



ENTOMOLOGICAL NEWS

QL
461
E831
ENT

- Species of *Ironoquia* (Trichoptera: Limnephili-
form an intermittent slough of the central
riatte River, Nebraska *K.D. Alexander, M.R. Whiles* 1
- A new *Selenophorus* (Coleoptera: Carabidae) from the
Rio Grande in Texas *Foster Forbes Purrington* 8
- Monomorium minimum* species group: gyne number
and longevity (Hymenoptera: Formicidae) *Mark B. DuBois* 13
- New distributional data and first record of gregarious
behavior for *Aegithus melaspis* (Coleoptera:
Eratylidae) from Mexico *J.L. N-Heredia, R.N-Gutierrez* 21
- Platydoryctes* (Hymenoptera: Braconidae) a new
doryctinae genus from Brazil *S.M. Barbalho, A.M. P-Dias* 25
- New species and a new record of *Bordontilla* (Hymen-
optera: Mutillidae) from Chile *James P. Pitts* 32
- Variability in the larvae of *Serratella serrata* (Ephe-
meroptera: Ephemerellidae) *L.M. Jacobus, W.P. McCafferty* 39
- Plauditus grandis* (Ephemeroptera: Baetidae) a new
small minnow mayfly from Tennessee *N.A. Wiersema, L.S. Long* 45
- Leptohyphes zalope* (Ephemeroptera: Leptohyphidae)
a polytypic North and Central American species
D.E. Baumgardner, W.P. McCafferty 49
- Distribution and taxonomic contributions to the Ephe-
meroptera fauna of Mexico and Central America
N.A. Wiersema, D.E. Baumgardner 60
- Altered photocyclic regimes influence the duration of
maternal care in a burrower bug (Heteroptera:
Cydnidae) *Scott L. Kight* 67
- Cantharidin attraction in *Pyrochroa* (Coleoptera:
Pyrochoroidea) *G. Nardi, M.A. Bologna* 74
- BOOK REVIEW 24
- BOOKS RECEIVED AND BRIEFLY NOTED 31, 48, 59, 73
- CORRECTION NOTICE 12



ENTOMOLOGICAL NEWS is published bi-monthly except July-August by The American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pa. The October and March meetings are held at the Department of Entomology, University of Delaware, Newark, Delaware.

Society Members who reside outside the local eastern Pennsylvania, southern New Jersey, and Delaware area are urged to attend society meetings whenever they may be in the vicinity. Guests always are cordially invited and welcomed.

Officers for 1997-1998: President: Jon K. Gelhaus; Vice-President: Susan P. Whitney; Recording Secretary: Charles R. Bartlett; Corresponding Secretary: William J. Cromartie; Treasurer: Howard P. Boyd.

Publications and Editorial Committee: Howard P. Boyd, Chr., D. Otte, and Norman E. Woodley.

Previous editors: 1890-1920 Henry Skinner (1861-1926); 1921-1944 Philip P. Calvert (1871-1961); 1945-1967 R.G. Schmieder (1898-1967); 1968-1972 R.H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

Subscriptions: *Private subscriptions for personal use of members of the Society, domestic and foreign: \$10.00 per year postpaid. Subscriptions for non-members \$25.00. Subscriptions for institutions such as libraries, laboratories, etc., domestic: \$20.00 per year postpaid; foreign: \$22.00 per year post-paid. Communications and remittances regarding subscriptions should be addressed to ENTOMOLOGICAL NEWS, The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa. 19103-1195, U.S.A.*

Back issues of most numbers may be obtained by writing to the office of The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

Membership dues: \$15.00 per year (regular); \$10.00 per year (student).

Manuscripts and all communications concerning same should be addressed to the editor: Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A. Manuscripts will be considered from any authors, but papers from members of the American Entomological Society are given priority. It is suggested that all prospective authors join the society. All manuscripts should follow the format recommended in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, Sixth Edition, and should follow the style used in recent issues of ENTOMOLOGICAL NEWS. Three doublespaced, typed copies of each manuscript are needed on 8¹/₂ x 11 paper. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible. Articles longer than eight printed pages may be published in two or more installments, unless the author is willing to pay the entire costs of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Editorial Policy: Manuscripts on taxonomy, systematics, morphology, physiology, ecology, behavior and similar aspects of insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Papers on applied, economic and regulatory entomology and on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields.

(Continued on inside of back cover)

Postmaster: *If undeliverable, please send form 3579 to Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A.*

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088, U.S.A.

A NEW SPECIES OF *IRONOQUIA* (TRICHOPTERA: LIMNEPHILIDAE) FROM AN INTERMITTENT SLOUGH OF THE CENTRAL PLATTE RIVER, NEBRASKA¹

Kevin D. Alexander², Matt R. Whiles³

ABSTRACT: *Ironoquia plattensis*, a new limnephilid caddisfly species, is described from both males and females. The new species is similar to *Ironoquia parvula* but is easily distinguished based on its apically, unforked parameres and the shape of inferior appendages, upper cercal lobes and the supra-phallic plate. The new species is presently known only from one site on Mormon Island in the central Platte River valley, Nebraska. The site is a stopover point and staging grounds for migrating whooping cranes, sandhill cranes and various other waterfowl.

An aquatic ecology and biomonitoring study was conducted on a primary waterfowl migration stopover and staging area on the central flyway for various species including the endangered whooping crane (*Grus americana*). This area is located in the central Platte River valley on land owned by the Platte River Whooping Crane Trust in Hall County, Nebraska. During this study, a species of terrestrially pupating *Ironoquia* Banks was discovered in an intermittent slough on Mormon Island. This species was much smaller and morphologically distinct from *Ironoquia punctatissima* (Walker, 1852) which is the common species of *Ironoquia* on the Great Plains. Comparisons made to specimens, borrowed from the Illinois Natural History Survey (INHS), of the other four species in this genus (Morse, 1993) indicated that the specimens from the Platte River represented a previously undescribed species. Further investigations indicated that this new species was very similar to *Ironoquia parvula* (Banks, 1900), which is distributed in northeastern North America and its farthest westerly distribution reported in the literature to date is in Ohio (Huryn and Foote, 1983; J.C. Morse personal comm.). Descriptions of both the male and female, as well as a diagnosis, are provided here. The holotype and a paratype female are deposited at the Illinois Natural History Survey (INHS) and paratypes are deposited at Kansas State University (KSU), the National Museum of Natural History (NMNH) and the collection of the senior author (KDA).

¹ Received January 11, 1999. Accepted September 20, 1999.

² Math/Science Division, Wayne State College, 1111 Main St., Wayne, NE 68787.

³ Department of Entomology, 123 Waters Hall, Kansas State University, Manhattan, KS 66506-4004.

Ironoquia plattensis, NEW SPECIES

Figs. 1-4

Male. Body length 6.0 - 6.5 mm. Forewing length 7.0 - 8.0 mm. General color pale brown. Wing membranes and veins brown with small, pale spotting. Genitalia as in Figure 1A and 2. Inferior appendages triangular and projecting slightly posteriorly (Figs. 1A, 2 and 3C,E). Cerci laterally compressed and divided into dorsal and ventral lobes. Dorsal lobe is broadly truncate while ventral lobe is tab-like, dorso-ventrally compressed and slightly up-turned. Supra-phallic plate is rhomboid and sagittally folded approximately 45 degrees. Phallus with central tube slightly enlarged apically; parameres unforked, each with apical one-half sclerotized and slightly curved (Fig. 3A).

Female. Body length 5.5 - 6.5 mm. Forewing length 6.5 - 8.0 mm. Color pattern similar to male. Abdominal sternite 7 produced posterad approximately 1/4th of its length. The apical end broadly rounded across most of its width with a slight mesal notch (Fig. 1B). The internal spermathecal sclerite, weakly sclerotized and gradually narrowing posteriorly forming a "teardrop" shape (Fig. 4A).

Types. Holotype male and paratype female from Nebraska: Hall Co., Platte River intermittent slough on Mormon Island, 01-X-1997, M. Whiles (INHS). Additional paratypes (all same locality): 01-X-1997, M. Whiles, 2 males (NMNH); 30-IX-1997, M. Whiles and B. Goldowitz, 5 males, 4 females (KSU); 01-X-1997, M. Whiles, 1 male (KDA); reared from pupae in X-1997 by KDA and MRW, 04-VI-1997, M. Whiles, 5 males, 1 female (KDA). 30-IX-1997, M. Whiles and B. Goldowitz, 3 males, 3 females sacrificed for scanning electron microscopy.

Etymology. The species is named after the landscape of the Great Plains and the Platte River from which it was collected.

