated that the majority appears less than 500 years old. Until the age of the overlying volcanic ash is determined and more samples are subjected to modern dating techniques, we refer to the age of this material as undetermined, but probably Recent.

It appears that this material originated from resins of *Hymenaea* (Leguminosae: Caesalpinaceae) or similar plants (Poinar, 1992; Poinar and Poinar, 1994; Poinar, 1996). Details regarding the origin and deposition of this material are sketchy. Poinar (1996) indicated this resin comes from the Algarroba tree (*Hymenaea courbaril*, *H. oblongifolia*, and *H. parvifolia*) which is "...widely distributed throughout Southern Mexico, Central America, The Antilles, and the northern regions of South America." He indicated the resin accumulates between the bark and wood and under the roots.

BIOLOGICAL DETAILS

A total of 329 ant specimens (318 workers, 5 gynes, and 6 males) from Colombian copal were contained in 163 individual pieces of copal. Representatives of most species are stored in the personal collection of M. DuBois (Washington, Illinois). All material identified to genus is listed in the appendix. Specimens belong to the subfamilies listed below. Percentages for Boyaca and Santander represent only those specimens obtained from that locality. Although the bulk of specimens are Dolichoderinae (and most of these are *Azteca*), there is a significant amount of diversity. However, there are significant differences in biodiversity between these two sites.

	Total Specimens Examined	Percent of Total Specimens	Percent of Boyaca Specimens	Percent of Santander Specimens
Dolichoderinae	169	51.37%	65.80%	17.35%
Ecitoninae	4	1.22%	0.00%	4.08%
Formicinae	27	8.21%	6.49%	12.24%
Myrmicinae	93	28.27%	19.05%	50.00%
Ponerinae	13	3.95%	3.03%	6.12%
Pseudomyrmicinae	23	6.99%	5.63%	10.20%

Of the subfamilies represented, the majority of specimens are distributed among the following genera. As before, the percentages for Boyaca and Santander represent only those specimens collected at that locality.

	Total Specimens Examined	Percent of Total Specimens	Percent of Boyaca Specimens	Percent of Santander Specimens
Azteca	130	39.51%	55.84%	1.02%
Camponotus	22	6.69%	4.76%	11.22%
Crematogaster	47	14.29%	9.52%	25.51%
Dolichoderus	23	6.99%	6.49%	8.16%
Pheidole	22	6.69%	5.19%	10.20%
Pseudomyrmex	23	6.99%	5.63%	10.20%

Eight of the genera are represented by single specimens (*Acromyrmex*, *Atta*, *Gnamptogenys*, *Myrmecina*, Unidentified Myrmicinae, *Proceratium*, *Rogeria*, and *Smithistruma*).

COMPARISONS

For comparisons to be made with other faunas, we restricted our analyses to the level of genus. We anticipated a significant difference between species given the distributions (over time and geography); however, many genera represented are ubiquitous throughout the New World tropics. We anticipated limited variation in genera due to this fact coupled with the sampling method (sticky plant resin). Thus, a number of arboreal and above ground foraging genera should be typically represented.

Similarity Measures (Presence / Absence Data)

Comparisons were made with several disparate ant assemblages. Material presented in copal from both Boyaca and Santander Departments was compared to determine differences in the composition of the two fossil assemblages. The known extant ant fauna of Colombia was also compared (at the level of genus) to determine similarities between recent and fossil ants from Colombia. Finally, the known ant fauna found in amber from the Dominican Republic was also compared. This latter material is significantly older and geographically removed from Colombia. We included it as a baseline since many genera found in Colombia are presently known throughout northern South America and the Caribbean. Similarity might also indicate the relationship to method of preservation as well as possibly shedding additional light on the age of the copal.

The following sources of genera were used: Colombian copal (material directly examined from Boyaca and Santander), modern ant fauna of Colombia (Kempf, 1972 and Fernández et al., 1996), and Dominican Republic amber (Wilson, 1985). In all cases, names of genera were updated using Bolton, 1995.

Calculation of Jaccard's coefficient resulted in the following values: Boyaca vs. Santander (0.57), Colombian copal vs. Dominican Republic amber (0.44), all fossils vs. extant Colombian ant fauna (0.21) (Fig. 1). A value of 1 would indicate complete similarity and 0 would indicate complete dissimilarity. Although the faunas preserved in copal from Boyaca and Santander are somewhat similar, they exhibit significant differences (represented by the coefficient of 0.57).

Examples of the differences noted above include the genus *Azteca* that is represented mostly by specimens from Boyaca. Additionally, fossils of some genera (*Neivamyrmex*, *Smithistruma* and *Strumigenys*) are known exclusively from Santander while other genera (*Acromyrmex* and *Cephalotes*) are known exclusively from Boyaca.

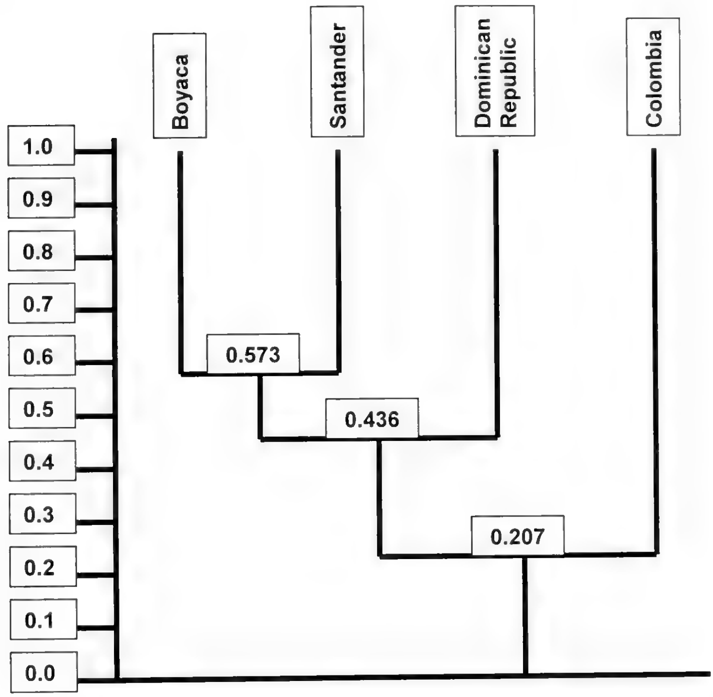

Figure 1. Unweighted pair group cluster analysis of Jaccard's Coefficient of Similarity. Ant faunas preserved in copal from Boyaca Department, Colombia, from Santander Department, Colombia preserved in amber from the Dominican Republic, and existing ant fauna of Colombia are clustered. A coefficient of 1 would indicate complete similarity; a coefficient of 0 would indicate complete dissimilarity. For further discussion, refer to text.

Examination of genera preserved in copal from Boyaca and Santander departments exhibit differences, which may indicate different environments. For example, more genera that typically forage at or near the soil surface are known from Santander copal. *Azteca* species typically nest in trees. Approximately 56% of all specimens from Boyaca are *Azteca* compared to 1% of all specimens from Santander. Both sites trapped comparable numbers of genera (Boyaca with 20 genera and Santander with 23 genera); there are 15 genera in common. Yet, Santander had roughly 30% of all specimens while Boyaca had 70%. Fully 50% of all genera from Santander are myrmicines.

Similarities exist between the faunas. For example, representatives of Attini are found in both deposits (Boyaca has *Acromyrmex* and Santander has *Atta*).

The copal ant faunas from Colombia are more similar to that of the ants found in amber from the Dominican Republic than to the modern Colombian ant fauna (Fig. 1). However, it is presumed the copal material is much younger than the ant material preserved in amber from the Dominican Republic. We suspect the main reason for this similarity is that plant resins trap a subset of the ant fauna in a given area. The fauna of Colombia is much more diverse than could be encountered in a few locations (much larger area with many divergent habitats). It should be significantly different from the fauna obtained in a small area.

Alpha Diversity Measures (Quantitative Data)

These measures attempt to account for richness (number of species) or evenness (equal abundance). It is presumed that material from both sites in Colombia was trapped in a similar manner and that both sites (when fully excavated) are similar in size. Several measures were selected as they have different sensitivity to sample size variation, discriminant ability, and a bias towards richness or evenness. Magurran (1988: 79) discussed details regarding sensitivity and bias of these measures. DuBois (1995) discussed the use of these selected measures in dealing with ant faunas. For each measure, calculations for Boyaca and Santander are listed and compared with calculations for the ant fauna of central North America (DuBois, 1995).

α Measure	Boyaca	Santander	North America
Margaleff's Index	3.49	4.78	13.4
Simpson's Index reciprocal	2.99	8.78	34.0
Shannon's Index	1.75	2.60	3.5
Q-statistic	4.83	10.10	24.6
Berger-Parker Index	0.56	0.26	0.1
Alpha (or log series)	4.91	10.14	25.6
Pielou's Evenness Index	0.60	0.82	0.8

We believe the reason the majority of the above calculations were low for tropical areas is that a limited portion of the total ant fauna was trapped in the resin. Many species forage in a manner that does not lend itself to ready exposure to resin. Also, given that there may have been seasonality to resin flows, reproductives of other species inhabiting the area may not have been trapped.

DISCUSSION

This paper briefly discusses some of the ant diversity found in copal. While these hardened resins are not as old as much other material previously studied, they are worthy of further investigations. For example, even relatively young material provides a clearer picture of the ant fauna prior to intense human activities in South America. For this reason alone, this material is worthy of further investigation. Once more accurate ages are determined, this material should be re-examined and implications concerning the presence of various species and genera should be evaluated in greater detail.

We believe this is the first time that ecological measures of biodiversity have been applied to fossil ant assemblages. Such measures should help quantify similarities between different locations over time.

ACKNOWLEDGMENTS

This paper is dedicated to the memory of the late Frank M. Carpenter (Museum of Comparative Zoology, Harvard Univ.) advisor and friend (of the senior author) for the past two decades. The first author wishes to thank his wife, Jeri, and son, Benjamin, for their continued support and encouragement. Without them, such work would not be possible. The second author wishes to thank his mother, Lorraine, and father, John, for their tremendous support of all the author's academic endeavors. Allen Graffham (Ardmore, Oklahoma) provided numerous comments regarding localities and possible age for the copal from Colombia. He also provided a photograph of the excavation. Ken Anderson (Argonne National Laboratory, Argonne, Illinois) reviewed his current analyses of assigning ages to copal and amber worldwide and discussed his view of the age of the copal resins with the senior author. This paper was reviewed by W. E. LaBerge and D. W. Webb (Illinois Natural History Survey, Champaign, Illinois) and three anonymous reviewers. Where possible we have attempted to incorporate reviewer's comments. We accept responsibility for any remaining errors or omissions.

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Appendix

The following ant genera are reported from various copal and amber deposits. Additionally, a list of genera presently known from Colombia is presented. Sources are listed in the text. A plus (+) indicates presence of this genus from a given locality; a minus (-) indicates absence from a given locality. Genera followed by an asterisk have many species which are typically arboreal (nesting and foraging) in South America today. The remaining genera are represented by many species which typically nest and forage on (or near) the soil surface.

Genus	Copal from Boyaca Dept.	Copal from Santander Dept.	Recent Ants from Colombia	Amber from Dominican Republic
Acanthognathus	–	–	+	–
Acanthoponera	–	–	+	–
Acanthostichus	–	–	+	–
Acromyrmex	+	–	+	–
Acropyga	–	–	+	–
Adelomyrmex	–	–	+	–
Allomerus	–	–	+	–
Amblyopone	–	–	+	–

Genus	Copal from Boyaca Dept.	Copal from Santander Dept.	Recent Ants from Colombia	Amber from Dominican Republic
Anochetus	–	–	+	+
Aphaenogaster	–	–	+	+
Apterostigma	–	–	+	–
Atta	–	+	+	–
Azteca *	+	+	+	+
Basiceros	–	–	+	–
Belonopelta	–	–	+	–
Blepharidatta	–	–	+	–
Brachymyrmex	–	–	+	–
Camponotus *	+	+	+	+
Carabarella	–	–	+	–
Cardiocondyla	–	–	+	–
Centromyrmex	–	–	+	–
Cephalotes *	+	–	+	–
Cerapachys	–	–	+	–
Cheliomyrmex	–	–	+	–
Creightonidris	–	–	+	–
Crematogaster *	+	+	+	+
Cylindromyrmex	–	–	–	+
Cyphomyrmex	–	–	+	+
Daceton *	–	–	+	–
Dendromyrmex *	–	–	+	–
Dinoponera	–	–	+	–
Discothyrea	–	–	+	–
Dolichoderus *	+	+	+	+
Dorymyrmex	–	–	+	–
Eciton	–	–	+	–
Ectatomma	–	–	+	–
Erebomyrma	–	–	–	+
Eucryptocerus *	–	–	+	–
Eurhopalotrix	–	–	+	–
Forelius	+	+	+	–
Gigantiops	–	–	+	–
Glamyromyrmex	–	–	+	–
Gnamptogenys	+	+	+	+
Heteroponera	–	–	+	–
Hylomyrma	–	–	+	–
Hypoponera	+	+	+	+
Ilemomyrmex	–	–	–	+
Labidus	–	–	+	–
Lachnomyrmex	–	–	+	–
Leptanilloides	–	–	+	–
Leptogenys	–	–	+	–
Leptothorax	–	–	+	+
Linepithema	+	+	+	+
Megalomyrmex	–	–	+	–
Monomorium	–	–	+	–

Genus	Copal from Boyaca Dept.	Copal from Santander Dept.	Recent Ants from Colombia	Amber from Dominican Republic
Mycetophylax	–	–	+	–
Mycocepurus	–	–	+	–
Myrmecina	–	+	–	–
Myrmelachista	–	–	+	–
Myrmicocrypta	–	–	+	–
Unidentified Myrmicinae	+	–	–	–
Neivamyrmex	–	+	+	+
Neostruma	–	–	+	–
New genus	–	–	–	+
Nomamyrmex	–	–	+	–
Ochetomyrmex	–	–	+	–
Octostruma	–	–	+	+
Odontomachus	–	+	+	+
Oligomyrmex	–	–	+	–
Oxydris	–	–	–	+
Pachycondyla	+	+	+	+
Paraponera	–	–	+	+
Paratrechina	+	+	+	+
Pheidole	+	+	+	+
Platythyrea	+	+	+	+
Pogonomyrmex	–	–	+	–
Prenolepis	–	–	–	+
Prionopelta	–	–	+	+
Probolomyrmex	–	–	+	–
Proceratium	+	–	+	–
Procryptocerus *	–	–	+	–
Prodimorphomyrmex	–	–	–	+
Protalaridris	–	–	+	–
Pseudomyrmex *	+	+	+	+
Rhopalothrix	–	–	+	–
Rogeria	+	–	+	–
Sericomyrmex	–	–	+	–
Simopelta	–	–	+	–
Smithistruma	–	+	+	+
Solenopsis	+	+	+	+
Stenamma	–	–	+	–
Strumigenys	–	+	+	–
Tapinoma	+	+	+	+
Tetramorium	–	–	+	–
Thaumatomyrmex	–	–	+	–
Trachymyrmex	–	–	+	+
Tranopelta	–	–	+	–
Typhlomyrmex	–	–	+	–
Wasmannia	–	–	+	–
Zacryptocerus *	+	+	+	+

ADULTS OF *CAMELOBAETIDIUS WALTZI* (EPHEMEROPTERA: BAETIDAE), WITH FIELD NOTES[1]

Thomas H. Klubertanz[2], Darrin M. Jones[3]

ABSTRACT: Adult males and females of *Camelobaetidius waltzi* (Ephemeroptera: Baetidae) are described for the first time. Previously, the species was known from larvae collected in Indiana, Iowa, and Texas. Adults were reared from populations in southeast Nebraska. Although the reliability of species-level characters in adult *Camelobaetidius* is uncertain, males of *C. waltzi* appear separable from sympatric species based on shape and color of the turbinate eyes and on abdominal coloration. Females are similar to males in wing and femoral coloration. Larvae were found in areas with current velocities greater than 0.52 m/sec and with a pH range of 8.5 to 9.0. Subimagos were observed emerging from eddies within riffle areas at dusk.

Eight nominal species of *Camelobaetidius* (Ephemeroptera: Baetidae) are known from North America; five are known from the United States (Lugo-Ortiz and McCafferty 1995, Wiersema 1998). Larvae of *C. waltzi* McCafferty were described by McCafferty and Klubertanz (1994) based on specimens from Iowa and Indiana. Recently, Baumgardner and Wiersema (1998) reported this species from Texas. McCafferty and Klubertanz (1994) also provided limited information about larval ecology and habitat. Although adults of four other species of North American *Camelobaetidius* are known, adults of *C. waltzi* have not been described. Recently, we found large populations of *C. waltzi* in southeast Nebraska and successfully reared adults. This paper describes male and female *C. waltzi* for the first time and includes new data regarding the larval ecology and emergence of the species.

Larvae were taken from southeast Nebraska and reared in the laboratory. The coloration of live adults was observed, and then specimens were preserved in alcohol. Wings were dry-mounted on slides. Genitalia were cleared briefly in dilute potassium hydroxide, dehydrated, and mounted in Lipshaw's medium (soluble in xylene). Voucher specimens have been deposited in the Purdue Entomological Research Collection.

Camelobaetidius waltzi McCafferty

Larva. Described in McCafferty and Klubertanz (1994).
Adult male (live or in alcohol). Body length 5-6 mm, forewings 4-5 mm, hindwing 1 mm,

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caudal filaments 9 mm. Head mostly pale; dorsum slightly darker than venter; dark brown stripe along anterior margin of head between compound eyes and base of antennae. Ocelli white. Turbinate portions of eyes brown-orange, well developed, oval in dorsal view and obstructing view of lateral portion of the eyes and the pronotum; anterior portions separated by distance nearly equal to width of lateral ocelli; posterior portions variably separated but never touching. Antennae gray-brown, first segment slightly paler than second. Thorax gray, yellow-brown, and orange; pronotum mostly gray; mesonotum pale yellow-brown medially, gray-brown laterally, with thin black line along meson; mesoscutellum yellow; metanotum gray-brown; intersegmental areas in meso- and metathorax bright orange, fading to white in alcohol; prosternum entirely white, mesosternum and metasternum gray. Legs yellowish-white; irregular, dorsal lemon-yellow patch on distal end of femora, fading quickly in alcohol; foretibial length 1.1 times length of foretarsus. Wings as in Figure 1, membrane and veins mostly hyaline; forewings of live specimens slightly yellow at base and in costal and subcostal interspaces, tip of wing sometimes with 0.5 mm wide yellow band; usually seven slanting, stigmatic crossveins; marginal intercalaries paired, except last three near wing base. Hindwings (Fig. 1b) with two longitudinal veins; costal process long, acute, and occasionally yellow; undulation of wing margin distal to costal process subtle and visible only in anterior, edge-on view. Abdomen mostly pale; segments 1-6 hyaline, terga variably marked yellow in live specimens, occasionally as a medial stripe; trachea not pigmented; segments 7-10 brown to yellow-brown, tergum 7 slightly paler, sterna 7-10 chalky white. Genitalia white and as in Figure 1c; slightly clubbed setae on posterior margin of sternum 9, similar setae medially on second segment of forceps; basal segment of forceps with rounded medial projection; terminal segment of forceps 3 to 4 times longer than wide,

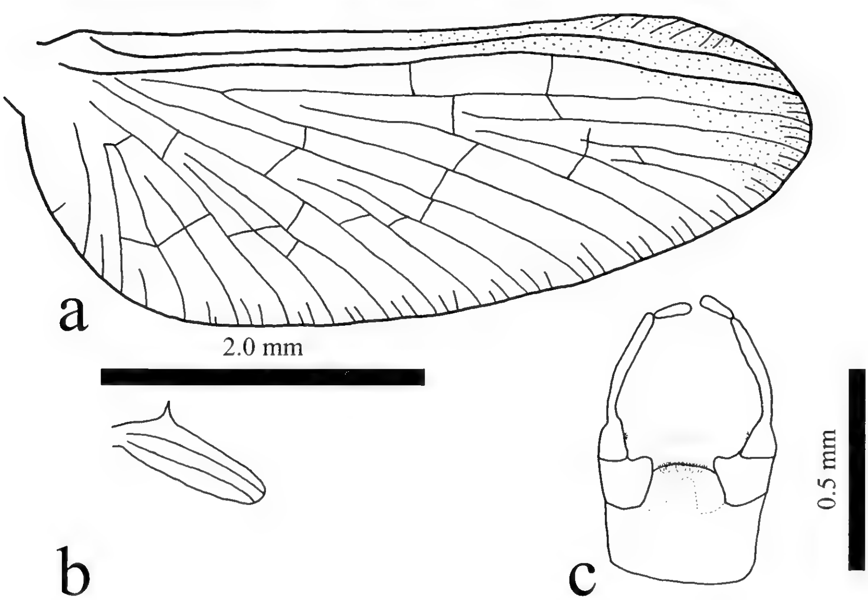

Figure 1. *Camelobaetidius waltzi*, adult male: a. forewing; b. hindwing; c. genitalia (ventral view).

slightly wider at tip. Tails white.

Adult female (live or in alcohol). Size similar to male, but coloration more uniformly yellow-brown. Head without dark, transverse band under eyes. Thoracic coloration similar to male. Legs of fresh specimens pale, dorsal yellow band at distal end of femora as in male. Wings hyaline, yellow color more restricted than in male. Abdomen brown to yellow-brown; terga pale brown medially, nearly orange-brown laterally; sterna paler than terga. Tails white.

Material examined (reared adults). North Fork of Big Nemaha River, 6.4 km N of Table Rock, Pawnee Co., NE, IX-3-1997 (9 ŒŒ, 6 œœ), IX-7-1997 (2 œœ), T. Klubertanz, and D. Jones. South Fork of Big Nemaha River, Hwy 8, 12.9 km SW of Humboldt, Richardson Co., NE, VII-23-1997 (1 œ), T. Klubertanz, VIII-3-1997 (4 ŒŒ, 1 œ), T. Klubertanz and D. Jones.

Diagnosis. Species identification of *Camelobaetidius* adults is made difficult by the lack of reliable characters. In the *C. waltzi* we examined, the color and shape of the turbinate eyes, the distribution and shade of color on the thorax and abdomen, and the shape of the hind wings were consistent.

C. variabilis and *C. waltzi* occur together in Texas (Baumgardner and Wiersema 1988). Adults of *C. variabilis* from Texas were examined and compared to *C. waltzi* from Nebraska. *C. waltzi* is slightly smaller and has shorter wings. Its turbinate eyes are larger, broader, and far more elevated above the head than in *C. variabilis.* The latter also has paler eyes than *C. waltzi.* The abdominal terga of *C. variabilis* are uniformly brown, with darkly pigmented trachea. In *C. waltzi*, the anterior segments of the abdomen are pale, and the trachea are not visible.

The turbinate eyes of *C. waltzi* are similar in shape, but not in color, to those of *C. mexicanus* (Traver and Edmunds) described in McCafferty and Provonsha (1993). Although *C. penai* (Traver and Edmunds) larvae from Argentina have labial palpi similar to *C. waltzi*, the turbinate eyes in adults of that species are contiguous dorsally (Traver and Edmunds 1968). None of the males or females of *C. waltzi* show purplish abdominal markings often found on *C. arriaga* (Traver and Edmunds).

The yellow pigment on the wings, femora, and abdomen were useful in separating *C. waltzi* from other baetids in our bulk samples. However, since they fade rapidly, they are not useful for identifying preserved specimens at either the generic and species level.

Field Notes. Ecological data for *C. waltzi* have been published only in McCafferty and Klubertanz (1994). This species is known from the Des Moines River (Iowa), the Wabash River (Indiana), and from Texas (Baumgardner and Wiersema 1998). The Des Moines and Wabash Rivers are larger than either the North or South Fork of the Big Nemaha River of Nebraska. In 1996, one larva also was taken from Muddy Creek, a much smaller river in southeast Nebraska (Richardson Co.). During August and September, 1997, we monitored depth, current velocity, and pH of the North and South Forks of the Big Nemaha River. Larvae were common in current velocities between 0.52 and 1.19 m/sec, the greatest velocity recorded at any site. These conditions frequently were found in riffle areas where the water was only 0.3 to 1.0 m deep. Water pH where larvae were found ranged from 8.5 to 9.0. Larvae typically were found on the upper surface of rocks that were covered with mats of filamentous algae.

McCafferty and Klubertanz (1994) listed mayflies found with *C. waltzi* in the Des Moines River. However, the sites along the North and South Forks of the Big Nemaha River have been more thoroughly sampled. In the North Fork of the Big Nemaha River, *Isonychia sicca* (Walsh) was the most common mayfly, whereas *Baetis intercalaris* was the most common mayfly found with *C. waltzi* at the South Fork site. Other species commonly found with *C. waltzi* were *Fallceon quilleri* (Dodds), *Tricorythodes* sp., and *Stenonema terminatum* (Walsh). Hydropsychid caddisfly genera abundant on rocks with *C. waltzi* were *Hydropsyche*, *Cheumatopsyche*, *Ceratopsyche*, and *Potamyia.*

Adult Emergence. Emergence of five subimagos was observed at dusk, 12.9 km N of Table Rock in Pawnee County, NE, on IX-7-1997. Emergence was from a small eddy (1 m in diameter) within a riffle area with high current. Subimagos emerged directly from the water surface and quickly ascended before being netted. Two of the captured subimagos (females) successfully were reared to confirm species identification.

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NOTES ON NORTH AMERICAN *BAETIS* (EPHEMEROPTERA: BAETIDAE): *BAETIS MOFFATTI* NEW SYNONYM OF *B. TRICAUDATUS* AND RANGE EXTENSION FOR *B. BUNDYAE*[1]

R. S. Durfee, B. C. Kondratieff[2]

ABSTRACT: *Baetis moffatti* is synonymized with *B. tricaudatus* based on comparisons of the type material of the former with reared specimens of the latter, and on the apparent absence of any other *B. rhodani* group species larvae from the type locality and vicinity. The range of *Baetis bundyae* is extended into southern Wyoming.

The specific identity of *Baetis moffatti* Dodds (1923), originally described from adults from South Boulder Creek at Tolland, Gilpin County, Colorado, has remained unclear. The only records published for this species since its description were by Traver (1935) for female specimens from El Paso County and Gunnison County, Colorado, and by McDunnough (1925a) and Walley (1927) for specimens from Canada. Previous to the adults of *Baetis magnus* McCafferty and Waltz being described, McCafferty et al. (1993) suggested a possibility that *B. moffatti* and *B. magnus* were synonymous. Attempts have been made to collect and rear *B. moffatti* from the type locality, however, only the larvae of *B. bicaudatus* Dodds and *B. tricaudatus* Dodds have been collected and reared from this site (Durfee and Kondratieff 1993). The type material of *B. moffatti*, a holotype male and a female allotype, were examined and critically compared to the other *rhodani* group species known from Colorado: *B. bicaudatus*, *B. magnus* and *B. tricaudatus*. Both type specimens remain in relatively good condition and the apparent color patterns of the abdomen, legs and head are retained. The males of *B. bicaudatus* are distinguished from the others by the smaller turbinate eyes on a longer stalk and the uniformly brown abdominal tergites, and the adults of *B. magnus* are characterized by distinct femoral and abdominal markings (Durfee and Kondratieff 1993). Comparison of the types of *B. moffatti* with *B. tricaudatus*, however, indicates that *B. moffatti* falls within the range of known variation for *B. tricaudatus* in Colorado. Since the adults of many species in the *rhodani* group are so morphologically similar as to be inseparable without associated larvae, we do not propose a synonym solely on the basis of finding no discernible differences between adults of the two species. The number of intercalaries between veins two and three of the hind wing is the character used to distinguish these species.Traver (1935) used this character to separate *B. tricaudatus* (2 intercalaries), *B. intermedius* Dodds

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(now a junior synonym of *B. tricaudatus*, 1 intercalary) and *B. moffatti* (no intercalaries). We have reared series of *B. tricaudatus* in which the number of intercalaries between veins two and three of the hind wing varies from zero to two, and have found this character to be of no taxonomic value. Additionally, Dodds (1923) stated that both sexes of *B. moffatti* have been collected in South Boulder Valley, from "5,900 to 11,000 feet", which indicates this species does not have a restricted habitat. The Colorado mayfly fauna is now relatively well known (McCafferty et al. 1993, Durfee and Kondratieff 1994), and in particular, the streams in the vicinity of South Boulder Creek have been intensively surveyed (Ward 1986, Ward and Kondratieff 1992).To date, the only larvae in the *B. rhodani* group that have been collected from these streams are *B. bicaudatus* and *B. tricaudatus*. This does not mean that other *rhodani* group species could not occur here, however, based on the above evidence we propose that *B. moffatti* is a junior subjective synonym of *B. tricaudatus* and provide the following nomenclatural summary.

Baetis tricaudatus Dodds

Baetis tricaudatus Dodds, 1923: 111. Type locality: Tolland, Colorado.
Baetis intermedius Dodds, 1923: 110. Type locality: Tolland, Colorado. (Syn. Morihara and McCafferty, 1979a: 153, Article 24, Principle of the First Reviser).
Baetis moffatti Dodds, 1923: 112. Type locality: Tolland, Colorado. **New synonym.**
Baetis vagans McDunnough, 1925b: 219. Type locality: Covey Hill, Quebec. (Syn. Ide 1937: 221; Bergman and Hilsenhoff 1978: 133; Morihara and McCafferty, 1979a: 153).
Baetis sp. 1 Traver, 1932: 231. Type locality: Black Mountain, North Carolina. (Syn. Traver 1935: 691; McCafferty 1996: 24).
Baetis jesmondensis McDunnough, 1938: 25. Type locality: Jesmond, British Columbia. (Syn. Waltz and McCafferty 1990: 138).

Baetis bundyae Lehmkuhl

Baetis bundyae was originally described from larvae collected from shallow tundra ponds in the Northwest Territories, Canada, by Lehmkuhl (1973). It was treated as a subspecies of the northern European *B. macani* Kimmins by Morihara and McCafferty (1979b). However, species status was reinstated when populations of *B. macani* and *B. bundyae* were found to coexist as distinct species in Scandinavia (McCafferty 1994, Engblom 1996).

Four larvae of *B. bundyae* were collected in a sweep net sample from the following location in Wyoming: Carbon Co., near Sand Lake, Medicine Bow National Forest, 11 July 1996, R. B. Rader. These specimens were collected at an elevation of 3,017 m from a habitat similar to that described by Lehmkuhl (1973). Previously, the recorded distribution for this species included Alaska, Yukon, Northwest Territories, Manitoba, Quebec and Labrador (Harper and Harper 1981 as *B. m. bundyae*). Lager et al. (1982) provided an additional record from a stream in Lake County in northeastern Minnesota. The discovery *B. bundyae* in southern Wyoming extends its range 750 km to the south. It is expected that additional populations of this species will eventually be discovered in similar habitats and elevations in other areas of the Rocky Mountains.

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SOCIETY MEETING OF OCTOBER 28, 1998

Dr. Karl Kjer
Department of Entomology, Cook College, Rutgers University

MOLECULES, MORPHOLOGY AND INSECT EVOLUTION

Dr. Kjer began with a brief review of molecular systematics. He pointed out the need for good morphology-based systematics to support development of evolutionary hypotheses from molecular sequence data. He then offered an assessment of what has been learned from molecular studies about the phylogeny of insect orders.

He illustrated some of the problems that arise in sequence studies. Homoplasy, the independent acquisition of a character state in unrelated lines of descent, is sometimes tractable with morphological traits but frequent in molecular sequences, where one substitution (for example, T to A) is like another. Long branch attraction, when extended periods of parallel development follow a short separation between two lineages, leads to groups being lumped when they should be split. Site change rate variation, compositional bias (the tendency of certain bases to accumulate disproportionately) and multiple substitutions at the same site on a molecule, all add to the possibility of error. Arthropods change rapidly, the main branching of insect orders occurred hundreds of millions of years ago. Fast-evolving groups like Diptera are pushed toward the bottom of phylogenetic trees as their molecular distance from other groups increases. He stressed the need for more extensive sampling of diverse taxa and genes; many studies have been very narrow. To illustrate each of these potential pitfalls, Dr. Kjer showed a number of proposed phylogenies based on sequence data from different insects and molecules. The lack of consistency in the positions of the major and minor insect orders in these trees led him to conclude that much remains to be done before evolution of the insect orders is fully understood.

In notes of entomological interest, President Gelhaus reported that several members showed up for Bioblitz in Fairmont Park, Philadelphia, despite very rainy weather. Over 1,000 taxa were found in the mowed fields, play areas and remnant natural sites in the 24-hour inventory. It is hoped that this effort will be repeated annually at different sites within the region. President Gelhaus also noted that Insect Field Day attracted over one hundred participants; Hal White showed his pictures from the event. Hal also reported that the Calvert Award information is posted on the website. He also described a mass movement of larvae of the green June beetle, crawling, characteristically, on their backs with legs in the air. Bill Day noted that former President David Rentz has published *Grasshopper country: the Abundant Orthopteroid Insects of Australia,* which has been very favorably reviewed.

William J. Cromartie, Corresponding Secretary

ADDITIONAL OBSERVATIONS ON THE NESTING BEHAVIOR OF *TACHYSPHEX TARSATUS* (HYMENOPTERA: SPHECIDAE)[1]

Frank E. Kurczewski[2]

ABSTRACT: New information on the nesting behavior of *Tachysphex tarsatus* from lower Michigan, southwestern Ontario, northern New York, and Long Island is given.

The *pompiliformis* group is the largest *Tachysphex* species group in North America. It is characterized by the "absence of specializations" found in the other groups. This large group contains nearly 60 nearctic species with diverse behavioral and ecological characteristics (Pulawski 1988). Because of its large size the *pompiliformis* group should be separated into several subgroups with common characteristics (Elliott and Kurczewski 1985). Nesting behavior information for 14 and prey records for another six species in this group were delineated and tentative subgroups assembled (Kurczewski 1987a).

Tachysphex tarsatus (Say) is one of the most widely distributed species in the *pompiliformis* group in North America north of Mexico (Pulawski 1988). The nesting behavior of this common species has been studied in some detail (Kurczewski 1991). The present paper intoduces new information on the nesting behavior of *T. tarsatus* from regions not examined previously such as lower Michigan, southwestern Ontario, and Long Island. The study substantiates the placement of this species, *T. laevifrons* (F. Smith), and *T. williams* R. Bohart in a common subgroup (Kurczewski 1987a, 1987b).

Nesting Behavior

Eleven females were observed nesting in sand or fine gravel in lower Michigan, southwestern Ontario, northern New York, and Long Island. Nests were studied at the edge of a field [Allegan State Game Area, Allegan County, Michigan; 11 June 1993], rest area parking lot [Hart, Oceana County, Michigan; 12 July 1993], roadside ditch [Canfield Lake, Manistee, Manistee County, Michigan; 12 July 1993], two-track car trail [Huron Beach, Presque Isle County, Michigan; 28 June 1995; Canadian Forces Base Borden, Simcoe County, Ontario; 27 July 1996], gravel pit [1 km E Croghan, Lewis County, New York; 3 August 1996], base of dune [Hepworth Sand Dunes, Grey County, Ontario; 30 June 1997], fitness trail [Fort Drum Military Reservation, Jefferson County, New York; 5, 6, 12 July 1997], and utility power line right-of-way [Route 31,

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Westhampton, Suffolk County, New York; 25 June 1998]. The wasps nested between 0952 and 1605 h (EDT) at air temperatures of 21-33° C and sand surface temperatures of 32-43° C.

All wasps transported prey to their nests on the ground. All nests were single-celled. Entrance diameter ranged from 5 to 10 mm (mean, 7.9 mm; N=11). Tumuli in front of two entrances were 26-30 mm long, 25-30 mm wide, and 6-8 mm high. Burrows were 23 to 47 mm long including cell length (Table 1). Cells were 12 to 28 mm deep including cell depth (Table 1). Cell length ranged from 13 to 15 mm; cell height, 5 to 8 mm; and cell width, 6 to 8 mm. The number of prey per fully provisioned cell was either 1 or 2 (Table 1). All grasshoppers were placed in the cells in a head inward and ventral side upward position, even when there were two prey in the cell. Seven wasp eggs were affixed to the prey's left and four to the right forecoxal coria. The grasshoppers weighed (wet) 49 to 143 mg (Table 1). The wasps weighed (wet) 23 to 35 mg (Table 1). The prey Acrididae were identified as nymphs of *Dissosteira carolina* (L.) (6), *Trimerotropis maritima interior* E. M. Walker (1), *Melanoplus f. femurrubrum* (DeGeer) (2), and *Melanoplus* sp. (4), and a female nymph of a new prey species, *Chloealtis conspersa* Harris (1) (Table 1).

Discussion

Tachysphex tarsatus is structurally and behaviorally similar to *T. laevifrons* and *T. williamsi*. The species belonging to this subgroup of the *pompiliformis* group omit a temporary closure of the nest entrance, capture small to large acridids, transport them in flight or on the ground depending on their size, and store one or a few prey in a single-celled nest (Kurczewski 1987a, 1987b, 1991).

Table 1. Nest data for *Tachysphex tarsatus*, 1993-1998.

Locality*	Burrow length (mm)	Cell depth (mm)	No. prey/ cell	Wasp wgt (mg)	Prey wgt (mg)	Prey species
1	29	12	1	23	98	*Dissosteira carolina*
2	36	20	1	31	124	*Dissosteira carolina*
3	38	23	1	28	107	*Trimerotropis maritima interior*
4	42	20	1	24	127	*Dissosteira carolina*
5	46	28	1	26	138	*Dissosteira carolina*
6	41	22	2	34	58,77	*Melanoplus f. femurrubrum* (2)
7	37	20	1	35	143	*Chloealtis conspersa*
8	23	13	2	25	51, 49	*Melanoplus* sp. (2)
9	29	17	2	28	57, 61	*Melanoplus* sp. (2)
10	47	23	1	33	90	*Dissosteira carolina*
11	44	24	1	32	91	*Dissosteira carolina*

*Localities numbered according to order in text.

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W. J. Pulawski confirmed the identity of *Tachysphex tarsatus*. M. F. O'Brien named some of the prey Acrididae.

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SOCIETY MEETING OF NOVEMBER 18, 1998

David G. Furth
Smithsonian Institution

SEARCHING FOR SUMACS AND FLEA BEETLES: FROM AFRICAN POISON ARROWS TO MEXICAN POISON IVY

The genus *Blepharida* is the primary genus in a group of about 16 genera worldwide which have similar adult and larval morphology as well as an interesting natural history in common. Recent research by Dr. Furth has increased the knowledge of the host plant relationships of these genera and a pattern has begun to emerge demonstrating a probable phytochemical relationship between the two main foodplant families Anacardiaceae and Burseraceae. Perhaps the most unusual members of this complex *(Diamphidia* and *Polyclada)* contain extremely toxic hemolytic and neurotoxic poisons concentrated in the pupal stage and have been long used by the Bushmen tribes of southern Africa to poison their arrows. The poison is fabricated by the larvae rather than being sequestered from its foodplant *(Commiphora:* Burseraceae).

Dr. Furth began studying the biology of this complex of genera in Israel and Kenya, then later in North America, Central and South America, Asia and Australia. An Asian member of this group, *Podontia lutea,* is the largest flea beetle (Alticinae) in the world, reaching almost 20 millimeters in length. Dr. Furth has just published a monograph on the New World *Blepharida* which has 38 species, 31 of which are endemic to Mexico, and 16 of which are new to science. All species feed monophagously on species of *Bursera,* except the common North American *Blepharida rhois* on sumacs and one new species feeding on the Mexican poison ivy tree *(Pseudosmodingium perniciosum).*

In notes of entomological interest, President Gelhaus brought out parts of his collection of winter craneflies. Other topics discussed were new statistics on insects and human deaths and the recently introduced Lyme disease vaccine. Bill Day introduced the slate of candidates for February 1999 Society election.

William J. Cromartie,
Corresponding Secretary

NOTES ON THE NESTING BEHAVIOR OF *EREMNOPHILA BINODIS* (HYMENOPTERA: SPHECIDAE)[1]

Sandor Christiano Buys[2,3]

ABSTRACT: This paper presents observations on the nesting behavior of *Eremnophila binodis* in a tropical rain forest in southern Brazil. These observations deal mainly with the digging of the nest and its temporary closure The behavior of this species is essentially similar to that of other species of *Eremnophila* and some species of *Ammophila*.

The genus *Eremnophila* Menke was first proposed as a subgenus of *Ammophila* Kirby (Menke 1964) and elevated to genus status later (Menke 1966). This genus has nine species distributed in the Neotropical region (Menke 1964). The biology of species in the genus *Eremnophila* is poorly known, the published data limited to a few short notes on some species (Richards 1937, Evans 1959, Genise 1981). Herein I present observations about the nesting behavior of *E. binodis* (Fabricius).

The studies on *E. binodis* were carried out in the Biological Reserve of Poço das Antas (20⁰ 30' S and 42⁰ 15' W), Rio de Janeiro, in southern Brazil. The vegetation of this area consists of well preserved tropical rain forest (Atlantic forest). The summer is the hot, rainy season, and the temperature reaches 42⁰C. The winter is the colder and more dry season, but the temperature is always above 20⁰C.

During 1995 and 1996 I observed several specimens of *E. binodis* along unpaved roads, hovering near vegetation and collecting nectar from herbaceous plants like *Borreria* sp. (Rubiaceae). However, their nests were not easily discovered, probably because females usually nest beneath clumps of vegetation. Some wasps were seen in copulation resting on plants or flying around, but I was not able to find their nests.

On May 12, 1995, I found a female while she was digging her nest beneath small tufts of grass in the midst of a dirt road where the soil was very compact. She bit off lumps of soil with her mandibles, accumulating them between her mouthparts. She repeatedly flew off about 30-40 cm, always using a similar trajectory, and dropped the lumps of soil on the same spot. While digging the soil she emitted an easily audible buzzing sound. She dug a cylindrical nest, 1 cm in width and 5 cm in depth. After digging the burrow the female closed it

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temporarily. The temporary closure consisted of two small leaves, small pebbles, and some earth scuffed over the top. First she placed the leaves inside the burrow. These were used to support the pebbles and the earth. She packed the last with the oral surface of her head, with her mandibles open. The wasp then added a small pebble on the nest entrance and flew away. When the female departed, I removed the closure so that I could observe in detail the construction of a new temporary closure when she returned. First she placed a small dry leaf collected on the ground far away from the burrow, even though there were several other apparently similar leaves around the nest entrance. Soon after collecting the first leaf, she obtained four more leaves that she collected beside her nest. The first leaf was apparently collected away from the nest because she had to select an object capable of supporting the other ones efficiently. After arranging the leaves inside the nest she brought a large pebble with her mandibles. She could hardly carry this pebble after a set of short flights. She deposited then another smaller pebble and started scooping with her forelegs, throwing little lumps of earth behind her. She interrupted the digging twice. The first time, she added two more small pebbles into the nest. The second time, she put in another leaf. The earth excavated formed a mound beside the burrow which the wasp pushed towards the nest entrance all at once. The overall process of closure took seven minutes. Once the closure was done, the wasp flew off, possibly to search for prey. Another day a female was observed carrying a notodontid caterpillar over the ground, holding it with her mandibles.