Diagnosis. The smaller size of this species easily separates it from the much larger Nearctic species (Schmid, 1955): *I. punctatissima*, *Ironoquia kaskaskia* (Ross, 1944) and *Ironoquia lyrata* (Ross, 1938) which have forewing lengths > 14 mm. It is most similar in size to, but distinctly smaller than *I. parvula*. Based on very similar genitalic structures, it is most closely related to *I. parvula*. However, *I. plattensis* is most easily separated from *I. parvula* based on the presence of unforked parameres (Fig. 3A) as opposed to bifurcate parameres in *I. parvula* (Figs 3B). A small, subapical fork may occasionally be present on only one of the parameres of *I. plattensis*, however, it is never apical. In addition, this new species possesses shorter and more blunt inferior appendages (Fig. 3C,E) than *I. parvula* (Fig. 3D,F), the upper cercal lobes are more apically acute in *I. plattensis* (Fig. 3G) than in *I. parvula* (Fig. 3H), and the lateral wings of the supra-phallic plate are also longer with the tips more recurved in *I. plattensis*. *Ironoquia plattensis* females possess a gradually narrowing "teardrop" shaped spermathecal sclerite (Fig. 4A) whereas the spermathecal sclerite of *I. parvula* females narrows abruptly and forms a "key-hole" shape (Fig. 4B). The coloration of *I. plattensis* is lighter and the spotting on the wings is much more pronounced than in *I. parvula*.

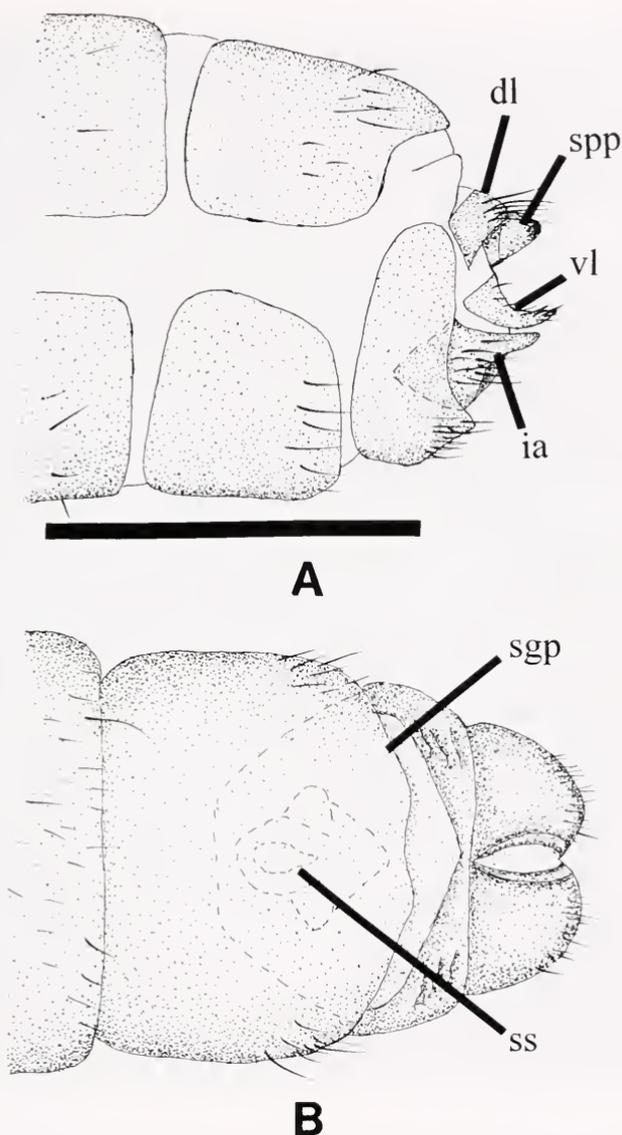


Figure 1. Illustrations of *Irenoquia plattensis* male and female genitalia (scale bar = 0.5mm). A. Male, lateral view (dl = dorsal lobe of cercus, ia = inferior appendage, spp = supra-phallic plate, vl = ventral lobe of cercus). B. Female, ventral view (sgp = subgenital plate, ss = spermathecal sclerite).

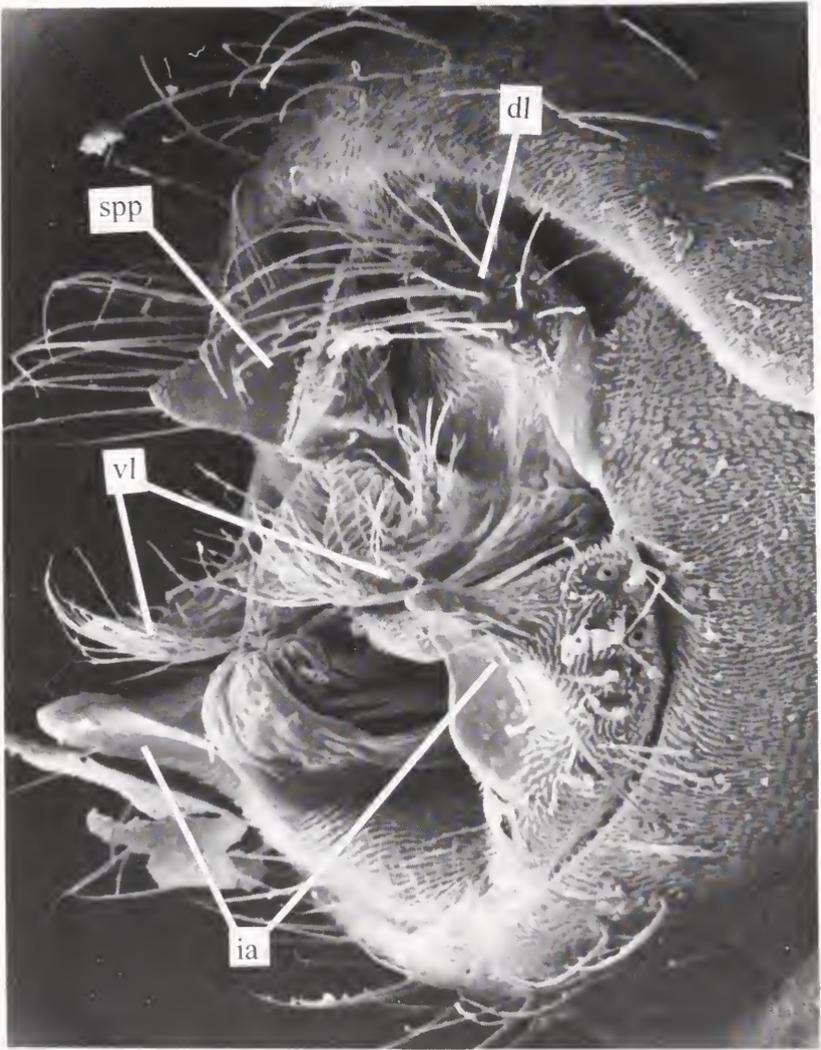


Figure 2. Scanning electron micrograph of *Ironoquia plattensis* male genitalia; postero-lateral view (dl = dorsal lobe of cercus, ia = inferior appendage, spp = supra-phallic plate, vl = ventral lobe of cercus).

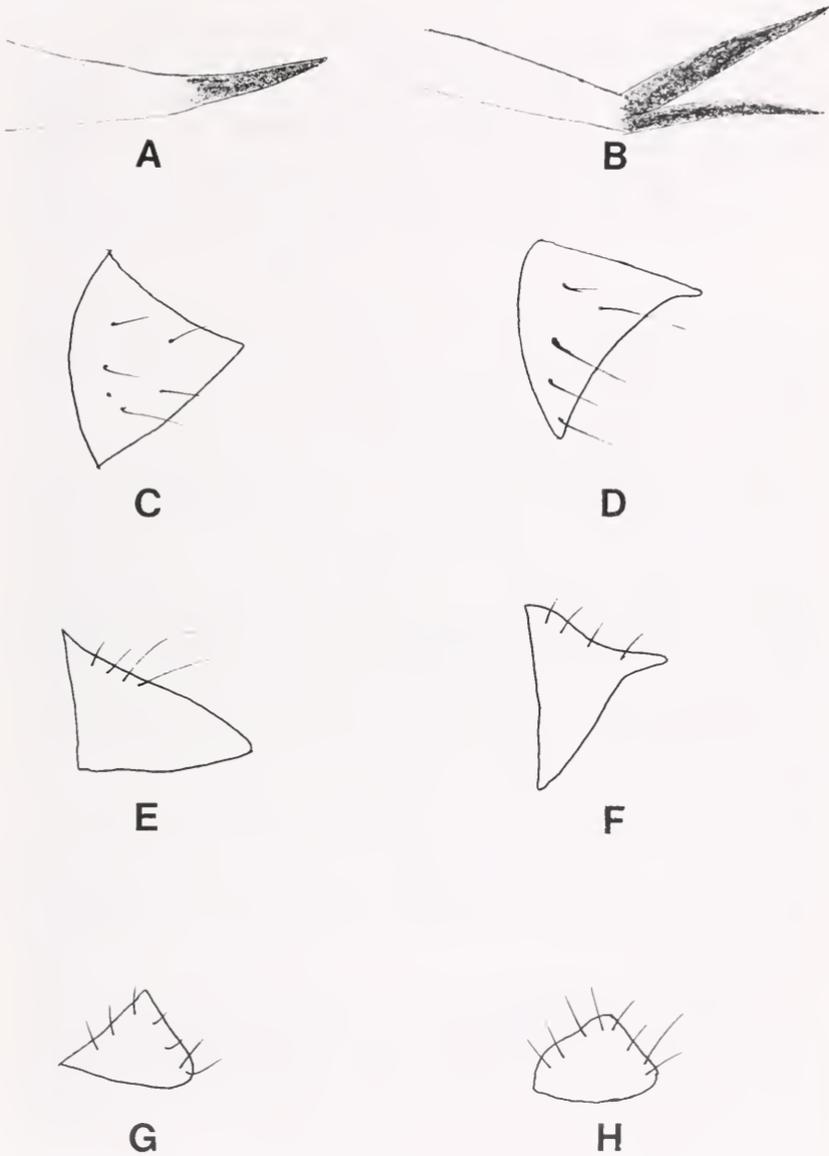


Figure 3. Diagnostic male genital structures for *Ironoquia plattensis* and *Ironoquia parvula*. A. *I. plattensis* paramere. B. *I. parvula* paramere. C. *I. plattensis* inferior appendage, lateral view. D. *I. parvula* inferior appendage, lateral view. E. *I. plattensis* inferior appendage, dorsal view. F. *I. parvula* inferior appendage, dorsal view. G. *I. plattensis*, upper cercal lobe, dorsal view. H. *I. parvula* upper cercal lobe, dorsal view.



Figure 4. Female spermatheca and spermathecal sclerite, ventral view. A. *I. plattensis*. B. *I. parvula*

DISCUSSION

To date, larvae of *I. plattensis* have been found only at one site along the central Platte River even though intensive sampling of aquatic macroinvertebrates has been conducted for two years at similar habitats in the vicinity. The Mormon Island collection site is a 20m reach of an approximately 500 m intermittent, backwater slough of the Platte River that is occasionally connected to the river channel during periods of high water. When water was present during 1997, wetted width of the collection site averaged ca. 13m and average maximum depth was 30 cm. However, both width and depth fluctuate greatly throughout the year. Water flow at the site is very slow and it is primarily a lentic habitat. The site is intermittent and dries in summer; during 1997, it dried from 02 July to 11 August and again from 10 to 22 September. The slough also completely freezes over during winter.

Substrate at the site is a thick layer of detritus and silt overlaying sand. Aquatic macrophytes and algae are abundant, especially in summer. The dominant macrophytes consist of *Potamogeton* sp., *Typha* sp., *Scirpus* sp., *Carex* sp., and *Lemna* sp. Riparian vegetation is typical treeless wet meadow, consisting of grasses and forbs on sandy soil and the groundwater table is generally near the surface.

As is typical of species in this genus, the larvae of *I. plattensis* become terrestrial and migrate away from the stream during late spring. Migrating larvae were first noticed in pitfall traps intended to capture amphibians. Larval aestivation and terrestrial pupation occurred in the surrounding tallgrass prairie, with adult emergence occurring in late September and early October. Laboratory reared pupae exposed to natural photoperiod but sheltered from extremes in temperature emerged at the same time as well.

Much of this biological information about *I. plattensis* is similar to what occurs in *I. parvula* (Flint 1958, 1960) which reinforces our hypothesis that

these two species are closely related. We also hypothesize that these two species shared a common ancestor that was split into two vicariant populations by Pleistocene glaciers (Souders et al. 1990). The eastern species evolved into what is now *I. parvula* and the western species that survived in the Platte River valley is now *I. plattensis*. This may be similar to what occurred in the perlid stonefly species, *Perlesta xube* Stark and Rhodes and *Perlesta adena* Stark which are morphologically similar and share a similar distribution pattern (Stark and Rhodes, 1997) to *I. plattensis* and *I. parvula*.

ACKNOWLEDGMENTS

We thank B. Goldowitz, C. Morgan, and M. Wolfe for field assistance; M. Yeska for laboratory assistance; K.W. Stewart for the use of a light microscope with drawing attachment; R.E. DeWalt at the INHS for the loan of specimens; A. Huryn, J.C. Morse and S.R. Moulton for advice and assistance; E. Rosa-Molinar and K. Lee for invaluable assistance and use of the SEM facilities at the University of Nebraska-Lincoln; and the Platte River Whooping Crane Maintenance Trust for cooperation and assistance. This research was partially supported by a grant from the U.S. Environmental Protection Agency to B. Goldowitz and MRW.

LITERATURE CITED

- Banks, N.** 1900. New genera and species of Nearctic neuropteroid insects. Trans. Amer. Entomol. Soc. 26: 239-259.
- Flint, O.S., Jr.** 1958. The larva and terrestrial pupa of *Ironoquia parvula* (Trichoptera: Limnephilidae). J. N. Y. Entomol. Soc. 66: 59-62.
- Flint, O.S., Jr.** 1960. Taxonomy and biology of some Limnephilid larvae (Trichoptera), with special reference to species in eastern United States. Entomol. Amer. 60: 1-117.
- Huryn, A.D. and B.A. Foote.** 1983. An annotated list of the caddisflies (Trichoptera) of Ohio. Proc. Ent. Soc. Wash. 85: 783-796.
- Morse, J.C.** 1993. A checklist of the Trichoptera of North America, including Greenland and Mexico. Trans. Amer. Entomol. Soc. 119(1): 47-93.
- Ross, H.H.** 1938. Descriptions of nearctic caddis flies (Trichoptera) with special reference to the Illinois species. Bull. Ill. Nat. Hist. Surv. 21: 101-183.
- Ross, H.H.** 1944. The caddisflies, or Trichoptera, of Illinois. Bull. Ill. Nat. Hist. Surv. 23: 1-326.
- Schmid, F.** 1955. Contribution a l'etude des Limnophilidae (Trichoptera). Mitt. Der Schweiz. Entomol. Ges. 21: 1-225.
- Souder, V.L., J.B. Swinehart and V.H. Dreeszen.** 1990. Postulated evolution of the Platte river and related drainages. Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.
- Stark, B.P. and H.A. Rhodes.** 1997. *Perlesta xube*, a new stonefly species from Nebraska (Plecoptera: Perlidae). Ent. News 108(2): 92-96.
- Walker, F.** 1852. Catalogue of the specimens of neuropterous insects in the collections of the British Museum. Part 1. 190 pp. London.

A NEW *SELENOPHORUS* (COLEOPTERA: CARABIDAE) FROM THE RIO GRANDE IN TEXAS¹

Foster Forbes Purrington²

ABSTRACT: *Selenophorus chaparralus* n. sp. is described from Val Verde, Zapata, and Cameron Counties on the lower Rio Grande of Texas. The male is distinguished by a pair of carinate prominences positioned bilaterally on the disc of abdominal sternum VII.

In North America north of Mexico, the New World genus *Selenophorus* Dejean (Coleoptera: Carabidae: Harpalini) presently contains 38 species arranged by Bousquet and Laroche (1993) in three informal groups. The largest, their *palliatius* group of 28 species, subsumes two of Lindroth's groups, *opalinus* and *palliatius*, that together keyed only nine current *Selenophorus* species (Lindroth 1968). As Lindroth commented, a review of the North American species would imply an interesting task, for which we await a pending modern revision by George E. Ball (pers. comm., G.E. Ball).

In Casey's (1914) key to genera of Selenophorini, *S. chaparralus* n. sp. goes to *Hemisopalus* (type *S. opalinus* LeC.) and thence to *H. opalinus*, that differs, *inter alii*, by being much larger, and to *H. perpolitus* Csy., with only a faint elytral iridescence.

In America north of Mexico, *Selenophorus* is more diverse in the southern United States, especially from North Carolina to Florida, through the Gulf states and into Arizona. Six species are recorded from Canada; none are known from California (Bousquet and Laroche 1993). Many appear to be xerophilous and occur on sandy soils (Lindroth 1968).

Micrographs were obtained with an ISI-40 scanning electron microscope. Measurement of length follows Kavanaugh (1979) who measured apparent body length (ABL) from apex of mandible to apex of elytron.

In reference to the numbering of abdominal sterna of this beetle, I note that in Coleoptera, sternum II is basalmost, sternum I evidently having been lost from the ancestral coleopteran stock (as determined by the lack of a sternum to match abdominal tergum I). Thus, with six pregenital sterna (i.e., those exposed when the male is not *in copulo*, or a female is not ovipositing), the last one is abdominal sternum VII. Imms (1948) states that in most (adult) insects the first abdominal segment, and especially its sternum, is reduced or vestigial.