Other species of *Eremnophila* build temporary closures with materials similar to those of *E. binodis*. Richards (1937) observed a female of *E. opulenta* Guérin temporarily closing the nest with plant debris. Evans (1959) found a female of *E. aureonotata* Cameron using a single dried leaf as a temporary plug. However, in order to build the final closure, *E. aureonotata* used lumps of earth and bits of leaves and scraped the soil into the burrow with her forelegs. Genise (1981) observed *E. eximia* (Lepeletier) using small pebbles, plant debris, and sand to temporarily close the nest. The digging behavior and the structure of the temporary closure of the nest of *E. binodis* are quite similar to those of some species in the genus *Ammophila* (Evans 1959, Powell 1964), which is closely related to *Eremnophila*. Caterpillars from the following families have been recorded as prey for females of *Eremnophila*: Hesperiidae (Richards 1937), Notodontidae (Evans 1959), and Sphingidae (Genise 1981).

Voucher specimens of *Eremnophila binodis* have been deposited in the collection of the Department of Zoology of the Museu Nacional/Universidade Federal do Rio de Janeiro.

ACKNOWLEDGMENTS

Sérvio Amarante has kindly identified specimens of *E. binodis*. A female specimen of this species with her prey has been collected by Fernando Ferraz and Antônio Siqueira Campos. The manuscript benefited from the useful comments of Gabriel Mejdalani, Jorge

Campos. The manuscript benefited from the useful comments of Gabriel Mejdalani, Jorge Nessimian, and Marcos Caldas. The Laboratory of Insect Ecology of the Universidade Federal do Rio de Janeiro receives grants from CNPq, FAPERJ, and Boticário Foundation.

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SOCIETY MEETING OF MARCH 24, 1999

John Abbott
Stroud Water Research Center

DRAGONFLY AND DAMSELFLY DIVERSITY IN THE SOUTH-CENTRAL U.S.

Dr. Abbott began by explaining that the south-central United States serves as an important biogeographical link and dispersal corridor between Nearctic and Neotropical elements of western hemisphere odonate faunas. The species are reasonably well known because of substantial collections, but there had never been a concerted effort to document the extent of biodiversity and possible geographic affinities of dragonflies and damselflies in this region. Dr. Abbott then gave a brief review of the diversity of Odonata in the region including some of the species that have been added to the region's fauna since the conception of this study five years ago. These included 13 previously unreported species from Texas, including five new to the U.S. and one species each to the Louisiana and Oklahoma faunas.

Dr. Abbott has documented a total of 12,515 records of Odonata found in 408 counties within the south-central U.S. A total of 73 species of damselflies and 161 species of dragonflies have been documented in the region. The 234 (198 in Texas) Odonata species are distributed among 10 families and 66 genera.

Dr. Abbott then went on to show patterns in diversity and biogeographical affinity for the Odonata fauna in this region. He summarized the ranges of each species in the region with regards to compass direction. He showed that further compass analysis revealed the predominant biogeographical pattem for dragonflies in this region is to have affinities with more eastern and widespread distributions. He compared the diversity of Odonata within the region to caddisflies (Trichoptera) and butterflies (Lepidoptera). He also compared the diversity of Odonata in the conterminous U.S. with that of breeding birds, and described differences in these apparent pattems. He found that there is no strong correlation between land area and species diversity of Odonata within the south-central or conterminous U.S., but found those areas where aquatic systems and topographic heterogeneity are the greatest provide a broader spectrum of potential Odonata habitats and thus support a greater number of Odonata species. He suggested then that a small area (or state) that has been well-studied may support as many species as larger well-studied areas (or states).

William J. Cromartie, Corresponding Secretary

ACERPENNA THERMOPHILOS, comb. n. (EPHEMEROPTERA: BAETIDAE)[1,2]

W. P. McCafferty[3]

ABSTRACT: The western North American baetid species *Acerpenna thermophilos*, comb. n., is removed from *Baetis*, where it was originally described. Recent work on the genus *Acerpenna* indicates that hindwing and male genitalia characteristics of the species are typical of the genus *Acerpenna*, not *Baetis*. Only the future discovery of the larval stage of this species will indicate the degree of relationship with *A. pygmaea*.

Waltz and McCafferty (1987) established the North American genus *Acerpenna* based primarily on the distinctiveness of its larvae. Certain species that were previously placed in *Baetis* were included in *Acerpenna*. Those species are not related to *Baetis* and are not members of the *Baetis* complex of genera, as defined by larval characters (see generic key in Lugo-Ortiz and McCafferty [1998]). Species initially placed in *Acerpenna* were known in the larval stage, and included *A. macdunnoughi* (Ide) and *A. pygmaea* (Hagen). Waltz and McCafferty (1987) also indicated a combination of hindwing and forceps shape characteristics that could be diagnostic of the adults of the genus. McCafferty and Waltz (1990) added *A. harti* (McDunnough) and *A. akataleptos* (McDunnough) to *Acerpenna*. At that time, these latter species were unknown as larvae but possessed adult characteristics consistent with *Acerpenna*. Waltz et al. (1998) reared *A. harti* and showed that its larvae and adults had characteristics that fell within a range that they could associate with *A. pygmaea*.

Numerous western, and especially Californian species of *Baetis*, remain unknown in the larval stage and poorly known in general. For example, of the nine valid California species currently considered in *Baetis* and listed by Day (1956), only *B. adonis* Traver, *B. bicaudatus* Dodds, and *B. tricaudatus* Dodds are known in the larval stage (see McCafferty and Silldorff 1998). In reviewing the adults of the other six California species, it was obvious that one of them was not correctly placed in *Baetis*, but apparently belonged to *Acerpenna*. This species is *Acerpenna thermophilos* (McDunnough), comb. n.

Hindwings and genitalia characteristics of *A. thermophilos* agree with those of other species of *Acerpenna*. Most revealing is the costal border distal to the costal process of the hindwing, which is undulate as indicated for *Acerpenna* by Waltz and McCafferty (1987). Also, as is often the case in *Acerpenna*, the apex of the hindwing is somewhat blunt and the anal margin is slightly con-

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cave in the basal half. Compare Fig. 163 (Traver 1935) of *A. thermophilos* with Fig. 1 (McCafferty and Morihara 1979) of *A. macdunnoughi* and Fig. 2 (Waltz et al. 1998) of *A. pygmaea*. Only the genus *Camelobaetidius* Demoulin has similar hindwings (see Traver and Edmunds 1968). The genital forceps of *A. thermophilos* are also typical of *Acerpenna*, particularly in terms of the elongate terminal segment (see Fig. 2 in Morihara and McCafferty [1979]). However, some *Camelobaetidius* species also have this type of forceps.

Traver and Edmunds (1968) indicated that all species of *Camelobaetidius* had only two longitudinal veins in the hindwings. I have seen no exceptions to this in material studied since then, not even the presence of a short third vein or a long intercalary vein. Waltz et al. (1998) showed in two of the variations of hindwings in *A. pygmaea* that short third veins were present, and McCafferty and Morihara (1979) showed that *A. macdunnoughi* had a third vein in the hindwing extending from about mid-wing to the apical margin. *Acerpenna thermophilos* has a third vein in the hindwing that extends for about three quarters of the length of the wing. This is an essential criterion at this time for placing the species in *Acerpenna* rather than *Camelobaetidius*. Although the adults of *Acerpenna* and *Camelobaetidius* are similar, the larvae of these two genera are very distinct.

Acerpenna thermophilos was described from Yellowstone, Wyoming, and has subsequently been taken in California near the Eel River and probably also Cloverdale (Traver 1935). Waltz et al. (1998) indicated that in addition to *A. harti*, the west Canadian species *A. akataleptos* may also prove to be a synonym of the widespread *A. pygmaea*. Both McDunnough (1926) and Traver (1935) indicated that adults of *A. thermophilos* were highly distinguishable from the *pygmaea*/*harti*/*akataleptos* type. Although the presence of the long third vein in the hindwing and larger size might suggest that *A. thermophilos* is a valid species, experience with baetids has shown that hindwing venation can sometimes be deceptive because it can be highly variable. This was demonstrated by Durfee and Kondratieff (1993), for example, with multiple rearings of *B. magnus* McCafferty and Waltz and *B. tricaudatus* in Colorado. Discovery of the larvae of *A. thermophilos* will probably be the final arbiter as to the validity of the species.

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SOCIETY MEETING OF FEBRUARY 24, 1999

(continued from page 192)

native beetle to the rates for the introduced biological control agent, *G. nymphaeae* eggs were also placed in the field and the number of eggs eaten was counted daily. Egg predation rates were much higher for this native beetle, around 50% were eaten in this experiment. These results indicate that the introduced beetles may be less vulnerable to predators found in North America than native herbivores. This suggests that egg predators should not prevent *G. calmariensis* from maintaining viable populations in North America.

Since their release in 1992, all three biological control agents have established populations in some loosestrife stands in North America. A thriving population of *G. pusilla* at Tinicum Marsh near Philadelphia, Pennsylvania has been monitored for the past three summers to determine whether the beetles are having an impact on the loosestrife there. There was no detectable decline in density of loosestrife at the marsh, but the number of loosestrife seeds in the seedbank appeared to have declined. This indicates that the beetles may be causing a decrease in flowering and subsequent seedset. More time is needed to determine whether the beetles are able to cause a significant decline in loosestrife densities in the area.

In notes of entomological interest, Andrew Short reported that he collected *Zorytypus hubbardi* (Zoraptera) from a dead log at a locality in northeastern Delaware. This marks the most northeasterly record of the order in the eastern U.S. Joe Sheldon shared a few of his slides from a recent biological inventory trip to Belize. Debbie Carr requested help with the bio blitz to be held in Fairmont Park, May 21-22.

William J. Cromartie,
Corresponding Secretary

SCIENTIFIC NOTE

ADDITIONS TO THE SOUTH DAKOTA EPHEMEROPTERA[1,2]

W. P. McCafferty[3], B. C. Kondratieff[4]

The mayfly fauna of South Dakota was first treated by McCafferty (1990), wherein 21 species were noted, 19 of which were new state records taken from the Black Hills region. Herein we report an additional 16 species of mayflies from South Dakota. All reported material is deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana (PERC) or the C. P. Gillette Museum of Arthropod Diversity, Fort Collins, Colorado (CSU).

The new state records include *Acerpenna macdunnoughi* (Ide): larvae, Beadle Co, Hitchcock, V-6-1959, PERC, and Minnehaha Co, Big Sioux R, Palisade State Park, IV-10-1996, R. W. Baumann & B. C. Kondratieff, CSU; *Acerpenna pygmaea* (Hagen): larvae, Brule Co, Missouri R, Chamberlain, VI-23-1989, B. C. Kondratieff & M. Harris, CSU; *Baetis bicaudatus* Dodds: larvae, Lawrence Co, Spearfish Cr 5 mi S Spearfish at US Hwy 14A, VI-9-1961, G. F. Edmunds & W. L. Peters, and Spearfish Cr, 8 mi S Spearfish at Hwy 14A, III-25-1968, H. H. Ross & T. L. Harris, PERC; *Baetis magnus* McCafferty and Waltz: larvae, Lawrence Co, False Bottom Cr, 7 mi N Deadwood, VII-24-1968, H. H. Ross & T. L. Harris, PERC; *Caenis latipennis* Banks: male adults, Harding Co, Little Missouri R, Camp Crook, Hwy 20, VII-7-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Drunella doddsi* (Needham): larvae, Lawrence Co, Spearfish Cr, 5 mi S Spearfish at US Hwy 14A, VI-9-1961, G. F. Edmunds & W. L. Peters, PERC; *Epeorus longimanus* (Eaton): male and female adults, Lawrence Co, Jim Cr, Rd 208 E Merritt, VII-11-1997, and stream in Jenny Gulch, N Pactola Reservoir, VII-11-1997, and Pennington Co, Burnt Fork, Rd 208 E Merritt, VII-11-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Heptagenia diabasia* Burks: male and female adults, Brule Co, Missouri R, Chamberlain, VI-23-1989, B. C. Kondratieff & M. Harris, CSU; *Hexagenia limbata* (Serville): male and female adults, Brule Co, Missouri R, Chamberlain, VI-23-1989, B. C. Kondratieff & M. Harris, CSU; *Labiobaetis propinquus* (Walsh): larvae, Lawrence Co, Squaw Cr at confluence with Spearfish Cr, VI-9-1961, G. F. Edmunds & W. L. Peters, PERC, and Little Spearfish Cr, VII-13-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Leptophlebia nebulosa* (Walker): male and female adults, Fall River Co, Cheyenne R, Angostura Reservoir, Angostura State Park, VII-8-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Leucrocuta maculipennis* (Walsh): male and female adults, Butte Co, Belle Fourche R, Hwy 79 N Sturgis, VII-15-1997, and Belle Fourche R at Belle Fourche, VII-13-1997, and Harding Co, Little Missouri R, Camp Crook, Hwy 20, VII-7-1997, R. W. Baumann & B. C. Kondratieff, CSU & PERC; *Paraleptophlebia debilis* (Walker): larvae, Pennington Co, Rapid Cr 3 mi below Pactola Reservoir on SD Hwy 40, VI-8-1961, G. F. Edmunds and W. L. Peters, PERC, and male adults, Rapid Cr below Pactola Reservoir, VII-11-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Paraleptophlebia memorialis* (Eaton): male and female adults, Custer Co, Iron Cr, Hwy 16A, Lakota Campground, VII-10-1997, and Pennington Co, stream in Sunday Gulch, Hwy 87, S Hill City, VII-9-1997, and Rapid Cr, Rapid City Golf Course, VII-11-1997, R. W. Baumann & B. C. Kondratieff, CSU;

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Siphlonurus occidentalis (Eaton): male and female adults, Custer Co, stream entering Sylvan Lake, VII-9-1997, R. W. Baumann & B. C. Kondratieff, CSU; *Stenacron interpunctatum* (Say): male and female adults, Pennington Co, Rapid Cr, Rapid City Golf Course, VII-11-1997, R. W. Baumann & B. C. Kondratieff, PERC.

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SCIENTIFIC NOTE

DISTRIBUTION OF SIPHLAENIGMATIDAE (EPHEMEROPTERA)[1,2]

W. P. McCafferty[3]

The restricted family Siphlaenigmatidae was reported from Australia by Lugo-Ortiz and McCafferty (1998), with the description of *Siphlaenigma edmundsi* Lugo-Ortiz and McCafferty based on larvae labeled as collected by G. F. Edmunds in 1966 from New South Wales. This monogeneric family, which is related to Baetidae, had been known only from New Zealand (Penniket 1962). Because Edmunds collected in New Zealand and Australia on the same trip, and because specimens were sorted at the same time, there has remained a possibility that the material was mislabeled. Other data concerning this possibility have recently come to my attention. According to P. J. Suter (pers. comm.), an Australian mayfly authority, the reported locality of *Siphlaenigma* in Australia is a well-known aquatic collecting site and a presence of *Siphlaenigma* there cannot been confirmed by him, nor has it been confirmed by other field workers in Australia (P. S. Cranston, pers. comm.). Also, the Edmunds Australian field collecting number for the putative locality of *Siphlaenigma* in Australia is the same as his New Zealand field number for a locality from where *Siphlaenigma* was originally taken (W. L. Peters, pers. comm.). More importantly, I have now confirmed that mislabeling between Australian and New Zealand had taken place within the Edmunds collection. I have recently found specimens of the Australian baetid species *Edmundsiops instigatus* Lugo-Ortiz and McCafferty, which had been collected by Edmunds, in vials from the Edmunds collection with New Zealand labels. Baetidae does not occur in New Zealand and the latter specimens are certainly incorrectly labeled. Obviously, there had been some misappropriation of labels when materials were first sorted. Based on all of the above, the family Siphlaenigmatidae should be expunged from Australian records, and I regard S. *edmundsi* as a junior synonym of S. *janae* Penniket.

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2 Purdue Agricultural Research Journal No. 15952.

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SOCIETY MEETING OF FEBRUARY 24, 1999

BIOLOGY OF THE LEAF BEETLES INTRODUCED AS BIOCONTROL AGENTS ON PURPLE LOOSESTRIFE

Ann Herzig,
Bryn Mawr College

Purple loosestrife *(Lythrum salicaria)*, a wetland plant from Europe, has aggressively invaded North American wetlands, displacing native plants and animals. In an effort to restore the integrity of our wetlands, three beetles have been introduced from Europe as biological control agents to feed on the plant, *Hylobius transversovittatus* (Curculionidae), *Galerucelia calmariensis*, and *Galerucelia pusilla* (Chrysomelidae). The hope is that these insects will kill or weaken purple loosestrife to the point that it loses its competitive edge, allowing native plants and animals to reclaim loosestrife-dominated wetlands.

Two experiments were conducted to study some life history traits of *Galerucella calmariensis* beetles that may influence their effectiveness as biological control agents. The first experiment examined their dispersal behavior, which will affect how well these beetles should spread once released. A massive mark-recapture experiment was conducted near Ithaca, New York. One thousand color-coded beetles were released at each of six different release points ranging from 15 to 850 meters from a target patch of purple loosestrife. Beetles from all distances, even the farthest distance, arrived at the target patch. The number of beetles recaptured from each release point suggested that beetles flew in a random fashion and that there was high mortality (a 3% chance of dying, or otherwise disappearing, for every 10 meters travelled) when flying long distances (the hundreds of meters measured in this experiment). In addition to measuring the ability of these beetles to fly over large distances, the experiment was also designed to measure whether beetles would be attracted to conspecifics already present on the target patch. The target patch was divided into sections that contained either a large number of *G. calmariensis* beetles or no beetles. A large majority (86%) of all recaptured beetles flew to segments that contained conspecific beetles. These results suggest that, due to the high mortality associated with long dispersal flights, *G. calmariensis* may not be very good at spreading far from their original release sites. In addition, the beetles are likely to form aggregations in the field due to their tendency to disperse to occupied areas. Because *G. calmariensis* actively form aggregations, occurring in large groups probably provides some advantage to these beetles. Therefore, a release strategy in which beetles are initally released in large groups rather than spread evenly over an area is warranted.

A second experiment was designed to test the vulnerability of *G. calmariensis* eggs to egg predators found in North American wetlands. Two common predators of chrysomelid eggs found in the area of this study, near Ithaca, New York, were two coccinelid beetles, *Harmonia axyridis* (a beetle introduced from Asia) and *Coleomagilla maculata* (a native of North America). The rate at which *G. calmariensis* eggs were eaten was measured by placing known numbers of egg masses in the field and noting how many were eaten each day until they hatched. *G. calmariensis* deposits a narrow strip of excrement on the top of its eggs immediately after the eggs are laid. To test whether this frass deterred egg predators, it was removed from some eggs; the rate at which these eggs were eaten was compared to the control eggs from which the frass had not been removed. About fifteen percent of the eggs were eaten, regardless of whether or not they were covered with frass. Thus, in this experiment, the frass did not appear to deter predators.

A native chrysomelid beetle, *Galerucella nymphaeae*, has broadened its host range and now feeds on purple loosestrife in some areas. To compare egg predation rates of this

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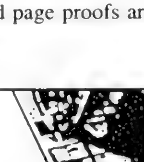

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(Continued on inside of back cover)

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MADACHAULIODES RANOMAFANA, A NEW MADAGASCAN SPECIES OF CHAULIODINAE (MEGALOPTERA: CORYDALIDAE), WITH A KEY TO THE WORLD GENERA OF CHAULIODINAE[1,2]

Norman D. Penny[3]

ABSTRACT: A new species, *Madachauliodes ranomafana* is described from Ranomafana National Park, Madagascar, and compared with *M. torrentialis*, the only other known species of the genus. An original key is given to known genera of Chauliodinae (Megaloptera: Corydalidae), of which *Madachauliodes* is a member.

Paulian (1951) erected the genus *Madachauliodes* without giving specific character states to distinguish it from other genera of Chauliodinae ("Because of characters of the wing venation, form of the labrum and of the genitalia this Malagasy megalopteran forms a separate genus"). Neither were character states of related genera given to allow comparisons. Kimmins' (1954) key to genera of Chauliodini (now Chauliodinae) did not include this genus, except to state (in a footnote) that it is related to *Platychauliodes* from South Africa because of the lack of a basal r-m crossvein in the hindwing, but differs in having a longer fork of the Cu1. The discussion of this genus in a footnote seems to indicate doubt as to its validity.

The original description of *M. torrentialis* indicated a type from the Mount Tsaratanana (14°00'S, 49°00'E) in the northern part of the country at 2500 m elevation. Although there was no indication as to the number of specimens involved in that description (nor sex of the type), males, females, pupae and larvae were illustrated. Paulian indicated that specimens of *M. torrentialis* had also been collected south of the capital (Antananarivo) in the Ankaratra Range (19°00'S, 47°15'E), especially at Manjakatompo at 2000 m elevation. There are two males and one female of this species in the USNM collection from Ranomafana National Park.

In the course of examining specimens of Neuroptera and Megaloptera from Madagascar in the collections of the National Museum of Natural History (NMNH) and California Academy of Sciences (CAS), representatives of two species of *Madachauliodes* were encountered. Because only one species had previously been named, the second species is herein described.

Materials and Methods: Male specimens had the tips of their abdomens re-

[1] Received December 29, 1998. Accepted February 17, 1999.

[2] This is contribution Number 2 of the California Academy of Sciences, Center for Biodiversity Research and Information.

[3] Department of Entomology, California Academy of Sciences, San Francisco, CA 94118.

moved and macerated in 10% KOH. These abdominal apices were then preserved in glycerin genital vials. The macerated material was examined in glycerin using a Wild Stereoscopic microscope and drawn using a camera lucida attachment. Names used for structures of male terminalia follow Glorioso (1981).

Madachauliodes ranomafana Penny, NEW SPECIES

Diagnosis: The whereabouts of the type of *M. torrentialis* is unknown. However, original description and illustrations of this species allow good comparison with an identified series of two males and one female of *M. torrentialis* in the collection of the United States National Museum. Adults of the newly described species can be separated from those of *M. torrentialis* by several characteristics: *M. ranomafana* have pale brown antennae on the basal half rather than black antennae throughout; the tarsal claw base is conspicuously broadened, strikingly contrasting with the narrow apical portion, rather than being evenly tapered to an unexpanded base; the tenth gonostyli-gonocoxite structure is relatively much larger, as large as the ninth sternite; and the tenth tergites are much more robust and apically rounded rather than elongate and apically pointed, as in *M. torrentialis* (Fig. 4).

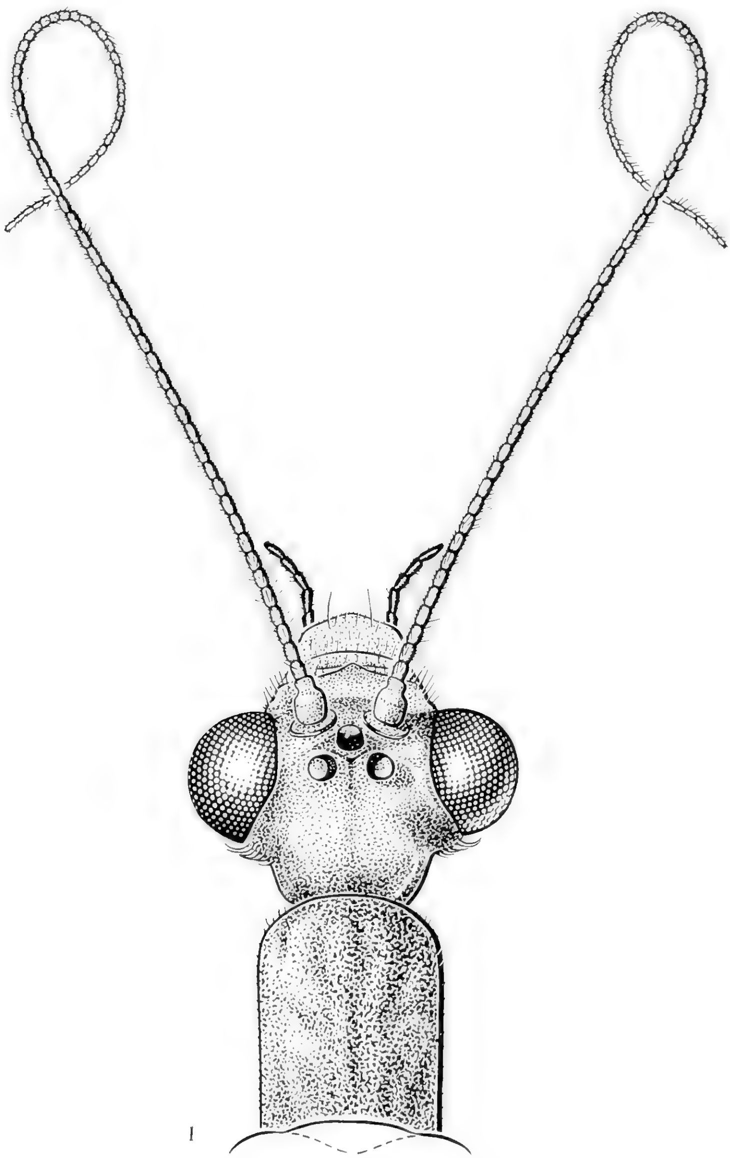
Description:

Head: Vertex, frons, clypeus and labrum yellowish brown. Vertex tapered posteriorly. Maxillary and labial palpi dark brown. Mandibles with several very small apical teeth. Three transparent ocelli in triangular configuration with black pigmentation on inner aspect of each ocellus. Antennae (Fig. 1) filiform with 55 flagellomeres; pale brown basally, becoming dark brown on apical half.

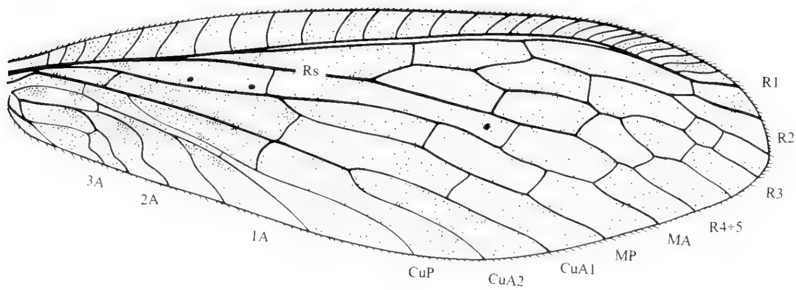
Thorax: Pronotum cylindrical, uniformly pale brown. Meso- and metanota dark brown laterally, pale brown medially. *Legs:* uniformly pale brown; bearing golden brown setae longer than tibial width. Tarsal claws three times as long as wide, evenly tapering to broader unnotched base. *Wings:* Forewing length 25-28 mm (holotype – 28 mm) (Fig. 2), membrane pale brown with numerous small dark brown infuscations. Costal area slightly broader than basal width of r cells; 16-17 costal crossveins before pterostigmal area. R2 two-branched; R3 two to three-branched; R4+5 unbranched. Three nygmata between R and M. MA and MP unbranched. Cu A two-branched, CuP unbranched. 1A, 2A and 3A each two-branched. Cell A1 closed distally by crossvein between A1 and A2. Hindwing with 12 costal crossveins. R2 two-branched; R3 two-branched; R4+5 unbranched. MA and MP unbranched. CuA two-branched; CuP two-branched. 1A two-branched; 2A two-branched; 3A unbranched.

Abdomen*:* Uniformly pale brown. First eight abdominal segments membranous.

Male terminalia: Ninth sternite reduced to membranous quadrate lobe about one-half size of preceding sternites, apically slightly concave. Tenth gonostyli and tenth gonocoxites (Fig. 3) fused as an enlarged, heavily sclerotized 10th sternite dorsal to ninth sternite. Tenth sternite composed of a ventral, apically truncate lobe; a dorsal, apically truncate and recurved second lobe; and two narrow lateral arms which are flattened and expanded at their lateral margins; about as large as ninth sternite. Ninth gonostyli absent. Tenth tergites relatively short, about twice as long as wide with a medial field of small teeth; apex rounded. Callo cerci relatively large, covering one-half lateral surface of tenth tergite.



1. *Madachauliodes ranomafana* n.sp. Head and prothorax in dorsal view.



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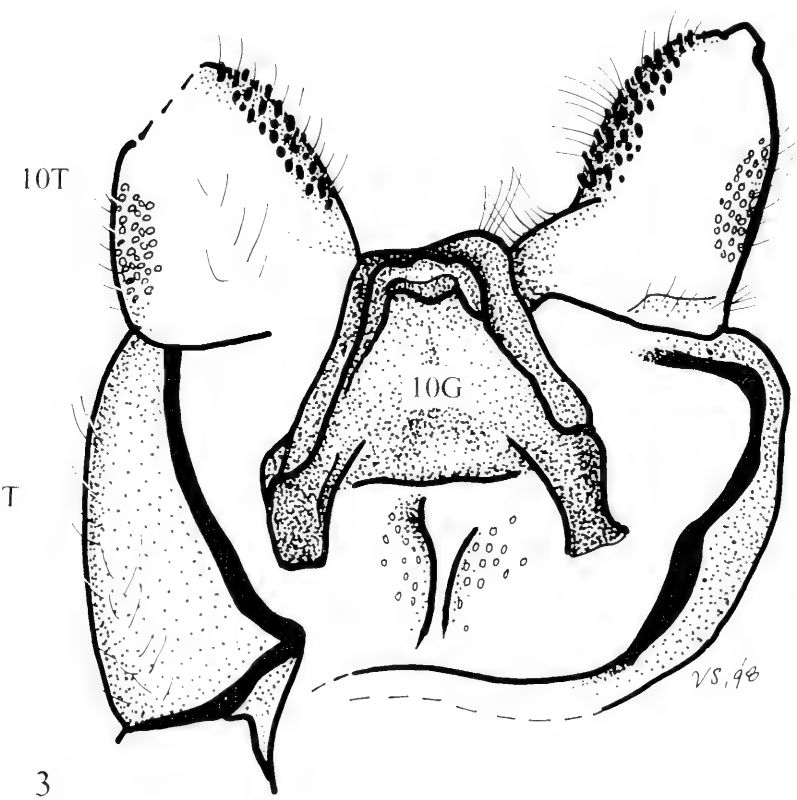

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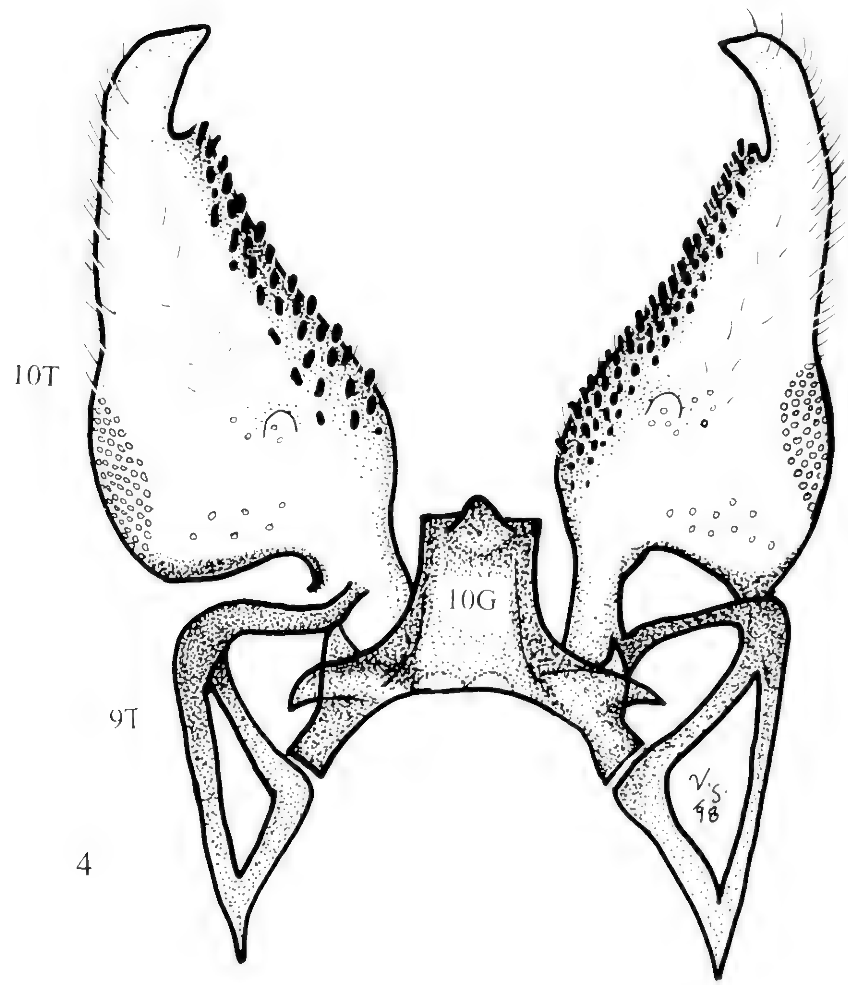
3. *Madachauliodes ranomafana* n.sp. Male genitalia in ventral view. 9T = ninth tergite, 10T = tenth tergite, 10G = fused tenth gonocoxites and tenth gonostyli (tenth sternite).



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4. *Madachauliodes torrentialis* Paulian. Male genitalia in ventral view.

Holotype: male: MADAGASCAR, Fianarantsoa Province, Ranomafana National Park, Talatakely (21°14'53.5"S, 47°25'36.9"E), 940 m, 30 October to 20 November 1998, Vincent F. Lee and Keve J. Ribardo, black light and mercury vapor light (CAS).

Material Examined: (all paratypes): same data as holotype, 3 males (CAS); 7 km west of village of Ranomafana [Ranomafana National Park], 1100 m, 11-17 November 1988, 1 male, C. Kremen collector (NMNH).

Distribution: At Ranomafana National Park the three known specimens of *M. torrentialis* were all collected in March, whereas the five known specimens of *M. ranomafana* were all collected in November. The geographical distribution of the two species must await study of more specimens, especially those specimens upon which the original description of *M. torrentialis* was based.

Etymology: This species name is a noun in apposition in reference to the national park where the known specimens were collected.

DISCUSSION

The genus *Madachauliodes* is one of three genera having the posterior branch of Rs unforked in the forewing, cell A1 closed distally by a crossvein between A1 and A2, and male antennae filiform. The hindwing of *Archichauliodes* contains the basal r-m crossvein, which is lacking in *Platychauliodes* and *Madachauliodes*. These latter two genera appear to form a rather compact group, but as Kimmins (1954) noted, the fork of CuA in the forewing of *Madachauliodes* extends well basad of the termination of CuP, while in *Platychauliodes* the fork originates at the termination of CuP or only slightly more basad. The ninth sternite of male *Madachauliodes* is evenly rounded or only slightly notched medially, while sternite 9 of male *Platychauliodes* bears four elongate caudal lobes.

The most commonly used key to genera of Chauliodinae is that of Kimmins in 1954. The genus *Madachauliodes* was only included as a footnote in that publication, and two additional genera have subsequently been described (*Nothochauliodes* Flint, 1983; *Orohermes* Evans, 1984). In that key some of the couplets used only geographical distributions, not morphological characters, for separating taxa. A newer key (New and Theischinger, 1993) eliminates these earlier problems, but it cannot be found in many libraries. Because Kimmins' key is outdated and New and Theischinger's is not easily accessible to many researchers, a third and original key is provided here.

Key To The World Genera Of Chauliodinae[4]

1a. Posterior branch of Rs forked in both wings (western North America) 2
1b. Posterior branch of Rs unforked, at least in forewing 3

2a. Posterior branch of M simple in hindwing; thoracic vestiture short and sparse; male tenth tergites short; female tenth tergites bifid with the dorsal lobe smaller . . *Orohermes* Evans
2b. Posterior branch of M forked in hindwing; thorax covered with long, wooly setae; male tenth tergites elongate and deeply notched; female tenth tergites bifid with long lobes . . . . *Dysmicohermes* Munroe

3a. Cell A1 in forewing closed distally by anterior fork of A2 4
3b. Cell A1 in forewing closed distally by crossvein between A1 and A2 7

4a. Anterior branch of M in hindwing forked (Western Hemisphere) 5
4b. Anterior branch of M in hindwing simple (South Africa) . *Taeniochauliodes* Esben-Petersen

5a. R4 of both wings simple (Chile) . . . . *Nothochauliodes* Flint
5b. R4 of both wings forked (North America) 6

6a. Male antenna without whorl of erect hairs on each segment; no crossvein in apical fork of R4 in forewing (present in a few large specimens) . . *Protochauliodes* Van der Weele
6b. Male antenna with whorls of erect hairs on each segment; a crossvein in apical fork of R4 in forewing (absent from a few specimens) . . . . *Neohermes* Banks

7a. Male antennae filiform 8
7b. Male antennae serrate or pectinate 10

8a. Basal r-m crossvein present in hindwing (Australia, Chile) . *Archichauliodes* Van der Weele
8b. Basal r-m crossvein absent in hindwing 9

9a. Origin of CuA fork in forewing well basad of termination of CuP; male ninth sternite caudally rounded or slightly notched medially (Madagascar) . . . *Madachauliodes* Paulian
9b. Origin of CuA fork in forewing at or only slightly basad of termination of CuP; male ninth sternite caudally bearing four elongate lobes (South Africa) . . . . *Platychauliodes* Esben-Petersen

10a. Small black species (forewing length: 19 to 28 mm) with white wing maculations, particularly concentrated at mid-length; male ninth tergite very elongate, more than three times as long as wide (eastern North America) . . . . *Nigronia* Banks
10b. Large black species (forewing length: 30 to 48 mm) with white wing maculations scattered throughout forewing, or forewing coloration pale brown to black, without extensive white spots; male ninth tergite at most only slightly longer than wide 11

11a. 1A in forewing with three or four branches (Oriental) . . . . *Anachauliodes* Kimmins
11b. 1A in forewing with only two branches 12

12a. In forewing, fork of 2A with a definite footstalk 13
12b. In forewing, fork of 2A sessile (Oriental) . . . . *Ctenochauliodes* Van der Weele

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[4] Based in part on Kimmins (1954).

13a. Forewing alternating dark and pale pattern on all veins (eastern North America) . . . . *Chauliodes* Latreille
13b. Forewing veins predominately brown, occasionally with paler areas (Oriental and southeastern Palearctic) 14

14a. Male antenna serrate, tenth gonostyli widely separated . . *Parachauliodes* Van der Weele
14b. Male antenna pectinate, tenth gonostyli medially fused . . . *Neochauliodes* Van der Weele

ACKNOWLEDGMENTS

I wish to thank Victoria Saxe for the drawings of male terminalia and Virginia Kirsch for drawings of the head, prothorax and forewing. Wojcieh J. Pulawski and David H. Kavanaugh (CAS) are gratefully acknowledged for reviewing an earlier draft of this manuscript. Oliver S. Flint, Jr. and Nancy Adams are to be thanked for loan of specimens of *Madachauliodes* from NMNH.

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LECTOTYPE DESIGNATIONS IN XYLOMYIDAE AND STRATIOMYIDAE (DIPTERA)[1]

Norman E. Woodley[2]

ABSTRACT: Lectotypes are designated for *Arthropeina fulva* Lindner, 1949; *Solva inamoena* Walker, 1859; *Xylophagus marginatus* Meigen, 1820; and *Xylophagus varius* Meigen, 1820 in the Xylomyidae, and, *Clitellaria aberrans* Schiner, 1868; *Oxycera liburna* Walker, 1849; *Cyclogaster peregrinus* Hutton, 1901; *Cyanauges ruficornis* Schiner, 1868; *Anacanthella splendens* Macquart, 1855; and *Exodontha villosa* Lindner, 1969 in the Stratiomyidae. *Dysbiota peregrina* (Hutton), NEW COMBINATION and *Spaniomyia liburna* (Walker), NEW COMBINATION are proposed in the Stratiomyidae.

During the course of long-term revisonary work on several groups of Xylomyidae and Stratiomyidae, I have labeled some specimens of syntype series as lectotypes. As some of the publications in which these taxa will be dealt with are not imminent, I feel it is pertinent to publish these lectotype designations at this time.

Species-level names are arranged alphabetically within each family. Label data are quoted with a slash "/" between each label. I have not gone into greater detail regarding labels, such as their color, handwritten versus printed, etc., as this information is not necessary to identify the specimens being designated. Paralectotypes have been labeled when I have examined additional syntypes if they exist. I have gone into some detail in describing the condition of lectotype specimens, as I feel this gives future workers a historical point of reference. Acronyms for the collections in which the specimens are kept may be found in the acknowledgments section. The current valid combination is given for each name.

Xylomyidae

fulva Lindner, 1949: 790. [*Arthropeina*]. Current name: *Arthropeina fulva* Lindner.

LECTOTYPE ♂ [BMNH], is labeled: "Brasilien Nova Teutonia 27°11'B. 52°23'L. Fritz Plaumann 22.11.1937/Brit. Mus. 1938-40./Arthropeina fulva Lind./Type Lindner 1940/SYN-TYPE/SYNTYPE Arthropeina fulva Lindner det. J. E. CHAINEY 1981/LECTOTYPE Arthropeina fulva Lindner, 1949, 790. des. N. E. Woodley 1984". The specimen is in excellent condition. A syntype is also in the collection and is labeled as PARALECTOTYPE.

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[1] Received January 19, 1999. Accepted March 6, 1999.

[2] Systematic Entomology Laboratory, PSI, ARS, USDA, Smithsonian Institution NHB 168, Washington, DC 20560.

inamoena Walker, 1859: 98. [*Solva*]. Current name: *Solva inamoena* Walker.

LECTOTYPE ♂ [UMO] is labeled: "Mak./Solva inamoena [apparently Walker's handwriting]/Solva inamoena Wlk. Makassar Wallace E Mus Saunders 1867 10/Xylomyia [Subula] inamoena ♂ Walk. Det. E. Brunetti 1924/Type Dip: 97 Solva inamoena Walker HOPE DEPT. OXFORD/LECTOTYPE Solva inamoena Walker, 1859: 94. des. Woodley 1999".

There is one paralectotype ♀ [BMNH] labeled: "SYN-TYPE ♀ Type [verso reads] Solva inamoena Walker/Mak./inamoenus/Celebes Macassar A. R. Wallace./Genotype of Solva Walk./Syntype. Another ♀ syntype in Oxford as DIP. TYPE No. 97 det. K. G. V. Smith, 1963/LECTOTYPE ♀ Solva inamoena Walker, 1859: 98. des. N. E. Woodley 1984". The specimen is dirty and is missing the last 4 tarsomeres of the right middle leg, tarsus of left hind leg, and apical halves of both wings.

Previous workers have mistaken the Oxford lectotype specimen as a female. It is actually a male, and is in better condition than the BMNH specimen.

marginatus Meigen, 1820: 15. [*Xylophagus*]. Current name: *Solva marginata* (Meigen).

LECTOTYPE ♂ [MNHN] is labeled: "Meigen [verso reads] 723 40/ Xylopha-gus varius/LECTOTYPE Xylophagus marginatus Meigen, 1820: 15 des. N. E. Woodley 1984." The specimen is in excellent condition, missing the second segment of the right palpus, last two flagellomeres of the left antenna, and the last 4 tarsomeres of the left fore leg.

varius Meigen, 1820: 14. [*Xylophagus*]. Current name: *Solva varia* (Meigen).

LECTOTYPE ♀ [MNHN] is labeled: "Meigen [verso reads] 724 40/ Xylopha-gus mar-ginatus./LECTOTYPE Xylophagus varius Meigen, 1820: 14 des. N. E. Woodley 1984". The specimen is in good condition, missing the left halter, last 4 tarsomeres of the right middle leg, both hind legs beyond trochanters, and both cerci.

Only two species of *Solva* occur in western Europe, *Solva marginata* and *S. varia*, both described by Meigen. Meigen's (1820) descriptions of the two species are quite accurate and diagnostic, and it is very easy to identify them based on these alone. I believe that the name labels on Meigen's two specimens in Paris have been inadvertently switched at some point in time prior to my examination of them. I have therefore designated the above two lectotypes based on how well the specimens matched the original descriptions rather than their labels. The latter course would reverse the long-standing usage of these two names.