In Lindroth's key to *Selenophorus* Dejean, *S. chaparralus* n. sp. will run to couplet 4. The new species is accommodated by going to a new couplet 3a., inserted after couplet 3., as follows:

¹ Received May 13, 1999. Accepted July 16, 1999.

² Department of Entomology, The Ohio State University, 1735 Neil Avenue, Columbus, OH 43210.

- 3a. Abdominal sternum VII of male with a pair of carinate prominences. Texas *S. chaparralus* n. sp.
 Abdominal sternum VII of male without prominences 4

Selenophorus chaparralus Purrington, NEW SPECIES

Recognition: This is the only *Selenophorus* bearing paired carinate prominences on the last visible abdominal sternum of the male.

Description: **Holotype male.** Total length (ABL) 8.0 mm. **Color.** Dorsal forebody ferruginous, antennae testaceous, labrum orange, also mandibles but their apices piceous, contrasting, palpi testaceous; legs testaceous except coxae rufescent; entire underbody ferruginous; elytra piceus, except base anterior to margin, scutellum and epipleurae rufescent. **Luster.** Entire dorsal surface very shining; forebody not iridescent, elytra with pronounced iridescence, ventral surfaces very slightly iridescent. **Microsculpture.** Absent from head except labrum with well-defined slightly transverse meshes, irregular transverse meshes on anterior edge of clypeus and behind eye in vicinity of supraorbital seta; absent from pronotum; dense microlines on elytral intervals; all striae (including the broad stria 9 lying mesad of the lateral bead) with granulate isodiametric meshes; ventral surfaces without microsculpture except some shallow microlines and transverse meshes on genae and abdominal sterna. **Head.** Head rather small; eyes moderate in size; frontal foveae deep; anterior scape and pedicel with sparse scattered short pubescence; labrum with concave anterior margin; labial mentum edentate. **Thorax.** Pronotum slightly broader than long, widest slightly before middle, sides evenly arcuate; anterior angles produced; basal bead entire; hind angles broadly rounded; median sulcus impressed but not extended to base or front margin; posterolateral impressions shallow, linear, divergent anteriorly, separated from corners by a broad shallow convexity and marked with weak rugose punctation. Prosternum with intercoxal process unmarginated. **Elytra.** Striae rather wide with dull granulate floors, parascutellar striae short but distinctly impressed, with setigerous puncture at base; intervals convex with irregular micropunctulae; seriate setigerous punctures on interval 3 very near stria 2, on interval 5 near stria 5, on interval 7 near stria 7; setigerous umbilicate puncture series widely separated into 6 anterior and 9 posterior; subapical sinuation distinct; humerus subangulate and lacking a tooth; apex and base with sparse short pubescence. **Abdomen.** Abdominal sternum VII of male ventrally with a pair of carinate prominences positioned bilaterally on the disc as in Fig. 1. **Genital armature.** Median lobe of aedeagus long; 3mm; apical 1/5 angled abruptly right as in Fig. 2; basal 1/5 curved left; shaft inflated near middle with 2 parallel longitudinal swollen ridges, left ridge subcarinate, dorsal ridge smoother; surfaces of the swollen midsection of median lobe with longitudinal rugulosity as in Fig. 3; apex with a well-developed approximately horizontal disc bearing a hook-like anteriorly directed termination on its left margin as in Fig. 2; membranous zone occupying the right apical 1/5; internal sac without armature.

Type Series. HOLOTYPE, male: "Val Verde Co. TEX, Amistad Reservoir, 19-III-98 F.Purrington//AMIS-259: 913//Holotype *Selenophorus chaparralus* Purrington 1999", deposited in the U.S. National Museum (USNM), Washington, D.C. Seven PARATYPES, sex and label data as follows: 1 female, same as holotype except "Amis-259: 914", deposited in the USNM. 1 male, 1 female: "Port Isabel, Tex., X-20-'49 O.Bryant//Collection of the California Academy of Sciences, San Francisco, Calif." (Cameron County), deposited in the California Academy of Sciences, San Francisco, California. 1 male, 3 females: "Texas: Zapata County//Falcon State Park//15-X-1985//Robert Davidson and John Rawlins", deposited in the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

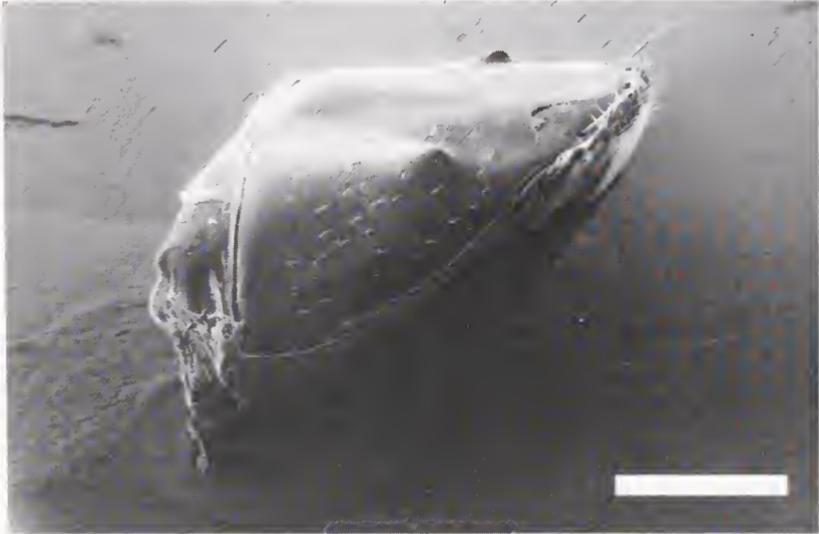


Figure 1. *Selenophorus chaparralus* Purrington, n. sp., HOLOTYPE ♂: scanning electron micrograph of last visible abdominal sternum AB-VII, right ventral aspect. Scale bar = 0.5 mm.

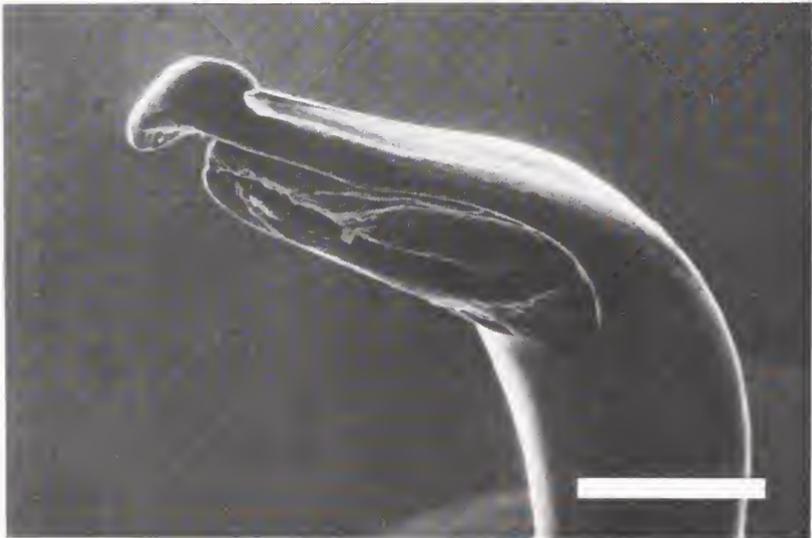


Figure 2. *Selenophorus chaparralus* Purrington, n. sp., HOLOTYPE ♂: scanning electron micrograph of aedeagus median lobe, ca. distal 1/3, dorsal posterior aspect showing apical disc and membranous aperture that accommodates eversion of the internal sac. Scale bar = 0.25 mm.

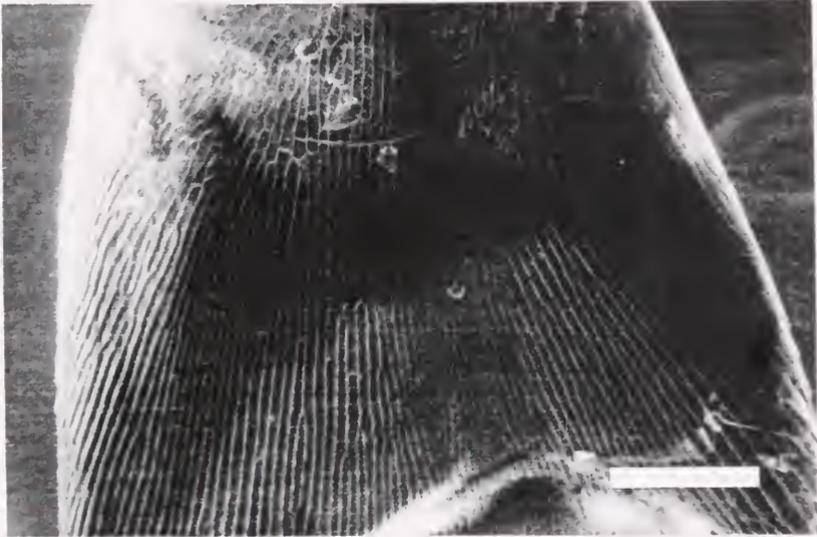


Figure 3. *Selenophorus chaparralus* Purrington, n. sp., HOLOTYPE d: scanning electron micrograph of aedeagus median lobe mid-length rugosity, left aspect. Scale bar = 0.1 mm.