Stratiomyidae

aberrans Schiner, 1868: 55. [*Clitellaria*]. Current name: *Octarthria aberrans* (Schiner).

LECTOTYPE ♀ [NMW] is labeled: "X/N. Seeland/[purple parallelogram]/ aberrans Alte Sammlung/Type/LECTOTYPE Clitellaria aberrans Schiner, 1868: 55 des. N. E. Woodley 1981/Octarthria aberrans (Schiner) Det. N. E. Woodley 1981". The specimen is in good condition, missing only the right antennal flagellum, both scutellar spines, and the right halter. Each wing is cracked and glued at the stigma, and the abdomen is glued to the thorax.

Despite having examined much of the available material of New Zealand Stratiomyidae in museums, I have not seen another specimen of Schiner's species. I believe that the specimen probably originated in Australia, and it may in fact be a synonym of *Octarthria flavipalpis* (Macquart). A critical revision of *Octarthria*, presently containing six valid species (Woodley, 1989: 315), is necessary.

liburna Walker, 1849: 528. [*Oxycera*]. Current name: *Spaniomyia liburna* (Walker), NEW COMBINATION.

LECTOTYPE ♂ [BMNH] is labeled: "Type/Jamaica [verso reads] 45 110/ W. Indies Jamaica purchased Gosse 45.110/One of Walkers series so named. EAW [verso reads] Oxycera liburna Walk./This appears to be a Spaniomyia sp. det. J. E. Chainey 1982/SYN-TYPE/SYNTYPE Oxycera liburna Walker det. J. E. Chainey 1982/LECTOTYPE ♂ Oxycera liburna Walker, 1849: 528. des. N. E. Woodley 1995/Spaniomyia liburna (Walker) det. Woodley 1995". The specimen is in good condition, missing the right antennal flagellum, the distal four tarsomeres of the left hind leg, and the right hind leg beyond the trochanter. An additional syntype is labeled as a paralectotype.

Walker (1849) probably placed this species in *Oxycera* Meigen because of the superficial similarity of the antennae of the Jamaican species with European *Oxycera*. Although differing from other *Spaniomyia* in having bare eyes, *Oxycera liburna* is best placed in that genus at present.

peregrinus Hutton, 1901: 10. [*Cyclogaster*]. Current name: *Dysbiota peregrina* (Hutton), NEW COMBINATION.

LECTOTYPE ♂ [CMC] is labeled: "Wangarei/Cyclogaster peregrinus Hutt. F. W. Hutton det./TYPE/I. 480/LECTOTYPE ♂ Cyclogaster peregrinus Hutton, 1901: 10 des. N. E. Woodley 1981". The specimen is in good condition, missing the last two tarsomeres of the left fore leg and the last three tarsomeres of the right hind leg. The mesonotum is somewhat damaged, which probably occurred during mounting. The terminalia are cleared and in a plastic microvial on the specimen pin. One ♀ syntype was examined and has been labeled as paralectotype.

Hutton (1901) described this species in the genus *Cyclogaster* Macquart, which most authors considered a synonym of *Lasiopa* Brullé subsequent to Brauer (1882). The latter genus was a dumping ground in the early part of the 20th Century. Kertész (1908) included 15 species in *Lasiopa* that are now placed in 6 genera in 3 subfamilies. *Lasiopa* is now a well-defined genus containing 16 species known from the Palaearctic, Afrotropical, and Oriental Regions, which differ greatly from *Cyclogaster peregrinus*. Lindner (1958) described *Dysbiota parvula* as a new genus, new species from New Zealand. Despite some differences in the structure of the male terminalia and the antenna between Hutton's and Lindner's species, they are quite similar. They share dichoptic males with parallel-margined frons; face strongly receding; head with genal region behind eye produced ventrally; wing with a short, trapezoidal to triangular cell r_1; cell r_{2+3} elongate, with vein R_{4+5} not forked; and the scutellum only weakly convex, weakly margined apically but without marginal spines. I believe both species should be placed in *Dysbiota*.

ruficornis Schiner, 1868: 54. [*Cyanauges*]. Current name: *Antissa ruficornis* (Schiner).

LECTOTYPE ♂ [NMW] is labeled: "Z/Novara 1857.-59. Reise/ruficornis Alte Sammlung/Cyanauges ruficornis Schin./LECTOTYPE ♂ Cyanauges ruficornis Schiner, 1868: 54 des. N. E. Woodley, 1982". The specimen is in good condition, slightly dusty, and is missing only part of the knob of the left halter. The thorax is slightly crushed. The terminalia are cleared and in a plastic microvial on the specimen pin.

splendens Macquart, 1855: 59. [*Anacanthella*]. Current name: *Anacanthella splendens* Macquart.

LECTOTYPE ♂ [BMNH] is labeled: "Co-type/Anacanthella splendens Macq AUSTRALIA ex. Bigot Coll: B.M. 1960-539. SYN-TYPE/SYNTYPE Anacanthella splendens Macquart det. J.E. CHAINEY 1982/Anacanthella splendens ♂. n.g., n.sp. Macq/LECTOTYPE ♂ Anacanthella splendens Macquart, 1855: 39 des. N. E. Woodley 1984". The specimen is in poor condition, missing the left antennal flagellum, right fore leg, right middle and left hind legs beyond trochanters, entire right wing, and most of left wing. The abdomen is detached and glued to a point on the specimen pin. The terminalia are cleared and in a plastic microvial on the specimen pin. A second ♂ syntype, also in poor condition (including missing the entire abdomen) is labeled as paralectotype.

villosa Lindner, 1969: 3. [*Exodontha*]. Current name: *Antissa villosa* (Lindner).

LECTOTYPE ♂ [SMN] is labeled: "Brasilien Nova Teutonia 27°11'B. 52°23'L. Fritz Plaumann IV. 1960 300-500m/Exodontha villosa Lind. Lindner det./Typus Lindner 1966/LECTOTYPE Exodontha villosa Lindner, 1969: 3. des. N. E. Woodley, 1982". The specimen is in excellent condition. The terminalia are cleared and in a plastic microvial on the specimen pin.

ACKNOWLEDGMENTS

I wish to thank the following curators for lending specimens or otherwise facilitating their study: J. E. Chainey, the Natural History Museum, London, England (BMNH); R. A. Savill, Canterbury Museum, Christchurch, New Zealand (CMC); D. J. Mann and A. C. Pont, Hope Department of Entomology, Oxford University, Oxford, England (UMO); L. Matile, Muséum national d'Histoire naturelle, Paris, France (MNHN); R. Contreras-Lichtenberg, Naturhistorisches Museum Wien, Vienna, Austria (NMW); B. Herting, Staatliches Museum für Naturkunde, Stuttgart, Germany (SMN). Wayne N. Mathis, Douglass R. Miller, Allen L. Norrbom, Vera Silva, and F. C. Thompson provided critical comments on the manuscript.

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A NEW ORIENTAL *SPHEGINA* SPECIES (DIPTERA: SYRPHIDAE)[1]

F. Christian Thompson[2]

ABSTRACT: The only known *Sphegina* from the Philippines is described and named *philippina* (HT ♂ Bishop Museum).

INTERPRETATIVE SUMMARY: A new pollinator is described and illustrated. The information will enable users to identify species and will contribute to the inventory of the biological diversity of the Philippines.

Sphegina flower flies are small inconspicuous pollinators, whose larvae breed under bark in accumulations of decaying sap. The genus is most diverse in the north temperate region, but a few species are known from the Orient. A name is provided here for the only species known from the Philippines to assist a colleague (V. Mutin) doing a phylogenetic analysis of the subgenus *Asiosphegina*.

Sphegina (Asiosphegina) philippina Thompson, NEW SPECIES

Male. Head: Face yellow on ventral 1/2, darker dorsally; gena yellow anteriorly, brown posteriorly; frontal lunule brownish black, shiny; front narrow, head-width/front-width ratio - 1:10, length/width ratio - 3.5:1, black, shiny narrowly dorsad of antenna, elsewhere grayish-brown pollinose, with short appressed yellow pile; occiput black, gray pollinose, with short sparse yellow pile. Antenna: Brownish orange, with yellow pile; basoflagellomere large, slightly rectangular, about twice as long as front is wide; arista orange becoming brownish apically, with short pile, with some hairs about as long as basal aristal width.

Thorax: Black except postpronotum light brown; dorsum grayish brown pollinose, more dense and gray on notopleuron, with yellow short appressed pile; pleuron gray pollinose, with short appressed yellow pile; scutellum black, gray pollinose, with yellow pile, without apical bristles; calypter white; halter orange; wing microtrichose, with alula absent, with r-m crossvein distinctly beyond end of sc, hyaline except slightly infuscate around fork of Rs. Legs: Pro and mesolegs yellow except apical 2 tarsomeres brownish black, with pale pile; metacoxa black except yellowish apically, gray pollinose, with yellow pile; metatrochanter black; metafemur short, length/width ratio- 2.6:1, yellow on basal 1/3, apically black, with yellow pile, with two ventral rows on spines on apical 2/3; metatibia produced into spur apically, with a ventromedial carina on basal 1/2, brownish black except basal 1/4 and subapical annulus yellow; metatarsus black, with pale pile; metabasitarsomere not greatly swollen, about as wide as tibial apex.

Abdomen (fig. 1): 1st tergum black, sparsely gray pollinose, with yellow pile, with 3 apicolateral yellow bristles; 2nd tergum elongate, length/maximal width ratio - 3:2, minimal (basal)/ maximal (apical) width ratio - 1:2.7, twice as long as 3rd, black except basal 1/4 brownish orange in some individuals, shiny, with yellow pile, with some lateral hairs longer than maximal tergal width; 3rd tergum trapezoid, length/maximal width ratio - 0.75:1, twice as wide apically as basally, only 1/2 as long as 2nd, orange on basal 1/3, black apically, pollinose, with appressed yel-

[1] Received March 1, 1999. Accepted May 7, 1999.

[2] Systematic Entomology Laboratory. ARS, USDA, NHB- 168, Smithsonian Institution, Washington, DC 20560.

low pile; 4th tergum rectangular, only 1/4 wider than long, as long as 3rd, black, pollinose basally, shiny apically, with appressed yellow pile; 2nd & 3rd sterna brownish orange; 4th sternum appearing to be produced dextrolaterally, black except brownish orange apicomedially and projection yellow, with yellow pile, gray pollinose; 6th-9th segments black, gray pollinose, with yellow pile. Male genitalia: Cercus short, not enlarged, yellow.

Female. Similar to male except normal sexual dimorphism and 3rd and 4th terga with basolateral yellow maculae on basal 1/4.

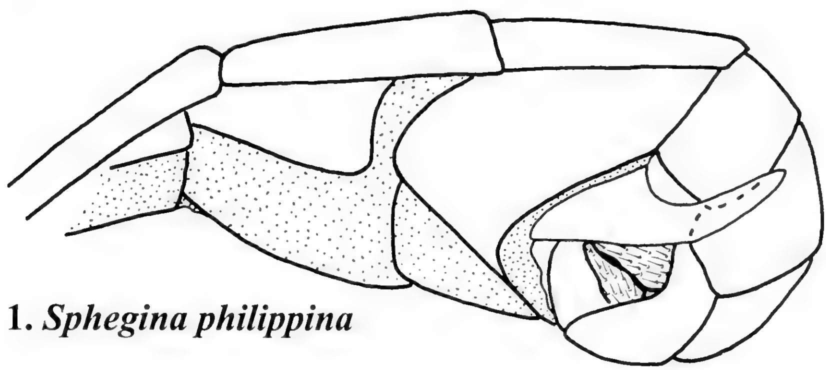

Fig. 1. *Sphegina philippina*. Male abdomen, ventrolateral view.

Holotype: Male. PHILIPPINES, **Mindanao,** Misamis Or. , Mt. Balatukan, 15 km southwest of Gingoog, 1000-2000 m, 27-30 April 1960, H. Torrevillas, deposited in the Bishop Museum, Honolulu (BPBM 15,881). Paratypes: PHILIPPINES. **Luzon:** Camarines Sur, Mt. Isarog, 500 m, 4 April 1963, H Torrevillas (1 ♂ USNM); Camarines Sur, Mt. Isarog, Pili, 800 m, 30 April 1965, H Torrevillas (1 ♀ BPBM); Baguio, Benguet, Baker (1 ♂ SMF (Sack Coll.), 2 ♀ USNM); Mt. Makiling, C. F. Baker (1 ♀ USNM); Ifugao Prov., Jacmal Bunhian, 24 km east of Mayoyao, 800-1000 m, 1-10 May 1967, L. M. Torrevillas (1 ♂ BPBM). **Negros Or.,** L. Balinsasayao, 1-7 October 1959, L. W. Quate (1 ♂ 1 ♀ (at light trap) USNM). **Mindanao,** Bukidnon, 1480 m, Mt. Katanglad, 27-31 October 1959, L. W. Quate (2 ♀ BPBM) ; Misamis Or., Mt. Pomalihi, 21 km west Ginnog City, 800-1000 m, 30 April 1965, H. M. Torrevillas (1 ♂ BPBM). **Panay,** Culasi, June 1918, McGregor (1 ♀ USNM).

Sphegina philippina is easily recognized in the male from all other *Sphegina* species by the sickle-shaped apical process of the 4th sternum. The females are recognized by the uniformly pollinose mesonotum; the other Oriental *Asiosphegina* species (all described by Shiraki from Taiwan [*apicalis, nigerrima* and *varidissima*]) all have distinct gray pollinose vittae on the mesonotum. Sack (1926: 576) incorrectly identified this species as *orientalis* Kertész, a species that has brown maculate wings (syntype ♂ from Taihorin studied from Klocker collection [ZMUC]).

ACKNOWLEDGMENTS

I thank Neal Evenhuis, Bishop Museum, Honolulu (BPBM) and Lief Lyneborg, Zoologisk Museum, Copenhagen (ZMUC) for permission to study material in their care. The acronym USNM is here used for National Entomological Collections of Smithsonian Institution, Washington; and SMF for Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt-am-Main. I also thank Neal Evenhuis (vide supra); Wayne N. Mathis, Department of Entomology, National Museum of Natural History (USNM), Washington; John W. Brown, Allen Norrbom, and Manya B. Stoezel of the Systematic Entomology Laboratory, USDA, Washington; for their critical review of the manuscript.

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(Continued from page 252)

color, mostly live specimens, which will illustrate their appeal (Plate 39 is upside down), For the most part, the illustrations are superb. A few, like Fig. XXII, are slightly out of focus but I guess it was better to have the illustration rather than none at all. The book is attractive, has a durable cover, and is well bound. My only criticism is that the bibliographies are at the end of each chapter rather than at the end of the book.

This review is written not only to publicize a nice book, but also to relate the important contributions dedicated non-professionals (I hate the term "amateur") like Mr. Brock make to science. People like Mr. Brock are driven to these pursuits because they are compelled to do so. They do not receive governmental grants or require large amounts of "overheads" but utilize their own funds to subsidize trips, etc. They are not constrained or, more realistically, "restrained" as are professionals by current financial ideologies such as "economic rationalism" which actually prevent the rest of us from getting on with the job. *Vive l'amateur.*

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A NEW SPECIES OF *CALLOSOBRUCHUS* (COLEOPTERA: BRUCHIDAE) FROM THAILAND AND CHINA[1]

John M. Kingsolver[2]

ABSTRACT: *Callosobruchus imitator*, new species, is described from Thailand and China. It is apparently closely related to *Callosobruchus rhodesianus* in Africa. It attacks seeds of *Vigna unguiculata*, and *Vigna umbellata*.

James Madenjian of the Department of Health and Human Services, Food and Drug Administration in Los Angeles recently submitted specimens of a bruchid seed-beetle from Thailand and China found in regulatory samples of commercial products (mostly or entirely dead) from *Vigna unguiculata* (L.) Walp. subspecies *cylindrica* (L.) Verdc. (catjang), from *Vigna unguiculata* subsp. *unguiculata* (black-eyed peas or cowpeas), and from *Vigna umbellata* (Thunb.) Ohwi and H. Ohashi (rice bean). All host plants are in the Leguminosae, Papilionidae.

I have been unable to reconcile this bruchid with any of the described species of *Callosobruchus* known from that region. In the key to the Indonesian species of *Callosobruchus* by C.P. Haines (1989), it would be identified as *C. chinensis* (L.) or to *C. rhodesianus* (Pic).

Callosobruchus imitator Kingsolver, NEW SPECIES

Figures 1-8, 11-13

This species' characters are consistent with those of *Callosobruchus*, and similar in color pattern to that of *Callosobruchus rhodesianus* (Pic).

Color.- Most of body dark red to piceous, head black, antenna in both sexes yellow, pygidium reddish yellow, forelegs and midlegs yellow, abdomen and hind legs often partly red, partly piceous.

HOLOTYPE ♂: Head with median fringe of yellowish setae on medial margin of each eye, vertex with sparse yellowish setae, postocular fringe yellow. Scutellum white. Pronotal vestiture yellowish white, setae long, fine, sometimes abraded on disk, basal lobe with quadrate, bilobed pad of waxy, matted white setae; elytral setae yellowish white except piceous on lateral maculae, occasionally with prominent but short white stripe on third interstice; pygidial vestiture without markings, white; ventral vestiture of thinly distributed, white setae except for intensely white patch at lateral margin of each of abdominal segments 3-5.

Structure.- Body obovate, deep. Head turbiniform; eye slightly protuberant; ocular sinus less than one-half length of eye; vertex densely punctulate, frons more coarsely punctate with setae extending toward median line; frontal carina sharp, prominent; pronotum campaniform, strongly convex, slightly sulcate either side of basal lobe; discal sculpture microfoveolate, each foveola bearing median seta; scutellum quadrate, bifid distally. Elytra together as long as wide, lateral margins gently arcuate; striae moderately deep, sinuate, evenly spaced, 2d, 3d, 4th and 5th with

[1] Received January 19, 1999, Accepted March 6, 1999.

[2] Florida State Collection of Arthropods, 1911 SW 34th Street, Gainesville, Florida, 32608.

minute basal denticles. Pygidium subtriangular, slightly truncated, reflexed into terminal emargination of sternum 5. Metacoxa evenly punctulate; metafemur (fig. 2) swollen, lateroventral margin with broadly triangular, acute denticle, mesoventral margin with single, acute denticle (fig. 3) whose length is one-half width of metatibia at point of juncture when closed; metatibia slightly arcuate, mucro acute (fig. 2), lateral denticle acute, two coronal denticles placed at terminus of dorsal margin.

Body length.- 2.25-2.50 mm; width.- 1.5-1.7 mm.

Male genitalia.- Median lobe long, narrow, six times as long as width at apex (fig. 7); ventral valve ogival, arcuate, apex acute; internal sac with elongate granular cluster at apical orifice (fig. 11), apical one-half of sac lined with elongate, slender spicules (fig. 12), morphological apex of sac with two burr-like sclerites (fig. 13); lateral lobes long, slender, separated more than one-half their lengths, apices scarcely expanded (fig. 8).

Female.- Head and pronotum similar to that of male; elytra with more extensive piceous lateral and apical maculae (occasionally lacking lateral maculae); pygidium vertical, immaculate, occasionally with indistinct subapical spots, with basal band of setae, usually with apical one-half denuded with exposed integument dark red; ventral and lateral areas of abdomen as in male.

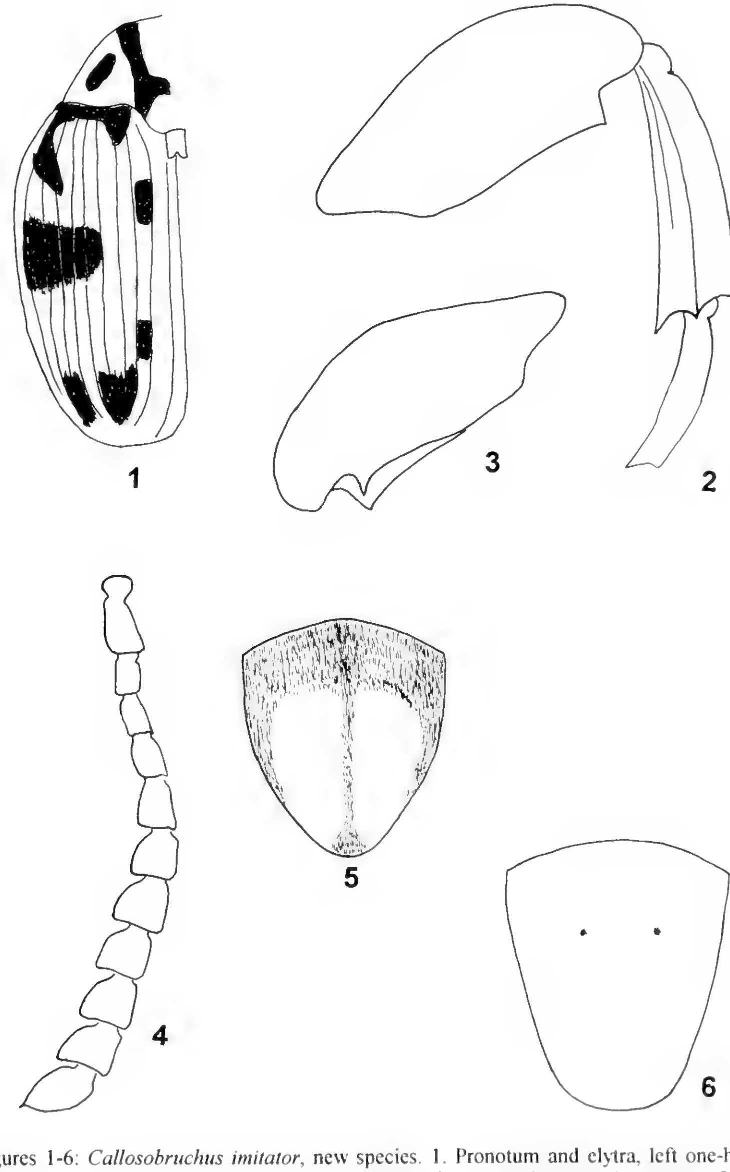
HOLOTYPE ♂: Thailand, no specific locality, November 1991, ex. red bean, *Vigna unguiculata* subsp. *cylindrica* (L.) Verdc., J.J. Madenjian. Type deposited in the National Museum of Natural History, Washington DC.

PARATYPES: 21 ♂♂♀♀, same data as holotype; 1- same data except October; 1- Thailand, August 2, 1994, *Vigna unguiculata* subsp. *unguiculata*, J.J. Madenjian; 1- China, July 10, 1995, ex. *Vigna umbellata* (Thunb.) Ohwi and H. Ohashi, R.W. Potter. Paratypes deposited in the National Museum, Washington DC.; California Academy of Sciences, San Francisco; Texas A & M University, College Station; Florida State Collection of Arthropods, Gainesville; Los Angeles County Museum, California; University of California collections at Riverside and Berkeley; collections at the Department of Health and Human Services, FDA, in Los Angeles, and in Washington, DC.

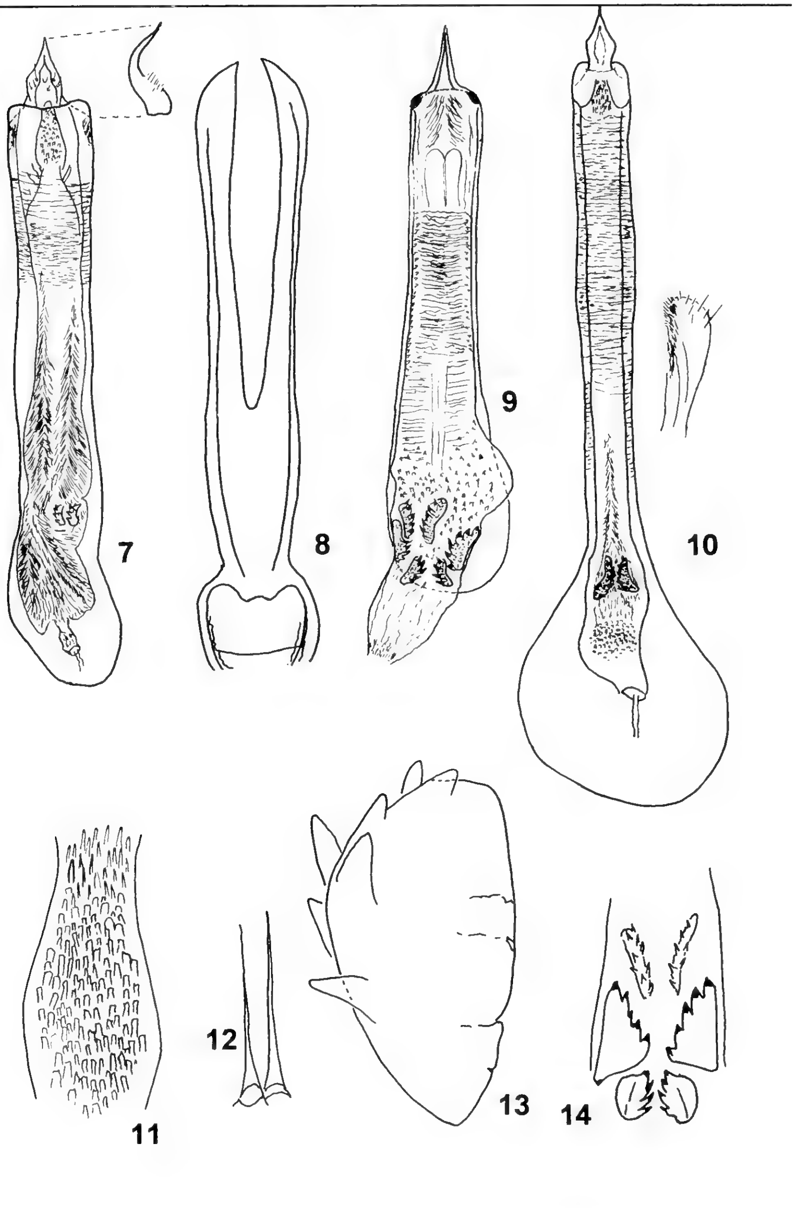
DISCUSSION

Callosobruchus imitator belongs to a group of species including *C. chinensis* (L.), *C. indica* Pajni and Gupta, *C. rhodesianus* (Pic), *C. theobromae* (L.), and probably *C. cajanis* Arora (no specimens available) characterized in part by the elongate median lobe and lateral lobes of the male genitalia, antennae serrate (male antennae of *C. chinensis* pectinate), the dorsal portions of abdominal segments 3-5 with an intensely white patch of setae, the swollen basal lobe of the pronotum likewise with an intensely white setal patch covered with a glazed coating. Differences in male genitalia within the group can be found in the numbers and positions of the burr-like sclerites and clusters of needle-like spicules in the male genitalia (figs. 7, 9, 10 and 14).

The new species is most similar in appearance to *C. chinensis* and *C. rhodesianus* but with the following differences: 3d and 4th elytral striae of *C. chinensis* originating basally in a tubercle surmounted by two fine denticles, whereas in *C. rhodesianus* and *C. imitator*, the tubercle is lacking; male and female antennae of *C. imitator* similar in both sexes (fig. 4), slightly serrate, not dimorphic; inner tooth of hind femur short, acute, not as long as the broadly triangular lateral tooth in *C.imitator* (fig. 3), but of similar length to lateral tooth in *C. chinensis*; male genitalia of *C. imitator* with median lobe 8 times as long as its width at middle (fig. 7), whereas, in *C. chinensis*, the length is 12 to



Figures 1-6: *Callosobruchus imitator*, new species. 1. Pronotum and elytra, left one-half with patterns 2. Left hind leg, lateral aspect. 3. Left hind femur, ental aspect. 4. Antenna. 5. Female pygidium showing extent of denudation. 6. Male pygidium.



Figures 7-14: *Callosobruchus* spp., male genitalia. 7. *C. imitator*; median lobe, inset- ventral valve, lateral aspect. 8. *C. imitator*, lateral lobes. 9. *C. theobromae*, median lobe. 10. *C. chinensis*, median lobe, inset-apex of lateral lobe. 11. *C. imitator*, scaly area near ventral valve. 12. *C. imitator*, spicules of internal sac. 13. *C. imitator*, burr-like sclerite at apex of internal sac. 14. *C. rhodesianus*, sclerites at apex of internal sac.

14 times the width (fig. 10, after Kingsolver, 1969). The internal sac in *C. imitator* is lined for half its length with needle-like spicules (fig. 12) unlike *C. chinensis* and *C. rhodesianus* wherein the mass of spicules is confined to the apex of the sac.

In Haines' (1989) key to *Callosobruchus* infesting stored pulses, *C. imitator* will key to *C. rhodesianus*. It may be differentiated from males and females of that species by the partly denuded pygidium (fig. 5) of *C. imitator*, by the presence of 2 burr-like sclerites in the male genitalia (6 in *C. rhodesianus*) and by the acute apex of the lateral lobe (truncate in *C. rhodesianus*). The antenna is similar in shape in each species.

Callosobruchus indica Pajni and Gupta (1975) is described as having entirely black male antennae with female antennae testaceous, whereas in *C. imitator*, the antennae of both sexes are yellow. Vestiture of the male pygidium is nearly always uniformly white in both species. The female pygidium of *C. indica* as illustrated is black with a median white stripe, but the apical one-half of the *C. imitator* female pygidium is usually denuded with the integument dark red. The illustration of the male genitalia of *C. indica* (p. 448, fig. 2) is not sufficiently detailed to make a good comparison with those of *C. imitator* but the latter species has one pair of small denticles and two elongate apical masses of needle-like spines (fig. 7) contrasted with the clusters of short tubercles described by Pajni and Gupta.

Arora (1977) described *C. cajanis* from India with body dark brown, antennae testaceous, elytra with basal tubercle on 3d and 4th striae, and internal sac of the male genitalia with toothed plates in middle.

In specimens of *C. theobromae* available to me, the male genitalia (fig. 9) have six irregular apical sclerites similar to those in *C. rhodesianus*. Arora's illustration showed six sclerites. Haines, however, described the number and position of sclerites as two in the middle of the sac.

ACKNOWLEDGMENTS

The author thanks the following FDA employees of the Los Angeles District. Entomologists Vernon K. Avaritt III, James J. Madenjian, and Richard W. Potter (deceased); and Physical Science Technician Melchor G. Mariscal who obtained specimens during the analysis of the regulatory samples. Entomologists James J. Madenjian and Nicholas J. Richter, and Consumer Safety Inspectors Elsa Burrola and Michele R. Douglas collected these regulatory samples.

Host determinations were made by Joseph H. Kirkbride, Jr. of the U.S. Department of Agriculture (Beltsville) with the permission of Allan K. Stoner.

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TYPE SPECIMENS OF TWO SEED BUG SPECIES FROM JAPAN DESCRIBED BY P. R. UHLER (HETEROPTERA: LYGAEOIDEA: PACHYGRONTHIDAE)[1]

Richard C. Froeschner[2]

ABSTRACT: Examination of the U.S. National Museum of Natural History for specimens of two Uhler-described Japanese species of the genus *Pachygrontha* Germar confirmed the "holotype" status of one specimen of *Pachygrontha similis* and made necessary the designation of a lectotype for *Peliosoma* Uhler [now in *Pachygrontha*] *antennata*.

At the request of J. Péricart, who is preparing "lygaeoid" sections of the upcoming *Catalogue of Palaearctic Heteroptera*, the National Museum of Natural History Heteroptera collection was searched for the type material of two Japanese species described by P.R. Uhler. The results showed one of those species to have had a single specimen indicated as the "type" in conformity with the original description, whereas a lectotype designation is needed for the other.

Pachygrontha antennata antennata (Uhler)

Peliosoma antennata Uhler (1860:229). The "type" numbers on the two syntypes listed here are not relevant to this examination because they were assigned to the specimens much later, after the Smithsonian's Department of Entomology Type Book was begun in 1894; that type book was abandoned in the 1980's when a new, computerized listing of types was begun.

In the original description of this species, reference was made to both sexes; thus Uhler had at least two specimens. Two potential syntypes were found. One is a male pinned through the scutellum, with the following parts missing:- antennal segment IV on the right side, anterior tibia and tarsus on the right side, left femur badly damaged by dermestids; and rostral segments II-IV. This specimen bears four labels:- (1) in Uhler's handwriting, *Peliosoma antennata* mihi," "Simoda"; (2) a second label in a different script, *Peliosoma antennata* mihi" (obviously copying the first label), and a line of print "Det Uhler"; (3) "PRUhler Collection"; and (4) a red label reading "Type No, 25856 U.S.N.M." Because this is the only available specimen labeled from the locality given in the original description, it hereby is designated the lectotype and given a red label:- "Lectotype, *Peliosoma antennata* Uhler, by Froeschner 1999."

The second specimen, also a male pinned through the scutellum, is without locality but has two labels:- (1) an identification label in Uhler's handwriting:

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[1] Received February 1, 1999. Accepted March 21, 1999.

[2] Department of Entomology, MRC-0105, National Museum of Natural History, Washington, D.C. 20560-0105.

Pachygrontha antennata Uhler, Japan"; (2) a red label Paratype No.25856 U.S.N.M." Obviously, the identification label was affixed to the specimen at a later date, but that does not preclude the specimen's having been in Uhler's hands at the time of the original description. The original description contained a single measurement of 8 mm, and both specimens at hand are of that length. Now added is a red label: Paralectotypes, *Peliosoma antennata* Uhler, by Froeschner 1999."

Additional Japanese specimens at hand had been donated to the Smithsonian Institution by Dr. K. Mitzukuri after the 1893 World's Columbian Exposition in Chicago (as reported by Uhler 1896:255) and so cannot be part of the original series.

This species was transferred to the genus *Pachygrontha* by Stål (1874:141) and was given nominate subspecies status by Slater (1955:72).

Pachygrontha similis Uhler

Pachygrontha similis Uhler (1896:264). Four specimens from the type series were found. One bore a red label agreeing with the original description's statement, "Type.-No. 3100, U.S.N.M." and must be considered the holotype. This carded specimen is a complete female. It bears four labels as follows:- (1) Glued to the underside of the specimens-bearing card is a small square of paper with Japanese script for "Gifu, 25, 90 No. 7; (2) Plain paper with handwritten number (in ink) "1253"; (3) Hand-written "*Pachygrontha similis* Uhler," NOT Uhler's handwriting; (4) Red "Type No. 3100 U.S.N.M." A "holotype" label has now been added to the pin.

The three other specimens, each now labeled with a blue "Paratype" label, include:- (First) A damaged female pinned through the scutellum, with following parts missing: antennal segments III and IV on the left side and II-IV on the right, all tarsal segments on left side, and tarsals II and III on the right anterior leg. Its labels are (1) "*P achygrontha similis* Uhler, Japan" in Uhler's handwriting. (2) "Paratype, No. 25856 U.S.N.M." The latter label refers to the above-mentioned, now obsolete type catalog.

(Second) A female, head and prothorax reaffixed to body with glue, pinned through scutellum, with following parts missing: left antennals III-IV and all of right antenna, left front leg and middle and hind tibiae and tarsi. Its labels are (1) with two lines of badly faded script (scribe?), "Simo" on one line and a second line that could be interpreted as "Jap"; (2) "PRUhler Collection;" (3) an identification label "*Pachygrontha similis* Uhl. Det. J.A. Slater, 1957."

(Third) A female pinned through scutellum, abdomen glued to pinned card, and with following parts missing: right front leg, left middle tibia and tarsus, and both hind tarsi; with label, "PRUhler Collection."

ACKNOWLEDGMENTS

My grateful thanks are extended to Ms Keiko Hiratsuka Moore, of the National Marine Fisheries at the Smithsonian Institution, for translating the Japanese script on the label of the lectotype of *Pachygrontha similis*; and to Jerry A. Louton, Museum Specialist in the Department of Entomology, the Smithsonian Institution, for information on the old type catalog. For careful, helpful reviews of the manuscript I am indebted to T.J. Henry, U.S.D.A. Systematic Entomology Laboratory at the Smithsonian Institution, Washington, D.C., and to J.E. McPherson, Department of Zoology, Southern Illinois University, Carbondale, Illinois.

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NEW SPECIES OF *PARALEPTOPHLEBIA* (EPHEMEROPTERA: LEPTOPHLEBIIDAE) FROM IDAHO AND WASHINGTON[1]

W. P. McCafferty[2], B. C. Kondratieff[3]

ABSTRACT: *Paraleptophlebia jenseni*, n. sp., is described from male adults from Klickitat County, Washington. The species has also been collected from Owyhee County, Idaho, and is most closely related to *P. traverae*, n. sp., which is based on the male adult from Idaho County, Idaho, previously misidentified as *P. rufivenosa*. Forewing pigmentation and morphology of the penes are diagnositic of the new species.

A much-used aid to the identification and study of mayflies of northwestern North America has been the unpublished Masters thesis on the mayflies of Idaho by S. L. Jensen (1966). Besides providing invaluable keys and figures therein, Jensen proposed several new taxa from Idaho, including a species of *Paraleptophlebia* Lestage. Jensen (1966) ostensibly determined that the new *Paraleptophlebia* species, which he knew only as male adults from Owyhee County, was similar to *P. rufivenosa* Eaton, a species known from Oregon [lectotype locality (Spieth 1941)], Washington, and California (Eaton 1884); British Columbia (McDunnough 1924); and questionably Idaho (Traver 1935). Although *P. rufivenosa* was described from female adults and female subimagos, a single male adult from Idaho was assigned to the species by Traver (1935). Female adults of *Paraleptophlebia* exhibit few reliable specific characteristics and have not been treated comparatively (Traver 1935, Harper and Harper 1986). Thus, Traver's (1935) male adult has formed the essential basis of the taxonomic concept of *P. rufivenosa* (Spieth 1941, McCafferty 1996) and was used for comparison by Jensen (1966), although he had not examined Traver's specimen.

George Edmunds (who served as Jensen's advisor at the University of Utah during the Idaho study) recently requested that WPM publish a formal description of the new species, but unfortunately none of Jensen's material of the new species could be located, and such a description could not proceed. More recently, Robert L. Newell of Richland, Washington collected a series of an unknown *Paraleptophlebia* species from Klickitat County, Washington, and kindly made the material available to BCK. Characteristics of the male adult specimens from Washington are consistent with Jensen's unpublished description of a new species from Idaho. We are pleased at long last to be able to describe this species as *P. jenseni*, n. sp., after Steve Jensen.

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We have also compared the new species to the male that Traver (1935) assigned to *P. rufivenosa*. Traver never indicated the basis of assigning her male specimen from Grangeville, Idaho to *P. rufivenosa*. In fact, "Paraleptophlebia rufivenosa?" is the way that Traver labeled the actual preserved specimen. Her assignment of the specimen to *P. rufivenosa* appears to have been based on speculation because the male genitalia were different from those of any other species known at the time. Certainly the general dark coloration of the body found in Traver's specimen is typical of several species of *Paraleptophlebia* and of little use in associating sexes. Significantly, Traver's male is devoid of any membrane staining in the forewings, whereas Eaton indicated that forewings of the female adults of *P. rufivenosa* were uniformly and lightly tinted. This along with any definitive evidence to link the putatively identified specimen to *P. rufivenosa* leads us to conclude that Traver's male is not *P. rufivenosa*. Below, we consider it as a new species and name it in memoriam to Jay Traver, as *P. traverae*, n. sp.

Eaton (1884) described *Paraleptophlebia vaciva* (Eaton) from Mount Hood, Oregon based on male adults. Female adults have not been described. Based on Eaton's (1884) descriptions of both the male of *P. vaciva* and the female of *P. rufivenosa*, and the fact that lectotypes of both species are from Mount Hood (Spieth 1941), we maintain that there is a strong possibility that the two will eventually prove to be conspecific.

Paraleptophlebia jenseni, NEW SPECIES

Male adult. Body length 7.5-9.0mm; forewing length 7.0-8.0mm. Color generally dark brown. Head: Coloration shining dark brown to black; antennae brown basally, pale apically; ocelli white; eyes meeting along midline, each divided, with upper portion tan and lower portion black. Thorax: Nota shining dark brown to black; pleura brown to dark brown (membranous areas light brown); sterna brown. Forewings stained brown in apical one-third to one-half, clear or only very faintly tinted basally; longitudinal veins light brown; crossveins pale, those in stigmatic area anastomosed. Hindwings clear throughout, with pale venation. Legs light brown to dark brown, mid- and hindlegs lighter; femora and foretibiae darker; apex of femora and base of tibiae with dark brown markings. Abdomen: Coloration generally brown with pale posterior margins on segments dorsally and pale markings on segments ventrally; segments 1-7 with dark spiracular markings. Terga 1-2 dark brown; terga 3-7 lighter brown and translucent, with darker paired submedian dashes anteriorly; terga 8-10 brown, opaque. Sterna 2-8 light to medium brown with paired submedian spots anteriorly; sternum 9 often with conspicuoulsy lighter postermedial area bordered by dark brownish black anterior area extending posterolaterally. Genitalia brown; forceps without dorsal enlargement at base; penes (Fig. 1) with deep, narrow, U- to V-shaped furcation; penal lobes produced apicolaterally into narrow-acute spine-like projections. Caudal filaments brown to gray basally, lighter apically.

Female adult. Unknown.

Material examined. Holotype: male adult, Washington, Klickitat County, Rock Creek, above Hwy bridge, V-31-1998, R. L. Newell. Paratypes: eight male adults, same collecting data as holotype. The holotype is deposited in the Purdue Entomological Research Collection (PERC), West Lafayette, Indiana. Paratypes are deposited in PERC and the C. P. Gillette Museum of Arthropod Diversity, Fort Collins, Colorado (CSU). Other material examined consisted of one male adult, Washington, Klickitat County, Badger Gulch Creek Hwy bridge, V-31-1998, R. Newell; five male adults, Washington, Klickitat County, Holter Gulch Creek, upper station, V-16-1998, R, Newell; and 14 male adults with the same data as holotype.

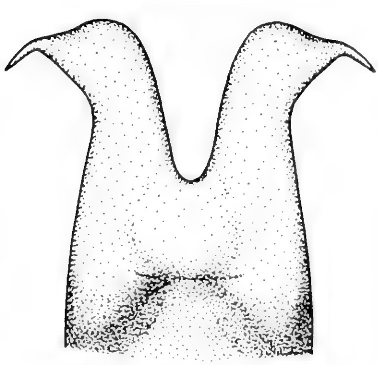
Discussion. *Paraleptophlebia jenseni* and *P. traverae* have penal lobes that are expanded somewhat laterally at their apices, but otherwise do not possess any recurved processes or incisions as many species do, but neither are they narrow and attenuated as those of *P. brunneipennis* (McDunnough). This particular penes type should allow these two species to be distinguished from other species of *Paraleptophlebia* in North America. Male adults of the two species can also readily be distinguished from each other. Those of *P. jenseni* have the forewings shaded with brown stain in the apical one-third to one-half, and the lateral aspect of the apices of the penal lobes are much more sharply pointed and elongate. For comparative figures of *Paraleptophlebia* spp. genitalia in general see Traver (1935) and Harper and Harper (1986).

Paraleptophlebia jenseni is known from Washington as indicated above. Based on Jensen (1966), it has also been taken from Marys Creek, six miles southeast of Grasmere in Owyhee County, Idaho. Because Klickitat County in Washington and Owyhee County in Idaho both adjoin the state of Oregon, it is reasonable to assume that *P. jenseni* will eventually be found in Oregon.

Paraleptophlebia traverae, NEW SPECIES

Paraleptophlebia rufivenosa, Traver, 1935:528. (misidentification).