Etymology: From the Tamaulipan chaparral plant association that characterizes the type locality.

Notes. The holotype is missing the right maxillary palpomere 4; its genitalia and sternum AB-VII are removed and glued on a card point; the sternum was platinum-coated in preparation for electron microscopy, which contributes a slight metallic luster artifact.

Habitat. The holotype and the female paratype from Val Verde County were collected under a small rock in a dry grassy acacia savanna upland ca. 1 km from the Amistad Reservoir shoreline at San Pedro campsite, Amistad National Recreation Area. Average annual precipitation (1965-1994) is 50.3 cm (Garwood 1996). Floristic elements from the Chihuahuan Desert, the Tamaulipan Chaparral and the Edwards Plateau intersect in the Amistad Reservoir area (Shelford 1963), and this perhaps reflects the potential for unique faunal associations and moisture-driven vicariance mechanisms that characterize desert ecosystems (Erwin 1996, Williams et al. 1985, Hendrickson and Minckley 1985, Minckley 1984). These circumstances, combined with low systematic collection effort on this daunting terrain, make it not altogether

surprising to discover a well-differentiated unknown ground beetle species of a genus familiar to southwestern United States aridlands.

ACKNOWLEDGMENTS

George E. Ball, University of Alberta, Edmonton, encouraged this description in anticipation of his planned revision of the genus, and I greatly appreciate his perspicacity and confidence. He also checked the holotype male of this new species against several *Selenophorus* types in his possession to ascertain its distinctiveness. I thank Charles A. Triplehorn of my Department for sharing taxonomic insights, Robert L. Davidson, Carnegie Museum of Natural History, Pittsburgh, for his generous help with advice on taxonomic conundrums, and David J. Horn of my Department for commenting on an early draft and for his continuing support. Robert E. Whitmoyer, Director of the Electron Microscope Laboratory, Ohio Agricultural Research and Development Center, Wooster, prepared the SEM micrographs; Jose G. Diaz, Department of Evolution, Ecology, and Organismal Biology (Ohio State University), prepared the plates. David H. Larson and Bill Sontag, National Park Service, permitted my research at Amistad National Recreation Area.

LITERATURE CITED

- Bousquet, Y. and A. Laroche.** 1993. Catalogue of the Geadephaga (Coleoptera: Trachypachidae, Rhysodidae, Carabidae including Cicindelini) of America north of Mexico. Mem. Entomol. Soc. Can. No. 167, 397 pp.
- Casey, T. L.** 1914. Memoirs on the Coleoptera. V. The New Era Printing Co., Lancaster, PA, 387 pp.
- Erwin, T. L.** 1996. Evolution at the equator: arboreal and alticolous beetles and their taxon pulses (Coleoptera: Carabidae). (Abstr. p. 18) Proc. XX Int. Cong. Entomol. Firenze, Italy.
- Garwood, A. N.** 1996. [ed.] Weather America. Toucan Valley Publ., Milpitas, CA, 1412 pp.
- Hendrickson, D. A. and W. L. Minckley.** 1985. Cienegas - vanishing climax communities of the American southwest. Desert Plants 6: 131-175.
- Imms, A. D.** 1948. A general textbook of entomology including the anatomy, physiology, development and classification of insects. 7th Ed. Methuen & Co., London, 727 pp.
- Kavanaugh, D. H.** 1979. Studies on the Nebriini (Coleoptera: Carabidae), III. New Nearctic *Nebria* species and subspecies, nomenclatural notes, and lectotype designations. Proc. Calif. Acad. Sci. 42: 87-133.
- Lindroth, C. H.** 1968. The ground-beetles (Carabidae excl. Cicindelinae) of Canada and Alaska, Pt. 5. Opusc. Entomol., Suppl. 33; Lund, 296 pp.
- Minckley, W. L.** 1984. Cuatro Cienegas fishes: research review and a local test of diversity versus habitat size. J. Ariz.-Nev. Acad. Sci. 19: 13-21.
- Williams, J. E., D. B. Bowman, J. E. Brooks, A. A. Echelle, R. J. Edwards, D. A. Hendrickson and J. J. Landye.** 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. J. Ariz.-Nev. Acad. Sci. 20: 1-62.
- Shelford, V. E.** 1963. The ecology of North America; Univ. Ill. Press, Urbana, 610 pp.

CORRECTION NOTICE

The cover of the November & December 1999 issue of Entomological News indicated it was issue No. 4. This was in error. That issue was No. 5 as indicated on the masthead of inside pages. Entomological News regrets this error.

H. P. B.

MONOMORIUM MINIMUM SPECIES GROUP: GYNE NUMBER AND LONGEVITY (HYMENOPTERA: FORMICIDAE)¹

Mark B. DuBois^{2, 3, 4}

ABSTRACT: Gyne number is reported for 13 species of the *Monomorium minimum* species group; life span, and worker mortality rates are presented for 5 species: *Monomorium cyaneum*, *M. emarginatum*, *M. minimum*, *M. trageri*, and *M. viride*. Most species appear able to establish colonies haplometrotically; most exhibit presumed secondary polygyny. Average gyne lifespans (under laboratory conditions) ranged from 1.08 years (*M. minimum*) to 7.54 years (*M. emarginatum*). Worker longevity for *M. cyaneum* ranged up to 1.4 years.

The ant genus *Monomorium* is represented by over 350 species (Bolton, 1995). There is no information concerning basic biology (such as number of gynes per colony and life span of gynes and workers) of most species. Keller (1998) conducted an extensive literature review and incorporated unpublished information regarding ant gyne life spans and related factors. Of the 53 ant species he discussed, only one species (*Monomorium pharaonis* (Linnaeus)) was included (Peacock and Baxter, 1950; Peacock et al., 1955). Keller's work expanded on the known life spans of 31 ant species' provided by Hölldobler and Wilson (1990: 169). Bolton (1995) listed over 9,500 species of ants.

The purpose of Keller's research was, "to test evolutionary theories on aging by investigating whether the evolution of eusociality had been paralleled by an increase in queen life span..." This is the expected pattern if life span is influenced by extrinsic mortality factors (Keller, 1998: 236). A side result was the confirmation of the paucity of knowledge of this aspect of basic ant biology. Comparative theories are difficult to evaluate when there are limited observations within a large and diverse group.

This publication provides longevity data for *Monomorium cyaneum* Wheeler, *M. emarginatum* DuBois, *M. minimum* (Buckley), *M. trageri* DuBois, and *M. viride* Brown. These are the first recorded observations for multiple members of the *minimum* species group (DuBois, 1986) for colonies kept under similar laboratory conditions. Although colonies were collected at different times, all were subjected to a similar regimen in the laboratory.

¹ Received March 1, 1999. Accepted April 10, 1999.

² 116 Burton Street, Washington, IL 61571-2509.

³ Research Affiliate, Center for Biodiversity, Illinois Natural History Survey, 607 East Peabody Drive, Champaign, IL 61820.

⁴ Send reprint requests to the Washington, Illinois address.

Information concerning the number of queens per colony is included for members of the *Monomorium minimum* species group. This information is based principally from information gleaned during my revision (DuBois, 1986) and from subsequent field collections. Although isolated studies have reported gyne counts for a few species, this is the first time all species (within this group) have been included and compared.

METHODS AND MATERIALS

Longevity Study — Colonies of each species were collected and transported to the laboratory for study. Locality data for each colony is presented in Appendix A. Each colony was isolated in Fluon® coated chambers and provided suitable habitat (water filled test tubes wrapped with red cellophane as described in DuBois and DuBois, 1994). Ants were fed a combination of artificial ant diet (Hölldobler and Wilson, 1990: 632), a 50:50 mixture of honey and water, and chopped insects (typically grasshoppers, cockroaches, and Lepidoptera larvae). Observations were made weekly. Any dead individuals were removed and enumerated. Each species was identified by examination of both gyne and worker corpses. Identifications were made using DuBois (1986) and comparison with previously identified specimens. Voucher specimens were retained in the author's personal collection. Regression analyses were conducted for each colony to identify mortality rates in the laboratory. Colonies were maintained until all individuals had died. The final dates were recorded and life spans were calculated from the initial date of colony collection. In some cases, workers lived significantly beyond the death of the gyne. In these instances, an attempt was made to determine worker life span.