Male adult. [The body of the single known specimen of this species is preserved in alcohol and is deteriorated and fragmented; however, a description of the color pattern was provided by Traver (1935), under *P. rufivenosa*, and the wings and genitalia are slide mounted and remain in good condition.] Wings completely hyaline, with no staining. Penes (Fig. 2) with lobes separated by broad U-shaped emargination, with apices broadly beak-like laterally, but not narrowly acute or spine-like.



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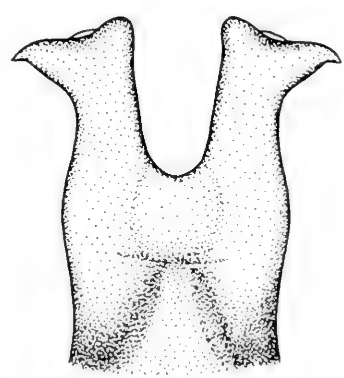

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Figs. 1-2. *Paraleptophlebia* penes (ventral view). 1. *P. jenseni*. 2. *P. traverae*.

Female adult. Unknown.

Material examined. Holotype male adult, Grangeville, Idaho, VI-27-1907, J. M. Aldrich (genitalia [in balsam] and one set of wings [dry mounted] on two slides). The holotype is deposited in the Cornell University Insect Collection, Ithaca, New York.

Discussion. *Paraleptophlebia traverae*, *P. jenseni*, and *P. brunneipennis* may form a closely related group of species within *Paraleptophlebia* based on their relatively simple penes lobes. *Paraleptophlebia traverae* is most similar to *P. jenseni*; however, the two are easily distinguished based on wing membrane staining and penes apices differences as discussed above, under *P. Jenseni*.

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AN UNUSUAL NEW SPECIES OF *CAMELOBAETIDIUS* (EPHEMEROPTERA: BAETIDAE) FROM PARAGUAY[1, 2]

C. R. Lugo-Ortiz[3], W. P. McCafferty[4]

ABSTRACT: *Camelobaetidius tuberosus*, new species (Ephemeroptera: Baetidae), is described from Paraguay. The species, known only in the larval stage, is distinguished by the presence of erect, apically blunt tubercles on the pronotum and metanotum; minute, fine, simple setae between the mandibular prosthecae and molae; apicomedially produced maxillary palp segment 1; number of tarsal claw denticles; and abdominal coloration. The tuberculate condition is not known in other species of *Camelobaetidius*.

The small minnow mayfly genus *Camelobaetidius* Demoulin (Ephemeroptera: Baetidae) is found in the Western Hemisphere, from Argentina to Saskatchewan and Indiana (Traver and Edmunds 1968, Lehmkuhl 1976, McCafferty and Klubertanz 1994). Larvae are mostly found in large, warm-water streams (Traver and Edmunds 1968, McCafferty et al. 1992, McCafferty and Klubertanz 1994). Based on habitat ecology, predominantly southwestern distribution in the Nearctic, and demographics, McCafferty et al. (1992) and McCafferty (1998) hypothesized a Neotropical center of origin for *Camelobaetidius*. There are currently 11 valid species of *Camelobaetidius* described from South America, eight from North America (including Mexico), and three from Central America (Traver and Edmunds 1968; Lugo-Ortiz and McCafferty 1995, 1999; Wiersema 1998).

In South America, nominal species of *Camelobaetidius* have been reported from Argentina, Brazil, Peru, Suriname, Venezuela, and Uruguay (Traver and Edmunds 1968, Lugo-Ortiz and McCafferty 1999). Six species are known from larvae only, four from adults only, and only one from both larvae and adults (Traver and Edmunds 1968, Lugo-Ortiz and McCafferty 1999). Additional unnamed species of *Camelobaetidius* have been reported from Colombia (Rojas de Hernández et al. 1995), and we have examined considerable *Camelobaetidius* material from Ecuador. Herein, we describe a highly unusual new species of *Camelobaetidius* from Paraguay. Although the material is limited, we consider it imperative to describe this species at this time because it demonstrates new characteristics within *Camelobaetidius*. The material is housed in the Purdue Entomological Research Collection, West Lafayette, Indiana.

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Camelobaetidius tuberosus Lugo-Ortiz and McCafferty, NEW SPECIES

Larva. Body length: 4.4 mm; caudal filaments length: 3.0 mm. Head: Medium yellow-brown in vertex, cream in frons, clypeus, and genae. Antennae pale yellow-brown, approximately 2.5x length of head capsule. Labrum (Fig. 1) with anterodorsal row of eight long, fine, simple setae. Left mandible (Fig. 2) with six denticles; prostheca robust, apically denticulate; minute, fine, simple setae between prostheca and subtriangular process. Right mandible (Fig. 3) with six denticles; prostheca slender, with minute, fine, simple setae apically and medially. Maxillae (Fig. 4) with palp segment 1 medially produced subdistally; segment 2 subequal in length to segment 1. Labium (Fig. 5) with glossae subequal in length to paraglossae, somewhat narrow-elongate; paraglossae narrow-elongate; palp segment 1 subequal in length to segments 2 and 3 combined; segment 2 approximately 5.0x longer than segment 3, moderately produced distomedially; segment 3 basally broad, apically narrow. Thorax (Fig. 6): Pronotum with medial pair of erect, apically blunt tubercles; (Fig. 7) cream to medium brown; femora cream, with medium brown proximal, dorsal, and distal margins and thin anterodorsal line, and with row of 40-45 long, robust, simple setae dorsally; tibiae cream, with numerous short, fine, simple setae dorsally and scattered short, acute, simple setae ventrally; tarsi medium brown, bare dorsally and with scattered short, acute, simple setae and subdistal long, robust, simple seta ventrally; spatulate tarsal claws (Fig. 8) with 15-17 denticles. Abdomen: Terga 1-9 with faint thin medial line; tergum 1 cream, suffused with black; terga 2 and 5 cream, anteriorly light brown; terga 3 and 4 cream, suffused with black submedially and sublaterally; terga 6-10 pale yellow-brown, slightly darker marginally. Sterna cream to pale yellow-brown. Gills untracheated or poorly tracheated. Median caudal filament approximately 0.6x length of cerci.

Adult. Unknown.

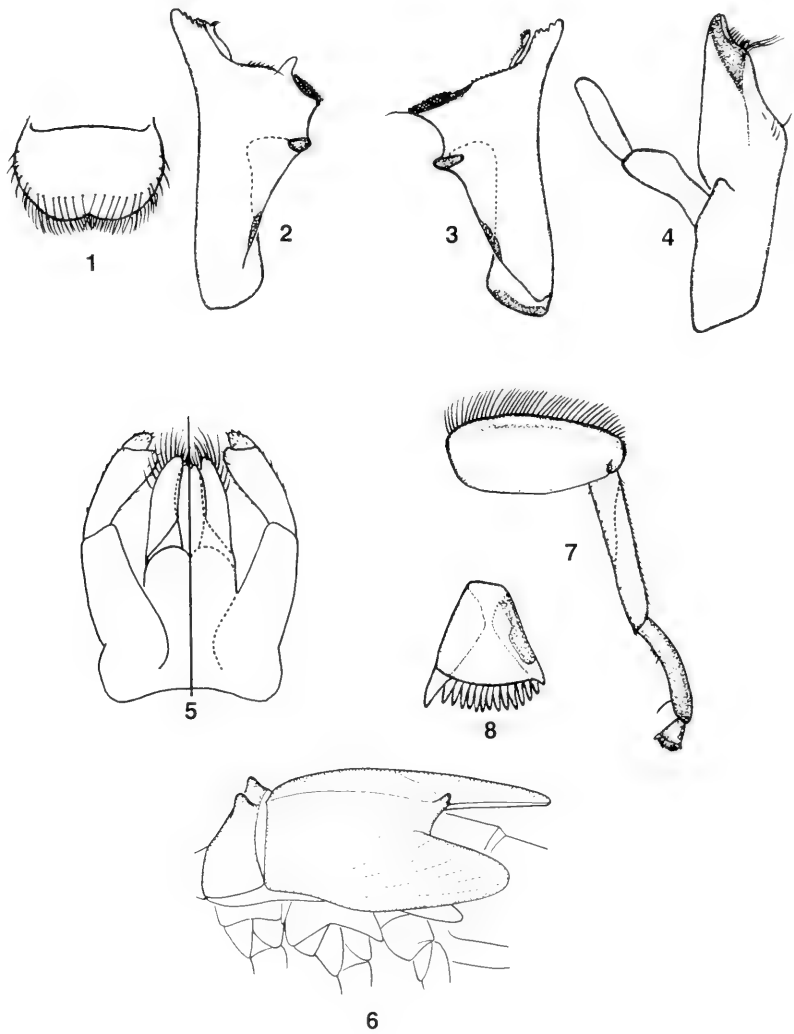
Material examined. Holotype: Larva, Paraguay, Departamento Cordillera, Pirebibuy, Río Pirebibuy, 3-V-1985, R. T. Bonace [mouthparts and left foreleg mounted on slide (medium: Euparal)].

Etymology. The specific epithet is a Latin word meaning "full of tubercles."

Discussion. The presence of a medial pair of erect, blunt tubercles on the pronotum and a single medial slightly erect, blunt tubercle on the metanotum readily distinguishes *C. tuberosus* from all other known larvae of *Camelobaetidius* (Fig. 6). Other distinguishing features of *C. tuberosus* include the presence of minute, fine, simple setae between the prosthecae and molae of the mandibles (Figs. 2, 3), apicomedially produced maxillary palp segment 1 (Fig. 4), number of tarsal claw denticles (Fig. 8), and abdominal coloration.

Camelobaetidius tuberosus appears closely related to the Brazilian species *C. phaedrus* (Traver and Edmunds). Both species have similar labral setation (Fig. 1; Traver and Edmunds 1968: Fig. 36), a long labial palp segment 2 that is moderately produced apicomedially (Fig. 5; Traver and Edmunds 1968: Fig. 54), and long and slender procoxal osmobranchia. The morphology of maxillary palp segment 1, however, is most similar to that of the Brazilian species *C. anubis* (Traver and Edmunds) (Fig. 4; Traver and Edmunds 1968: Fig. 35).

In Western Hemisphere baetids, only the genus *Baetodes* Needham and Murphy possesses dorsal tubercles (Lugo-Ortiz and McCafferty 1996). However, with the exception of some species that have a single metanotal tubercle,



Figs. 1-8. *Camelobaetidius tuberosus*, new species. 1. Labrum (dorsal). 2. Left mandible. 3. Right mandible. 4. Right maxilla. 5. Labium (left-ventral; right-dorsal). 6. Thorax (lateral). 7. Left foreleg. 8. Tarsal claw.

those tubercles are located on the abdomen in *Baetodes*, and they vary considerably in degree of development. No known species of *Baetodes* has pronotal tubercles.

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HOST ASSOCIATIONS OF BRACONID PARASITOIDS (HYMENOPTERA: BRACONIDAE) REARED FROM LEPIDOPTERA FEEDING ON OAKS (*QUERCUS* SPP.) IN THE MISSOURI OZARKS[1]

J. B. Whitfield[2], R. J. Marquis[3], J. Le Corff[3,4]

ABSTRACT: Host/parasitoid records are provided for 32 species of braconid wasps attacking a large complex of caterpillars that feed upon five species of oaks (*Quercus* spp.) in the Missouri Ozarks. Forty of the 62 host records are new for the given species of braconids.

The faunas of both oak-feeding herbivores and their associated parasitoid communities have been found to be among the most diverse yet studied on any plant group (Opler, 1974). The forests of the Ozark Plateau are dominated by oaks and hickories, and thus are likely to harbor a large fauna of herbivores (especially caterpillars) and parasitoids. However, this region of the U. S. has been less intensively studied faunistically than many regions on the east and west coasts of North America.

From 1991 until the present, we have been intensively and quantitatively sampling the herbivore faunas of five species of oaks (white oak, *Quercus alba* L.; scarlet oak, *Q. coccinea* Muench.; northern red oak, *Q. rubra* L.; post oak, *Q. stellata* Wang.; and black oak, *Q. velutina* Lam.). These field surveys will result in the production of a field guide to the caterpillars found on these oaks in the Missouri Ozarks (Marquis et al., in press), as well as analyses of temporal and spatial variation in the herbivore (Marquis and Le Corff, 1997; Le Corff and Marquis, 1999; Marquis and Whitfield, unpublished data) and associated parasitoid (Le Corff et al., in press) communities.

The parasitoid faunas, being poorly studied in this part of the country, pose a substantial challenge in terms of species identification. The present paper focuses on those host/parasitoid records we have been able to strongly confirm within this herbivore community for braconid wasps.

MATERIALS AND METHODS

The above-mentioned quantitative field surveys of oak herbivores were being conducted from April to September of each year. Parallel collecting efforts targeted towards trees not used in the quantitative survey (but relatively

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nearby) were used to obtain caterpillars for photographic documentation, to obtain the adult stages of the herbivores to aid in identification, and to assess the identities and relative abundance of the associated parasitoids. The sites sampled (all in Missouri) were: Little Lost Creek State Forest, Daniel Boone State Forest (both near Warrenton, Montgomery Co.), Washington University's Tyson Research Center (Eureka, Jefferson Co.), Deer Run State Forest (Reynolds Co., near Ellington), Paint Rock State Forest, Cardareva State Forest, and Carr Creek State Forest (Shannon Co., near Ellington), and Peck Ranch Wildlife Reserve (Van Buren, Carter Co.). Field-collected caterpillars were brought back to the laboratory (roughly 2,000 caterpillars representing 150-200 species were collected each year) in plastic bags, sorted into individual species, then placed in 6-in diameter plastic cups with clear lids and provided with food (leaves of the tree species from which they were collected). Each caterpillar was then followed until it either died, or yielded an adult herbivore or parasitoid(s). Thus we have accurate records of the host (herbivore) insect species from which each parasitoid was reared, the oak species on which that herbivore was collected, and the locality and plot from which the sample was taken. Parasitoids from black (*Q. velutina*) and white (*Q. alba*) oaks are relatively better represented, since these two oak species were sampled for more years of the project than the other three.

After emergence, adult parasitoids were point-mounted, or placed in gelatin capsules, and labelled with respect to all relevant field collection and lab rearing data. The herbivore species were then identified by a variety of individuals listed in the Acknowledgments, while the braconid parasitoids were identified by the senior author. The following sources were especially useful in obtaining and/or confirming the braconid identifications: Marsh (1979); Muesebeck (1920, 1922, 1923, 1927, 1932, 1970); Sharkey and Janzen (1995); Shaw (1983); and Wharton et al. (1997). Host records were checked against those listed in Marsh (1979); records which then appeared to be new were subjected to computer literature searches to obtain any recent literature.

Voucher specimens of the herbivores and braconids have been deposited in the Natural History Museum, University of Missouri, St. Louis, while additional vouchers of the braconid species are in the University of Arkansas Arthropod Museum, Fayetteville.

RESULTS AND DISCUSSION

Table 1 provides a summary of the braconid species reared, with associated host herbivore and herbivore host plant species. Readers interested in relative abundance of these parasitoids are referred to Le Corff et al. (in press).

Those braconid species that attacked microlepidoptera (esp. Gelechiidae, Oecophoridae, and Tortricidae) were niche specific. In other words, the set of hosts each of these braconid species might attack could belong to several unrelated lepidopteran families, but all would have some feeding niche (and usually also seasonality) in common – e.g., spring-feeding leaf-rollers. Examples of this pattern were the sampled braconid species of *Bassus*, *Dolichogenidea*, *Hypomicrogaster*, *Microgaster* and *Macrocentrus* (see Table 1). Our braconid parasitoids specializing in microlepidoptera thus behaved similarly to those attacking leaf-miners in previous studies (e.g. Whitfield and Wagner, 1988, 1991, and many other studies). Braconid species specializing upon microlepidoptera (N = 16) attacked a mean of 2.27 ± 1.23 host species while only 44% of them attacked only a single host species in our study. Fifty percent of them attacked species in more than one host family (mean of 1.71 ± 0.79 host families per braconid species).

In contrast, the braconid species that attacked macrolepidopteran hosts (e.g. Geometridae, Limacodidae, Noctuidae, and Notodontidae) were relatively more host-specific, attacking either a single host species or a taxonomically related set of hosts from the same genus or family (or very closely related families). Examples of this latter pattern are our records for species of *Cotesia*, *Diolcogaster*, *Protapanteles* and *Sigalphus* (see Table 1). Braconids that specialized upon macrolepidoptera (N = 16) attacked a mean of 1.67 ± 1.05 host species (except for *D. facetosa*, always from the same host family), and 69% of them attacked only a single host species.

Forty of the host/parasitoid associations provided here are new to the literature (these are marked with an asterisk in Table 1), and several of them represent newly reported (albeit not surprising) host families for their parasitoid species. In many cases, the fact that these associations have not been previously reported is not because they are actually rare in nature. Instead, it is because the caterpillar and parasitoid faunas in the Ozarks have not been previously extensively studied, and also because the parasitoids are difficult, for all but specialists, to identify. The lists we have provided are not exhaustive as several braconid species, for which we reared only one sex or only one individual, could not be identified with any confidence and were thus omitted. It is likely that most of the common species to be encountered in the Ozarks attacking oak caterpillars are represented here, given our intensive sampling over several years.

Comparisons with results of extensive malaise trap sampling of braconids from the same areas of Ozark oak-hickory forest suggest that the oak herbivores harbor approximately 30-40% of the nearly 100 braconid species that attack all caterpillars in this plant community. Thus it is likely that many of the species reported here will be reported to attack herbivores on other plant species as well.

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Table 1. Identified braconid species reared from caterpillars on oak leaves in the Missouri Ozarks. Braconid species were identified by the senior author; host caterpillars were identified initially by the authors and checked by the specialists listed in the Acknowledgments. Oak species abbreviations: R- red oak (*Quercus rubrum*); B-black oak (*Q. velutina*); S - (scarlet oak, *Q. coccinea*); P-post oak (*Q. stellata*); W- white oak (*Q. alba*). * - Host species not known to be previously recorded for the given parasitoid, although in a few cases the host genus may have been previously recorded.

Braconid species reared	**Subfamily**	**Host species**	**Host family**	**Oaks**
Aleiodes sp.	Rogadinae	*Nadata gibbosa* (J. E. Sm.)	Notodontidae	W
Apanteles plesius Viereck	Microgastrinae	*Sparganothis pettitana* (Rob.)	Tortricidae	B,P,R,S,W
Apanteles polychrosidis Viereck	Microgastrinae	* *Ancylis divisiana* (Wlk.)	Tortricidae	W, P
"	"	* *Argyrotaenia alisellana* (Rob.)	Tortricidae	W, P
"	"	**Oneida lunalalis* (Hlst.)	Pyralidae	B
Ascogaster canadensis Shaw	Cheloninae	*Sparganothis pettitana* (Rob.)	Tortricidae	B, W
Bassus annulipes (Cresson)	Agathidinae	**Argyrotaenia quercifoliana* (Fitch)	Tortricidae	W
"	"	**Choristoneura rosaceana* Harr.	Tortricidae	W
"	"	**Sparganothis pettitana (Rob.)*	Tortricidae	B, W
Bassus calcaratus (Cresson)	Agathidinae	**Chionodes fuscomaculella* (Cham.)	Gelechiidae	W
"	Agathidinae	* *Psilocorsis quercicella* Clem.	Oecophoridae	P, W
"	"	* *Psilocorsis reflexella* (Pack.)	Oecophoridae	W
"	"	**Sparganothis pettitana* (Rob.)	Tortricidae	W
Bassus cinctus (Cresson)	Agathidinae	**Argyrotaenia quercifoliana* (Fitch)	Tortricidae	B
"	"	*Dichomeris ligulella (Hbn.)*	Gelechiidae	P, W
"	"	**Pseudotelphusa* sp.	Gelechiidae	W
Cotesia prob. *acronyctae* (Riley)	Microgastrinae	*Acronycta haesitata* (Grt.)	Noctuidae	W
Cotesia diacrisiae (Gahan)	Microgastrinae	* *Dasychira obliquata* (G. & R.)	Lymantriidae	B
"	"	* *Dasychira tephra* Hbn.	Lymantriidae	W
Cotesia empretiae (Viereck)	Microgastrinae	* *Apoda biguttata* (Pack.)	Limacodidae	S
"	"	*Euclea delphinii* (Bdv.)	Limacodidae	W
"	"	*Parasa indetermina* (Bdv.)	Limacodidae	W
Cotesia flavicornis (Riley)	Microgastrinae	*Erynnis juvenalis* (Fab.)	Hesperiidae	B
Cotesia hyphantriae (Riley)	Microgastrinae	* *Morrisonia confusa* (Hbn.)	Noctuidae	B,P,R,S,W
Cotesia phobetri (Rohwer)	Microgastrinae	*Halysidota tessellaris* (J. E. Sm.)	Arctiidae	B
Deuterixys sp. (probably undescribed)	Microgastrinae	*Bucculatrix sp.*	Bucculatrigidae	W
Diolcogaster facetosa (Weed)	Microgastrinae	* *Catocala amica* (Hbn.)	Noctuidae	W
"	Microgastrinae	**Lochmaeus manteo (Doubleday)*	Notodontidae	B, W

"	"	* *Oligocentria lignicolor* (Wlk.)	Notodontidae	W
"	"	**Oligocentria semirufescens* (Wlk.)	Notodontidae	W
Distratrix sp. (probably undescribed)	Microgastrinae	* *Hyperstrotia secta* (Grt.)	Noctuidae	W
Dolichogenidea sp. (species uncertain)	Microgastrinae	*Psilocorsis reflexella* (Pack.)	Oecophoridae	W
"	"	*Sparganothis pettitana* (Rob.)	Tortricidae	W
"	"	*Telphusa latifasciella* (Chamb.)	Gelechiidae	W
Hypomicrogaster ecdytolophae (Muesebeck)	Microgastrinae	*Arogalea cristifasciella* (Cham.)	Gelechiidae	W
"	"	* *Chionodes fuscomaculella* (Chamb.)	Gelechiidae	B,P,R,S,W
"	"	* *Pseudotelphusa* sp.	Gelechiidae	B,P,R,S,W
"	"	* *Psilocorsis quercicella* Clem.	Oecophoridae	B,P,R,S,W
Macrocentrus delicatus Cresson	Macrocentrinae	**Antaeotricha schlaegeri* (Zell.)	Oecophoridae	W
"	"	**Argyrotaenia quercifoliana* (Fitch)	Tortricidae	B, W
"	"	* *Chionodes fuscomaculella* (Chamb.)	Gelechiidae	B, R, S, W
Meteorus autographae Muesebeck	Meteorinae	* *Acronicta haesitata* (Grt.)	Noctuidae	W
Microgaster epagoges Gahan	Microgastrinae	* *Chionodes* n. sp.	Gelechiidae	P, W
"	"	* *Dichomeris ligulella* (Hbn.)	Gelechiidae	W
"	"	*Sparganothis pettitana* (Rob.)	Tortricidae	B,P,R,S,W
"	Microgastrinae	* *Telphusa latifasciella* (Chamb.)	Gelechiidae	W
Microplitis hyphantriae Ashmead	Microgastrinae	* *Amphipyra pyramidoides* Gn.	Noctuidae	W
"	"	**Cosmia calami* (Harv.)	Noctuidae	W
Orgilus gelechiae (Ashmead)	Orgilinae	*Bucculatrix* sp.	Bucculatrigidae	P, W
Parapanteles n. sp.	Microgastrinae	* *Meganola minuscula* (Zell.)	Noctuidae	B
Phanerotoma tibialis (Haldeman)	Cheloninae	* *Salebriaria engeli* (Dyar)	Pyralidae	B
Pholetesor bedelliae (Viereck)	Microgastrinae	*Bucculatrix* sp.	Bucculatrigidae	R
Pholetesor ornigis (Weed)	Microgastrinae	*Phyllonorycter fitchella* Chamb.	Gracillariidae	P, W
"	"	*Tischeria citripennella* (Clem.)	Tischeriidae	P, W
Protapanteles paleacritae (Riley)	Microgastrinae	**Anacamptodes defectaria (Gn.)*	Geometridae	W
"	"	* *Lambdina fervidaria* (Hbn.)	Geometridae	W
"	"	**Nacophora quernaria* (J. E. Sm.)	Geometridae	B, W
"	"	*Phigalia titea* (Cramer)	Geometridae	B
Pseudapanteles n. sp.	Microgastrinae	* *Antaeotricha schlaegeri* (Zeller)	Oecophoridae	P, S
Sigalphus bicolor (Cresson)	Sigalphinae	* *Acronicta lithospila* Grt.	Noctuidae	B
Stiropius bucculatricis (Muesebeck)	Rogadinae	*Bucculatrix* sp.	Bucculatrigidae	B
Venanides xeste Mason	Microgastrinae	*Dichomeris ligulella* (Hbn.)	Gelechiidae	S, W

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MORPHOLOGY OF FINAL INSTAR *OCHROTRICHIA XENA* (TRICHOPTERA: HYDROPTILIDAE)[1]

J. B. Keiper[2]

ABSTRACT: Morphological descriptions of final instar *Ochrotrichia xena* are given. Specimens were collected from a small woodland stream in northeastern Ohio. This species is readily separated from other described *Ochrotrichia* larvae by the mandible morphology, two setae on the posterolateral corner and bristles on the inner margin of the right mandible only, pale rectangular prosternal sclerites, and oblate dorsal sclerotized abdominal rings.

Ochrotrichia is the second largest genus of microcaddisflies (Trichoptera: Hydroptilidae) in North America with over 50 species (Wiggins 1996a), but few larval/adult associations have been recorded. Few *Ochrotrichia* larvae have been described (Flint and Herrmann 1976, Vaillant 1984, English and Hamilton 1986), and identification of field collected larvae is impossible without the benefit of rearing males. Huryn and Foote (1983) recorded four species from Ohio, and Keiper and Foote (1998) recently reported *O. xena* (Ross) as a new state record bringing the total to five. The larvae dwell in mats of the filamentous green alga *Cladophora* (Chlorophyta) growing in a small woodland stream, and consume the contents of individual cells within these filaments. Larvae of *O. wojcickyi* Blickle and *Hydroptila jackmanni* Blickle co-occur with *O. xena* (Keiper and Foote 1998).

Ross (1944) gave a brief description of fifth instar *O. xena*, but this was limited to total length and coloration. Herein, I provide morphological descriptions of the fifth instar, and compare its morphology to those species described previously.

MATERIALS AND METHODS

Keiper and Foote (1998) described South Fork Eagle Creek (OH, Portage Co.) where larvae were collected and described the rearing techniques used to associate the larvae and adults. Most specimens were used to rear adults for species identification, but several fifth instars were killed in near boiling water, fixed in Kahle's solution, and preserved in 70% ethanol. Morphological descriptions are based on 13 living and five preserved specimens; head capsule width measurements were taken from 10 living and five preserved specimens, and other measurements given were obtained from three preserved specimens. Measurements were made with a Wild MZ-8 dissecting microscope outfitted with an ocular micrometer, or with a Leica compound light microscope (slide-mounted specimens). Values are given as mm (mean ± 1 S.E.). Tagged Image

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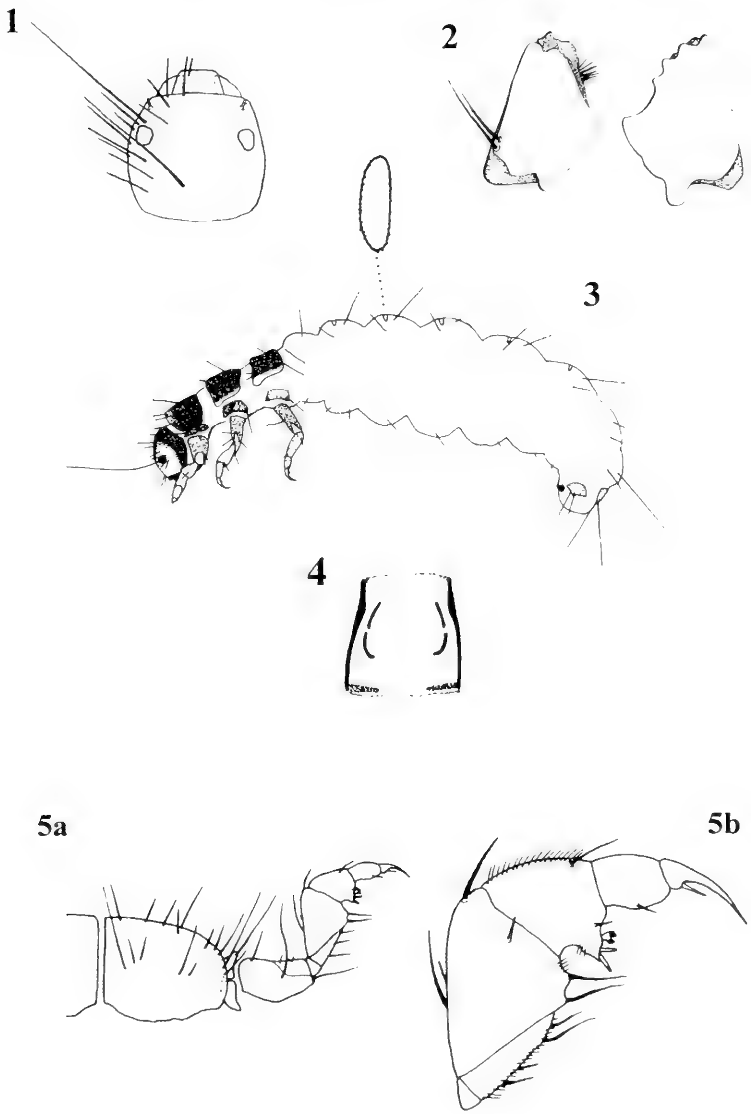
Format (TIF) files of preserved larvae were obtained using a low light camera attached to the microscopes and Image Pro Plus™ software on an IBM personal computer; TIF images were printed with a laser printer, and the images traced on a light table to facilitate illustration.

RESULTS AND DISCUSSION

Fifth instar. Head capsule: length 0.227 ± 0.001, width 0.205 ± 0.0; dark brown, with pale area around eyes reaching anterolateral margin broadly; faint muscle scars scattered postero-dorsally; primary setae as in Fig. 1; antennae short, inconspicuous, approximately 0.5x diameter of eye spot; mandibles dark brown, asymmetrical, right with two setae on posterolateral corner and bristles on inner margin, left lacking setae and bristles, both with robust cusps (Fig. 2). Thorax: prothoracic sclerite dark brown, lateral and posterior margins black, anterior margin with narrow pale area not reaching lateral margins, primary setae as in Fig. 3, length 0.155 ± 0.003; mesothoracic sclerite dark brown, pale lateral margins ~ 0.025 wide, muscle scars scattered posteriorly; metathoracic sclerite dark brown, pale lateral margins ~ 0.100 wide, anterolateral corner produced and encompassed by pale margin, muscle scars scattered posteriorly; membranous areas milky white; prosternum with two faint poorly-defined sclerotized areas posteriorly (Fig. 4). Legs: coxae and femora dark brown, legs becoming increasingly pale distally, tarsi light brown; anterior face of coxae with long seta subequal to length of coxa; prothoracic leg 0.305 ± 0.018, tibia with row of fine hairs dorsally and ventral projection with two stout apical setae, tarsal claw gradually curved (~ 0.05 long), basal seta approximately 0.3-0.4x length of claw (Fig. 5); mesothoracic leg 0.385 ± 0.010 long; metathoracic leg 0.410 ± 0.019 long; ratio of legs 0.75:0.9:1.0, prothoracic to metathoracic, respectively. Abdomen: distended greatly in mature specimens, concolorous with membranous areas of thorax, no lateral protuberances, venter of some segments invaginated slightly (not observed in living specimens); first, seventh, and eighth segments lacking sclerites; oblate dorsal sclerotized rings on segments 2-6 only, inconspicuous (Fig. 3); segment nine with pale rectangular dorsal sclerite; segment 10 with small brown sclerites on anal prolegs, anal claw small and dark brown contrasting all other abdominal sclerites (Fig. 3). Case: Purse-like, composed of two silken valves with mineral and detrital material attached, similar to those illustrated by Ross (1944) and Wiggins (1996b) for *Ochrotrichia*.

Extrapolating head capsule width for early instars using Dyar's Rule (Dyar 1890) gives values of 0.072 mm, 0.094 mm, 0.122 mm, and 0.158 mm for instars 1-4 respectively. Previous work with other hydroptilid species from four genera indicates that Dyar's Rule accurately predicts head capsule width for Hydroptilidae (Keiper and Foote 1999, J.B. Keiper, pers. obs.).

Ochrotrichia xena is readily separated from other described *Ochrotrichia* spp. based on its mandibular structure, two setae on the posterolateral corners of the right mandible vs. none on the left, presence of bristles on the inner margin of the right mandible, prosternal sclerites pale and not well defined, and dorsal abdominal ring sclerites oblate. *Ochrotrichia arizonica* Denning and Blickle (English and Hamilton 1986), *O. susanae* Flint and Herrmann (Flint and Herrmann 1976) and *O. anisca* (Ross) (Ross 1944) also have dorsal abdominal ring sclerites, but these species exhibit sclerites that are rounded to quadrate; the co-existing larvae of *O. wojcickyi* also have quadrate sclerites (J.B. Keiper, pers. obs.). Other described species such as *O. riesi* Ross (Ross



Figs. 1-5. *Ochrotrichia xena*. 1. Head, dorsal view. 2. Mandibles, ventral view (modified from Keiper and Foote 1998). 3. Fifth instar, lateral view with enlargement of dorsal abdominal sclerite of segment three. 4. Prosternum, anterior up. 5a. Right half of dorsal prothoracic sclerite and leg. 5b. Enlarged view of right prothoracic femur, tibia, and tarsus.

1944) and *O. confusa* (Morton) (Vaillant 1984) have robust, darkly-pigmented sclerites.

Larval *Hydroptila* and *Ochrotrichia* are very similar morphologically and are often separated by differences in sclerite shape or number (Peckarsky et al. 1990, Morse and Holzenthal 1996). One such character is *Hydroptila*'s lack of the protruded anterolateral metathoracic corner which is exhibited by *Ochrotrichia*; *O. xena* exhibits a very pale lateral margin and anterolateral corner. Cursory inspection of *O. xena* in lateral view can lead to misidentifications of larvae as *Hydroptila* because the elongated area is nearly concolorous with the membranous areas of the thorax. It is recommended that stream-dwelling larvae identified as *Hydroptila* be viewed at higher power (30x minimum) and at different angles relative to the light source to determine if a pale protrusion is present on the metathorax. An alternative character used to separate these two genera is the number of prosternal sclerites, with *Ochrotrichia* usually having two and *Hydroptila* three (Wiggins 1996b). However, some *Ochrotrichia* have three (Wiggins 1996b) and some *Hydroptila* have only two such sclerites (Wiggins 1996b, Keiper and Foote 1999), rendering this character somewhat unreliable. Wiggins (1996b) notes that *Hydroptila* spp. fifth instars have three short posterior gills which are lacking in *Ochrotrichia*, but I have found that placing live specimens directly in 70% ethanol causes these gills to shrink occasionally and become useless taxonomically. These problems underscore Wiggins' pleas for the proper preservation of trichopteran larvae (Wiggins 1996b) and for further larva/adult associations (Wiggins 1990) to aid with taxonomic challenges commonly faced by aquatic entomologists working with Trichoptera.

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SCIENTIFIC NOTE

NEW NORTHERN RECORDS FOR *NECRODES SURINAMENSIS* (COLEOPTERA: SILPHIDAE) AND *NITIDULA NIGRA* (COLEOPTERA: NITIDULIDAE) FROM THE NORTHWEST TERRITORIES, CANADA [1]

Grant D. De Jong, James W. Chadwick[2]

In mid-July, 1998, the second author collected insects sporadically from several carcasses on roadways near Great Slave Lake in the Northwest Territories. Each had presumably been killed by an automobile and the species included seagull and raven. Insects were collected by picking them directly off the carcasses. The collected taxa are widespread in distribution and most can be generally collected at carrion. Of particular interest, however, are the collections of adults of the silphid beetle *Necrodes surinamensis* (F.) and the nitidulid beetle *Nitidula nigra* Schaeffer.

Necrodes surinamensis has been collected throughout southern Canada. The northernmost collections of this species in western Canada have been in central Alberta near Edmonton and east-central British Columbia at Pouce Coupe, near Dawson Creek (Ratcliffe 1972, Anderson and Peck 1985). It has not previously been reported from the Northwest Territories (Campbell 1991). The collection of this species from a dead raven at a site 48 km east of the Hay River extends its distribution about 750 km north of its previous known distribution and represents a new record for the Northwest Territories.

The sap beetle *N. nigra* has been reported from Alaska and the Yukon Territory, British Columbia, Alberta, and Manitoba in Canada (Parsons 1943, McNamara 1991). Given its known distribution, the collection of this species from a dead seagull carcass at a site 80 km north of Ft. Providence is not surprising, but represents a new record for the Northwest Territories.

The specimens of *N. surinamensis* and *N. nigra* have been placed in the collections of the C. P. Gillette Museum of Arthropod Biodiversity at Colorado State University as voucher specimens.

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DESCRIPTION OF THE MALE OF *ANAGRUS FLAVIAPEX* (HYMENOPTERA: MYMARIDAE), WITH NEW DISTRIBUTION AND HOST RECORDS[1]

Serguei V. Triapitsyn[2]

ABSTRACT: The male of *Anagrus flaviapex*, previously known from the female sex only in China, is described and illustrated based on Indian specimens. This mymarid egg parasitoid is an economically important species in India, where its host associations include the leafhoppers *Empoasca devastans* and *Typhlocyba sudra*.

The mymarid wasp *Anagrus empoascae* Dozier, originally described from Haiti (Dozier 1932), was first reported from India as an egg parasitoid of the cotton jassid, *Empoasca devastans* Distant, by Subba Rao (1966). One year earlier, Subba Rao et al. (1965) referred to this species as *Anagrus* sp. Singh and Baldev Parshad (1967) discovered that *Typhlocyba sudra* Distant, also found in India, is an alternate leafhopper host of this parasitoid. Because *E. devastans* is an economically important pest of several agricultural crops throughout India (Subba Rao et al. 1968), correct determination of its major natural enemy is desirable. It is clear from Subba Rao (1966) that the initial identification of this species as *A. empoascae* was not based on a comparison of Indian specimens with the type series of the Neotropical *A. empoascae*; therefore, confirmation of such an odd record was necessary.

In the collection of the Essig Museum, University of California, Berkeley [EMEC], I found seven female and 13 male specimens of *Anagrus* poorly mounted on three slides (on one of the slides together with a female *Arescon enocki* (Subba Rao and Kaur) and a male *Stethynium triclavatum* Enock) and labeled: "ex eggs of *Empoasca devastans*, New Delhi, India, Aug. 10, 1964, B.R. Subba Rao". I determined that these specimens all belong to *Anagrus flaviapex* Chiappini and Lin, a species in the *atomus* species-group of *Anagrus* as defined by Chiappini and Lin (1998). *Anagrus flaviapex* was described from three female specimens collected in Fujian Province of China, the holotype [reared from the egg of a rice planthopper, probably *Sogatella furcifera* (Horváth)] and two paratypes [yellow pan trap] (Chiappini and Lin 1998). *Anagrus empoascae*, a member of the *incarnatus* species-group, occurs in the Neotropical region and is also found in Hawaii (Triapitsyn 1997). Although I have not had a chance to examine any additional material of *Anagrus* reared from eggs of either *E. devastans* or *T. sudra* (my request for a loan of specimens from the Indian Agricultural Research Institute at New Delhi was ignored), it is very probable that all the above-mentioned records of *A. empoascae*

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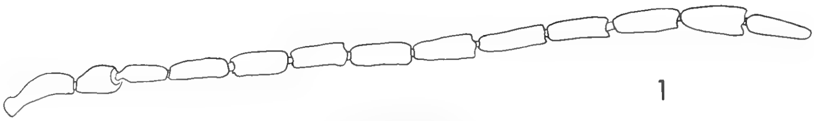

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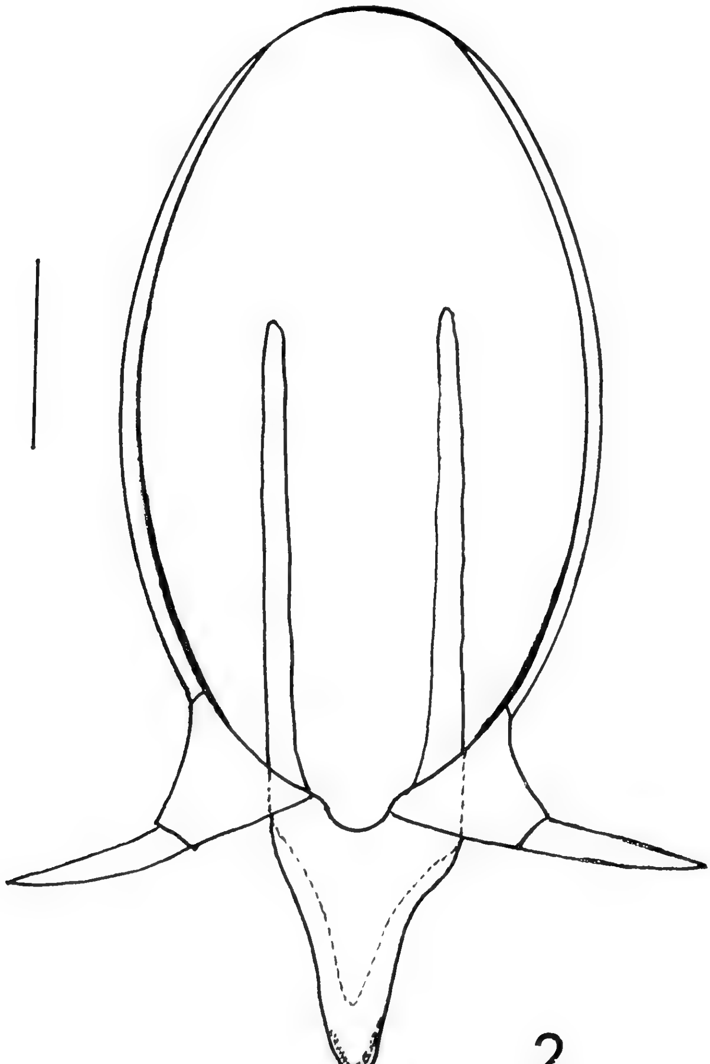

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Figures 1-2. *Anagrus flaviapex*, male. (1) Antenna [scale line = 0.1 mm]; (2) Genitalia, dorsal view [scale line = 0.01 mm].

from India are erroneous due to misidentifications.

A short description of the male of *A. flaviapex* follows. The terminology and choice of measured anatomical features follows that found in Chiappini and Lin (1998). All measurements (length/width) are given in microns (μm) as an average, with the range following in parentheses. Abbreviation used: F = flagellar segment of the antenna.

Anagrus empoascae Dozier; Subba Rao, 1966: 189 (misidentified).
Anagrus flaviapex Chiappini and Lin, 1998: 562-564.

Male (n = 7). Similar to female, as described by Chiappini and Lin (1998), except for the sexually dimorphic characters normal for the genus (antenna as in fig. 1) and the following: general body color brown except head, anterior mesoscutum and metasomal terga all darker; two apical segments of metasoma more or less concolorous with remainder of metasoma, not conspicuously yellow as in female. Male forewing (length/width ratio 7.2-8.1:1) wider than female's (8.6-9.0:1, n = 7) and often without a well-differentiated hairless area along posterior margin. Genital capsule compact, aedeagus relatively short for the species-group, digiti with apical segment long and straight (Fig. 2). Measurements (n = 7). Body: 501 (432-585). Antenna: Scape: 60 (51-71); Pedicel: 37 (35-40); F1: 36 (29-42); F2: 44 (33-51); F3: 45 (34-52); F4: 46 (37-55); F5: 48 (39-55); F6: 49 (40-55); F7: 49 (40-58); F8: 50 (42-55); F9: 50 (44-55); F10: 51 (47-55); F11: 50 (44-60). Forewing: 508 (441-621)/66 (58-77). Genitalia: 66 (54-86).

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NEW BLATTODEA RECORDS FROM MISSISSIPPI AND ALABAMA[1]

Nathan M. Schiff,[3] Terence L. Schiefer[4]

ABSTRACT: *Pseudomops septentrionalis* is reported from seven counties in Mississippi dating back to 1987. These records suggest a gradual range extension hypothesis for this species rather than the accidental human transport hypothesis proposed to explain an apparently isolated population in Auburn, Alabama. *Panchlora nivea* is reported from four counties in Mississippi including two early records considered to be adventive introductions with bananas. *Plectoptera picta* is reported from Alabama for the first time.

The recent publication of *The Catalog and Atlas of the Cockroaches (Dictyoptera) of North America North of Mexico* by Atkinson et al. (1991) is a compilation of museum specimen data and the available North American literature on cockroach distribution and serves as a useful reference for establishing whether a new collection represents a significant range extension. Based on these summarized distributions, Roulston and Appel (1997) reported a large range extension (500km) for *Pseudomops septentrionalis* Hebard from its reported native range of Texas, Oklahoma, Louisiana and northern Mexico to a disjunct site in Auburn, Alabama. This is noteworthy because, although the ranges of exotic species are often expanded by human transportation, Atkinson et al. (1991) suggest there is no evidence that the range of a native species has been expanded by human transport. Since Roulston and Appel stated that *P. septentrionalis* had not been reported from Mississippi, the intervening area, they postulated that the existence of the Auburn, Alabama population reflected recent human activity rather than a natural range extension.

Pseudomops septentrionalis was first noted in Mississippi in 1987 when Michael Ledlow collected four specimens at his home in Starkville, Oktibbeha County. Since then specimens have been collected in six additional counties scattered across the southern two-thirds of the state. Collections in the Mississippi Entomological Museum, Mississippi State (MEM), the University of Mississippi Insect Collection, University, MS (UMIC) and the Southern Hardwoods Laboratory research collections, Stoneville, MS (SHL) contain the following Mississippi specimens of *P. septentrionalis:*

Harrison Co.: Long Beach, 25 July 1994 (1) (MEM); **Hinds Co.:** Clinton, 5 July 1994 (1), 17 July 1995 (1), 28 July 1995 (1) (UMIC); **Holmes Co.:** 1.8 mi. S. Cruger on Hwy 49, 16 June 1989

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(2) (MEM); **Lincoln Co.:** Brookhaven, 12 July 1990, in home (1) (MEM); **Madison Co.:** Madison, 24 July 1998 (1) (MEM); **Oktibbeha Co.:** Starkville, 2 June 1987, incandescent light (1), 26 June 1987, incandescent light (1), 8 July 1987, blacklight trap (2), 25 June 1997 (1) (MEM); **Washington Co.:** Greenville, 10 July 1997 (1) (SHL); Leland, 20 June 1997 (1) (SHL).

These few records show that *P. septentrionalis* was present in central Mississippi approximately halfway between the edge of the presumed native range and the distant Auburn, Alabama population at least nine years prior to the discovery of the Auburn population and that *P. septentrionalis* is widespread in Mississippi. Although it is impossible to discount that the Auburn population was introduced through human activity, we feel the existence of widespread populations of *P. septentrionalis* in Mississippi supports a natural range extension hypothesis for the distribution of this species. It is possible that all the Mississippi records were the result of adventive introductions because the sites are all near major roads, but the proximity to highways may merely reflect accessibility to sites for collectors. We suggest the possibility that the native range of *P. septentrionalis* may include Mississippi and that cockroaches were not well represented in the extant collections from which the range maps were drawn. Presumeably future collections, especially in areas away from highways and development, will help resolve this question.

Panchlora nivea (L.) is another cockroach species that has not been previously recorded from Mississippi. Its reported distribution is southern Louisiana and Texas south through Mexico and Central America, the Greater Antilles, Bahamas, and peninsular Florida where it is common although probably introduced during the late 1970's (Atkinson et al., 1991). Atkinson et al. (1991) have speculated that *P. nivea* should also occur in coastal Mississippi, Alabama, the Florida panhandle, Georgia and South Carolina, but the following records are the first confirmed for Mississippi:

Harrison Co.: Gulfport, T7S R10W sec. 32, 8 May 1989 (1), 31 May 1989 (1), U.V. light (MEM); **Jackson Co.:** 1 mile West of Hwy 90 X Hwy 57, T7S R8W Sec. 25, 12 Apr. 1991, blacklight trap (1) (MEM); Gulf Coast Research. Lab., T7S R8W sec 33 NW, 12-13 Apr. 1991 (1) (MEM); I 10 at Escatawpa River, T75 R5W Sec.1 SW, 13 Apr. 1991 (1) (MEM); Grand Bay Savanna, 30°27'31"N 88°25'14"W, 28 Aug. 1995, blacklight trap in coastal savanna (1) (MEM).

There are two earlier Mississippi records (**Desoto Co.:** Horn Lake, 4 Dec. 1925, on bananas; **Oktibbeha Co.:** Starkville, 18 Nov. 1926, on bananas) that would extend the presumed northern range of this species by approximately 500 km, but we consider these specimens to be adventive because they were collected on bananas which at that time must have been shipped to these inland sites. The fact that the first recent records in Mississippi are from Gulfport, a major port for the importation of bananas, suggests that populations on the Mississippi coast may have originated through introduction. Conversely, the species may have spread naturally from populations in Louisiana or Florida. Several of the Jackson County sites are in natural areas far from human habitation, indicating that the species is probably well established on the Mississippi coast.

The presence of the neotropical cockroach *Plectoptera picta* Saussure and Zehnter in the United States was confirmed by Nickle and Gurney (1985) who considered it more likely that the species was introduced rather than native to the U. S. Its known distribution includes Costa Rica and Veracruz, Mexico with separate disjunct populations in Louisiana and eastern Texas, and in Virginia and North Carolina (Nickle and Gurney, 1985; Atkinson et al. 1991). MacDonald and Combs (1989) also reported the species from southwestern Mississippi, a record that was overlooked by Atkinson et al. (1991). Schiefer collected a single specimen of *P. picta,* the first for Alabama, on 3 Aug. 1991 in Houston County, 0.5 miles north of the Florida line on Highway 109 by beating dead and dying trees. J. R. MacDonald collected a second specimen in Geneva Co., 6 miles West of Geneva, T1N, R20E, S25, SW 1/4 on 28 Aug. 1998 on *Liatris spicata* in a savanna area. These records represent a rather large range extension from either of the known United States populations but is approximately midway between them. The proximity of this record to Florida (0.5 miles) and Georgia (27 miles) suggests that *P. picta* will eventually be found in both of these states as well.

ACKNOWLEDGMENTS

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NEW RECORDS OF AQUATIC HETEROPTERA FOR COLORADO: NOTONECTIDAE, PLEIDAE, CORIXIDAE[1]

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ABSTRACT: Four species of aquatic Heteroptera, *Notonecta borealis*, *Neoplea striola*, *Hesperocorixa vulgaris* and *Graptocorixa abdominalis* are reported from Colorado for the first time. The Colorado record for *N. borealis* extends the known range for this species 500 km southward. Distributional notes are given for each species.

The state of Colorado has a diverse physiography with elevations ranging from 1020 to over 4300 m. The western limits of the Great Plains cover the eastern two-fifths of the state, the Rocky Mountains traverse the central part from north to south, and deep canyons dissect the Colorado Plateau in the western quarter (Mutel and Emerick 1984). This diversity provides a variety of climates and habitats that support a rich insect fauna (Herrmann et al. 1986, Kippenhan 1994, McCafferty et al. 1993, Polhemus 1994). We report the first documented occurrence for four species of aquatic Heteroptera in Colorado. All specimens are deposited in the C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado.

The backswimmer *Notonecta borealis* Hussey was recently collected from two locations in Colorado during a study of the biology of the threatened boreal toad (*Bufo boreas*). A total of four individuals were collected from the following localities: Boulder Co.: 1 male, 1 female, pond above Peaceful Valley, 2,695 m, 27 August 1998, L. J. Livo; Larimer Co.: 1 male, 1 female, Horseshoe Park, Rocky Mountain National Park, 2,609 m, 30 July 1998, L. J. Livo. The site above Peaceful Valley is a large (approximately 80 x 180 m), permanent pond with yellow pond lilies (*Nuphar luteum*), located behind a glacial moraine in a mixed subalpine forest. The site in Horseshoe Park is a small (approximately 23 x 55 m), shallow pond with extensive emergent sedges, located in the glaciated flood plain of Fall River. These specimens were collected in collapsible funnel traps (25 x 25 x 43 cm) with 3 cm openings and 1.6 mm mesh. The traps were placed along the shore for a period of 24 hours. Two additional specimens of *N. borealis* were found in unsorted material in the museum at Colorado State University. Both specimens were collected in Jackson County from the Routt National Forest in north central Colorado. One female was collected on 6 September 1997 by J. M. Burt and one male was collected 10

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September 1989 by W. Willis at Burns Reservoir, elevation 2651 m.

Although *N. borealis* is widely distributed across Canada from British Columbia and the Northwest Territories to Quebec and Newfoundland (Brooks and Kelton 1967, Polhemus and Polhemus 1988), published records for it in the United States, with one exception, have been limited to states bordering Canada. Hilsenhoff (1984) found this species to be rare in extreme northern Wisconsin and absent elsewhere in the state. In the western United States, Roemhild (1976) lists a single record from northwestern Montana. Torre-Bueno and Hussey (1923) examined specimens from Maine, Michigan, Minnesota and South Dakota; paratypes from Brookings County, South Dakota represent the southernmost report of *N. borealis* to date. The Colorado specimens extend the known range of this species 500 km southward. Scudder (1966) discussed the likelihood that *N. borealis* is incapable of flight, so it seems unlikely that these Colorado records are the result of recent "fly ins." Many arthropods that are widespread in northern latitudes are known to occur much farther south in cooler isolated habitats (i.e., higher elevations) (Danks 1981). If *N. borealis* fits this pattern, as it now appears, additional populations of this species will probably be found in other high elevation areas of the Rocky Mountains and the Cascades. There are now four species of *Notonecta* recorded from Colorado; *N. borealis, N. kirbyi* Hungerford (Polhemus and Polhemus 1988), *N. undulata* Say and *N. unifasciata unifasciata* Guerin (Polhemus 1997).

A single specimen of the pygmy backswimmer, *Neoplea striola* (Fieber), was collected from the following locality in Colorado: Yuma Co.: Stalker Lake near Wray, 1074 m, 2 October 1998, B. Kondratieff and R. Durfee. This individual was collected while sweeping through beds of *Chara* sp. along the lake shore. *Neoplea striola* is widespread throughout the eastern and central United States including Kansas and Nebraska (Polhemus 1988), and its discovery in eastern Colorado was not unexpected. This is the first report of the family Pleidae from Colorado.

The water boatmen, *Hesperocorixa vulgaris* (Hungerford), was recently collected from the following two localities in Colorado: Larimer Co.: 1 male, Cathy Fromme Natural Area, Fort Collins, 1524 m, 29 October 1998, R. Durfee. Yuma Co.: 1 male, 1 female, Stalker Lake near Wray, 1074 m, 2 October 1998, B. Kondratieff and R. Durfee. This finding was not unexpected because *H. vulgaris* is widespread throughout the United States and Canada (Polhemus et al. 1988). Only three individuals were collected from both sites where it occurred with the more abundant *H. laevigata* (Uhler). This apparent scarcity may partially explain why it had not been previously collected in Colorado.

Graptocorixa abdominalis (Say) is newly reported for Colorado from the following location: Baca Co.: 1 male, Picture Canyon, small pool, 15 November 1998, B. Kondratieff and R. Durfee. This southwestern corixid was previously known from California and Nevada to Texas and Mexico (Polhemus et al. 1988), and records from northeastern New Mexico and the panhandle of Oklahoma (Hungerford 1948) suggested that it might eventually be found in southern Colorado.

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A LIST OF MICHIGAN CORIXIDAE (HEMIPTERA) WITH FOUR NEW STATE RECORDS FROM THE GREAT LAKES OF MICHIGAN[1]

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ABSTRACT : *Corisella tarsalis, Sigara lineata, Trichocorixa borealis*, and *Trichocorixa kanza* were recently identified from Michigan and constitute new state records. These four species were collected from two of the Great Lakes or their connecting rivers and increase the number of corixids for Michigan to 47 species. We newly report the genus *Corisella* for Michigan. Although most abundant in the western United States and Canada, scattered *Corisella* records in the Midwest (Wisconsin, Ohio and Ontario, Canada) indicated there was a good probability of its occurrence in Michigan. Finally, we provide an updated list of Michigan Corixidae.

As a zealous and avid aquatic Hemiptera worker, H.B. Hungerford, who was a staff member of the Michigan Biological Station from 1923 through 1954, provided much of the knowledge we have concerning the corixid fauna of Michigan (Woodruff, 1956). In Hungerford's superb monograph (Hungerford, 1948) he listed 6 genera encompassing 43 species for Michigan. Since this publication, there have been no newly reported corixids for the State (Polhemus et al, 1988; Steve Chordas and Patrick Hudson, unpublished data). Thus, it has now been over 50 years since any additional corixids have been reported for Michigan.

A Great Lakes invertebrate biodiversity project, initiated at the Great Lakes Science Center (Ann Arbor, Michigan), was recently begun to establish a long term network of taxonomic expertise, invertebrate reference collection, data bases and archival system for Great Lake invertebrates. Collections for this project have been taken from deep water sites, where the fauna is well known, and from various near shore sites, where the fauna is less known. Culmination of these efforts will result in keys and ecological notes that should improve monitoring of Great Lakes invertebrates and enable investigators to gauge their health and the quality of their habitat.

During this project, many corixids have been collected. From these specimens, we have identified one genus and four species that were previously unreported for Michigan. We newly report these species together with an updated list of Michigan corixids.

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METHODS

Adult corixids were collected by black light traps, dip nets, seines, plankton nets or were found in fish stomachs. Identifications were made using keys, illustrations and descriptions by Hungerford (1948) and Sailer (1948). References of known distribution were Polhemus et al (1988), Hungerford (1948) and Sailer (1948). Notes by Hilsenhoff (1984) for Wisconsin specimens were used as comparative references to discuss newly reported taxa. Specimens were preserved in 70% ethanol and deposited in the Ohio Biological Survey's Aquatic Insect Collection (Museum of Biological Diversity at The Ohio State University, Columbus, Ohio) or the aquatic invertebrate collection at the Great Lakes Science Center - U.S.G.S. (Ann Arbor, Michigan).

SPECIES LIST AND NEW STATE RECORDS

We newly report *Corisella tarsalis* (Fieber, 1851), *Sigara lineata* (Forester, 1771), *Trichocorixa borealis* Sailer, 1948, and *Trichocorixa kanza* Sailer, 1948, for Michigan. These four species together with the genus *Corisella* increase the total number and genera of corixids for Michigan to 47 and 7, respectively (Table 1). All four species have been previously recorded for at least one state bordering Michigan and it may be that the Upper Peninsula and southern Lower Peninsula, where these species were obtained, had simply not been extensively collected in the past. Alternatively, in Michigan, these species may be restricted to specific Great Lakes habitats which also have been generally overlooked.

***Corisella tarsalis**:* A single black light sample taken in June at Toledo Beach, Monroe County contained this species. Of the four *Corisella* species known for the United States and Canada, this species has the widest distribution extending from California east to Ontario and New York and south to Mexico. It has been reported as a fairly uncommon species for only one state, Wisconsin, bordering Michigan (Hilsenhoff, 1984). In Canada, the closest record is Ontario (Hungerford, 1948; Polhemus et al, 1988). Given the proximity of these records, we suspected that it may occur in Michigan. Since it was unknown to previous workers who avidly collected in the State (e.g. H.B. Hungerford) and we have but a single collection from southeast Michigan, we suspect that this species (even if found in additional localities) will be generally uncommon in Michigan. Further, given that we found it in the most southeastern county of Michigan, we think this species may also occur in similar habitats in northwest Ohio or northeast Indiana.

Sigara lineata: This species was identified from a dip net sample taken along the shore of Thunder Bay, Lake Huron in Alpena County and 10 separate seine and plankton tow samples taken from St. Marys River, Chippewa County. Additionally, specimens were found in the stomachs of juvenile Lake Trout

(*Salvelinus namaycush*) and Slimy Sculpin (*Cottus cognatus*) collected at a depth of 10 to 30 meters from North Point, Lake Huron in Alpena county. All collections were made during May and June.

The distribution of this little species is confined to a handful of Midwest States and a few provinces in Canada. It has been reported, in part, from Illinois, Ohio, Wisconsin and Ontario, fully placing Michigan within its range (Hilsenhoff, 1984; Hungerford, 1948; Polhemus et al, 1988). With its addition there are now 23 *Sigara* species, comprising approximately 50% of the total Corixidae taxa, reported for Michigan (Table 1).

This species is apparently a fluvial form as it has repeatedly been reported from lotic habitats. Hilsenhoff (1984) reported it as common in Wisconsin from sandbottom rivers while Hungerford (1948) indicated it preferred aquatic habitats possessing some type of current or moving water. Our collections were obtained from these habitat types. The Great Lakes have permanent, or at least seasonal, water circulation patterns resulting from wave action and barometric pressure differences which induce, along with near shore wave action, currents that are comparable to large rivers. Thus, the appearance of this species in both Lake Huron shore line samples and the stomachs of fish collected at depths greater than 10 meters is not a deviation from the general fluvial nature of this species.

This species was often found in association with *Sigara trilineata*. However, *S. lineata* was consistently less abundant than *S. trilineata*. Most of our collections contained many *S. lineata*, indicating good populations, and we think it may occur in other similar habitats in Michigan.

Trichocorixa borealis: A seine and plankton tow collection taken in June from St. Marys River, Chippewa County contained this species. It is generally distributed through Canada and the north portion of the Midwest United States. In the Great Lakes area, it has previously been reported for Iowa, Minnesota, Ohio, Wisconsin and Ontario which clearly placed Michigan within its range (Hilsenhoff, 1984; Polhemus et al, 1988). Although presently known from only one county in the State, given its distribution in the Great Lakes region, it may be found in other localities in Michigan.

Trichocorixa kanza: A series of 10 black light samples taken from June through September at Toledo Beach, Monroe County contained this species. It occurs across the United States and northern Mexico with records extending north into Wisconsin, Iowa, Pennsylvania (Hilsenhoff, 1984; Polhemus et al, 1988) and now Michigan. Chordas and Armitage (1998) recently reported this species from Ohio, establishing its occurrence in the southern Great Lakes region. Of the four newly reported taxa, this species was the least expected. Typically being a southern species and given that we found it only from the most southeastern county, *T. kanza* may be uncommon in Michigan and restricted to the southern portion.

Table 1. List of water boatmen species for Michigan. Number of species per genus in ( ). Genus in bold followed by "*" denotes a genus new to Michigan. Species in bold followed by "++" denote new state records.

Genus	Species
Calicorixa White, 1873 (2)	*C. alaskensis* Hungerford, 1926 : *C. audeni* Hungerford, 1928
Corisella **Lundblad, 1928 * (1)**	***C. tarsalis*** **(Fieber, 1851) ++**
Cymatia Flor, 1860 (1)	*C. americana* Hussey, 1920
Hesperocorixa Kirkaldy, 1908 (12)	*H. atopodonta* (Hungerford, 1927) : *H. interrupta* (Say, 1825) *H. kennicotti* (Uhler, 1897) : *H. lobata* (Hungerford, 1925) *H. lucida* (Abbott, 1916) : *H. michiganensis* (Hungerford, 1926) *H. minorella* (Hungerford, 1926) : *H. nitida* (Fieber, 1851) *H. obliqua* (Hungerford, 1925) : *H. scabricula* (Walley, 1936) *H. semilucida* (Walley, 1930) : *H. vulgaris* (Hungerford, 1925)
Palmacorixa Abbott, 1912 (3)	*P. buenoi* Abbott, 1913 : *P. gillettei* Abbott, 1912 *P. nana* Walley, 1930
Sigara Fabricius, 1775 (23)	*S. alternata* (Say, 1825) : *S. bicoloripennis* (Walley, 1936) *S. compressoidea* (Hungerford, 1928) : *S. concephala* (Hungerford, 1926) *S. decoratella* (Hungerford, 1926) : *S. defecta* Hungerford, 1948 *S. dolabra* Hungerford, and Sailer, 1943 *S. douglasensis* (Hungerford, 1926) : *S. grossolineata* Hungerford, 1948 *S. knighti* Hungerford, 1948 : ***S. lineata*** **(Forester, 1771) ++** *S. mackinacensis* (Hungerford, 1928) : *S. macropala* (Hungerford, 1926) *S. mathesoni* Hungerford, 1948 : *S. modesta* (Abbott, 1916) *S. mullettensis* (Hungerford, 1928) : *S. penniensis* (Hungerford, 1928) *S. signata* (Fieber, 1851) : *S. solensis* (Hungerford, 1926) *S. transfigurata* (Walley, 1930) : *S. trilineata* (Provancher, 1872) *S. variabilis* (Hungerford, 1926) : *S. zimmermanni* (Fieber, 1851)
Trichocorixa Kirkaldy, 1908 (5)	*T. calva* (Say, 1832) : ***T. borealis*** **Sailer, 1948 ++** ***T. kanza*** **Sailer, 1948 ++** : *T. macroceps* (Kirkaldy, 1908) *T. sexcincta* (Champion, 1901)

ACKNOWLEDGMENTS

We thank the Ohio Biological Survey for providing partial funding for this project. We are indebted to Richard C. Froeschner (U.S. Museum of Natural History) for identification of *Sigara lineata* from fish stomachs as well as Marc A. Blouin for providing black light trap material from Toledo Beach and the St. Mary River. We thank Margret Chriscinske and Jaci Savino (USGS) for reviewing early drafts of this manuscript. Criticisms and suggestions from two anonymous reviewers greatly improved the manuscript. Contribution 1080 of the Great Lakes Science Center, United States Geological Survey, 14751 Green Road, Ann Arbor, Michigan 48105.

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ROSS LANG RECEIVES THE AMERICAN ENTOMOLOGICAL SOCIETY'S 1999 CALVERT AWARD

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.

This year, the thirteenth Calvert Award was presented to Ross Lang, an eighth grade home-schooled student from Yardley, Pennsylvania. His project, conducted over the past year, was entitled, "Maximum Moth Metabolism — Determined by Warburg." Ross, inspired by an article in Scientific American, built himself an apparatus to measure oxygen consumption and used it to measure respiration by codling moths at different temperatures. Last year, Ross was runner up for the Calvert Award with a project on whether yellow jackets can remember where they found food from one day to the next.

As the winner of the Calvert Award, Ross Lang received memberships in the American Entomological Society and the Young Entomologists' Society as well as a $50 check. Jon Gelhaus, president of the Society, made the presentation at the membership meeting of the Society on April 28 at the Academy of Natural Sciences in Philadelphia.

Another student was honored at the meeting. Abigail Kochanik, a senior from Cherokee High School in Marlton, New Jersey, took second place for her study, "To kill or not to kill? Part II." Ross and Abigail participated in the annual Delaware Valley Science Fairs held on March 31 at the Expo Center in Fort Washington, Pennsylvania.

Harold White, Chair,
Education Committee

MILDRED MORGAN HONORED

At its meeting on April 28, 1999, The American Entomological Society recognized and honored Mildred Morgan for her more than twenty-one years of dedicated service to our Society by electing her to become an Emeritus Member of the Society. According to our by-laws, an Emeritus member is one who merits special recognition because of having rendered unusual service to the Society for a period of at least fifteen years. Mildred is the only individual so honored bv the Society within recent memory.

Mildred came to the Society as our Office Manager in January 1978. After mastering the intricacies of the job, she soon became more involved than simply as a Society employee by attending virtually all of our Philadelphia based membership meetings, by attending and participating in the Society's annual Insect Field Day, and by becoming involved in many other activities of the Society, all far beyond normal expectations.

At the same time, encouraged and assisted by lepidopterist Jane Ruffin, she has developed her own interests in insects, particularly butterflies, and has participated in activities such as monarch butterfly tagging at Cape May, NJ, butterfly walks with New Jersey Audubon naturalist, Pat Sutton, and has developed her own outstanding butterfly garden at her and her husband Ralph's newly reconstructed home in Cape May Point.

Honoring Mildred on this occasion was not saying "goodby" because she will continue to be active in the Society and will assist the Society during heavy work load periods.

Photo taken April 28, 1999 by Harold White. H.P.B.

BOOK REVIEW

THE AMAZING WORLD OF STICK AND LEAF INSECTS. Paul D. Brock. The Amateur Entomologist. Vol. 16, 165 pp. Cost 14.75 lbs. Sterling, UK., 16.20 elsewhere.

Most Americans may not be aware that stick insects (walking sticks in the USA) are popular pets in many parts of the world. Many Americans may never have seen a live stick and the thought of keeping them as living curiosities may never come to mind. However, in the UK and Europe, this is a different story. Stick insects are sold in most pet shops, with some places offering more than a half dozen species. Almost all are exotic, some coming from as far away as Madagascar, Singapore, and Australia. But why keep these insects? What is the fascination? Perhaps the answer is they are relatively easy to keep, feeding on a variety of plant material, and require little space and offer an interest for children.

The stick insect fancy is so intense that there is a society called the Phasmid Study Group which is dedicated to the care and culture of these insects. [Their website is worth a look: http://www.insect-world.com/main/psg.html]. What is more important is that members are particularly interested in the biology and behavior of their subjects. These aspects are reported in the several publications of the group and are important scientific records since most of what we know about stick insect biology has come from members of this organization.

The Phasmid Study Group comprises about 500 members from many countries but mostly from the UK and Europe. This tally is more than for many learned scientific societies!! The society is open to anyone and membership ranges from children to professionals like myself. They have regular meetings, newsletters, and publications. Members are encouraged to exchange "livestock" and are not allowed to sell any of their insects.

With that background, we come to the topic of this review, the book. It is an interesting compendium covering a wide range of topics in a rather limited number of pages. It is written by an extraordinarily dedicated individual who is not a professional entomologist (he works in a bank) and classes himself as an "amateur". His interest, or avocation, has taken him to several continents in search of insects and the taxonomists who study them. He has visited all of the important public and private collections. His pursuits have resulted in his becoming an expert in the field. He has published several useful papers and other books.

The present book is an outstanding contribution to the field and can serve professionals and amateurs alike. It is well written in an interesting way that is neither overly technical nor pedestrian. The range of topics is most appealing and is covered cleverly and concisely. Briefly, these are anatomy, classification, taxonomic publications through history (you can see a full page photograph of Brunner von Wattenwyl!!), the dilemma of common names, biogeography, conservation, the collecting "code", biology and life history, phasmid records (largest and smallest species, etc.), behavior, and all aspects of keeping stick insects, including what to do with excess livestock. [This is a good place to emphasize that the primary goal of Mr. Brock and his colleagues is not to build dead collections of these insects but to understand their life histories].

Useful chapters cover stick insect photography and the essentials of studying phasmid taxonomy. There is a section listing the important collections of these insects around the world. Some will find the chapter on phasmid folklore and poems charming and informative. These chapters cover the first 70 pages of the book, the remaining comprise highlights of the fauna on a zoogeographical basis.

The book is replete with photographs that are informative, interesting, and unique. They range from a look at a typical drawer of the insects in Dresden at the Staatliches Museum to Mr. Brock (and a few questionable Australian characters) capturing these insects in the midst of a bush fire in the Northern Territory of Australia. In addition, there are 40 plates of stick insects in

(Continued on page 208)

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Titles should be carefully composed to reflect the true contents of the article, and be kept as brief as possible. Classification as to order and family should be included in the title, except where not pertinent. Following the title there should be a short informative abstract (not a descriptive abstract) of not over 150 words. The abstract is the key to how an article is cited in abstracting journals and should be carefully written. It should be an informative digest of the significant contents and of the main conclusions of the research. The author's complete mailing address, including zip code number, should be given as a footnote to the article. All papers describing new taxa should include enough information to make them useful to the nonspecialist. Generally this requires a key and a short review or discussion of the group, plus references to existing revisions or monographs. Authors must include the name(s) of recognized institution(s) where their voucher specimens have been deposited. Illustrations nearly always are needed. All measurements shall be given using the metric system or, if in the standard system, comparable equivalent metric values shall be included. Authors can be very helpful by indicating, in pencil in the margin of the manuscript, approximate desired locations within the text of accompanying figures, tables and other illustrations.

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(Continued on inside of back cover)

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BLACK FLIES (DIPTERA: SIMULIIDAE) AND A NEW SPECIES OF CADDISFLY (TRICHOPTERA: HYDROPSYCHIDAE) IN A NORTHWESTERN GEORGIA CAVE STREAM[1]

W. K. Reeves, E. S. Paysen[2]

ABSTRACT: Larvae of *Prosimulium saltus, Simulium parnassum* (Diptera: Simuliidae) and a new species of *Diplectrona* (Trichoptera: Hydropsychidae), were collected in 1998 from a cave stream in northwestern Georgia, USA. Simuliidae have not previously been reported from Nearctic cave streams. The cavernicolous simuliids were morphologically similar to those collected on the surface but with less pigmentation. The collection of *P. saltus* is a state record and marks the known southern extent of the species. The adult male, larva, and pupa of the new *Diplectrona* are described and compared with other known *Diplectrona* species.

Cavernicolous invertebrates can be separated into three classes. Troglobites are obligate cave dwellers, with specific adaptations for a cave or cave system (Gertsch 1979). Troglophiles are facultative cave dwellers. Trogloxenes are cave dwellers that must return to the surface to fulfill part of their life cycle (Barr and Holsinger 1985).

Troglophilic aquatic Diptera in the families Chironomidae, Dixidae, and Psychodidae have been reported in southeastern caves (Holsinger and Peck 1971, McDaniel and Smith 1976, Peck and Lewis 1978, Peck 1995, Peck 1998). The known Nearctic simuliid larvae with cavernicolous modifications are *Parasimulium crosskeyi* Peterson and *Pa. stonei* Peterson, which are found in the hyporheic zone (Courtney 1986). Larvae of these species have many similarities with troglobitic organisms including apparent blindness and lack of pigmentation (Courtney 1993). The adults are not cavernicolous and are found on trees near seepages (Wood and Borkent 1982). Both species could be categorized as trogloxenes, because they must fulfill part of their life cycle outside the cave environment.

Peck (1995) suggested the possibility of cavernicolous Trichoptera in the southeastern U.S., but no further study has ensued. Records exist for Trichoptera in Texas caves, but the specimens were identified only to the ordinal level (Reddell 1966). Outside the Nearctic region, Polycentropodidae have been collected from a cave in Japan (Sato 1964). Species of Limnephilidae are found in the caves of Turkey, France, Italy, Germany, and Romania (Nimmo 1996). One of these cavernicolous Trichoptera, *Micropterna testacea* Gmel, has been collected 300 meters into a cave (Bitsch and Frochot 1962). In French caves, *M. testacea* is a trogloxene with cave-dwelling larvae and adults that emerge and disperse (Bournaud and Gautheron-Duranthon 1969).

[1] Received May 10, 1999. Accepted June 11, 1999.

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MATERIALS AND METHODS

Collections were made at two sites on an unnamed subterranean stream in Newsome Gap Cave, Dade County, Georgia (34° 47' N, 85° 28' W, 430-m above mean sea level). One site was in total darkness 14-m from the main entrance of the cave. The second site, located 1-m upstream of the main entrance and 3-m from a small side entrance was partially lit. Collections began on 13 March and continued through 22 May 1998.

Specimens were preserved in Carnoys fixative (1 part glacial acetic acid: 3 parts 95% ethanol), and voucher specimens were deposited in the Clemson University Arthropod Museum and the U.S. National Museum, Washington, D.C.

The cave stream was physically characterized at the mouth by measuring pH, conductivity, temperature, discharge, depth, width, surface velocity, and substrate composition. Depth was averaged from three evenly spaced measurements across the stream. Conductivity was measured with a conductivity meter (model 19820-00, Cole-Parmer), and pH was measured with a pH/mV/ORP meter (model 5938-00, Digi-Sense).

The subterranean streambed had a nearly uniform width of 1-m. The substrate was sandstone-limestone bedrock with coarse sand to boulder overlay. Temperature varied between 12° and 15°C, pH from 8.3 to 7.8, and conductivity from 110.7 to 121.0 micro-siemens. The spring discharged 0.026 m3/sec at the cave mouth on 13 March.

The stream flows year-round through the subterranean passages, but becomes intermittent after leaving the cave. No leaves or other indications of surface intrusions were found inside the cave. At least one subterranean tributary joins the main stream before the cavern becomes inaccessible to humans. On 27 March, the surface stream gradually sank into the substrate approximately 40-m beyond the mouth of the cave.

Caddisfly larvae collected in the cave stream were observed in the laboratory in 1.5-m long by 15-cm wide artificial laboratory streams. The streams remained at 19-21°C in complete darkness. Larvae were fed every three days. Food consisted of larval Simuliidae, dead phorids (*Megaselia cavernicola* Brues), wax moths, and TetraMin® fish food flakes. Food was removed after 24 hours if not consumed.

Diplectrona marianae Reeves, NEW SPECIES

Figs. 1, 2, 3

HOLOTYPE MALE: Length of male from front of head to tips of folded wings: 10.13-mm; Length of antenna 7.6-mm. Warts and other structures on dorsum of head (Fig. 3.) similar to those of *D. rossi* (Fig. 4).

Male genitalia: Inferior appendages each 1.14-mm in length, slender at base and broadening near the apex, then narrowing again. Inferior appendages lightly sclerotized, setose apically. Phallus simple, blunt, 0.65-mm long.

Larva: Length of mature larva: 12.7-15.9-mm. Head capsule width 1.74-mm. Left mandible (Fig. 1 and 2) 0.82-mm long, 0.57-mm wide at base. Left mandible with prominent ridge process.

Pupa: Length of pupa: 9.1-9.3-mm from head to abdomen; 5 teeth on left mandible, 4 teeth on right mandible.

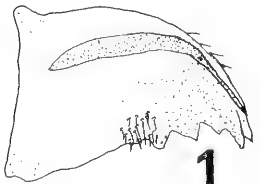
Holotype: Male, Newsome Gap Spring Cave, Dade County, Georgia, USA, May 22 1998, N 34° 47' , W 85° 28', 430-m elevation, collected by Will K. Reeves. Holotype deposited at he U.S. National Museum, Washington, D.C. **Paratypes:** 2 pupae and 4 larvae same data.

Diagnosis: The genitalia of most *Diplectrona* spp., including *D. marianae*, lack dorsal lobes on the tergum, which are present on the tergum of *D. californica* Banks (Morse and Barr 1990). The lack of dorsal lobes on the tergum is diagnostic for separating *D. mariane* from *D. californica*. Because the dorsolateral lobe was not truncate, *D. marianae* can be diagnosed from *D. rossi* Morse and Barr. The genitalia of *D. marianae* were not differentiable from those of *D. modesta* Banks and *D. metaqui* (Ross), which have very similar genitalia. The warts on the head have been used to differentiate species of *Diplectrona* (Morse and Barr 1990). The warts on the head of *D. marianae* resemble those of *D. rossi* (Fig. 4), and differ from those of *D. modesta* (Fig. 5) and other similar species of *Diplectrona*. Larvae are similar to those of *D. metaqui* in general structure. *Diplectrona marianae* is the sister species of *D. metaqui* based on similar larval head-capsule patterns, notched frontoclypeal apotome, and mandibular process. Larvae of both species differ from those of other species of *Diplectrona*, because of the mandibular processes. *Diplectrona marianae* larvae can be differentiated from those of *D. metaqui,* because the latter have a thumb-like process on the left mandible, and *D. marianae* has a prominent ridge. The pupal mandibles differ from those of *D. modesta*, but were similar to those of *D. rossi.* In *D. rossi,* the first tooth is as far from the next tooth as that tooth is from the apex (Morse and Barr 1990). The teeth of *D. marianae* are not so separate, and the first tooth is closer to the second tooth than that tooth is to the apex.

Distribution: The species has been collected only from the type locality in Dade County, Georgia.

Phylogeny: The species is the sister species of *D. metaqui*, as suggested by the homologues in the larval mandibles, head capsule, and notched frontoclypeal apotome. According to Wiggins (1996), the mandibular process of *D. metaqui* was so different from other *Diplectrona* that it was originally placed in an unknown genus (genus a Ross 1944). *Diplectrona marianae* shares the prominent mandibular process, indicating sister species status with *D. metaqui.*

Etymology: The species is named in honor of Mary Hyatt who assisted in our cave projects.



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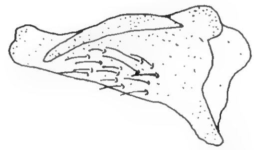

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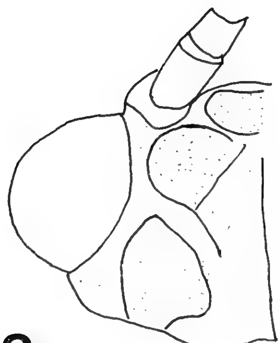

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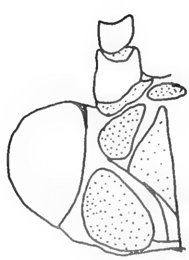

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Fig. 1. Dorsal view of the left mandible of *Diplectrona marianae* larva. Fig. 2. Lateral view from the outside edge of left mandible of *Diplectrona marianae*. Fig. 3-5. Left dorsal view of the male heads of. Fig. 3. *Diplectrona marianae*. Fig. 4. *Diplectrona rossi* (Modified from Morse and Barr 1990). Fig. 5. *Diplectrona modesta* (Modified from Morse and Barr 1990).

Biological and behavioral notes

Diplectrona marianae

Five *D. marianae* larvae were collected on 13 March from rocks in the subterranean stream and preserved in 85% ethanol. The larvae were pale in color compared with species of epigean *Diplectrona*. Four additional larvae were collected on 20 March and five on 27 March. These were returned to the lab in an unsuccessful attempt to rear adults. An adult male was collected in the cave on 22 May. No *D. marianae* were collected from the surface stream; however, other genera of Trichoptera were present.

In the laboratory, larval behavior was recorded from three specimens. The larvae wandered in the laboratory stream and did not build filter nets on the provided screens. However, larvae produced silk strands as anchors while foraging or anchoring debris to the screens. Two of the larvae displayed thigmotactic behavior by crawling between the screen frame and the tank wall. Based on the observation of three individuals in the laboratory, larvae are predators of *P. saltus and S. parnassum* and cannibalize smaller instars. *Diplectrona marianae* might be predators of *P. saltus, S. parnassum*, and aquatic isopods in the cave environment.

Prosimulium saltus and *Simulium parnassum*

Approximately 30 larvae of *P. saltus* and 180 larvae of *S. parnassum* were collected from the intermittent surface stream. Simuliid larvae do not exhibit net upstream movement (Crosskey 1990), so any immature stages in the cave must reflect oviposition there.

The range of *S. parnassum* is restricted to the mountains of eastern North America. The species is typically found in streams less than 3 m in width, with rocky substrate and steep grade. *Simulium parnassum* larvae are common in surface streams with cave-like features. Typical habitat often includes small streams with dense riparian vegetation that blocks direct sunlight, creating an environment similar to the twilight zone of caves. Females take blood meals from humans and other mammals. The species overwinters in the egg stage, hatching in the spring as water temperatures reach 9.5-10.0° C (Adler and Kim 1986). Our collections of *S. parnassum* from the subterranean stream include 20 larvae on 3 April, one pupa on 9 May, and one larva, two pupae, and three pupal exuviae on 19 May. In 1998 one generation of *S. parnassum* occurred in the surface stream of Newsome Gap.

Prosimulium saltus, an uncommon species inhabiting intermittent streams, has been reported from two streams in West Virginia and the type locality in New York (Stone 1964, Adler and Kim 1986). Our collections of *P. saltus* from the subterranean stream included three larvae on 13 March, three larvae on 20 March, one larva on 27 March, and one larva and one pupa on 3 April. Our collections represent new state records for Georgia and the southern range of the species.

Simuliid specimens of both species from the cave had less pigmentation than specimens from the surface. Larval black fly pigmentation changes have been demonstrated in response to UV radiation, diet, and background color (Zettler et al. 1998). Reduced pigmentation in cave-collected specimens suggests pigmentation as a function of these factors.

Cave environments are less likely to freeze during the winter. The cave stream is closer to the water table and will not dry out during a summer drought. Adults can take refuge from summer heat in the cooler cave environment where females can deposit eggs. Larvae of both species were most mature inside the cave near the mouth of the surface spring. There was a trend downstream of the cave opening, with the earliest instars farthest from the cave. The cave stream was warmer underground during the winter months, and would accelerate development of individuals in the cave. Algal productivity and food availability were highest near the spring on the surface, which would create an optimum habitat combining buffered water temperature and food availability during the winter. Other possible explanations for larval development include competitive exclusion of early installs by more mature larvae that hatched first.

ACKNOWLEDGMENTS

We thank P. H. Adler for identifying *P. saltus* and for partial funding during this project (National Science Foundation grant DEB-9629456 to P. H. Adler); B. A. Robinson for aiding with Trichoptera identification, J. C. Morse for aiding in larval rearing and Trichoptera literature search, M. J. Schwallier and C. L. Evans for preliminary proofreading of this document, M. M. Hyatt and W. C. Reeves for helping with field work and proofreading this manuscript, A. D. Smith for assistance in collecting, and G. W. Courtney and G. A. Schuster for reviewing this manuscript and providing helpful comments. This is technical contribution 4464 of the South Carolina Agriculture and Forestry Research System, Clemson University.

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NOTICE TO AUTHORS

During this coming winter season, I plan to take an extended vacation. During this period, all mail, including papers submitted for publication, reviews, and author revisions, will be held until I return by or before the end of March, 2000. As soon as I do return, I will process all accumulated papers, in the order in which they were received, as quickly as possible.

I trust all authors will be understanding and patient during this diapause. After spring emergence, all will be caught up in short order. Thank you.

H.P.B.

NEW RECORDS OF WANDERING SPIDERS FROM TEXAS, WITH A DESCRIPTION OF THE MALE OF *CTENUS VALVERDIENSIS* (ARANEAE: CTENIDAE)[1]

W. David Sissom,[2] William B. Peck,[3] James C. Cokendolpher[4]

ABSTRACT. The Texan wandering spiders of the family Ctenidae are reviewed, and new records are added for *Leptoctenus byrrhus* and *Ctenus valverdiensis*. *Ctenus valverdiensis* is redescribed, based on the availability of adult male specimens and compared to its nearest relative, *C. mitchelli*. A new record for *C. mitchelli* in Tamaulipas, Mexico, is also listed. Diagnostic characters of Texas ctenid species are included.

Wandering spiders are not well represented in the U.S.A. Only eight species in three genera are known from Texas east to the southern states of the eastern seaboard (Peck 1981). In Texas, these spiders are uncommon and known only from the southern half of the state. Three species from different genera are recorded from the state. It is the purpose here to post new records of the species, where available, and to redescribe *Ctenus valverdiensis* Peck 1981 based on recently acquired adult males. In addition, diagnoses pertinent to identification of Texas material are provided.