Gynes per Colony Study — Records were extracted from the author's personal collection of *Monomorium* coupled with notes made while examining museum collections during revision of this group. Only those collections that contained dealate gynes were counted. As with all collections, the observed number of gynes is presumed to represent the minimum found in each colony; others may have escaped detection. No effort was made to determine whether all gynes were fully fertile and inseminated. The issue of functional polygyny remains open for these species.

Literature records were examined to determine additional information regarding the number of gynes per colony (for example, Bhatkar, 1992). The data presented by Peacock and Baxter (1950) was subjected to the same statistical analyses.

RESULTS

Number of Gynes per Colony (Tables 1 and 2).

Longevity Study — For each species examined, the number of gynes per

observed colony was noted. The total number of corpses removed confirmed this count. Statistics (average, standard deviation, and standard error of the mean) were calculated to provide the basis for comparisons. The number of colonies observed (n) is listed after the name of each species.

Table 1. Gynes per colony observed.

Species	Average	Min – Max	Standard Deviation	Standard Error
<i>M. cyaneum</i> (n = 15)	3.93	1 – 15	4.008	1.0349
<i>M. emarginatum</i> (n = 1)	4	N/A	N/A	N/A
<i>M. minimum</i> (n = 5)	1	1	0.000	0.000
<i>M. trageri</i> (n = 4)	7	3 – 15	5.477	2.7386
<i>M. viride</i> (n = 12)	1.75	1 – 4	1.055	0.3046

Field Collections and literature records — Each species is listed with the number of gynes per collected colony. Collections containing only workers or reproductives were eliminated. Statistics (average, standard deviation, and standard error of the mean) were calculated. The number of colonies observed (n) is listed. Peacock and Baxter's (1950) data for *Monomorium pharaonis* is presented at the bottom of this table. Only the original data representing field collections (for baited and trapped colonies with dealate gynes) was used to calculate these statistics.

Table 2. Gynes per field collection.

Species	Average	Min – Max	Standard Deviation	Standard Error
<i>M. compressum</i> (n = 2)	2.5	2 – 3	0.707	0.5000
<i>M. cyaneum</i> (n = 26)	2.8	1 – 12	3.020	0.5923
<i>M. ebeninum</i> (n = 13)	3.3	1 – 10	2.983	0.8273
<i>M. emarginatum</i> (n = 4)	4.3	1 – 11	4.717	2.3585
<i>M. ergatogyna</i> (n = 24)	4.9	1 – 20	5.445	1.1114
<i>M. marjorae</i> (n = 1)	1.0	N/A	N/A	N/A
<i>M. inquilinum</i> (n = 1)	1.0	N/A	N/A	N/A
<i>M. minimum</i> (n = 65)	2.4	1 – 23	3.432	0.4257
<i>M. pergandei</i> (n = 1)	7.0	N/A	N/A	N/A
<i>M. talbotae</i> (n = 1)	8.0	N/A	N/A	N/A
<i>M. trageri</i> (n = 3)	4.0	1 – 10	5.196	3.0000
<i>M. viride</i> (n = 17)	6.5	1 – 64	15.038	3.6472
<i>M. wheelerorum</i> (n = 12)	1.0	1 – 1	0.000	0.0000
<i>M. pharaonis</i> (n = 10)	26.8	2 – 110	37.416	11.8320

Observed Workers Produced (per Colony) and Mortality (Tables 3 & 4).

Dead workers were removed weekly from each colony and enumerated. Since some workers were undoubtedly eaten before they could be removed, these calculations represent the lower boundary of total workers. Colony count (n) is provided in Table 1. Dead workers provide an indication of the reproductive capacity of each colony over the life of the colony (Table 3). This data also provides an indication of worker mortality under controlled laboratory

conditions (fairly constant climate, consistent food supply and lack of predators) (Table 4).

Table 3. Workers produced per colony.

Species	Average	Min – Max	Standard Deviation	Standard Error
<i>M. cyaneum</i>	655.40	20 – 1323	388.724	100.3681
<i>M. emarginatum</i>	1658.00	N/A	N/A	N/A
<i>M. minimum</i>	329.80	101 – 773	264.321	118.2080
<i>M. trageri</i>	845.25	389 – 1560	502.345	251.1724
<i>M. viride</i>	785.17	87 – 2250	605.040	174.6601

Table 4. Weekly worker mortality.

Species	Number of weeks		Standard Deviation	Standard Error
	observed	Average		
<i>M. cyaneum</i>	775	13.0	8.547	2.207
<i>M. emarginatum</i>	76	21.8	0.000	0.000
<i>M. minimum</i>	160	10.8	6.936	3.102
<i>M. trageri</i>	267	12.7	7.249	3.625
<i>M. viride</i>	552	18.5	12.416	3.584

Observed Adult Gyne Life Span (days) (Table 5).

Observed life span was calculated from the date of colony collection until the date of observed death of the last gyne for each colony. Since workers are unable to reproduce, colonies were doomed from the point of the last gyne's death. This calculation is presented as it represents a boundary with respect to the longevity of each colony. Individual gyne life spans were also recorded, but are not presented herein (details can be obtained by contacting the author directly). Since colonies were well established prior to collection, the actual life span of the colony may have been one or two years beyond what was observed in the laboratory.

Table 5. Observed adult gyne life span (days).

Species	Average	Min – Max	Standard Deviation	Standard Error
<i>M. cyaneum</i>	632	207 – 927	203.956	58.8769
<i>M. emarginatum</i>	2755	N/A	N/A	N/A
<i>M. minimum</i>	395	294 – 778	214.390	95.8783
<i>M. trageri</i>	546	403 – 674	111.101	55.5503
<i>M. viride</i>	451	118 – 713	198.671	57.3512

Observed Adult Worker Life Span (days) (Table 6).

Worker life span was calculated from the date the last gyne perished until the last worker perished. This represents an absolute minimum life span and assumes the worker eclosed on the day the last gyne perished. Calculations were only made on colonies where workers outlived gyens.

Table 6. Observed adult worker life span (days).

Species	Average	Range	Standard Deviation	Standard Error
<i>M. cyaneum</i> (n=7)	239	14 – 516	196.224	74.1658
<i>M. minimum</i> (n=1)	14	N/A	N/A	N/A
<i>M. trageri</i> (n=1)	182	N/A	N/A	N/A
<i>M. viride</i> (n=6)	54	14 – 83	24.850	10.1448

DISCUSSION

Gynes per colony — Bhatkar (1992) reported 2 – 38 physogastric gynes per colony of *M. minimum* in Texas and Louisiana. Voucher specimens could not be located to confirm this identification. Most colonies were presumed to have a single foundress with secondary adoption of additional gynes. Gregg (1944) reported 12 – 14 gynes per colony of *M. minimum* in the Chicago region. Dennis (1938) reported 12 – 15 gynes per colony for the same species in Tennessee. Gregg (1945) reported 64 gynes in a colony of *M. viride* in Florida and a single gyne in a colony of *M. cyaneum* in Arizona. Brown (1943) reported 1 – 5 gynes per colony of *M. viride* in New Jersey.

Although the sample sizes are different, the following comparison is attempted for those species within the *minimum* group. Fundamental assumptions are made about the distributions of gynes: they are normally distributed and that the observed mean and standard deviation are reasonably close to the population mean (μ) and standard deviation (σ). This would imply that 99.7% of all observations would fall within 3 standard deviations of the mean and 95.4% of all observations would fall within 2 standard deviations of the mean. The following formula was applied to determine raw scores for each species observed for corresponding z scores of 3 and 2 (resulting in Table 7):

$$x = z\sigma + \mu$$

Where: x = raw score, z = z score, σ = population standard deviation, and μ = population mean.

Table 7. Raw scores for gynes per colony.

Species	Raw Score ($z = 2$)	Raw Score ($z = 3$)
<i>M. compressum</i> (n = 2)	3.91	4.62
<i>M. cyaneum</i> (n = 26)	10.30	13.72
<i>M. ebeninum</i> (n = 13)	9.27	12.26
<i>M. emarginatum</i> (n = 4)	12.37	16.46
<i>M. ergatogyna</i> (n = 24)	15.81	21.25
<i>M. marjorae</i> (n = 1)	N/A	N/A
<i>M. inquilinum</i> (n = 1)	N/A	N/A
<i>M. minimum</i> (n = 65)	8.98	12.31
<i>M. pergandei</i> (n = 1)	N/A	N/A
<i>M. talbotae</i> (n = 1)	N/A	N/A
<i>M. trageri</i> (n = 3)	16.02	21.18
<i>M. viride</i> (n = 17)	27.78	39.41
<i>M. wheelerorum</i> (n = 12)	1.00	1.00
<i>M. pharaonis</i> (N = 10)	101.63	139.05

For each species listed in these tables, the raw scores would indicate the maximum number of gynes expected within 2 or 3 standard deviations. This would indicate a larger amount of polygyny in some species than others (particularly *M. pharaonis*).