Anahita punctulata (Hentz 1844)

Ctenus punctulatus Hentz 1844: 394; F. O. Pickard-Cambridge 1897: 62; Banks 1898: 277; Bishop & Crosby 1926: 184.
Anahita punctulata: Simon 1897: 121; Bonnet 1955: 310; Peck 1981: 158.

Diagnosis. Size: males 6-8 mm, females 7-9 mm. Retromargin of the cheliceral fang bearing 4 teeth and 1-3 denticles. Distal leg segments not or sparsely scopulate. Male palpus with a long, spatulate median lobe; palpal tibia with a short, conical apical apophysis. Female epigynum indistinct (recognizable only by lightly sclerotized internal ducts), not emergent from the ventral surface; without lateral spurs.

Notes. The distribution of *Anahita punctulata* lies primarily in the south-central U.S.A. with a single record in southeastern Arkansas and another in southeastern Texas. The single Texas record is from the Houston area (Peck 1981). We have found no new records of this species.

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ENT. NEWS 110(5): 260-266, November & December, 1999

Leptoctenus byrrhus Simon 1888

(Figs. 1-2)

Leptoctenus byrrhus Simon 1888: 210; Gertsch 1935: 24.
Ctenus byrrhus: Simon 1897: 111; F. O. Pickard-Cambridge 1902: 414; Chickering 1937: 280; Peck 1981: 166.

Diagnosis. Size: male approximately 8.5-10.5 mm, female 9.5-13.5 mm. Pars thoracica of cephalothorax higher than pars cephalica. Retromargin of cheliceral fang bearing only three teeth. Scopulae moderately developed. Male palpal tibia with long apophysis, the latter stout basally and bearing a long, curved extension that bends sharply toward the palpal cymbium at mid-length; male palpal tibia excavated distally from base of apophysis. Female epigynum distinct, wider than long, with long and narrow neck; lateral spurs present.

Notes. *Leptoctenus byrrhus* is known from southwest Texas and northeast Mexico on the coastal plains and in the mountains. Peck (1981) reported that members of this species have been taken among detritus and, in one case, in a woodrat nest. Recent collections in Texas have revealed them under rocks and in a cave. Although the cave population shows no troglomorphic characteristics, it is apparently established in the cave because specimens were collected on several occasions over three years. The animals were always collected near the entrance to the cave on both occasions, but not outside the cave under nearby rocks or deeper in the cave. We have observed several specimens of this species in the wild and in captivity and noted the unusual manner in which the animal walks with its front pair of legs held forward like "antennae" (Fig. 1). Even when at rest, but alert, the animal will often hold these legs off the ground. Because the general morphology and markings of the body and the legs have never been illustrated for the species, or for that matter any member of the genus, we provide a dorsal view of a female (Fig. 2).

New Records. TEXAS: Kerr Co., "10/7" 1989, E. Galbraith, 1 juvenile (MSU). Bandera Co., Lost Maples State Park, 28-30 April 1988, R. Anderson, 1 male (TAMU), 26 April – 10 May 1986, P. W. Kovarik (TAMU). Bexar Co., 3.8 mi. NE Helotes, 22 Sept. 1995, A. G. Grubbs (TMM); Up the Creek Cave, 14 Nov. 1995, J. C. Cokendolpher, J. R. Reddell, M. Reyes, 1 female (TMM), 1 female (MSU); 10 Sept. 1998, J. C. Cokendolpher, J. Krejca, J. R. Reddell, M. Reyes, 1 female, 1 juvenile male (TMM); 22 April 1999, J. R. Reddell, M. Reyes, 1 juvenile (TMM). Hidalgo Co., Bentsen-Rio Grande State Park, 19 May 1965, W. B. Peck, 1 male (JCCC), 7 Aug. 1990, W. B. Peck, 2 females (1 JCCC, 1 TMM).

Ctenus valverdiensis Peck 1981

(Figs. 3-10)

Ctenus valverdiensis Peck 1981: 164.

Diagnosis. Size large: Male approximately 22-24 mm, female 30 mm. Pars thoracica of cephalothorax on same plane as pars cephalica. Retromargin of cheliceral fang bearing 4-5

Figs. 1-2. *Leptoctenus byrrhus* from Texas. 1, female from Bentsen-Rio Grande State Park holding legs aloft like antennae; 2, dorsal view of female from Up the Creek Cave; note darker more distinct pattern than in specimen from Bentsen State Park. Photos by JCC.

teeth and 1-3 denticles. Scopulae highly developed and covering tarsi, metatarsi, and distal portion of tibiae. Male palpal tibia with long, curved apophysis, the latter stout with a basal lobe; tip of apophysis thick and more or less rounded. Female epigynum distinct, bluntly triangular and broader anteriorly; neck narrow, but short; lateral spurs present.

The unique morphology of the male palp described below provides new characters to distinguish it from its close relative, *Ctenus mitchelli* Gertsch 1971 from caves in southern Tamaulipas (Gertsch 1971).

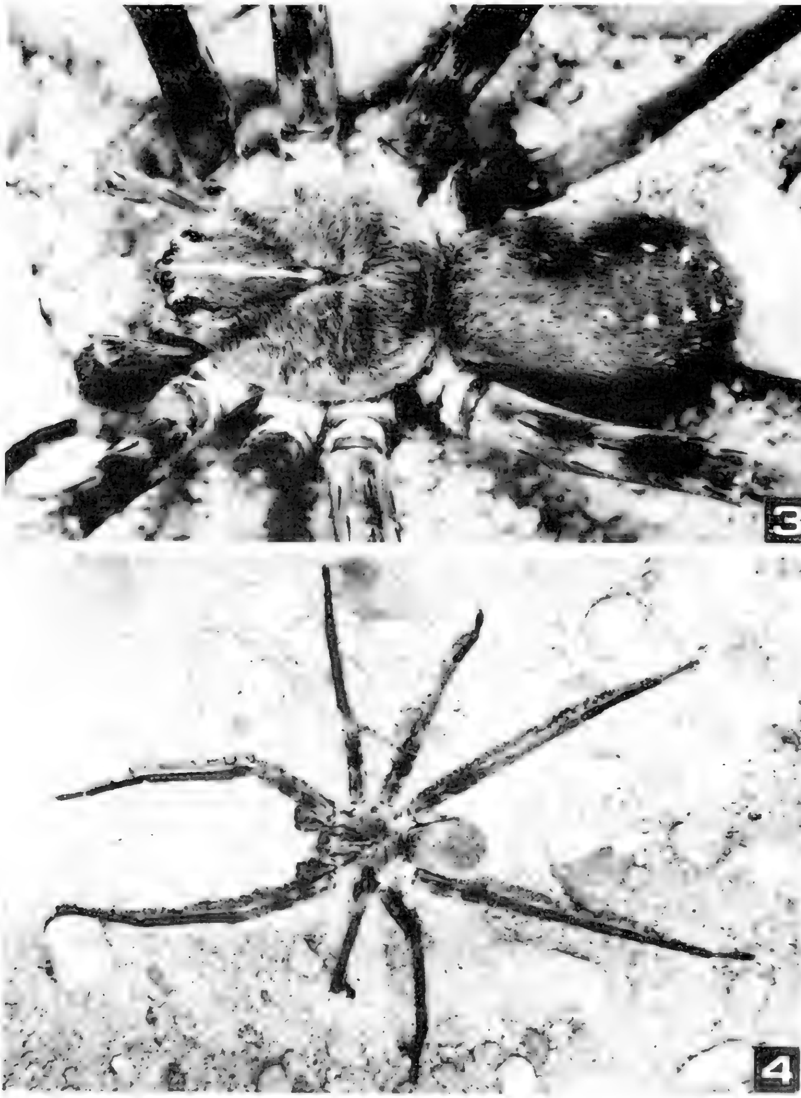
Description of Male: Basic structure and coloration as in female (Peck 1981). Cephalothorax with pars cephalica pronounced, more gradually tapered than in *C. mitchelli* (cf. Figs. 5-6). Tibia of palpus (Figs. 7-9) with long, curved lateral apophysis, this apophysis bearing distinct basal lobe; tibia distinctly shorter than cymbium, with two strong medial setae and one strong dorsolateral seta; embolus and median apophysis as illustrated; palpal bulb subcircular in ventral view; lateral surface of palpal bulb without strong basal process (cf. Figs. 7 and 10).

Coloration of specimens in alcohol: cephalothorax and basal segments of legs orange; distal leg segments orange-brown, abdomen creamy yellow; venter yellow-orange; palps orange-brown, darker distally. No leg bands, cephalothoracic stripe, or abdominal spots evident in preserved specimens. Color of living specimens differs greatly: cephalothorax with black and gray recumbent setae (lightest on lateral borders); thin distinct white stripe running from between PME to thoracic groove. Abdomen covered with black and gray setae, with six pair of small white dots (anterior pair almost indistinguishable); median pairs with faint interconnecting lines. Lateral sides of abdomen with few scattered white spots. Leg coxae and trochanters covered with white setae; other leg segments covered with black setae, bands of gray setae on femora and lateral sides of patellae. Overall body with velvety grayish appearance.

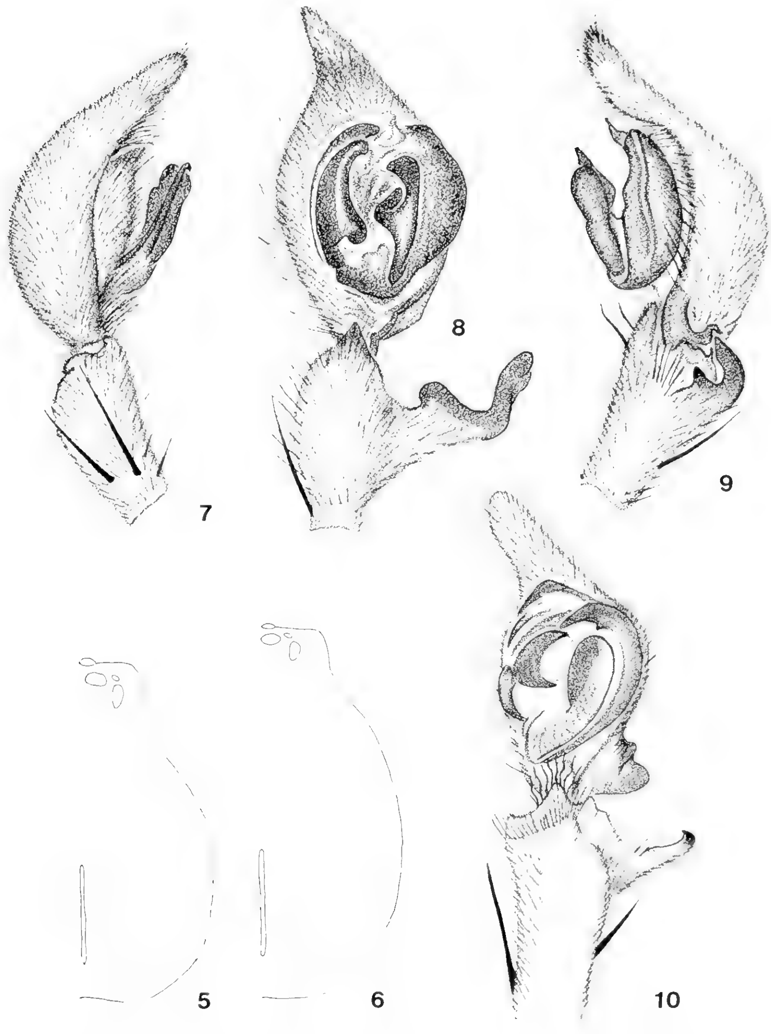
Measurements in mm of two adult males (to nearest tenth): Total L, 22.2/24.1; cephalothorax L, 10.9/10.8; cephalothorax W, 8.75/8.7; femur I L, 12.5/12.5; patella-tibia I L, 18.1/18.8; metatarsus I L, 11.8/12.4; femur II L, 12.2/12.2; patella-tibia II L, 17.2/17.1; metatarsus II L, 10.6/11.3. Eye sizes: AME, 0.43/0.35; ALE, 0.45/0.35; PME, 0.70/0.70; PLE, 0.70/0.70. Eye interdistances: AME-AME, 0.18/0.22; AME-ALE, 0.50/0.50; PME-PME, 0.20/0.20; PME-PLE, 0.40/0.45; PLE-ALE, 0.20/0.22. MOA L, 1.40/1.35; MOA front width, 1.00/0.95; MOA, back width, 1.57/1.48.

New Records: TEXAS: Val Verde Co., Tarantula Cave, at junction of Big Satan and Bluff Canyons, 3 May 1991, L. Bement, 1 male (AMNH); Tarantula Cave, 1 Sept 1991, 1 male, 1 female (TMM), 1 female (AMNH).

Notes. *Ctenus valverdiensis* was described on the basis of an adult female and several juveniles from caves in Val Verde Co., Texas (Peck 1981). It is the largest ctenid known from the state. Tarantula Cave (actually an old abandoned mine shaft) is 8 miles northeast of the Rough Canyon Recreation Area of Lake Amistad (north of Del Rio, Texas), approximately 40 miles east of the type locality. The males from the new series were reared to maturity. The penultimate male did not survive the molt to adulthood on 14 September, but was relatively undamaged. The antepenultimate male collected on 3 May molted on 8 August and again on 11 October to become adult; this specimen survived until February 1992, when it was preserved. Peck (1981) had a penultimate male but did not describe it because the palps were not developed.



Figs. 3-4. Penultimate male *Ctenus valverdiensis* from Tarantula Cave. 3, close-up of body; 4, dorsal view. Photos by JCC.



Figs. 5-10. Morphology of *Ctenus valverdiensis* Peck and *C. mitchelli* Gertsch. 5, dorsal aspect of cephalothorax of *C. valverdiensis*; 6, dorsal aspect of cephalothorax of *C. mitchelli*; 7, mesal aspect of left palpus of male *Ctenus valverdiensis*; 8, ventral aspect of left palpus of male *C. valverdiensis*; 9, lateral aspect of left palpus of male *C. valverdiensis*; 10, ventral aspect of left palpus of male *C. mitchelli*.

The earlier specimens of *C. valverdiensis* (including the penultimate male paratype) and *C. mitchelli* from the Peck Collection are now deposited in the American Museum of Natural History (AMNH), New York. In addition, a specimen of *C. mitchelli* collected from the "Cave at Rio Frio, Ciudad Mante, Tamaulipas, Mexico" by M. Culwell on 16 Feb 1970 is deposited in the California Academy of Sciences, San Francisco.

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DIVERSITY, PHENOLOGY, AND FLOWER HOSTS OF ANTHOPHILOUS LONG-HORNED BEETLES (COLEOPTERA: CERAMBYCIDAE) IN A SOUTHEASTERN OHIO FOREST[1]

W. B. Bond[2], T. K. Philips[3]

ABSTRACT: A total of 1523 anthophilous Cerambycidae in Washington County, Ohio, were recorded over four field seasons (1995-1998) and included 22 genera and 28 species. The most commonly used inflorescenses were those of goatsbeard (*Aruncus dioicus* [Walt.]) and wild hydrangea (*Hydrangea arborescens* L.) in June through mid-July and queen anne's lace (*Daucus carota* L.) in late July. *Judolia cordifera, Metacmaeops vittata, Strangalepta abbreviata* and two species of *Brachyleptura* preferentially feed upon goatsbeard and wild hydrangea. For the seven most abundant beetle species, there is a positive correlation between the number of plant species used and both the number of individuals of lepturine species and the length of their activity period, indicating that species which are common or have long seasonal phenologies use blossoms of many different plant species. At the most diverse site (Reas Run), the greatest number of species (16) was recorded in the third week of June while the greatest number of individuals (118, although only two species) was observed during a week in mid-July. The most abundant species was *Typocerus velutinus* accounting for 31% of the observations. *Analeptura lineola, Strangalepta abbreviata* and two species of *Brachyleptura* accounted for an additional 49.5% of the observations. The average length of adult activity on flowers (in species where a minimum of 10 individuals were collected) is 5.2 weeks, and the average number of plant species used is 9.38 with a maximum of 16 for *T. velutinus*.

Flower feeding or anthophilous Cerambycidae belong mainly to the subfamily Lepturinae, with smaller numbers in the Cerambycinae and fewer still in the Lamiinae. The majority of adults frequent blossoms where they gather to feed on flower parts and nectar (Linsley, 1959; Linsley and Chemsak, 1972). The sexes also locate each other and mate on flowers, with females, in most species, later flying off to oviposit in dead wood (Linsley and Chemsak, 1972). Although most anthophilous cerambycids use a variety of blossoms, some species are known to be quite specific. For example, Gorman (1921) discussed the close association of adults of *Megacyllene robiniae* (Forster) (Cerambycinae) with goldenrod (*Solidago* spp.), and Linsley (1957) and Linsley and Chemsak (1961) noted that adults of the genus *Crossidius* (Cerambycinae) usually frequent the blossoms of their larval host plants, where they mate and feed on pollen. Most lepturines do not use the flowers of their larval host plants and, in general, a wide variety of species may be found on any particular inflorescence. Knull (1946), though, does imply that several species have preferred flower hosts.

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The Lepturinae are known primarily as a northern hemisphere group. This distribution is illustrated within the United States. While the fauna of the northern Appalachians may be one of the most diverse, those more southern become progressively depauperate. For example, Ohio has nearly 70 species (Knull 1946, Keeney, pers. com.), north-central Texas only 14 species (Lingafelter and Horner, 1993), while southern Texas drops to four species (Hovore et al., 1987).

Although most students have a sense of which cerambycids are common or rare and the best flowers for collecting specimens, there are only a few long-term studies that actually document relative abundance, phenology, and flower preference of anthophilous species. Gosling (1986) studied the cerambycid fauna of northern Michigan and recorded species abundance (as common, frequent, occasional, or rare), phenology, larval hosts, and flower records. Gardiner (1970) noted flower records and phenology of lepturines from Ontario, western Quebec, and Alberta but without any precise information on numbers of individuals or sometimes even the species of plant blossoms used. Linsley and Chemsak (1972, 1976) recorded flower hosts for all species treated in their monographs of the Lepturinae of North America. Terron (1991) surveyed the cerambycid fauna of a preserve in Durango, Mexico and reported the phenology of 22 species. One other more inclusive study was that of Kakutani et al. (1990) where the seasonal pattern of insect visits to flowers was studied, although Cerambycidae were rare at their study site.

The Lepturinae in Ohio present a unique opportunity to study the diversity of a group of insects; species richness is high, the group is taxonomically well known, many species are diurnally active on blossoms, and individuals are relatively large and often distinctly colored and shaped, making identification easy. Here we report on the diversity and phenology of cerambycids found on flowers in a mixed Appalachian forest in southeastern Ohio. The species, numbers of individuals, and their flower hosts were recorded over a period of four years from early May through late July. Rather than collecting all individuals, most specimens were observed on the flowers and left undisturbed. We also attempted to determine if flower preferences exist in any of the species we observed.

MATERIALS AND METHODS

The study site was located at Reas Run (also known as Scotts Run), Washington County, Route 14, Ohio (39° 26' 21" N, 81° 10' 19" W), located approximately due east of Marietta near the Ohio River. The area is a completely forested ravine except for open edges averaging five meters in width adjacent to a narrow, paved, two-lane road, where most of the flowering plants are located.

The vegetation is typical of a relatively diverse mixed mesophytic forest

(Braun 1950) and is part of the unglaciated Allegheny Plateau (Braun 1961). The most abundant tree species include white and black oaks (*Quercus* spp.), maple (*Acer* spp.), beech *(Fagus grandifolia* Ehrh.), tulip poplar (*Liriodendron tulipifera* L.), sycamore *(Platanus occidentalls* L.), black locust *(Robinia pseudo-acacia* L.), sassafras (*Sassafras abidum* [Nutt.] Nees), virginia pine *(Pinus virginiana* Mill.), ironwood (*Carpinus caroliniana* Walt.), hickory (*Carya* spp.), dogwood (*Cornus* spp.), witchhazel (*Hamamelis virginiana* L.), and alder (*Alnus serrulata* [Alt.] Willd.). Shrubs include staghorn sumac (*Rhus typhina* L.), elderberry (*Sambucus canadensis* L.), and spice-bush *(Lindera benzoin* [L.]).

Nearly 800 meters of forest and road edges were surveyed for the presence of cerambycids on flowers. Beetles were observed from the beginning of May (as early as May 3) through the end of July (as late as July 25). Since the time of day and air temperature affect the activity of these diurnal beetles, all counts were made between 11:00 A.M. and 5:00 P.M. Each visit took from two to three hours. Data were collected from 1995 through 1998. Several other localities within Washington County were also periodically visited to assess more accurately the diversity of cerambycids and their flower hosts in this area.

All flowers were approached with caution to avoid alarming beetles and causing them to take flight. Due to the steepness of some of the terrain, relatively inaccessible flowers were censused with binoculars. The species, numbers of individuals, and the host flowers, were recorded. Voucher specimens (deposited in the TKP collection) were collected on several occasions, photographs were also taken, and identifications verified in the laboratory. All individuals were recorded to species except for two species of *Brachyleptura, B. champlainii* Casey and *B. rubrica* (Say), due to some difficulty in accurate identification (from similar color and morphology). Specimens of the cryptic *Typocerus deceptus* Knull may also have been recorded as *T. velutinus* although the former species is uncommon (Knull, 1946). One final species, *Grammoptera haematites* (Newman) typically has a red pronotum but rarely may be all black; hence it possibly could be misidentified as *G. subargentata* (Kirby). Since all individuals observed were generally not collected, there is a possibility that some individuals were recorded twice. We think this risk is minimal due to the minimum four day (but usually at least one week) spacing of visits and the relatively short lifespan of the adults (Linsley, 1961).

No attempt was made to quantify the abundance of various blossoms, due to the difficulty in comparing the different inflorescence forms as, for example, goatsbeard (a dioecious plant with small flowers in narrow elongated, spike-like clusters) and queen anne's lace (an umbel with broad clusters of flowers). We concentrate our discussion only on the seven most abundant species in Reas Run, as observations on other taxa are so few as to be potentially misleading. Statistics were performed using SYSTAT (version 5.0).

RESULTS AND DISCUSSION

Host flowers of Lepturinae and Cerambycinae in Washington County, Ohio are as follows, with new records (those not recorded in Linsley and Chemsak [1972, 1976] and Gosling [1986]) marked with an asterisk:

Lepturinae

Analeptura lineola: Appendaged waterleaf* (*Hydrophyllum appendiculatum* Michx.), blackberry (*Rubus* sp.), blue phlox* (*Phlox divaricata* L.), common fleabane* (*Erigeron philadelphicus* L.), cow parsnip* (*Heracleum lanatum* Michx.), dame's rocket* (*Hesperis matronalis* L.), false solomon's seal (*Smilacina racemosa* [L.]), wild geranium* (*Geranium maculatum* L.), goatsbeard (*Aruncus dioicus* [Walt]), sweet cicely* (*Osmorhiza claytoni* [Michx.]), water-hemlock* (*Cicuta maculata* L.), wild hydrangea (*Hydrangea arborescens* L.).

Brachyleptura vagans (Oliv.): Smooth sumac* (*Rhus glabra* L.), queen anne's lace* (*Daucus carota* L.)

Brachyleptura spp. (*champlaini* Casey or *rubrica* [Say]): Common elderberry (*Sambucus canadensis* L.), cow parsnip*, goatsbeard, pasture rose* (*Rosa carolina* L.), queen anne's lace*, smooth sumac, water-hemlock*, wild hydrangea, yarrow* (Achillea millefolia L.).

Brachysomida bivittata (Say): Appendaged waterleaf*, blackberry*, common fleabane*, goatsbeard*, multiflora rose* (*Rosa multiflora* Thunb.), ox-eye daisy* (*Chrysanthemum leucanthemum* L.), wild geranium, wild hyacinth* (*Camassia scilloides* [Raf.] Cory).

Charisalia americana (Hald.): Cow parsnip*.

Grammoptera haematites (Newman): Goatsbeard, wild geranium*, wild hydrangea*

Grammoptera subargentata (Kirby): Cow parsnip, goatsbeard, wild hydrangea.

Gaurotes cyanipennis (Say): Wild hydrangea*

Judolia cordifera (Oliv.): Common elderberry, goatsbeard*, ox-eye daisy*, queen anne's lace, smooth sumac*, wild hydrangea, yarrow*.

Leptura subhamata Rand.: Cow parsnip*, goatsbeard*, water-hemlock*, wild hydrangea.

Metacmaeops vittata (Swederus): Cow parsnip*, dogbane* (*Apocynum* sp.), goatsbeard, smooth sumac*, water-hemlock*, wild hydrangea.

Pseudostrangalia cruentata (Hald.): Cow parsnip*, goatsbeard*.

Strangalepta abbreviata (Germar): Blackberry, black cohosh* (*Cimicifuga racemosa* Nutt.), cow parsnip*, goatsbeard, multiflora rose, pasture rose, queen anne's lace*, wild hydrangea.

Strangalepta pubera (Say): Cow parsnip*, goatsbeard, wild geranium*, wild hydrangea*, yarrow.

Strangalia bicolor (Swed.): Wild hydrangea.

Strangalia luteicornis (Fab.): Black cohosh*, butterfly-weed* (*Asclepias tuberosa* L.), common milkweed* (*Asclepias syriaca* L.), goatsbeard*, pasture rose, queen anne's lace, water-hemlock*, wild hydrangea, yarrow*.

Strophiona nitens (Forst.): Goatsbeard.

Trigonarthris proxima (Say): Goatsbeard, wild hydrangea.

Typocerus acuticauda Casey: Queen anne's lace*, tall meadow rue* (Thalictrum polygamum Muhl), water-hemlock*, white snakeroot* (*Eupatorium rugosum* L.), wild hydrangea*.

Typocerus lugubris (Say): Goatsbeard*, smooth sumac*, wild hydrangea.

Typocerus velutinus: American bellflower* (*Campanula americana* L.), black cohosh*, common elderberry, common fleabane*, common milkweed, narrow-leaved mountain mint* (*Pycnathemum tenuifolium* Schrad.), ox-eye daisy*, queen anne's lace, swamp milkweed (*Asclepias incarnata* L.), teasel* (*Dipsacus sylvestris* Huds.), tall meadow rue*, water-hemlock*, white wood aster* (*Aster divaricatus* L.), wild hydrangea, wild bergamot* (Monarda fistulosa L.), yarrow*.

Xestoleptura octonotata (Say): Goatsbeard, wild hydrangea.

Cerambycinae

Callimoxys sanguinicollis (Oliv.); Cow parsnip.
Clytus ruricola (Oliv.): Wild hydrangea.
Cyrtophorus verrucosus (Oliv.): Cow parsnip.
Euderces picipes (Fab.): Cow parsnip, goatsbeard, smooth sumac, wild hydrangea.
Molorchus bimaculatus Say: Goatsbeard*.
Rhopalophora longipes (Say): Wild hydrangea.

The vegetation in Reas Run is quite diverse, supporting numerous species of deciduous and coniferous trees, various shrubs, and forbs. Although 68 lepturine species have been recorded in Ohio (Knull 1946, Keeney, pers. com.), eliminating single state records and nocturnally active species reduces the total to around 36 flower feeding species (Androw, pers. com.). Regardless, we observed only 18 species and 14 genera of lepturines in Reas Run (Table 1) (and 22 species and 16 genera in Washington County) over four years. Compared to our results, even lower diversity in the forest canopy was found by Krinsky and Godwin (1996), who recorded 16 species of lepturines from fogging samples in a five year survey of the northeastern United States. In northern Michigan, Gosling (1986) recorded 34 species of lepturines in 27 genera, but only 16 species were collected on flowers, undoubtedly due to extensive rearing of larval infested wood and perhaps greater influence of the boreal forest element. Not unexpectedly, we also observed six species of anthophilous cerambycines: three in Reas Run; *Euderces picipes* (Fab.), *Molorchus bimaculatus* Say, and *Rhopalophora longipes* (Say) and three more within Washington County; *Callimoxys sanguinicollis* (Oliv.), *Clytus ruricola* (Oliv.), and *Cyrtophorus verrucosus* (Oliv.).

There are several species of lepturines which we did not expect to find because of their rarity, nocturnal activity, or records only from the northern part of Ohio, such as *Leptorhabdium picta* (Hald.) or *Cosmosalia chrysocoma* (Kirby). But others, such as the relatively common *Pidonia* spp., *Trachysida mutabilis* (Newman), *Strangalia acuminata* (Oliv.), or some *Stenocorus* spp., were absent even though the recorded larval and adult food plants are present and the site is within the known distributions.

Gosling (1986) suggests that anthophilous beetles may have relatively little choice of blossoms in northern Michigan, and may have to use flowers

Table 1. Anthophilous Cerambycidae observed in 30 visits to Reas Run, 1995-1998. *Brachyleptura champlainii* and *B. rubrica* are combined under their generic name.

Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul	Total	% of Total	# Weeks Seen
Brachysomida bivittata	1	8	19	27	2	4	1						62	4.1	7
Analeptura lineola	3	1		10	39	40	76	25	14	7			215	14.2	9
Grammoptera haematites			2		5		1	3					11	0.73	4
Strangaleptura pubera			2	3	8		1						14	0.92	4
Metacmaeops vittata					6	3	7	11	32				59	3.9	5
Strangalepta abbreviata					27	18	106	28	8	13			200	13.21	6
Brachyleptura spp.					19	16	187	94	10	8			334	22.06	6
Judolia cordifera						4	42	28	7	4			85	5.61	5
Trigonarthris proxima						1	3	1					5	0.33	3
Typocerus lugubris							2	2					4	0.26	2
Leptura subhamata							4	7					11	0.73	2
Strangalia luteicornis							1	10	7	10	9	3	40	2.64	6
Xestoleptura octonotata							2						2	0.13	1
Strophiona nitens							1						1	0.07	1
Typocerus velutinus							16	17	103	123	109	106	474	31.31	6
Gaurotes cyanipennis									1				1	0.07	1
Typocerus acuticauda										2		2	4	0.26	2
*Euderces picipes**								6		4			10	0.66	2
*Molorchus bimaculatus**							1						1	0.07	1
*Rhopalophora longipes**								1					1	0.07	1
Total	4	9	23	40	106	86	450	226	182	167	118	111	1522		
# Visits, 1995-1998	2	2	2	2	2	2	5	3	3	3	1	3	30		
Average number / visit	2	4.5	11.5	20	53	43	90	75.3	60.7	55.7	118	37	50.7		

*Cerambycine – all others are Lepturinae.

they seldom visit in other areas. With the greater blossom diversity in Reas Run, lack of choice is probably not as pronounced. Knull (1946) implies that several species (e.g., *Strangalia bicolor* (Swed.) and *Stenocorus viffiger* (Rand.) do have flower preferences. McDowell (1990) also collected *T. deceptus* (n=31) throughout June and July, but only on wild hydrangea flowers. We also note preferences in the abundant *Judolia cordifera, Metacmaeops vittata, Strangalepta abbreviata, Strangalia luteicornis* and *Brachyleptura* spp.; specimens were found only on goatsbeard and wild hydrangea blossoms in Reas Run, in contrast to the other species listed in Table 2. It could be argued that flower selectivity may be due to the relative abundances of goatsbeard and wild hydrangea in this area, since other plant species were low in numbers. But with the numbers of beetles observed only on these plants (467 individuals), we think this is unlikely. Additionally, even though queen anne's lace is as available during much of the time as wild hydrangea, the former is not used until the latter is no longer flowering. Where goatsbeard and wild hydrangea are absent though, these same lepturines, in lower numbers, were located on several different, and perhaps less desirable, hosts.

The average activity period in Reas Run (for 12 species, where a minimum of 10 individuals were collected) is 5.2 weeks and the average number of plant species visited is 9.38. *Analeptura lineola* had the longest activity period and was recorded for 10 weeks (Table 2). In six weeks, *Typocerus velutinus* was recorded from the greatest number of plant species blossoms (16), including nine species in Reas Run and an additional seven in the surrounding areas of Washington County. Our ranges of adult activity (Table 2) are probably longer than in a typical year for most species (except for *S. luteicornis* and *T. velutinus* which were still present at the end of July), due to variance in annual phenologies over the four year recording period. Regression analyses of the seven most abundant species were done (except for *Brachyleptura* spp.). A correlation was found between the numbers of adults seen and diversity of flower hosts used ($p = 0.006$) (Fig. 1). There may also be a correlation between the length of the activity period and diversity of flower hosts. Although the p-value was not significant (0.343), the correlation is significant ($p = 0.028$) if the length of activity of *T. velutinus* is increased by two weeks (Fig. 2). Although *T. velutinus* was recorded for only six weeks to the end of our study period (July 25), it is usually present in the area until at least early or mid-August, an additional two or three weeks. These analyses may indicate that some species of lepturines are not very selective in their choice of flower host and can use many types of blossoms for a food source and mating substrate. It is also intuitive, though, that with longer seasonal activity periods of a beetle species, more varieties of blossoms will have to be used, since flowering phenology of many plant species is often relatively short. Perhaps part of the reason for numerical success of

Table 2. Adult flower host presence (——), date of appearance and the number of individuals of lepturines per collection week, 1995-1998, Reas Run, Washington County, Ohio.

Typocerus velutinus (Oliv.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Wild Hydrangea	*Hydrangea arborescens*							16	17	101	117	108	22
Tall Meadow Rue	*Thalictrum polygamum*									2	2		
Yarrow	*Achillea millefolia*						——	——	——	——	3	——	1
Ox-Eye Daisy	*Chrysanthemum leucanthemum*						——	——	——	——	1		
American Bellflower	*Campanula americana*									——	——	1	——
Queen Anne's Lace	*Daucus carota*									——	——	——	68
Common Milkweed	*Asclepias syriaca*									——	——	——	10
Black Cohosh	*Cimicifuga racemosa*											——	4
Aster	*Aster* sp.												1
Brachyleptura spp.*	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					19	16	177	56	——	1		
Wild Hydrangea	*Hydrangea arborescens*							10	37	10	7	——	——
Analeptura lineola (Say)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
False Solomon's Seal	*Smilacina racemosa*	3	1	——	7	——	11						
Wild Geranium	*Geranium maculatum*	——	——	——	1								
Appendaged Waterleaf	*Hydrophyllum appendiculatum*	——	——	——	1								
Blackberry	*Rubus* sp.	——	1										
Goatsbeard	*Aruncus dioicus*					39	29	79	13	——	——		
Poison Hemlock	*Conium maculatum*					——	——	1					
Wild Hydrangea	*Hydrangea arborescens*							——	12	14	7	——	——

*Cerambycine – all others are Lepturinae.

Table 2, continued

Strangalepta abbreviata (Germ.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					27	18	85	5	—	—		
Wild Hydrangea	*Hydrangea arborescens*							21	23	8	13	—	—
Judolia cordifera (Oliv.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					—	4	38	18	3	—		
Wild Hydrangea	*Hydrangea arborescens*							6	10	4	4	—	—
Metacmaeops vittata (Swed.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					6	3	7	—	—	—		
Wild Hydrangea	*Hydrangea arborescens*							—	11	32	—	—	—
Brachysomida bivittata (Say)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Wild Geranium	*Geranium maculatum*	1	8	19	23								
Multiflora Rose	*Rosa multiflora*				1	2							
Common Fleabane	*Erigeron philadelphicus*	—	—	—	1	—	2	—	—	—			
Blackberry	*Rubus* sp.			—	2								
Goatsbeard	*Aruncus dioicus*				—	1	1	—	—	—			
Appendaged Waterleaf	*Hydrophyllum appendiculatum*	—	—	—	—	—	1						
Strangalia luteicornis (F.)	Week ending	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	4-Jul	11-Jul	18-Jul	25-Jul
Goatsbeard	*Aruncus dioicus*					—	—	1	1	3	2		
Wild Hydrangea	*Hydrangea arborescens*							—	9	4	8	9	—
Queen Anne's Lace	*Daucus carota*							—	—	—	1		
Tall Meadow Rue	*Thalictrum polgamum*										—	—	1
Common Milkweed	*Asclepias syriaca*									—	—	—	1

some species may also be due to their wider host flower range. Although we have no evidence, in less abundant species there may be selective pressure to use the flowers of relatively few species of plants, to increase the opportunity of locating mates.

Although some species appear to switch from goatsbeard to wild hydrangea as soon as the latter appears (especially apparent in *M. vittata*) (Table 2), this does not actually occur. It is due to the different flowering phenologies through the four years of study. Both flower hosts are used by most lepturines when they are available. The only exception we found was *T. velutinus*. Even when goatsbeard was in bloom and numerous *T. velutinus* were present, we never saw individuals on flowers of this plant. In a typical year, adults of this species become abundant only after the peak flowering period of goatsbeard.

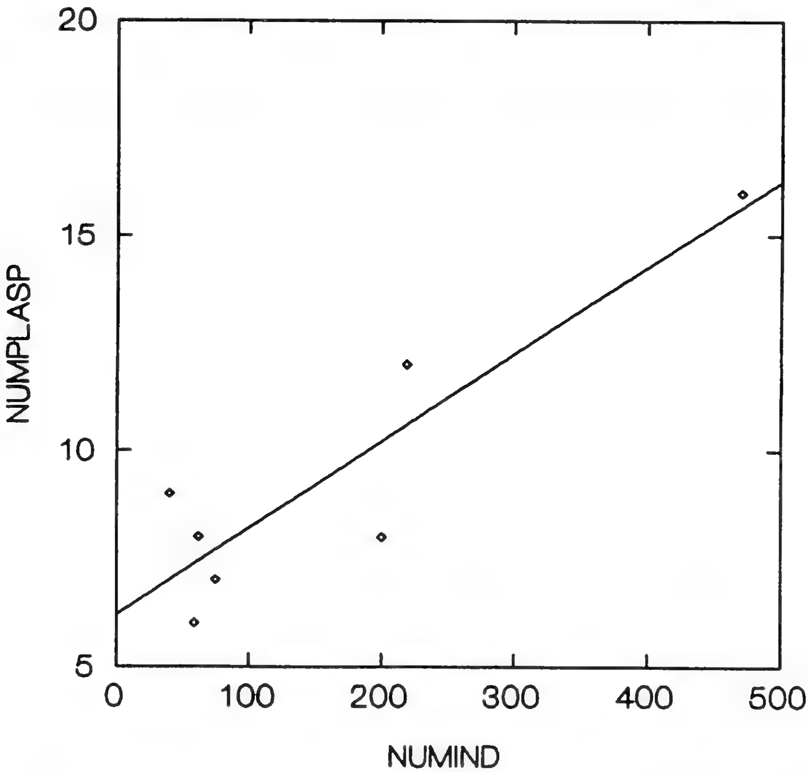

Fig. 1. Numbers of individuals of the seven most abundant lepturines compared to the number of species of plants (flowers) used.

The highest abundance of anthophilous cerambycids in Reas Run is slightly bimodal with a peak the third week of June and a second increase in mid-July. While the third week in June had the greatest species diversity, the high numbers in July were due mainly to the presence of just one species *T. velutinus*. Over the entire sampling period *T. velutinus* alone made up 30.8% of all individuals observed. *A. lineola, S. abbreviata* and two species of *Brachyleptura* were also quite abundant and accounted for an additional 49.4% of the observations. Four species, *Gaurotes cyanipennis* (Say), *Strophiona nitens* (Forster) (both Lepturinae), *Molorchus bimaculatus*, and *Rhopalophora longipes* (Cerambycinae) were only recorded once.

Both goatsbeard and wild hydrangea are used to a great extent by species of anthophilous Cerambycidae. The importance of this source of food may be critical for successful reproduction by these and other flower feeding

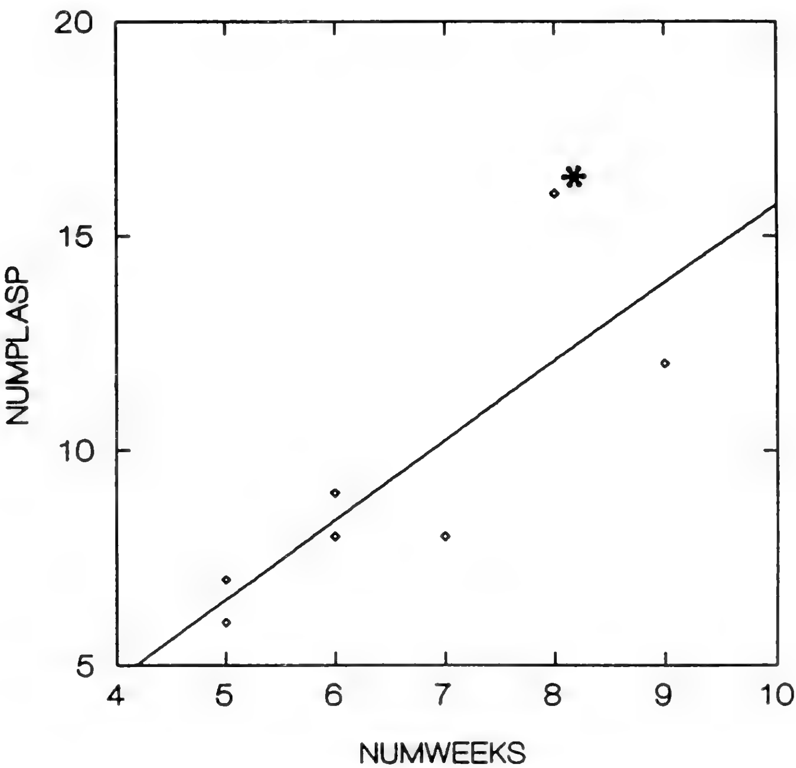

Fig. 2. Number of weeks of activity of the seven most abundant lepturines compared to the number of species of plants (flowers) used. Note that the period of activity of *Typocerus velutinus* (indicated by an *) has been increased by two weeks. See discussion for more details.

insect species. Roadside habitats adjacent to forests, where these flowering plant hosts are commonly found, should be protected from overzealous cutting and spraying by road maintenance crews.

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REINSTATEMENT OF *CALLIBAETIS ZONALIS* (EPHEMEROPTERA: BAETIDAE) AS A VALID NAME[1]

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ABSTRACT: *Callibaetis zonalis* is shown to be the valid name for the species from southern South America that contains the nominal species *Baetis opacus*.

Gillies, in his 1990 revision of the *Callibaetis* of Argentina, recognized eight species of Baetidae as synonyms of *Callibaetis zonalis* Navás, 1915a (*Callibaetis vitreus* Navás, 1915b, *Baetis opacus* Navás, 1915a, *Baetis virellus* Navás, 1915b, *Callibaetis sobrius* Navás, 1916, *Callibaetis apertus* Navás, 1917, *Callibaetis vitreus* Navás, 1919, *Callibaetis depressus* Navás, 1922, *Callibaetis amoenus* Navás, 1930). Because the names *Baetis opacus* and *Callibaetis zonalis* were published in the same paper by Navás (1915a), and because *B. opacus* appeared on an earlier page than *C. zonalis* (pages 12 and 13 respectively), McCafferty (1996) concluded that the valid name for this taxon should be *Callibaetis opacus* (Navás) on the grounds of "page priority."

However, Article 24 of the current International Code of Zoological Nomenclature (1985) specifies that if two or more nomenclatural acts are published on the same date and when they are subsequently considered to be synonyms their relative precedence is determined by the first reviser. Page priority is not an issue. Gillies (1990) clearly stated that the description of *Baetis opacus* was inadequate compared with the well-established concept of *Callibaetis zonalis*.