Workers produced per colony — Several authors have commented on the large colony size for many of the *minimum* species group species. However, there do not appear to have been any investigations into worker mortality or numbers of workers produced for the five species (*M. cyaneum*, *M. emarginatum*, *M. minimum*, *M. trageri*, and *M. viride*) discussed herein. With relatively low worker mortality for all species observed (11 – 22 workers per colony per week) and individual queen's ability to produce large numbers of workers within a relatively short time span, it is not surprising that some colonies can become quite large.

Longevity — Previously reported observations indicated life spans for *M. minimum* (gynes lived approximately 1 year, workers lived approximately 4 months; DuBois, 1986: 81), for *M. ergatogyna* (gynes lived approximately 2 years, workers lived 4 – 8 months; DuBois, 1986: 91), and for *M. pharaonis* (gynes lived 39 weeks, workers lived 9 – 10 weeks, and males lived 3 – 8 weeks; Peacock and Baxter, 1950). Worker longevity observed here is similar to previously published observations. Most workers appear to live approximately 6 months. One notable exception is the extended life for *M. cyaneum* (1.4 years). Since workers from 4 colonies lived for nearly one year or longer, it would appear that this species has a significantly greater life span than other species examined to date. All *minimum* group species exhibit significantly longer life spans than that observed for the tropical tramp species *M. pharaonis*.

What was surprising were the long life spans of some of the observed queens (for example, *M. emarginatum* gynes with a life span exceeding 7 years). If one assumes the majority of colonies collected had persisted in the field for at least one year before collection (to allow them to grow to a size where they were noticed), the life span for most observed species is double what has been previously reported. Most gynes lived between one and 1.7 years in the lab, for a presumed total life of 2 to 2.7 years. Only *M. ergatogyna* had a previously reported life span of this length. Future research should concentrate upon additional tropical and subtropical species of *Monomorium* to ascertain whether *M. pharaonis* is unique with its short life span. Curiously, I could find no published life span information on *M. floricola*, a species that exhibits similar opportunistic nesting behaviors as *M. pharaonis*.

Overall comments — With the inclusion of the tropical tramp species, *Monomorium pharaonis* (previously studied), we now have longevity data for 1.7% of all described *Monomorium* species. Based on Keller's (1998) review of literature and non-published observations for other ant species, the sum of our knowledge of ant longevity now represents 0.61% of all known ant spe-

cies. How long ants (gynes, workers, or males) live remains an area needing significant additional study. Comparative research such as that discussed by Keller (1998) may open more interesting lines of investigation once we have a clearer understanding of the entire range of variation with respect to how long ants live. This paper is intended to encourage others to continue documenting fundamental aspects of the biology of ants. Much work remains.

Appendix A

Locality information is provided for all colonies observed during this study. Locality information for additional field collections of *Monomorium minimum* and other species used to determine gyne numbers per colony is not presented below (to conserve space), but is available by contacting the author.

Monomorium cyaneum

Arizona: Pima Co., Santa Catalina Mountains, Loma Linda Picnic Area 7700', T11S R16E Sec 31, July 31, 1991, M. B. DuBois (MBD), J.R.DuBois (JRD), B.R.DuBois (BRD) Colonies: 1700 G, 1700 J, 1700 O, 1700 Q, and 1700 T.

Arizona: Pima Co., Santa Catalina Mountains, Inspiration Point 7700', T11S R16E Sec 31, August 6, 1991, MBD, JRD, BRD Colonies: 1704 A, 1704 D, 1704 E, 1704 F, 1704 H, 1704 J, 1704 L, 1704 M, 1704 N, and 1704 O.

Monomorium emarginatum

New York: Suffolk Co., Long Island (nest in sandy soil), May 17, 1987, Stefan Cover.

Monomorium minimum

Illinois: McLean Co., Funk's Grove, 600', T22N R01E Sec 19, May 23, 1992, MBD, J.D. Pratt.

Illinois: Mason Co., Revis Prairie, Easton 5.5 mi S, 0.25 mi W, T20N R07W Sec 26, August 30, 1992, MBD, F. Catchpole.

Illinois: Peoria Co., Jubilee College St. Park, Turkey Hollow 600', T10N R06E Sec 26, April 24, 1993, MBD Colonies: 1737 AA, 1737 AD, and 1737 AF.

Monomorium trageri

Florida: Alachua Co., 3.5 mi NE Gainesville, December 3, 1991, L. R. Davis, Jr. (LRD).

Florida: Clay Co., 1.3 mi S of Duval Co. line along Rte. 301, under bark of pine, May 17, 1992, LRD.

Florida: Columbia Co., Ichetucknee Springs St. Park, April 18, 1992, LRD.

Florida: Union Co., Worthington Springs, Santa Fe River, December 13, 1991, LRD.

Monomorium viride

Florida: Baker Co., Route 250, Vic. East Tower, Osceola Nat'l Forest, March 1, 1992, LRD Colonies: 1, 2.

Florida: Baker Co., Route 250 A, 0.25 mi N Route 90, Osceola Nat'l. Forest, March 1, 1992, LRD Colonies: 3, 4.

Florida: Baker Co., 1.3 mi W Duval Co., line along Route 90, May 17, 1992, LRD Colonies: 5, 6.

Florida: Union Co., Dukes, Along Route 18 A, 1.7 mi E Route 121, February 22, 1992, LRD.

Florida: Walton Co., Portland 1.1 mi NW, March 19, 1993, MBD, LRD, M. A. Deyrup (MAD) Colonies: 1732 C, 1732 D, and 1732 E.
Florida: Walton Co., Eglin Air Force Base, Freeport 4.5 mi NW, March 21, 1993, MBD, LRD, MAD Colonies: 1736 H and 1736 I.

ACKNOWLEDGMENTS

The author wishes to thank his wife, Jeri, and son, Benjamin, for their continued support and encouragement. Without them, such work would not be possible. Special thanks are also provided to Stephan Cover (MCZ) and Lloyd Davis, Jr. (Gainesville) for providing colonies of species not readily available to the author. Mark Deyrup (Archibald Biological Station) cheerfully provided transportation during a visit to Florida. Rick McWhite and Carl Patrick (National Resources, Eglin Air Force Base) provided assistance in visiting sites on the base. This paper was reviewed by Don Webb, John Bouseman, and Wallace LaBerge (Illinois Natural History Survey, Champaign, Illinois) and two anonymous reviewers. Where possible I have attempted to incorporate reviewer's comments. I accept responsibility for any remaining errors or omissions.

LITERATURE CITED

- Bhatkar, A. P.** 1992. Mating success in *Monomorium minimum* (Hymenoptera: Formicidae). J. Kans. Entomol. Soc. 65(3): 244 – 250.
- Bolton, B.** 1995. *A New General Catalogue of the Ants of the World*. Harvard Univ. Press, Cambridge, MA. 504 pp.
- Brown, W. L., Jr.** 1943. A new metallic ant from the Pine Barrens of New Jersey. Entomol. News 54: 243 – 248.
- Dennis, C. A.** 1938. The distribution of ant species in Tennessee with reference to ecological factors. Ann. Entomol. Soc. Am. 31: 267 – 308.
- DuBois, B. R. and M. B. DuBois.** 1994. Colony founding by queens of *Solenopsis molesta* (Hymenoptera: Formicidae). *Entomol. News* 105(2): 61 – 68.
- DuBois, M. B.** 1986. A revision of the native New World species of the ant genus *Monomorium* (*minimum* group) (Hymenoptera: Formicidae). Univ. Kans. Sci. Bull. 53: 65 – 119.
- Gregg, R. E.** 1944. The ants of the Chicago region. Ann. Entomol. Soc. Am. 37(4): 447 – 480.
- Gregg, R. E.** 1945. Two new forms of *Monomorium* (Formicidae). Psyche 52: 62 – 69.
- Hölldobler, B. and E. O. Wilson.** 1990. *The Ants*. Harvard Univ. Press, Cambridge, MA. 732 pp.
- Keller, L.** 1998. Queen lifespan and colony characteristics in ants and termites. Insectes Soc. 45: 235 – 246.
- Peacock, A. D. and A. T. Baxter.** 1950. Studies in Pharaoh's ant *Monomorium pharaonis* (L.). 3. Life history. Entomol. Mon. Mag. 86: 171 – 178.
- Peacock, A. D., J. H. Sudd and A. T. Baxter.** 1955. Studies in Pharaoh's ant *Monomorium pharaonis* (L.). 11. Colony foundation. Entomol. Mon. Mag. 91: 125 – 129.