Two other synonyms, *Callibaetis vitreus* Navás, 1915b, and *Baetis virellus* Navas, 1915b, were described the same year but for some reason were not considered by McCafferty as candidates for the valid name of the taxon. (Hubbard and Edmunds (1977) discussed the remarkable nomenclatural history of *C. vitreus*).

It has proven remarkably difficult to establish the publication date for many of Navás' papers. However, Article 21 of the International Code of Zoological Nomenclature specifies that if the date of publication is not completely specified in a work then the last day of the year when only the year is specified or demonstrated is to be adopted as the date of publication. This is the case in these two publications (Navás 1915a, 1915b). Therefore, these two works should be considered as having been published simultaneously on 31 December 1915.

Gillies (1990), acting as "first reviser," clearly determined the prece-

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dence of the name *Callibaetis zonalis* over *Baetis opacus*, *Callibaetis vitreus*, and *Baetis virellus*. McCafferty's (1996) assertion that *C. opacus* is the valid name contravenes the rules of the International Code of Zoological Nomenclature. *Callibaetis zonalis* is therefore the valid name for this taxon.

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PLAUDITUS TEXANUS (EPHEMEROPTERA: BAETIDAE), A NEW SMALL MINNOW MAYFLY FROM TEXAS[1]

N. A. Wiersema[2]

ABSTRACT: *Plauditus texanus*, n.sp., is described from larvae and male and female adults collected from the Hill Country Region of central Texas. The long terminal segments of the forceps and coloration of the male adult distinguishes this species from all others in North America. The sexually dimorphic male and female larvae of this species resemble those of *P. dubius* and *P. virilis*.

The small minnow mayfly genus *Plauditus* was recently established by Lugo-Ortiz and McCafferty (1998) for a small group of poorly known Nearctic species. Below is a description of an undescribed species of *Plauditus* recently discovered in Texas.

Plauditus texanus NEW SPECIES

(Figs. 1-9)

Larva. Body length: 4.5-6.0 mm, cerci 2.5-3.4 mm. Head: Head capsule with median rows of short, nearly transverse dashes on each side of medial trunk of epicranial suture. Labrum as in Figure 1. Maxillae with 2-3 crest setae; palpi two segmented and extending slightly beyond galealacinial crest, segment 1 subequal to segment 2. Left mandibular incisors as in Figure 3. Right mandibular incisors as in Figure 2. Segment 3 of labial palpi (Fig. 4) slightly broadened apically, with slight distolateral point and weakly concave distal margin; segment 2 with 3 dorsal setae. Thorax: Nota of male larva pale with extensive dark markings; nota of female larva mostly pale, with few brown markings. Legs poorly marked, femora with submedial band of faint brown pigment; tibia and tarsi darkened basally. Femora (Fig. 5) with dorsal row of 24-30 relatively short to long, sharp bristle-like setae; short, robust, sharp and spatulate setae adjacent to ventral margin. Tibiae with sparse ventral setae; tarsi with many long, stout setae ventrally. Tarsal claws (Fig. 6) relatively short and with 10-12 denticles, basal two small. Abdomen: Tergal patterning of mature male larva variable, but usually with terga 1-2 and 5-7 mostly dark blue-brown with pale areas; terga of female larva uniform light yellow-green to olive-green with pale submedial and sublateral spots. Tergum 2 with or without dark red subdermal marking medially. All terga with paired, submedial brown spots. Posterior marginal spines of middle and posterior terga small and triangular with rounded apices. Sterna 5-9 with paired submedial brown spots adjacent to anterior and posterior margins. Gills elongate and nearly symmetrical [length to width ratio 2.0-2.3] . Median caudal filament 2-3 segmented and subequal to mid-dorsal length of tergum 10. Cerci with band of darkened segments distal of midlength.

Male adult. Body length: 4.5-5.4 mm, forewings 4.5-5.0 mm. Head: Light brown in color; ocelli encircled in black basally. Antennae pale. Turbinate eyes round, on high stalks, slightly separated medially and slightly divergent; upper portions bright yellow, with green tinge (in life); lower stalks slightly darkened with light brown. Thorax: Nota and sterna medi-

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um brown, light brown to yellow brown adjacent to sutures and membranous areas. Anterior process of mesoscutum moderately developed (Fig. 7). Forewings with relatively long marginal intercalaries. Legs white to pale yellow. Abdomen: Segment 1 light brown anteriorly; segments 2-6 semi-translucent with yellow-olive overshading; segments 7-10 opaque. Terga 2-6 unmarked; terga 7-10 light brown to medium brown; sterna paler. Genitalia (Fig. 8) with very long terminal forcep segments; forceps segment 3 subdistally expanded and strongly constrict-ed between segment 2 and 3; basal forceps segment nearly cylindrical, poorly developed anteromedially and with strongly sclerotized, subquadrate process between them. Cerci white.

Female adult. Body lengths: 4.0-5.2 mm, forewings 4.0-4.6 mm. Entire body light olive-yellow in color. Legs and caudal filaments pale.

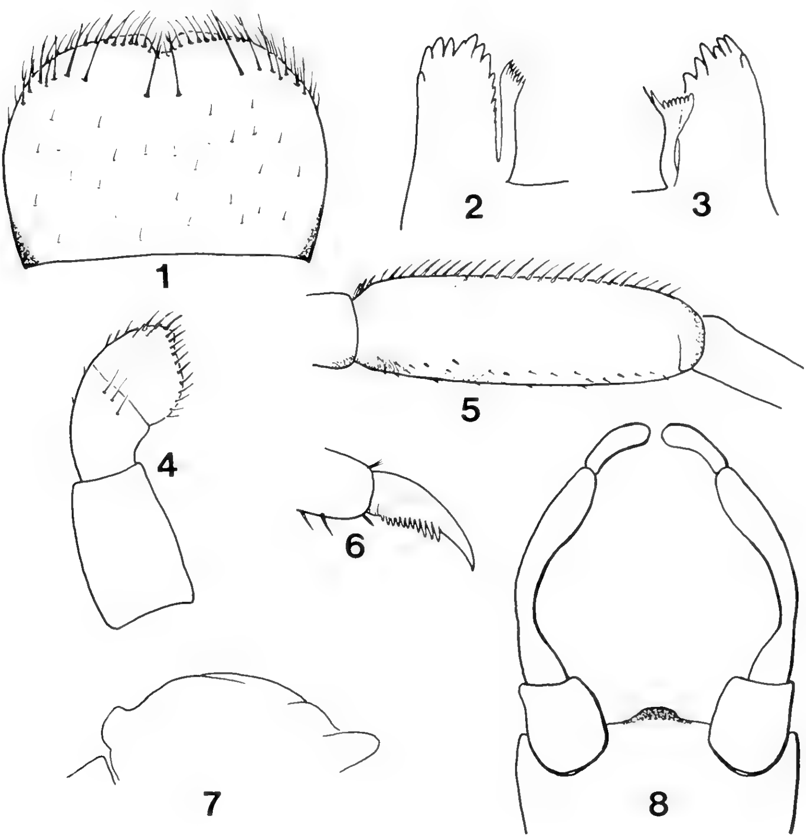
Type material. HOLOTYPE: male larva, Texas: Hays Co., Blanco River at Post Road, 29°56'08N, 097°53'40W, May 05, 1997, N. A. Wiersema (deposited in the Purdue University Entomological Research Collection). PARATYPES: 1 male and 1 female larva same data and deposition as holotype. Seven larvae same data and deposition as holotype, but collected on April 19, 1997.

Additional material examined. Larvae, adults, and subimago males and females (some reared), collected from same locality as holotype on April 16, 19, 20, and 24, 1997 and May 05, 1997 (NAW). Two adult males, Blanco Co., Blanco River at FM 165, June 08, 1993, N. A. Wiersema (NAW). Larva, Austin Co., San Bernard River at I-10, near Sealy, May 19, 1997 N. A. Wiersema (NAW).

Diagnosis. The long terminal forcep segments of the adult male will separate this species from all other described Nearctic species with the exception of *P. veteris*. However, *P. texanus* is easily distinguished by its unmarked abdominal terga and sterna, paler thoracic nota, and pale posterior abdominal terga. The female adult can be distinguished from other females by the combination of pale green-yellow coloration, lack of red or black tergal and or sternal markings and absence of black, branching tracheation markings. The abdominal coloration of the male and female larvae of *P. texanus* are most similar to those of *P. dubius* (Walsh) and *P. virilis* (McDunnough). However, the combination of lacking distinctive black, branching, subdermal, tracheation lines on some abdominal sterna, middle gill length to width ratios, and weak banding of the legs will serve to distinguish *P. texanus* larvae. The coloration feature unfortunately tends to fade over time in poorly marked specimens.

There are numerous additional undescribed species and unassociated larvae of *Plauditus* found throughout North America east of the Rocky Mountains. In addition, there are only a few modern descriptions adequate enough to enable species identifications and more importantly the specific limits for most species remain unclear within this group. For these reasons I suggest larvae and adults of *Plauditus* be identified with extreme caution until a complete phylogenetic revision is made available.

Remarks. *Plauditus texanus* was collected from medium to small sized limestone cobble and macrophytes in shallow riffles of a cool, clear, alkaline



Figs. 1-8. *Plauditus texanus*, n. sp., 1-6 Larva. 1. Labrum (dorsal view). 2. Right mandibular incisors. 3. Left mandibular incisors. 4. labial palpi (dorsal). 5. Partial leg. 6. Tarsal claw. 7-8 Adult male. 7. Partial thorax. 8. Genitalia (ventral).

river typical of those found in the Hill Country Region of central Texas. I recently described two new species of *Procloeon* collected from the same location as the type material of *P. texanus* (Wiersema 1999). *Plauditus texanus* has not been encountered west of the eastern fringe areas of the Edwards Plateau, nor has it been collected in far eastern Texas. It is therefore my opinion that this species is probably restricted to the central plains area of Texas as well as possibly Oklahoma and Kansas. It is likely that this species is the *P. veteris* cognate mentioned by Traver (1935) from Austin, Texas.

ACKNOWLEDGMENTS

I would like to thank S. K. Burian (New Haven, Connecticut) for providing a review of an early version of this publication. I would finally like to express my appreciation to H. P. Boyd (Vincentown, New Jersey), R. D. Waltz (Indianapolis, Indiana), and W. P. McCafferty (West Lafayette, Indiana) for their helpful comments and editorial advice.

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A NEW *PARADIRPHIA* (LEPIDOPTERA: SATURNIIDAE) FROM "SIERRA DE JUÁREZ", OAXACA, MEXICO[1]

Manuel A. Balcázar-Lara[2]

ABSTRACT: A new species of emperor moth, *Paradirphia ibarrai* n. sp., from the Sierra de Juárez in northern Oaxaca, Mexico, is described and illustrated. Male genitalia are figured, specific characters are compared with those of closely related species.

The genus *Paradirphia* contains 14 described species (Lemaire 1996). The genus is primarily a montane taxon that ranges from Mexico to Bolivia, but the majority of the species are distributed in Mesoamerica and only three in the Andes. Although no revisionary work has been published for the genus to date, Lemaire & Wolfe (1989) summarized most of the information for the genus. Twelve species of *Paradirphia* were magnificently illustrated by D'Abrera (1995), but care must be taken with some mistakes in this work –on page 161 the specimen depicted as *P. semirosea* (Walker) corresponds to *P. winifredae* Lemaire & Wolfe; on page 167 the names were misplaced under the pictures: *P. valverdei* Lemaire & Wolfe is labeled *A*[*utomeris*]. *peigleri*; *P. manes* (Druce) as *P. winifredae*; and *P. winifredae* as *A. staciae*. While the last species of *Paradirphia* was described five years ago from Honduras (Wolfe 1994), at least two more species remain to be described from mesomontane areas in Mexico.

Due to its great diversity and high number of endemic species, the Sierra de Juárez, in northern Oaxaca State, Mexico, has been one of the best butterfly collected areas in the last 25 years. Among butterflies, at least 12 species and subspecies have been described from the area (Luis et al. 1991). Personnel and collaborators of the Colección Nacional de Insectos (CNIN) have collected in the area in the past two decades, and while curating this material, I found three distinctive specimens of a new species of *Paradirphia*, which is described in this paper.

Paradirphia ibarrai, NEW SPECIES

(Figs. 1 -3)

Diagnosis. This new species is closely allied to *Paradirphia valverdei* Lemaire & Wolfe, but can easily be distinguished from any other dark *Paradirphia*, by the uniform and pure salmon color marginal band on the hindwings and the extreme reduction of the postmedial lines on the forewings.

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Description. Forewing length: ♂ 35–38 mm ($\bar{x}$ = 36.6, n = 3).
Male (Fig. 1-2).- *Head*: Black; labial palpi three-segmented, black; antennae dark grayish brown, quadripectinate to the apex. *Thorax:* Dark grayish brown; prothoracic collar ruby; legs mainiy ruby color. *Abdomen:* Dorsally black, ringed with ruby; ventrally dark brown. *Forewing:* Dorsally dark grayish brown, almost black; discal spot absent; sides of submarginal band suffused with salmon color; veins black; fringes dark brown; lines salmon color, very reduced; antemedian line absent, postmedian line reduced to a small patch in the costal margin. Forewing ventrally dark grayish brown; postmedian line straight, shaded with black; marginal area salmon color with scattered black scales; veins black (contrasting clearly over the marginal area). *Hindwing:* Dorsally dark grayish brown; postmedian line represented by a small salmon color costal spot; discal spot absent; marginal area salmon color with contrasting black veins (5–6 mm wide). Hindwing ventrally dark grayish brown; postmedian line shaded with black, except for a small, subcostal, salmon color dot; discal spot weak; marginal area salmon color with contrasting black veins. *Male genitalia* (Fig. 3): Uncus down-curved apically, simple, slightly notched at the apex; valves very broad, trilobed; the lower portion of the proximal lobe connected to the transtilla (very large); middle lobe with a posteriorly oriented, spine-like process; a very strong spine, posteriorly produced and ventrally curved, arising from the inner side of lower lobe; lateral arms of the transtilla medially fused in a strongly sclerotized subtrapezoidal ventral plate; juxta not concave, broadly fused to the anterior portion of the valves, with lateral sides slightly produced posteriorly; aedeagus straight (ventrally with a small apical spine); vesica without cornutus.
Female and Immature Stages. Unknown.

Type-Material. (The specimen codes are those of the "Colección Nacional de Insectos", Lepidoptera section) Holotype ♂: MEXICO: Oaxaca, San Juan Bautista Valle Nacional, Metates, 17°41'43"N, 96°19'35"W, 840, 16 Sep 1982 (coll. A. Ibarra) — CNIN LEP 066662.
Paratypes: MEXICO: Oaxaca, San Juan Bautista Valle Nacional, Metates, 17°41'43"N, 96°19'35"W, 840, Jul 1991 (coll. A. Ibarra) — CNIN LEP 066663 ♂; Sierra de Juárez, 17°43'0"N, 96°19'0"W, 600, 25-27 Aug 1996 (coll. G. Nogueira) — CNIN LEP 066664 ♂.
The Holotype and one paratype are in the Colección Nacional de Insectos (CNIN), Universidad Nacional Autónoma de México, one paratype will be deposited in the USNM.

Etymology. This species is named after Adolfo Ibarra, well known collector of Mexican Lepidoptera and the first person to collect this new species.
Distribution. The new species is known only from the Gulf slope of the Sierra de Juárez at medium altitudes between 600 and 900 m.
Flight Period. *Paradirphia ibarrai* has been collected from July to September.
Variation. Almost no variation can be discerned in the three known male specimens.

Remarks. *Paradirphia ibarrai* differs from other *Paradirphia* species in the dorsal, salmon marginal area on the hindwings, the very dark antennae, and the extreme reduction of the lines on the forewings, even more than in *P. oblita* (Lemaire). *Paradirphia fumosa* (R. Felder & Rogenhofer) and *P. michoacana* Beutelspacher have black antennae and colored marginal bands on the hindwings, pinkish suffused with black in the first case and bright orange in the second, but the forewings are also marked with a marginal

Fig. 1-2. *Paradirphia ibarrai* Balcázar, new sp. 1) Holotype ♂ (forewing length: 37 mm), dorsum. 2) same venter.

band, which is completely absent in *P. ibarrai*.

The genitalia of *P. ibarrai* are closest to those of *P. valverdei* Lemaire & Wolfe, but differ from the latter in the shape and size of the spine from the inner side of lower lobe being shorter, closer to the uncus and more ventrally recurved, the much larger spine like process of the medial lobe; also the anellus is more rounded, the saccus is truncated posteriorly, and the aedeagus has a small, ventral terminal spine.

One of the paratypes was collected during the day, apparently flying actively; the Holotype and the other paratype were attracted to ultraviolet light and mercury vapor light traps. This species is found at lower altitudes than *P. valverdei* (600–900 m against 1400-2000 m) in an ecotone zone between the tropical rain forest and the cloud forest with *Liquidambar* predominance.

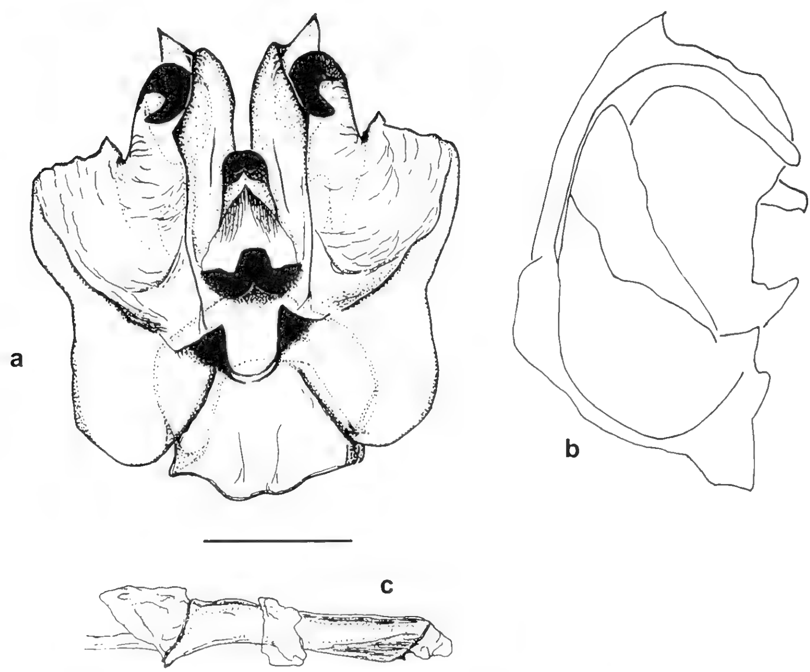

Fig. 3. *Paradirphia ibarrai* Balcázar, new sp., ♂ genitalia: a) ventral view, aedeagus removed; b) lateral view; c) lateral view of aedeagus (line = 1 mm).

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TWO NEW SPECIES OF *PLATYBAETIS* (EPHEMEROPTERA, BAETIDAE) FROM SULAWESI, INDONESIA[1]

Xiaoli Tong, David Dudgeon[2]

ABSTRACT: Two new species of *Platybaetis* (Ephemeroptera: Baetidae), *P. sulawesiensis* and *P. wallacei*, are described from Sulawesi, Indonesia. Larvae of *P. sulawesiensis* can be distinguished from all other species of *Platybaetis* by gills 2-7 each with numerous short, robust, simple setae near anterolateral margin of gill. Larvae of *P. wallacei* most closely resemble *P. edmundsi* morphologically, but can be differentiated from the latter by presence of hindwing-pads; terga 1-10 with broad, rounded posterior marginal spines; and terminal filament reduced to 1 segment that is approximately 2.5 times as long as the width at the base.

The genus *Platybaetis* established by Müller-Liebenau (1980a) from the Philippines is a small genus with only four species so far described: *P. edmundsi* from the Philippines and *P. uenoi* from Nepal (both Müller-Liebenau, 1980a), *P. bishopi* from West Malaysia (Müller-Liebenau, 1980b) and *P. probus* from East Malaysia (Müller-Liebenau, 1984). During the Royal Entomological Society Project Wallace Expedition to Sulawesi, Indonesia in 1985, two undescribed species of the genus *Platybaetis* were collected by one of us (DD). The two new species are described below.

Abbreviations used for collection localities, collectors, and deposition of types are: Sulawesi Utara Province (SUP), Dumoga-Bone National Park (DBNP); David Dudgeon (DD); Purdue Entomological Research Collection, West Lafayette, Indiana (PERC); Florida A & M University, Tallahassee, Florida (FAMU); Department of Ecology & Biodiversity, University of Hong Kong (HKU); and, the Insect Collection of South China Agricultural University, Guangzhou, P. R. China (SCAU).

Platybaetis sulawesiensis NEW SPECIES

(Figs. 1 and 3)

Larva. Body length (full grown specimens): 8.0-12.5 mm (female), 7.2-9.0 mm (male); cerci: 10.3-15.6 mm (female), 7.0-10.5 mm (male); terminal filament (Fig. 1g) reduced to 1 segment, approximately 0.1 mm.
Head: Flattened and subquadrangular, slightly wider than long; coloration yellow-brown, with irregular pale brown markings between eyes on vertex; head of female larva with notch in posterior margin, but very shallow emargenation in male. Antennae pale yellow, thick and short, slightly longer than width of head; scape nearly as broad as long, pedicel cylindrical, approximately 1.3-2.0 times longer than broad; flagellum with approximately 20 segments. Labrum nearly rectangular, approximately 2.0 times wider than long; dorsum with 1+6 (7) long, simple

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submarginal setae; labrum directed ventrally. Hypopharynx as in Figure 1e. Left mandible (Fig. 1b) with incisors with 6 to 7 denticles, molar area with stout, thumb like apical prolongation, approximately 2.0 times longer than wide. Right mandible (Fig. 1b) with incisors with 6 to 7 denticles. Maxillae (Fig. 1d) with 5-7 long, fine, simple setae on medial hump; palps 3-segmented, division between segment 1 and segment 2 indistinct; terminal segment nearly as long as proximal two segments, with small apical tip at apex. Labium (Fig. 1i) with glossae slightly longer than paraglossae, glossae slightly narrower than paraglossae; paraglossae approximately 2.0 times longer than broad; glossa with two large, stout, blunt setae near apex; apex of paraglossa with single row of seven long, robust, clavate setae (Fig. 1i); palps 3-segmented; terminal segment with numerous stout, acute setae.

Thorax: Coloration yellow-brown. Pronotum approximately as broad as head capsule in female, slightly narrower than head capsule in male; pronotum posterolateral margin of rounded. Hindwingpads (Fig. 1c) absent or vestigial. Legs paler than thorax, with single row of long, pinnate setae along dorsal margin of femora; similar row of less robust but denser setae present on dorsal margins of tibiae and tarsi; submarginal setae along the dorsal margin of femora stout and conical (Fig. 3); all submarginal setae approximately same length as distance between bases of long setae; tarsal claw with single row of denticles, denticle near apex longest (Fig. 1h).

Abdomen: Coloration yellow-brown; terga 2-9 each with two pairs of brown markings medially, anterior pair rodlike and divergent posteriorly, posterior pair shorter and smaller than anterior one; terga 1 and 10 without such markings. Terga 1-10 each with long, acute posterior marginal spines (Fig. 1f). Gills (Fig. 1a) simple and rather large; lamellae with dark brown and strongly ramified tracheae; gills 2-7 each with numerous short, robust, simple setae near anterolateral margin. Paraprocts similar to Figure 2d. Cerci longer than body, fringed with short hairs medially; terminal filament reduced to 1 segment.

Adult: Unknown.

Material Examined. Holotype: Mature male larva, INDONESIA, Sulawesi, SUP, DBNP, Tumpah River above the confluence with Toraut River, 2-VIII-1985. DD. Paratypes: 70 larvae, locality and date as holotype; 16 larvae, SUP, DBNP, Waterfall creek (tributary of Tumpah River), 5-VIII-1985, DD; 28 larvae, SUP, DBNP, upper Tumpah River, 1-VIII-1985, DD; 90 larvae, SUP, DBNP, lower confluence of Tumpah River and Toraut River, 8-VIII-1985, DD; 48 larvae, SUP, Irrigation Canal, downstream of the Tumpah-Toraut confluence, 10-VIII-1985, DD; 36 larvae, SUP, Irrigation Ditch, downstream of the Tumpah-Toraut confluence, 10-VIII-1985, DD; 10 larvae, SUP, DBNP, Toraut River above confluence with Tumpah River, DBNP, 15-VIII-1985, DD; 32 larvae, SUP, Agricultural Stream (tributary of Toraut River below Weir), near DBNP, 12-VIII-1985, DD. All types are in alcohol. Types are deposited in the following collections: holotype and 20 paratypes in PERC, 15 paratypes in FAMU, 30 paratypes in SCAU, the remaining paratypes in HKU.

Etymology. The specific epithet refers to the island of Sulawesi where the type locality is situated.

Remarks. The larva of *P. sulawesiensis* can be distinguished from all other species of *Platybaetis* by the following combination of characters: (1) gills 2-7 each with numerous short, robust, simple setae near anterolateral margin of gill; (2) terga 1-10 each with long, acute posterior marginal spines; (3) length of submarginal setae on femora approximately same length distance between bases of long marginal setae; and (4) terminal filament reduced to one segment.

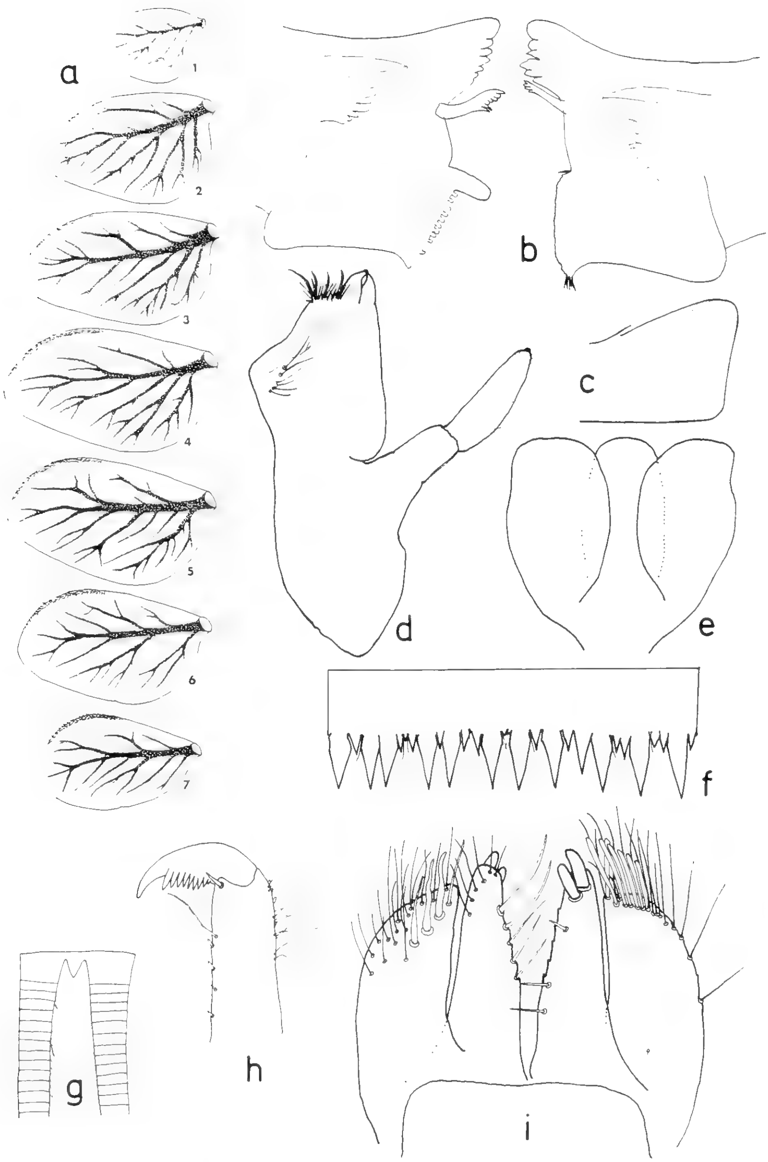

Fig. 1. Larva of *Platybaetis sulawesiensis* n. sp.
a) gills I to VII; b) canini and molar area of left and right mandibles; c) right half of metatergum, which lacks hindwing pads; d) maxilla; e) hypopharynx; f) posterior margin of tergum VI; g) base of cerci; h) apex of tarsus with long bristle; i) glossa and paraglossa, left: ventral view, right: dorsal view.

The new species lives on stone surfaces in moderate to swift current. The altitude of collection localities was approximately 210m.

Platybaetis wallacei NEW SPECIES

(Figs. 2, 4-6)

Larva. Body length: 7.7-8.8 mm (female), 7.2-8.2 mm (male); cerci broken in both sexes in material examined; terminal filament (Fig. 2h and 4) reduce to 1 segment, approximately 0.25 mm in length.

Head: Coloration yellow to pale brown; head nearly quadrangular, with irregular pale brown markings on vertex; head of female with distinct notch in middle of hind margin; male with shallow incision. Antennae pale yellow, shorter than head; scape slightly wider than long; pedicel cylindrical, approximately 1.3 times longer than broad; flagellum with approximately 20 segments. Labrum nearly oblong, approximately 2.0 times wider than long; dorsum with 1+6 long, robust, simple submarginal setae. Left mandible (Fig. 2a) with incisors with 6 to 7 denticles, molar area with large, stout, thumblike protrusion, approximately 2.0 times longer than wide. Right mandible (Fig. 2a) with incisor with 6 denticles. Maxillae (Fig. 2c) with four long, fine, simple setae on medial hump; palps 3-segmented, articulation of proximal two segments indistinct; terminal segment slightly longer than proximal two segments. Hypopharynx as in Figure 2b. Labium (Fig. 2f) with glossae slightly longer than paraglossae; glossa with two large stout, blunt setae near apex; apical margin of paraglossa with single row of seven long, robust, clavate setae (Fig. 2f); palps 3-segmented, 3rd segment with numerous stout, acute setae.

Thorax: Coloration pale yellow-brown. Pronotum nearly as broad as head capsule; pronotal posterolateral margin of rounded. Hindwing-pads minute and narrow (Fig. 2g). Legs paler than thorax. Dorsal margin of femora with regular dense row of long, robust setae fringed with fine feathered hairs; similar setae on dorsal margins of tibiae and tarsi, less robust and much denser than on femora; several broad, flat, truncate submarginal setae near dorsal margin of femora, approximately half as long as distance between bases of long marginal setae (Fig. 5, 6); tarsal claw with single row of denticles, denticle near apex longest.

Abdomen: Coloration pale yellow-brown; terga 2-9 with two pairs of brown markings medially, anterior pair rod-like, divergent posteriorly, posterior pair shorter and smaller than anterior pair; terga 1 and 10 without such markings. Terga 1-10 with broad, rounded posterior marginal spines (Fig. 2i). Gills (Fig 2e) with distinct dark brown branched tracheae toward hind margins; gill margins smooth, with few fine hairs. Paraprocts as in Figure 2d. Cerci medially fringed with short hairs; terminal filament reduced to single segment approximately 2.5 times as long as width at base.

Adult : Unknown.

Material Examined. Holotype: Mature larva, INDONESIA, Sulawesi, SUP, Irrigation Canal, downstream of the Tumpah-Toraut confluence; 10-VIII-1985; David Dudgeon. Paratypes: 2 larva, SUP, DBNP, upper Tumpah River, 1-VIII-1985, DD; 3 larvae, SUP, DBNP, Tumpah River above the confluence with Toraut River 2-VIII-1985, DD; 6 larvae, SUP, DBNP, Waterfall creek (tributary of Tumpah River), 5-VIII-1985, DD; 3 larvae, SUP, DBNP, lower confluence of Tumpah River and Toraut River, 8-VIII-1985, DD; 2 larvae, SUP, Irrigation Ditch, downstream of the Tumpah-Toraut confluence, 10-VIII-1985, DD. All types are in alcohol. Types are deposited in the following collections: holotype and 3 paratypes in PERC, 3 paratypes in FAMU, 4 paratypes in SCAU, and 5 paratypes in HKU.

Etymology. This species is named after Alfred Russel Wallace.

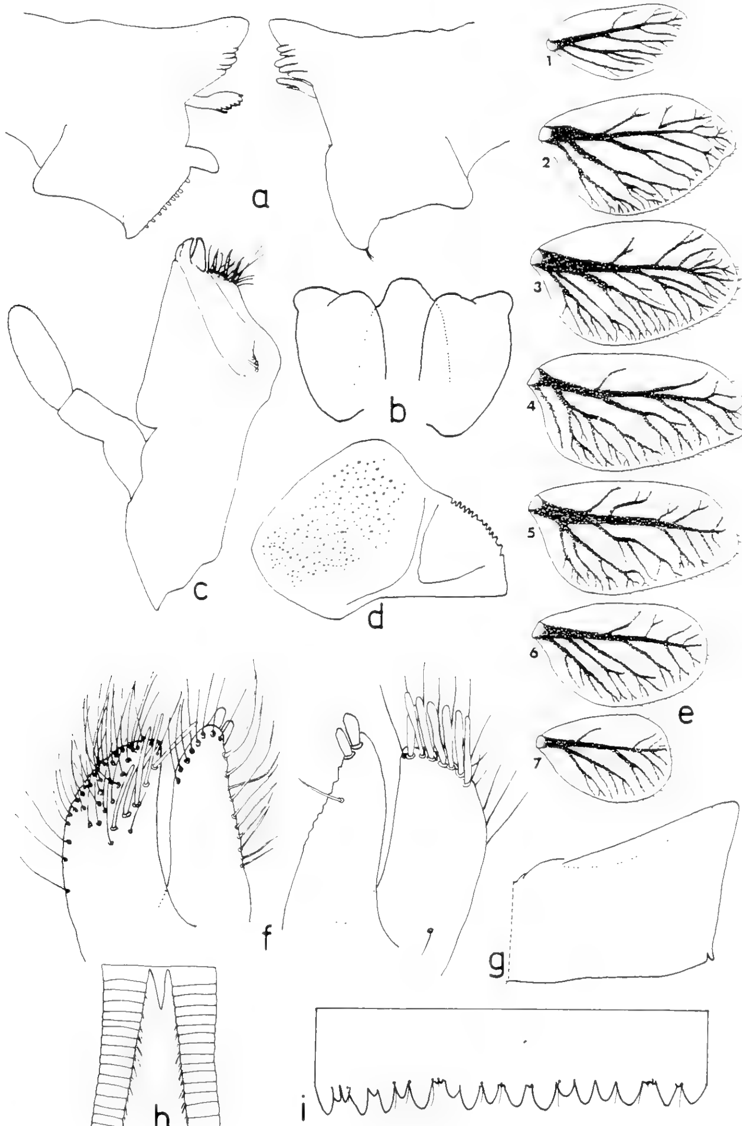

Fig. 2. Larva of *Platybaetis wallacei* n. sp.
a) canini and molar area of left and right mandibles; b) hypopharynx; c) maxilla; d) paraproct; e) gills I to VII; f) glossa and paraglossa, left: ventral view, right: dorsal view; g) right half of metatergum bearing hindwing pads; h) base of cerci; i) posterior margin of tergum VI.

Remarks. The larva of *P. wallacei* is morphologically very similar to *Platybaetis edmundsi* Müller-Liebenau, but can be differentiated from it by the following combination of characters: (1) presence of hindwingpads; (2) terga 1-10 with broad, rounded posterior marginal spines; and (3) terminal filament in both sexes reduced to 1 segment and approximately 2.5 times as long as the width at the base.

Larvae of *P. edmundsi* were collected in the Philippines highlands between 1,600-2,200 m (Müller-Liebenau, 1980a); *P. wallacei*, however, occurred at a lower altitude (210 m) in Sulawesi. *Platybaetis sulawesiensis* and *P. wallacei* were found together in Sulawesi streams, but *P. sulawesiensis* was predominant.

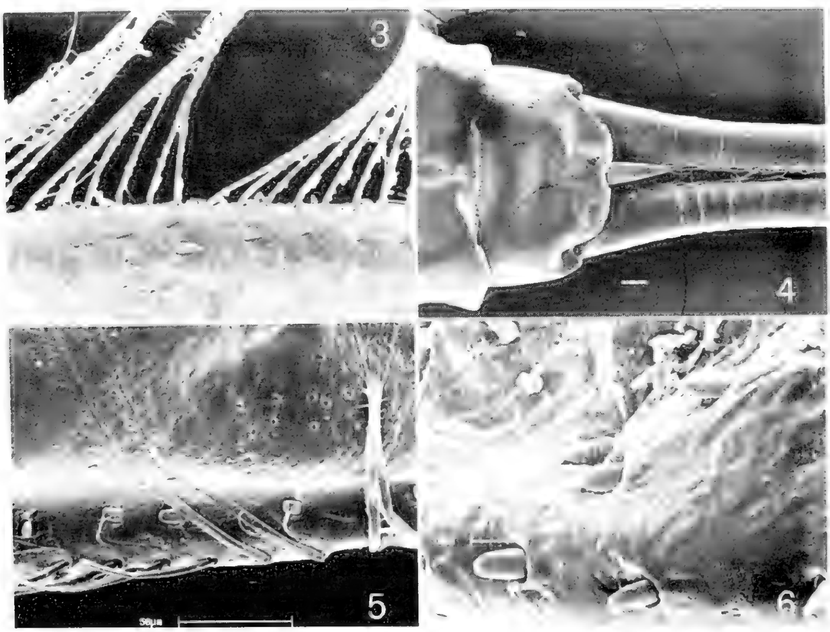

Fig. 3. *Platybaetis sulawesiensis* n. sp.: section of outer margin of femur with long marginal setae and stout, conical submarginal setae (note submarginal setae which are nearly the same length as the distance between the bases of the long marginal setae).
Fig. 4. Base of cerci of *Platybaetis wallacei* n. sp. (scale: 60 mm)
Fig. 5. *Platybaetis wallacei* n. sp.: section of outer margin of femur with long marginal setae and short, truncated submarginal setae which are about half as long as the distance between the bases of the long marginal setae.
Fig. 6 *Platybaetis wallacei* n. sp.: details of submarginal setae on outer margin of femur.

ACKNOWLEDGMENTS

We thank W. P. McCafferty and C. R. Lugo-Ortiz (Purdue University, West Lafayette) for reviewing the manuscript, and W. S. Lee, EM Unit, The University of Hong Kong, for assistance with the SEM.

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NOTES ON THE SAND FLIES (DIPTERA: PSYCHODIDAE) OF SOUTHERN ARIZONA[1]

Chad P. McHugh[2]

ABSTRACT: Two hundred twenty-eight sand flies were collected during a total of 30 trap nights conducted at two locations in southern Arizona. *Lutzomyia apache* was the species most commonly collected; *Lu. anthophora*, *Lu. californica* and an undescribed species of *Lutzomyia* also were present. Data on the abundance, trophic status, sex ratio, fecundity and geographic distribution of these insects are presented.

The leishmaniases are a complex of sand fly-borne, parasitic diseases which infect a wide range of vertebrate hosts. In the United States, locally-acquired, human cases have been reported from southern and central Texas (McHugh et al. 1996). The etiologic agent in this area, *Leishmania mexicana* Biagi, is transmitted among woodrats (*Neotoma micropus* Baird) by the sand fly *Lutzomyia anthophora* (Addis) (McHugh et al. 1990, McHugh et al. 1993, Kerr et al. 1995). Until recently, rodent isolates of *L. mexicana* have been limited to *N. micropus* collected in south Texas. However, given the wide host range of *Leishmania* spp., McHugh et al. (1996) suggested that leishmaniasis could potentially occur anywhere in the United States where sand fly vectors are found. To test this hypothesis, collection and screening of rodents for *Leishmania* and collection of associated sand flies was conducted in southern Arizona where *Lu. anthophora* is known to occur (Mead and Cupp 1995). This note reports the results of those sand fly collections.

MATERIALS AND METHODS

Collections were made at two locations in the Buenos Aires National Wildlife Refuge (BANWR), Pima County, Arizona. The refuge comprises approximately 46,540 ha paralleling state highway 286 southwest of Tucson. It is in the Sonoran life zone, and vegetation is a mix of desert shrub and mesquite grassland with riparian corridors.

Trapping was conducted along Arivaca Creek (approx. loc. 31°35'30" N, 111° 21'45" W), about 5.5 km northwest of the town of Arivaca. This intermittent creek was lined with grasses, shrubs and trees, primarily cottonwoods (*Populus* sp.), and mesquite (*Prosopis* sp.). Nests of white-throated woodrats (*Neotoma albigula* Hartley) were common among the brush and downed trees along the banks of the creek. Mead and Cupp (1995) reported collections of *Lu. anthophora* associated with woodrats and rock squirrels

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(Spermaphilus variagatus) [Erxleben]) in this area. *Leishmania mexicana* was detected in six of 18 (33%) white-throated woodrats collected along the creek. (Kerr et al. 1999).

Additional collections were made at a refuse area located near the El Cazador bunkhouse area (approx. loc. 31°50'10" N, 111°23'50" W) at the northern end of the refuge. Numerous white-throated woodrat nests were scattered among the discarded equipment, cans, barrels, lumber, and cars at the refuse area. The surrounding area was primarily mesquite savanna. None of 10 woodrats collected at this site was *Leishmania*-positive.

Solid-state Army miniature light traps were suspended above active nests and debris piles created by woodrats. A total of 30 trap nights, 19 along Arivaca creek and 11 at the El Cazador refuse area, were conducted from 28 September through 2 October 1998. The choice of dates was based on evidence that in Texas transmission of *Leishmania* takes place primarily in the fall (Kerr et al. 1995) and that adult sand flies were present at BANWR at this time (Mead and Cupp 1995).

Flies were anesthetized with triethylamine, cleared in 89% liquid phenol, and identified using the keys of Young and Perkins (1984). The trophic status – unfed, bloodfed, gravid – of females was noted and, when possible, the number of ova in gravid females was determined.

RESULTS

A total of 228 sand flies was collected (Table 1). Specific determinations were made for all but three individuals, one male and two females. Accounts for the three described and an undescribed species collected on the refuge are provided following the table.

Table 1. Sand flies collected at two sites in the Buenos Aires National Wildlife Refuge, Pima County, Arizona, 28 September through 2 October 1998.

	Arivaca Creek[1]		El Cazador Camp[2]	
Species	Female	Male	Female	Male
Lutzomyia apache	135	56	1	8
Lutzomyia anthophora	4	—	1	1
Lutzomyia californica	1	—	4	2
Lutzomyia sp.	2	—	6	4
Total	142	56	12	15

[1] 19 trap nights. 1 male, 1 female *Lutzomyia* sp. undetermined.
[2] 11 trap nights. 1 female *Lutzomyia* sp. undetermined.

Lutzomyia apache Young and Perkins

This species was the most abundant, comprising 88% of the total specimens collected. A majority of these came from just a few nests along Arivaca Creek. There, four one-night collections yielded 54, 19, 19 and 16 individuals. The female:male sex ratio at the creek was 2.4:1. Of the 135 females collected at Arivaca Creek, five were bloodfed and eight were gravid, indicating that *Lu. apache* is reproductively active during the fall in southern Arizona. The mean number of mature ova for six gravid females which were dissected was 54.2 (range 25-87, s.d. 21.1). Both male and female *Lu. apache* also were collected at the El Cazador dump, although not in such disproportionate numbers. Whether the abundance at Arivaca Creek was due to habitat preference or phenology of adult flies is unknown.

Three females collected at Arivaca Creek initially appeared to be gravid, with abdomens that were opaque and distended. On dissection, their abdomens were found to be filled with nematodes. A specific determination was not made, but most appeared to be third-stage filarid larvae (Bain and Chabaud 1986). One of the females also contained two additional forms, one of which was shorter and fatter, reminiscent of the early, "sausage-stage" seen in many filarids. *Dunnifilaria meningica* Gutierrez-Pena (Filarioidea: Onchocercidae) has been reported from *N. micropus* (Gutierrez-Pena 1987), a species closely related to *N. albigula*, and microfilariae similar to those of *D. meningica* were seen in several *N. albigula* collected at Arivaca Creek (S.F. Kerr, unpublished data). The host preference of *Lu. apache* is unknown. Other species of sand flies in the subgenus *Helcocyrtomyia* are reptile and/or amphibian feeders (Young and Perkins 1984), suggesting *Lu. apache* feeds on cold-blooded vertebrates. However, the presence of filarids in the flies and woodrats at Arivaca Creek and the association of *Lu. apache* with woodrat nests may indicate a preference for rodent hosts.

Lutzomyia apache was described from specimens collected in Apache and Cochise counties, Arizona, and is also known to occur in Gila County, Arizona (Young and Perkins 1984). The collection of *Lu. apache* at the BANWR is the first published report of this species from Pima County. Alsuhaibani (1990) collected specimens of *Lu. apache* in Larimer County, Colorado, in association with prairie dog (*Cynomys ludovicianus* [Ord]) burrows. This species is not known from Mexico, but, given its known range from northern Colorado southward to the U.S.-Mexican border and its abundance at Arivaca Creek, this species likely occurs at least into northern Mexico.

Lutzomyia anthophora (Addis)

This species was represented by two unfed and two gravid females collected at Arivaca Creek and a single male and unfed female at the El Cazador dump. Almost all United States records for this species were from southern and western Texas (McHugh 1991, Young and Duncan 1994). Mead and Cupp (1995) reported collections of this species at Arivaca Creek, thereby extending the known range of this species westward by about 724 km. It occurs southward to Morales State, Mexico. It is a nest associate of *N. micropus* (Endris et al. 1984, McHugh 1991) and is the vector of *L. mexicana* among these rodents (McHugh et al. 1996). The only isolates of *L. mexicana* from sand flies in North America, north of the Yucatan peninsula, are from *Lu. anthophora* collected in Bexar County, Texas (McHugh et al. 1993). *Lutzomyia anthophora* also is believed to be a vector of Rio Grande virus among *N. micropus* (Endris et al. 1983).

Lutzomyia californica (Fairchild and Hertig)

One gravid *Lu. californica* was collected at Arivaca Creek. Two males, three unfed females and a gravid *Lu. californica* were collected at the El Cazador refuse site. This species is wide-spread in the western United States, occurring in Washington, California, Arizona, and Texas (Young and Duncan 1994). The collections in the BANWF are the first published reports from Pima County, Arizona. This species may be conspecific with *Lutzomyia chiapanensis* (Dampf) which extends from Mexico southward into Panama (Young and Duncan 1994). *Lutzomyia californica* is believed to feed on reptiles (Chaniotis 1967).

Lutzomyia sp.

Four males and six unfed females of an apparently undescribed *Lutzomyia* species were collected at the El Cazador refuse area. Two unfed females were collected at Arivaca Creek. The armature of the male gonocoxite and gonostyle and the spermathecae and armature of the female cibarium are similar to that of *Lutzomyia shannoni* (Dyar), but the antennal ascoids lack the proximal spurs found in *Lu. shannoni*. The spermathecae of the undescribed species are extremely hyaline and often difficult to visualize. It is likely that the two female *Lutzomyia* collected in the BANWR for which determinations were not made belonged to this undescribed species. Examples of this species previously were collected at the residences of two cases of human leishmaniasis in Texas (P.G. Lawyer, unpublished data). Little is known of the biology of this undescribed species.

DISCUSSION

Three described and one undescribed species of sand flies were present at a focus of leishmaniasis in southern Arizona. Based on the presumed preference of *Lu. apache* for cold-blooded vertebrates and the known preference of *Lu. californica* for reptiles, these species probably are not involved in transmission of *L. mexicana* among rodents. *Lutzomyia anthophora*, a species known to feed on woodrats and one which was consistently found at foci of leishmaniasis in Texas (C.P. McHugh, unpublished data), is a likely candidate for vector at the southern Arizona focus.

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AQUATIC COLEOPTERA FROM LAKE XOCHIMILCO, MEXICO[1]

Silvia Santiago-Fragoso, Elizabeth Mejorada-Gómez[2]

ABSTRACT: Aquatic Coleoptera were collected in Lake Xochimilco, México, from April 1988 through May 1989, plus one collection in 1990. The collection consisted of 3 families with 22 species. The most diverse family was Hydrophilidae with 11 species. The family Dytiscidae was represented by 10 species. Only one species belonging to the family Haliplidae, *Peltodytes mexicanus* was collected. Line drawings of the male genitalia are included for the species identified, except for those whose identifications were to genus.

México's basin is located at the south border of the Mexican plateau, between 98° 15' - 99° 30' and 19° 00' - 20° 15'. This basin is formed by a group of lakes named Texcoco, Chalco, Zumpango, Xaltocan and Xochimilco. The marshy region with wide and shallow lakes was obliterated by natural aging processes; those processes were accelerated by human actions (Novelo, 1988). Actually, most of these lakes are reduced or have disappeared. Lake Xochimilco is endangered, therefore this is the main reason to study part of its fauna.

Lake Xochimilco is located SE Mexico city (Fig. 1) (Tamayo de Ham, 1981), at 2270 msnm and its inflow basin is mainly the Ajusco Sierra. At present the lake is reduced to a series of primary, secondary and tertiary channels with the water surrounding the cultivated parcels ("chinampas") and an urban area.

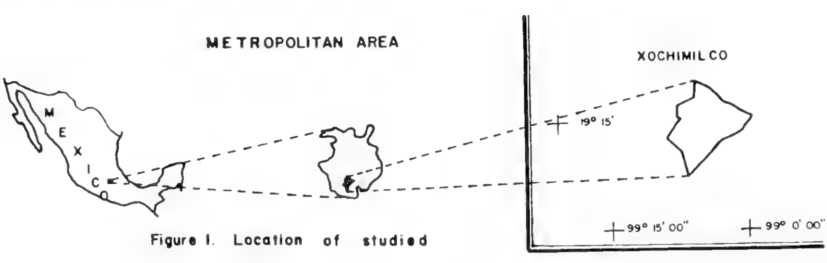

Fig. 1. Lake Xochimilco location.

Due to the demographic growth of Mexico city, in 1913 the aqueduct México-Xochimilco was built to provide potable water to the population.

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However, in 1953, it was necessary to reduce the water flow to the city because the water resource diminished considerably. That is why in 1959 the Departamento del Distrito Federal decided to reconstitute part of the water extracted, using treated sewage water (Báez & Belmont, 1972). Studies to determine the water quality in the lake have shown a high degree of salinity, and the physicochemical analysis indicate the polisaprobic nature of the water due to the presence of coliform bacteria. Also, the high values for the phosphates (up to 28 mg/l) cause eutrophication in the channels (Báez, Belmont & González,1975). Later, Ramos Espinosa et al. (1993), showed in the Primer Seminario Internacional de Investigadores de Xochimilco results very similar to those mentioned above.

In 1988, Lake Xochimilco was declared by UNESCO as patrimony of the world. However, the biodiversity is still threatened (Bojórquez y Olguín, 1993).

The dominant vegetation in the channnels are the free-floating hydrophytes *Eichhornia crassipes* and *Hydromystria laevigata* and two species of Lemnaceae, *Lemna gibba* and *Wolffia columbiana*. Another important element characteristic of the typical "chinampera " region SE of the Mexican plateau, is the tree called ahuejote (*Salix bonplandiana*) (Novelo y Gallegos, 1988).

The only studies dealing with aquatic insects from the area are as follows: Salcedo (1978), recorded the following species in the family Dytiscidae: *Cybister explanatus* LeConte, *Thermonectus basillaris* Harris and in the family Hydrophilidae: *Tropisternus tinctus* Sharp and *Paracymus* Thomson. Young (1985) reported a single species in the family Noteridae, *Hydrocanthus pallisteri* Young from Xochimilco. Also Campos & Fernández (1993) recorded the heteropteran *Belostoma* sp., the hydrophilid *Tropisternus lateralis* (Fabricius), and the dytiscid, *Thermonectus nigrofasciatus* Aubé. The latter species was not present in this study. However, another species of the same genus, *Thermonectus basillaris,* was collected by us.

METHODS

From April 1988 to May 1989 we made 6 collections and one more in January, 1990.

The collection sites were mainly in three types of habitats: "apancle", "acalote" and "laguna", as they are called by the local inhabitants.

The "apancles" are channels betweeen the chinampas which are shallow, with slow movement and great quantities of aquatic plants and detritus produced by plant decay.

The "acalotes" are the main channels which are deeper, wider and with greater volume of water; also, they are more altered.

The "lagunas" are wide open areas that are connected with the channel system.

RESULTS AND DISCUSSION

During our surveys, we collected a total of 1511 adults and 43 larvae in three families as follows: Haliplidae, Dytiscidae and Hydrophilidae.

Haliplidae
Peltodytes mexicanus Wehncke (Figs. 2-4)

Dytiscidae
Cybister explanatus LeConte (Figs. 5, 6)
Desmopachria majusculus Young (Figs. 7,8)*
Hydrovatus sp.
Hygrotus sp.
Laccophilus mexicanus mexicanus Aubè (Fig. 9, 10, 11)
Liodessus affinis (Say) (Figs. 12, 13)
Neobidessus sp
Neoclypeodytes sp.
Rhantus anisonychus Crotch (Figs. 14, 15)
Thermonectus basillaris Harris (Figs. 16, 17)

Hydrophilidae
Anacaena debilis (Sharp) (Figs. 18, 19)
Berosus mexicanus Sharp (Figs. 20, 21)
B. stylifer Horn (Figs. 22, 23, 24)
Cercyon praetextatus (Say) (Figs. 25)
Enochrus mexicanus Sharp (Figs. 26, 27)
E. ochraceus (Melsheimer) (Figs. 28, 29)
Hydrochus sp.
Paracymus mexicanus Wooldridge (Figs. 30, 31)
Tropisternus columbianus Brown, (Figs. 32, 33)
T. lateralis (Fabricius) (Figs. 34, 35)
T. tinctus Sharp (Figs. 36, 37)

* This is a new record for Mexico, and the second record since it was described from Guatemala.

The "apancle" was the habitat with the most diversity and greater number of beetles, so it was apparent that in this type of habitat the scavenging hydrophilids found enough food, and the predatory dytiscids found their prey. In the "acalotes" the aquatic beetles were found mainly along the margins where the food was abundant and the water moved slowly; in general, the entomofauna found was moderately diverse and not numerous. Finally, the Coleoptera were most poorly represented in the "lagoons".

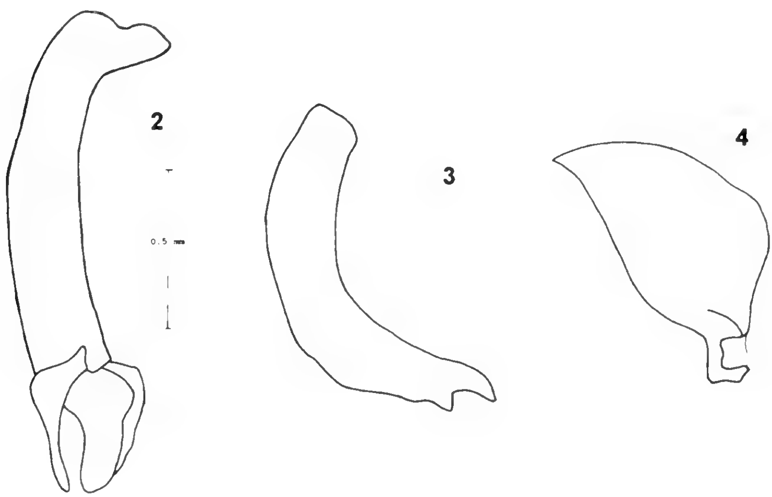
The Haliplidae were represented by one species of *Peltodytes*, the Hydrophilidae by 11 species, those pertaining to the genera *Tropisternus* and *Enochrus* were in greater number; Dytiscidae with 10 species, where *Laccophilus and Neobidessus* were the most numerous.

The hydrophilids and dytiscids were associated in the same habitat which was characteristically with abundant aquatic vegetation.

The haliplid *Peltodytes mexicanus* Wehncke (Figs. 2-4) was present only in the Canal del Japón, where in general the water was clear and with sparse decaying plants.

The results show a list of species where those typical of polluted environments dominate, that is, the situation of the water body studied, where different types of pollution have been detected as it is mentioned by Ramos et al (1993). The water in the channels is in hypoxic conditions with high ammonium concentrations, that make obvious the strong degradation of the organic matter. At the same time, the presence of coliform bacteria confirm the municipal type pollution (Gama y Fernández, 1993).

In general the scarce diversity found can be attributed to the ecosystems physicochemical characteristics, as shown by the studies conducted by Báez y Belmont (1972), Ramos et al (1993), Gama and Fernández (1993) and Olguín, 1993).



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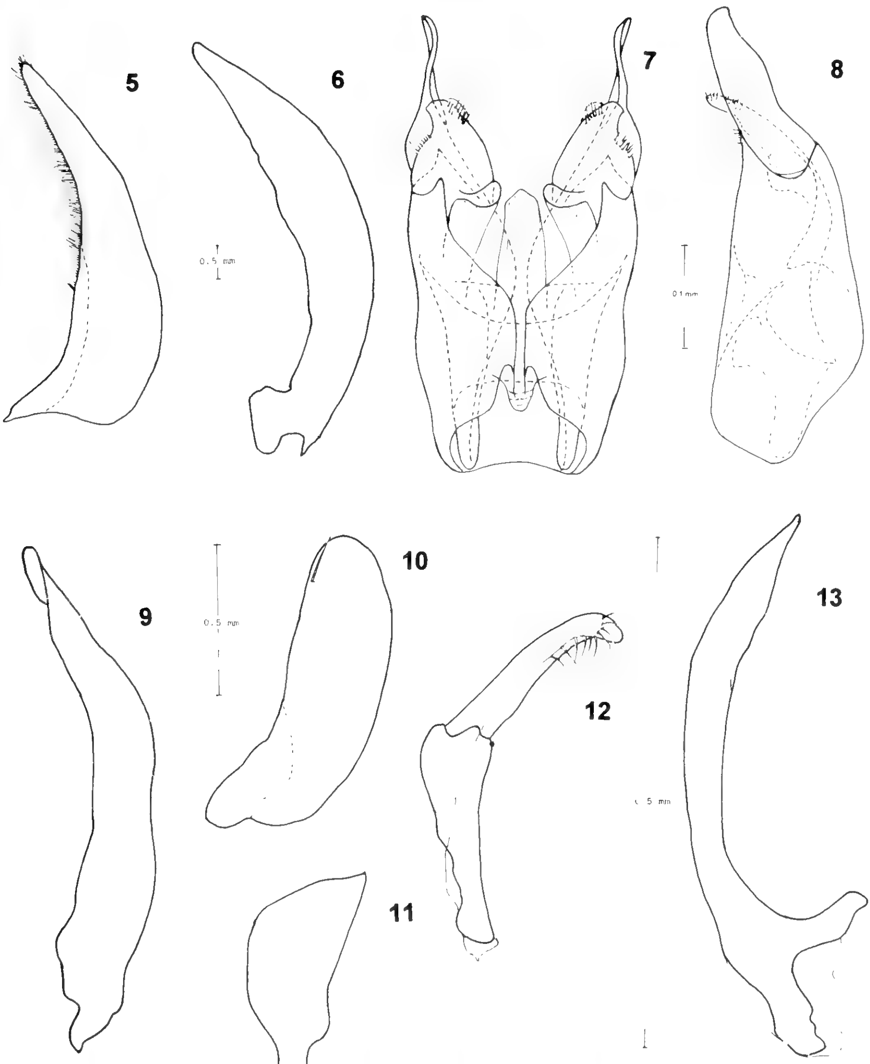
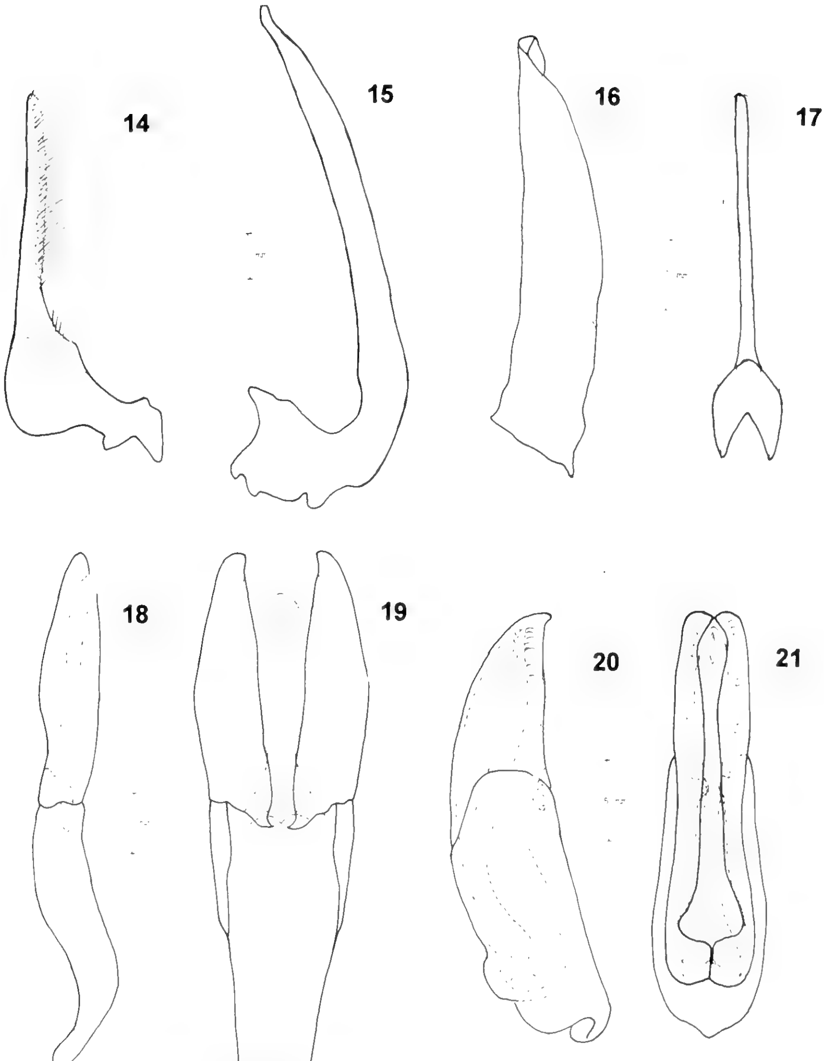
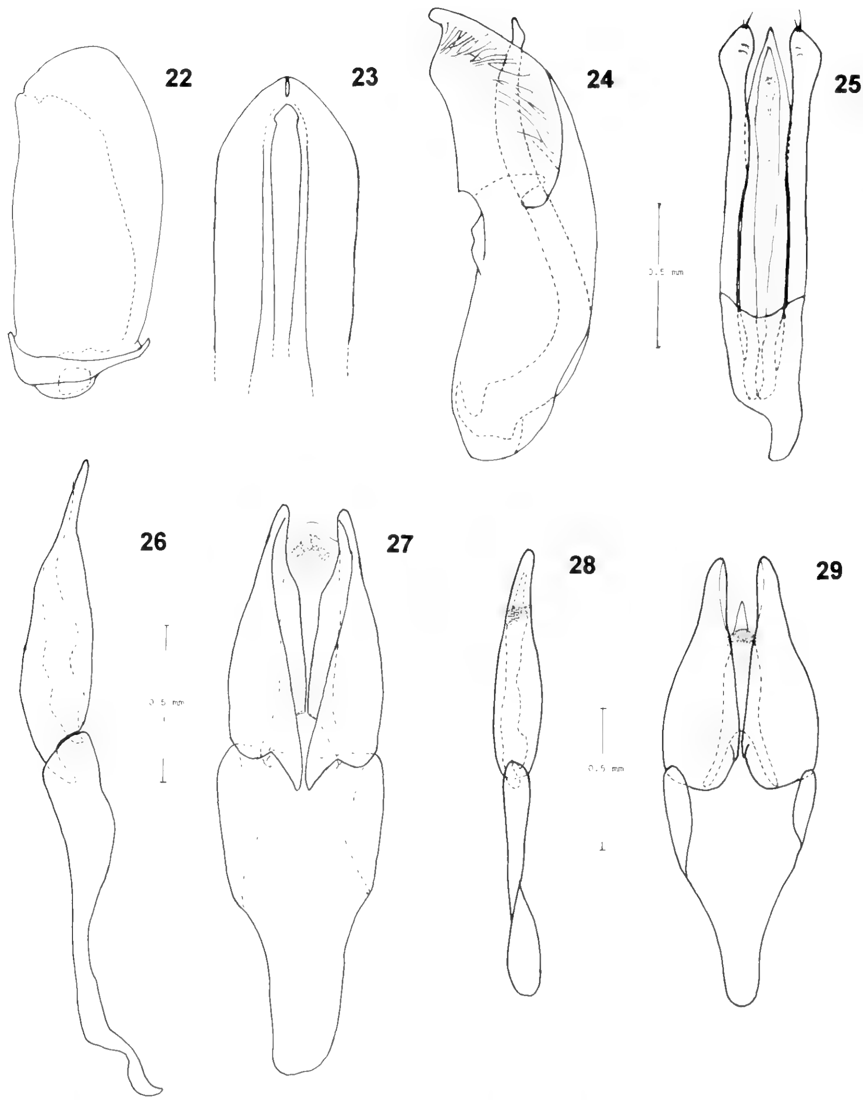
FIGS. 2-4. Male genitalia: *Peltodytes mexicanus* median lobe, lateral view 2; left paramere, lateral view 3; right paramere, lateral view 4.



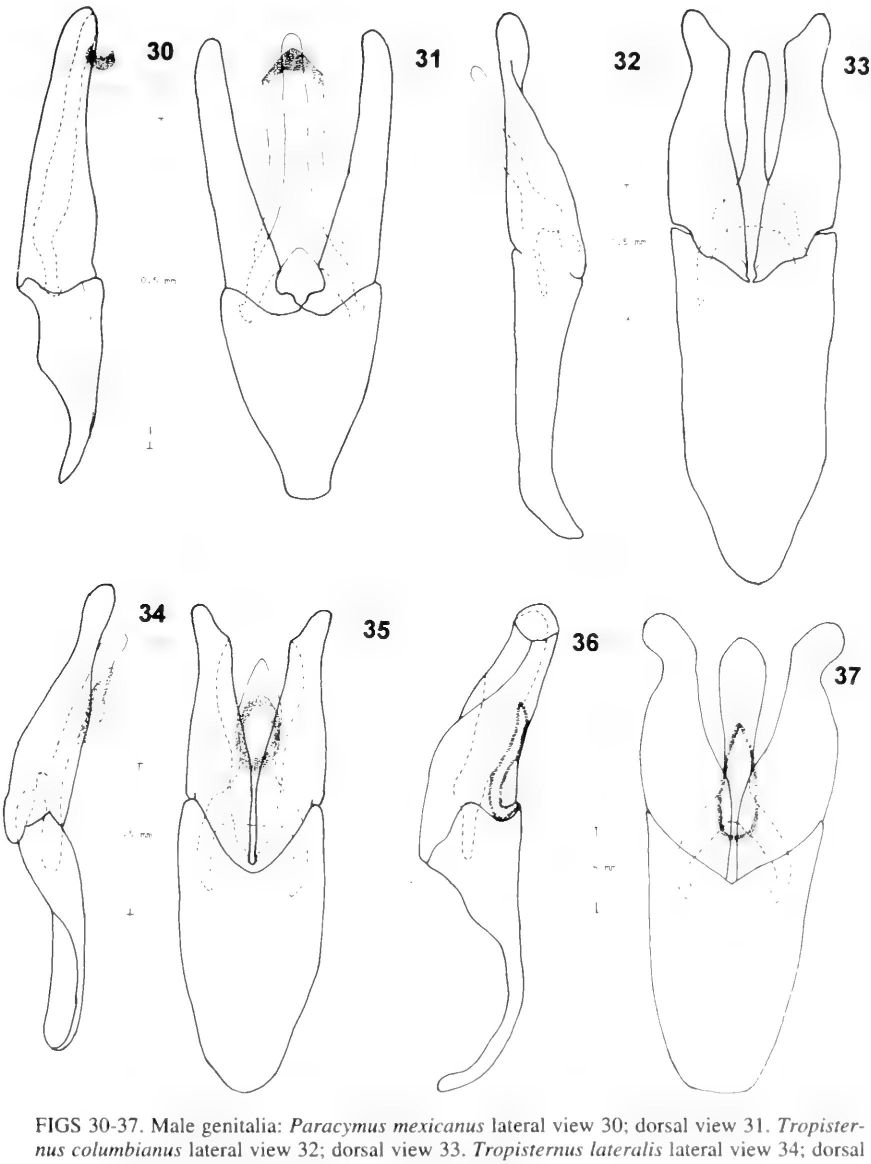
FIGS.5-13. Male genitalia: *Cybister explanatus* paramere, lateral view 5; median lobe, lateral view 6. *Desmopachria majusculus* dorsal view 7; lateral view 8. *Laccophilus mexicanus mexicanus* median lobe, lateral view 9; left paramere, lateral view 10; right paramere, lateral view 11. *Liodessus affinis* paramere, lateral view 12; median lobe, lateral view 13.



FIGS. 14-21. Male genitalia: *Rhantus anisonychus* paramere, lateral view 14; median lobe, lateral view 15. *Thermonectus basillaris* paramere, lateral view 16; median lobe, dorsal view 17. *Anacaena debilis* lateral view 18; dorsal view 19. *Berosus mexicanus* lateral view 20; dorsal view 21.



FIGS. 22-29. Male genitalia: *Berosus stylifer* paramere, lateral view 22, median lobe, dorsal view 23; lateral view 24. *Cercyon praetextatus* dorsal view 25. *Enochrus mexicanus* lateral view 26; dorsal view 27.: *Enochrus ochraceus* lateral view 28; dorsal view 29.



FIGS 30-37. Male genitalia: *Paracymus mexicanus* lateral view 30; dorsal view 31. *Tropisternus columbianus* lateral view 32; dorsal view 33. *Tropisternus lateralis* lateral view 34; dorsal view 35. *Tropisternus tinctus* lateral view 36, dorsal view 37.

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FORCIPOMYIA (MICROHELEA) TETTIGONARIS (DIPTERA: CERATOPOGONIDAE) PARASITIZING KATYDIDS (ORTHOPTERA: TETTIGONIIDAE) IN THE DOMINICAN REPUBLIC[1]

Daniel E. Perez-Gelabert,[2] William L. Grogan, Jr.[3]

ABSTRACT: The ectoparasitic ceratopogonid midge, *Forcipomyia (Microhelea) tettigonaris* was observed feeding on katydids of the genera *Polyancistrus* and *Spelaeala* (Pseudophyllinae) in two montane areas of the Dominican Republic. Previously known only from Peru and Costa Rica, these new records from Hispaniola considerably extend the known distribution of this species in the Neotropics.

"Stick-ticks" belonging to the subgenus *Microhelea* Kieffer of the genus *Forcipomyia* Meigen, are ectoparasitic biting midges (Diptera: Ceratopogonidae). As in other ectoparasitic ceratopogonids, adult females penetrate the exoskeleton of their host and suck out hemolymph, which causes their abdomens to swell in a tick-like manner as they feed. Their abdomens may remain in a swollen state during subsequent egg development (Wirth 1971). Wirth (1991) recognized two groups of stick-ticks distinguished by their general morphology and biting apparatus: (1) the *fuliginosa* group, which feed on larvae of Lepidoptera, have a subcylindrical proboscis and an abdomen that never becomes broader than the thorax when engorged; and (2) the *ixodoides* group, which are ectoparasites of walkingsticks and katydids, but have a proboscis that is expanded at the tip, and their abdomen often swells to several times the size of the thorax when engorged.

Members of the *ixodoides* group were originally known only to parasitize phasmatids. They were first reported to feed on katydids from Australia (Debenham 1987), and more recently on Neotropical katydids (Wirth and Castner 1990; Clastrier and Wirth 1995). *Forcipomyia (Microhelea) tettigonaris* Wirth and Castner (1990), was described from two females that were found attached to the scutellum of the pseudophylline katydid, *Roxelana crassicornis* (Stål), from Iquitos, Peru, and another female that was attached to an unidentified pseudophylline katydid from La Selva, Costa Rica. In their recent revision of *Microhelea*, Clastrier and Wirth (1995) reported an additional female of *F. tettigonaris* taken from a phasmatid in Peru, and designated the paratype of *F. tettigonaris* from a katydid from Iquitos, Peru, as the holotype (and only known specimen) of their new species, *F. (M.) brasiliana*.

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We report *F. (M.) tettigonaris* parasitizing two individual katydids belonging to the endemic Hispaniolan genera *Polyancistrus* and *Spelaeala*, from the northwestern and central sections of the Cordillera Central in the Dominican Republic, respectively. The *Polyancistrus* katydid was parasitized by 6 greatly swollen females and one unengorged specimen, that were attached in a tight group on the dorso-anterior portion of the katydid's abdomen, and some were under the developing tegminae. The second katydid, *Spelaeala bondi* Rehn (1943), had a single unengorged female attached to its abdominal tergum. These Hispaniolan records considerably extend the known range of *F. tettigonaris*, and suggest an even greater distribution for this ectoparasitic midge in the Neotropics.

Forcipomyia (Microhelea) tettigonaris Wirth and Castner

Forcipomyia (Microhelea) tettigonaris Wirth and Castner, 1990: 159 (female; Peru; figs. of flagellum, palpus, mandible, maxilla, spermathecae); Wirth, 1991: 126 (in key; diagnosis; distribution; figs. of palpus, mandible, maxilla); Clastrier and Wirth, 1995: 109 (female; figs. of mouth parts; mandible, maxilla, palpus).

Recognition. The 8 specimens from the Dominican Republic key to *F. (M.) tettigonaris* in the most recent key by Clastrier and Wirth (1995), and generally agree with the combination of characters and illustrations presented by Wirth and Castner (1990), and Clastrier and Wirth (1995) as follows: antennae and palpi not bicolored; legs entirely yellowish; mandible with low number of teeth (15); maxilla with highly pigmented transverse corrugations; and abdomen without dark striated scales, but with a sparse vestiture of fine brownish setae. Our initial examination with a dissecting microscope at 6-50X, was followed by a detailed study of the two unengorged individuals, which were cleared in phenol-alcohol and mounted in phenol-balsam on microscope slides in the manner of Wirth and Marston (1968) for observation at 40-400X with a compound microscope. We consider both of these slide-mounted females to be conspecific with the holotype of *F. tettigonaris* as features of their palpi, flagella, mandibles, maxillae and spermathecae are identical with or closely match the illustrations and descriptions of these structures provided by Wirth and Castner (1990) and Clastrier and Wirth (1995).

These Hispaniolan females differ from the holotype of *F. tettigonaris* in being slightly larger (wing length 1.40 mm and 1.55 mm vs. 1.25 mm for the holotype), and their spermathecae appear more elongate, perhaps due to them being slightly longer as well (largest spermatheca 0.110 mm and 0.115 mm vs. 0.091 mm for the holotype). Unfortunately, we were not able to compare them directly with the holotype of *F. tettigonaris*, as efforts to locate it in the collection of the U. S. National Museum of Natural History (USNM) housed at the Smithsonian Institution's Museum Support Center

(MSC) in Suitland, MD, were unsuccessful. This is most likely due to further needs to curate material returned by Dr. Wirth to the MSC before his death.

Comparison with similar species. Another species of the *ixodoides* group that has been reported from the West Indies is *F. (M.) willistoni* Wirth (1971), found on phasmatids from Puerto Rico, Jamaica, and Brazil. Females of *F. willistoni* readily differ from those of *F. tettigonaris* in having uniformly dark brown legs and bicolored antennae.

Females of *F. (M.) brasiliana* are also very similar to those of *F. tettigonaris* because of their mandible with 15-17 teeth and a similarly shaped 3rd palpal segment, but unfortunately, no measurements or descriptions were provided for the wings or spermathecae. Females of *F. brasiliana* differ from those of *F. tettigonaris* by having more slender 4th and 5th palpal segments, the 4th palpal segment is truncated mesobasally (oblique basally in *F. tettigonaris*), the prementum is divided medially (entire in *F. tettigonaris*), and the maxilla is dark brown or black with about 18 teeth ("plaques"of Clastrier and Wirth 1995) that extend across the breadth of that structure (16 teeth that extend to midportion of maxilla in *F. tettigonaris*).

Material examined. Seven females, DOMINICAN REPUBLIC, Elias Piña Prov., Loma de Las Tayotas, Loma Nalga de Maco massif, ca. 790 m, 2 oct. 1996, D. E. Pérez-Gelabert, attached to dorsum of green juvenile male *Polyancistrus*. Four specimens deposited in the entomological collection of the Museo Nacional de Historia Natural, Santo Domingo (MNHN), and three deposited in the USNM. One female, DOMINICAN REPUBLIC, La Vega Prov., just before Los Tablones, Parque Nacional J. A. Bermúdez, 1,150 m, 4 Sept. 1997, D. E. Pérez-Gelabert, attached to dorsum of green juvenile male *Spelaeala bondi* (deposited in MNHN).

Comments. Szadziewski and Grogan (1994) reported that biting midges of the genus *Forcipomyia* were the most abundant fossil ceratopogonids (254 of 584 specimens, or 43.5%) found as inclusions in several collections of amber from the Dominican Republic. This suggests that these midges were common 15-20 mya (Itturralde-Vincent and MacPhee 1996), and were likely attracted to the amber-forming resin as it was secreted by its source tree, *Hymenaea protera* Poinar (1991). No specimens of the subgenus *Microhelea* were found among the Dominican amber ceratopogonids studied by Szadziewski and Grogan (1998). This can probably be explained by their relative rarity then, as well as today.

No ectoparasitic Diptera are mentioned in the works of Rehn (1936, 1943), where 5 of the 6 species of *Polyancistrus* and the 2 species of *Spelaeala* were originally described, based on his studies of 80 (1936) and 8 individuals (1943). These are the first cases of Diptera ectoparasites encountered among the more than 20 *Polyancistrus* collected by DEPG from different areas of the Dominican Republic. Examination of 33 Hispaniolan Pseu dophyllinae (29 *Polyancistrus* and 4 *Spelaeala*) from the collection of the Carnegie Museum of Natural History (CMNH) failed to reveal any other *Forcipomyia* ectoparasites.

Species of *Polyancistrus* and *Spelaeala* are large katydids, more than 40 mm long and robust as adults, with strong armature and spiny bodies. Therefore, it is most likely that females of *F. tettigonaris* are only occasional parasites of these katydids and are probably only able to parasitize juvenile individuals which have much softer integuments than adults.

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NEW RECORDS OF STONEFLIES (PLECOPTERA) FROM KENTUCKY[1]

Gregory J. Pond[2]

ABSTRACT: Six species of stoneflies are reported for the first time for Kentucky. An undescribed species of *Yugus* (Perlodidae) represents the only record of the genus known from the state. Other species reported are *Leuctra tenuis* (Leuctridae), *Prostoia completa* (Nemouridae), *Agnetina flavescens* and *Paragnetina immarginata* (Perlidae), and *Pteronarcys comstocki* (Pteronarcyidae). A total of 86 stonefly species are now known to occur in Kentucky.

Tarter et al. (1986) presented the first checklist of stoneflies for Kentucky, listing 77 species. They also speculated on an additional 15 species which occur in neighboring states that may also occur in Kentucky. Since that time, several synonomies and new combinations have been published (Stark 1986, 1989, 1990, 1991), and new species and additional records were added by Kondratieff and Kirchner (1988, 1996). An updated list is maintained by Stark (1998). Species of one genus common in Kentucky (*Perlesta*), is not listed because either species identifications have not been verified or species remain undescribed.

Adult male specimens of *Leuctra tenuis* (Pictet) were taken from South Fork Station Camp Creek (Kentucky River Drainage), NE of Wind Cave in Jackson Co., KY (37° 32' 18"; 83° 54' 42") on 3 Sep 1998. In North America, this species has been collected from 22 states/provinces including adjacent IL, OH, VA, and WV (Stark 1998).

Adults of *Prostoia completa* (Walker) were collected from Clifty Creek (Cumberland River Drainage), 0.2 km above the confluence with Brushy Creek near Elrod in Pulaski Co., KY (37° 13' 02"; 84° 28' 30") on 2 Feb 1998. This species is known from 23 states/provinces including adjacent IL, VA, and WV (Stark 1998).

Mature nymphs of *Agnetina flavescens* (Walsh) were collected from cobble substrate in Clear Creek (Kentucky River Drainage) at the Hifner Road crossing north of Nonesuch in Woodford Co., KY (37° 56' 40"; 84° 45' 53") on 10 July 1998. I also collected specimens in similar substrate from South Fork Elkhorn Creek (Kentucky River Drainage), at Scruggs Lane outside of Frankfort, in Franklin Co., KY (38° 12' 33"; 84° 45' 02") on 27 Nov 1998. This species is known to occur in 18 states/provinces including adjacent IL, IN, OH, TN, VA, WV (Stark 1998).

Mature nymphs of *Paragnetina immarginata* (Say) were taken from cobble-boulder substrate in Fugitt Creek (Cumberland River Drainage), 0.5

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km upstream of its confluence with Clover Fork Cumberland River near Louellen in Harlan Co., KY (36° 55' 31"; 83° 02' 45") on 10 July 1997 and 14 Oct 1998. This species has been reported from 15 states/provinces including adjacent TN, VA, and WV (Stark 1998).

Nymphs of *Pteronarcys comstocki* Smith were collected from cobble-boulder substrate in Cavanaugh Creek (Kentucky River Drainage) 0.4 km upstream of Hopper Cave Branch in Jackson Co., KY (37° 32' 20"; 84° 58' 40") on 2 July 1998 and 1 Dec 1998. It is known from seven states/provinces and adjacent VA and WV (Stark 1998).

An undescribed species (being described by C.H. Nelson) belonging to the perlodid genus *Yugus* was collected from numerous small headwater streams in eastern Kentucky. I collected mature nymphs from an unnamed tributary to Line Fork Creek (Kentucky River Drainage) in Lilley Cornett Woods Natural Area, Letcher Co., KY (37° 04' 35"; 83° 00' 10") on 16 April 1996.

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CONTINUED PRESENCE OF *ANOPHELES ALBIMANUS* (DIPTERA: CULICIDAE) IN MONROE COUNTY, FLORIDA[1]

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ABSTRACT: The most recent collections of *An. albimanus* from Monroe County, Florida, are reported. The specimens were collected from Long Key and No Name Key, which are new locality records. The potential for larval breeding and malaria transmission is discussed.

Anopheles albimanus Wiedemann is the only member of the subgenus *Nyssorhynchus* that occurs in the United States (Faran 1980). Since its first collection in 1904 in Key West (Gardner 1904), *An. albimanus* has been reported infrequently from Florida. Although adults and larvae of *An. albimanus* were often collected in appreciable numbers during the 1940s, after 1950 its occurrence has been only sporadic, and the last collections reported from Florida were from Big Pine Key in 1957, when seven females were collected (Branch et al. 1958). The literature concerning this species' occurrence in Florida has been reviewed several times (Pritchard et al. 1946, Haeger 1949, Breeland 1982, Lounibos 1994). This note reports the most recent collections of *An. albimanus* from the Florida Keys, which are new locality records.

Light traps were baited with carbon dioxide (i.e., dry ice) and placed once per week on No Name Key from July through December 1998, and on Long Key from September to December 1998. Collections of *An. albimanus* were as follows: No Name Key – 12 Aug 1998 (1♀), 3 Sep 1998 (1♀), 23 Nov 1998 (1♀); Long Key - 17 Sep 1998 (5 ♀♀), 29 Sep 1998 (1♀). These are the first collections of this species from Long Key and No Name Key. Voucher specimens have been placed in the collections of the Florida Keys Mosquito Control District (FKMCD) and the Florida Medical Entomology Laboratory (FMEL).

Two questions on the biology of *An. albimanus* in the Florida Keys arise. No search for larvae was conducted during this study, so there may be doubt whether this species is breeding in the Keys or is an incidental introduction. Based on previous larval surveys it seems probable *An. albimanus* was established and breeding in the Florida Keys on several islands in fresh or brackish water with abundant emergent vegetation and greater than 50% sunlight (Haeger 1949, 1950). The specimens collected on No Name Key during this study were collected over a period of four months. Most probably these collections were due to reproduction of a small population on the

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island. It is possible, though unlikely, that there could have been repeated introductions of small numbers of females during that time. Development since the 1950s undoubtedly has reduced the amount of larval habitat available and this likely accounts for the small numbers collected.

Another question that remains is whether *An. albimanus* has been present continuously since 1957, the last reported collection, or did it disappear from the Keys and become reestablished later. There has been little mosquito surveillance in the Florida Keys for many years, and no voucher specimens were kept, so this question is impossible to answer. However, whenever systematic mosquito collections have been made, sooner or later *An. albimanus* has been detected. It is likely that this species has been present but undetected during the years since 1957.

Anopheles albimanus is an important malaria vector in Mexico, Central America, the Caribbean, and northern South America (Faran 1980). The popularity of the Florida Keys as a tourist destination means there is constant movement of people into and out of the area, including people who may have visited malarious areas prior to visiting the Keys. One confirmed case of imported malaria was reported from Key West in 1998 (Anonymous 1998). Additionally, south Florida, including the Florida Keys, is a favored arrival point for illegal immigrants from Cuba, Haiti, and Jamaica (Viglucci 1998). The possibility exists that one or more of these people may arrive with circulating gametocytes. In either case, there is a possibility that local *Anopheles* spp. can be infected and then transmit malaria to other people, as was documented in the panhandle region of Florida in 1990 and in Palm Beach County in 1996 (Florida Coordinating Council on Mosquito Control 1998).

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Viglucci. A. 1998. 35 more Cubans detained along Florida shores. *The Miami Herald*, Keys Edition, Dec. 30, 1998. P. B1.

BOOKS RECEIVED AND BRIEFLY NOTED

MITES. ECOLOGY, EVOLUTION AND BEHAVIOUR. 1999. D.E. Walter and H.C. Proctor. University of New South Wales Press. 322 pp. in 6-3/4" x 11" format, with 60 color plates. $95.00 hard.

A comprehensive natural history of mites in which the authors highlight the roles that mites have played in the development of important theoretical concepts in ecology and evolution (e.g. local mate competition, prey refugia, multi-level selection and tritrophic level interactions) and emphasize that, in many cases, the lives of mites clearly demonstrate that many currently accepted theories are flawed.

A REVISION OF THE GENUS *THEOPE*. ITS SYSTEMATICS AND BIOLOGY (LEPIDOPTERA: RIODINIDAE: NYMPHIDIINI). 1999. J.P.W. Hall. Scientific Publishers, Inc. 127 pp. in 8-1/2" x 11" format, with 68 species illustrated in full color on ten plates. $32.50 paper.

A comprehensive treatment of the complex Neotropical metalmark butterfly genus *Theope* is presented, including keys to species and notes on biologies. Two new species and two new subspecies are described; 15 lectotypes are designated. Also included are descriptions of all species, distribution maps, and illustrations of genital characters.

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5	Nov. & Dec.	253-324	November 30, 1999

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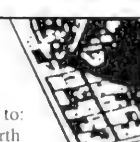

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