NEW DISTRIBUTIONAL DATA AND FIRST RECORD OF GREGARIOUS BEHAVIOR FOR *AEGITHUS MELASPIS* (COLEOPTERA: EROTYLIDAE) FROM MÉXICO¹

José Luis Navarrete-Heredia², Rodolfo Novelo-Gutiérrez³

ABSTRACT: New distributional records and observations of the gregarious behavior for *Aegithus melaspis* from México are provided.

Erotylid beetles are primarily mycophagous, mostly feeding on macro-basidiomycetes, although the species differ in particular requirements of fungal structures: some are surface grazers while others feed on gills or context (Skelley *et al.* 1991).

In México, the Erotylidae comprise about 100 species (Alvarenga 1994; Johnson 1967, Skelley 1998). *Aegithus* Fabricius is an American genus with 76 species, of which 12 have been recorded from México (Alvarenga 1994). In his treatment of the Erotylidae in the *Biologia Centrali Americana*, Gorham (1888) divided the genus into two groups: A, with smooth, not striate, elytra, and B, with gemellate-striate elytra.

Aegithus melaspis Gorham belongs to Group A. It is easily recognized within that group by its uniform dull brick-red color, and its moderately convex, smooth body, which is a little shiny ventrally. The antennae are mostly black, with the two basal antennomeres red; the tibiae, tarsi and scutellum are black. The male has a "punctiform setigerous dot" on the middle of the first visible abdominal sternite. This structure is similar to the "median pubescent fovea" present in some male ciids (Lawrence 1971).

Presently *A. melaspis* is known from México [Chilpancingo (Guerrero), Presidio and Orizaba (Veracruz), Tehuantepec (Oaxaca)], Guatemala (San Gerónimo), and Nicaragua (Chontales). Here we provide new distributional data and field notes for *A. melaspis*.

Material examined: GUERRERO: Mochitlán, Acahuizotla, tropical subdeciduous forest (TSDF), 650m, 8.IV.1986, L. Delgado, under bark (1 Male, 6 Female); JALISCO: Casimiro Castillo, TSDF, 390m, 25.II.1994, J.L. Navarrete, *ex log* with mycelia (2M, 2F); Puerto Vallarta, Ejido Las Palmas, 20°49'N, 105°04'W, TSDF, 1.VIII.1998, S. Guerrero and S. Zalapa, *ex fungus*

¹ Received March 17, 1999. Accepted June 30, 1999.

² Entomología, Centro de Estudios en Zoología, CUCBA, Universidad de Guadalajara, Apdo. Postal 234, 45100, Zapopan, Jalisco, México.

³ Departamento de Entomología, Instituto de Ecología, A. C., Apdo. Postal 63, 91000, Xalapa, Veracruz, México.

(1M, 1F) (new state record that extend the distribution of this species approximately 1,050 km NW from Chilpancingo); MICHOACÁN: Gabriel Zamora, tropical deciduous forest, 920m, 9.VI.1998, R. Novelo, on trunk of *Ficus petiolaris* H.B.K. tree (106M, 61F) (new state record). Specimens are deposited in the entomological collections of the Centro de Estudios en Zoología, Universidad de Guadalajara (CZUG), Instituto de Biología, Universidad Nacional Autónoma de México (IBUNAM) and Instituto de Ecología, A.C. (IEXA).

The specimens from Michoacán were collected around 1100 h during a warm sunny day. Hundreds of imagoes were observed on a *Ficus petiolaris* tree («amate amarillo»); individuals were located mainly from the basal portion of the tree trunk to approximately two meters high, completely covering its circumference. Some of the beetles were copulating while others remained crowded in several irregular large masses (Fig. 1). Apparently, the individuals were moving from the tree's base to the branches since the greatest abundance was observed at the lower part of the trunk. Furthermore, the ground around the tree was covered with a thick layer of decaying leaves well wetted by the previous night's heavy rain, the first after a long period of drought. Individuals apparently came out from this layer or maybe from the rock crevices in which the tree roots were attached.

There is little information available on the life cycles of the Erotylidae; however, some data indicate that larval and pupal stages are rather brief, while imagoes are longer-lived, becoming quiescent during unfavorable seasons (Skelley et al. 1991). In this context, the first heavy rain we observed probably was the trigger to break off such quiescence and to start the reproductive behavior of adults, which emerged in synchrony from the ground. This synchronous pattern enables rapid mate localization (Goodrich and Skelley 1991). Furthermore, the gregarious behavior plus the aposematic coloration of adults of this species could reduce the risks of predation during reproductive activity [for other examples in mycophagous species see Leschen (1994)], which apparently is very brief in *A. melaspis*, since after a period of 2.5 hours there was no evidence of any individuals. It is not known whether they flew away looking for a suitable place to oviposit or returned to the leaf litter.

ACKNOWLEDGMENTS

We thank M. K. Thayer (Field Museum of Natural History) and M. A. Morón (Institute of Ecology) for their invaluable criticism to improve the final manuscript. Dr. Morón also provided the name of the host tree.

LITERATURE CITED

- Alvarenga, M. 1994. Catálogo dos Erotylidae (Coleoptera) Neotropicais. *Revta bras. Zool.* 11(1): 1-175.



Figure 1. Accumulations of *Aegithus melaspis* adults on *Ficus petiolaris* (↑ Top).

- Goodrich, M. A. and P. E. Skelley.** 1991. The Pleasing fungus beetles of Illinois (Coleoptera: Erotylidae). Part I. The Dacninae. Trans. Ill. St. Acad. Sci. 84(3-4): 155-172.
- Gorham, H. S.** (1888. Erotylidae. In: Godman, F. D. and O. Salvin, eds., *Biologia Centrali-Americana, Insecta, Coleoptera*. Vol. 7:49-112.
- Johnson, D. H.** 1967. Neotropical species of the genus *Triplax* Herbst and review of the genus *Haematochiton* Gorham (Coleoptera: Erotylidae). Proc. U. S. Nat. Mus. 123(3601): 1-25.
- Lawrence, J. F.** 1971. Revision of the North American Ciidae (Coleoptera). Bull. Mus. Comp. Zool. 142(5): 419-522.
- Leschen, R. A. B.** 1994. Ecological and behavioral correlates among mycophagous Coleoptera. *Folia Entomol. Mex.* (92): 9-19.
- Skelley, P. E.** 1998. Revision of the genus *Ischyryus* Lacordaire (1842) of North and Central America (Coleoptera: Erotylidae: Tritominiinae). Occ. Pap. Fla. St. Coll. Arthr. 9: 1-134.
- Skelley, P. E., M. A. Goodrich and R. A. B. Leschen.** 1991. Fungal host records for Erotylidae (Coleoptera: Cucujoidea) of America North of México. *Entomol. News* 102(2): 57-72.

BOOK REVIEW

AN AFFAIR WITH AFRICA, Alzada C. Kistner. 1998. Island Press. Washington, DC. 246 pp. \$24.95 (hardcover).

Can an entomological book be a thriller? Alzada Kistner, a trained biologist, demonstrates that the answer can be yes. This book is a superb combination of biology, history, culture, adventure, and at times sheer terror, all the while showing the love of an entomologist for her subject and science. It provides an insight into how the minds of dedicated entomologists work and is an inspiration for those not able to live the lives of the author and her family.

The "Affair" starts in 1960 in the heart of Belgian Congo just three weeks before its independence and progresses for 13 years through troubled political times in Africa as the continent is changing from colonial to independent rule. The central focus of the book is the entomology of myrmecophiles and termitophiles, little staphylinid beetle "guests" living in ant and termite colonies. Unlike most scholarly entomological treatises, the other elements of life – the oppressive heat and mosquitoes, the risk of life to lions, elephants, green mambas, violent mobs, and dictators, and the wonderful people who helped them throughout their investigations – are not omitted. Woven throughout the book are facts and insights into the biology of the beetles, ants and termites that are being studied. Kistner provides a pictorial and historical account of biology in colonial Africa in a time that has now disappeared.

Although this book defies simple classification, it does work its magic on the reader. It is written in a positive, cheerful style that reaches out and grabs the reader and reveals the author's love of insects, people and science. Every so often a book comes along that serves to inspire. This is one of those rare books.

Justin O. Schmidt
Southwestern Biol. Institute
1961 W. Brichta Dr., Tuscon, AZ 85745

Editor's P.S. Although a century later, and the searching was for infinitely smaller organisms, this is a fascinating epic of biological exploration in the tradition of earlier 19th Century explorers. The book is equally as fascinating for the first hand experiences of the Kistners through the changing times in Africa during the second half of the 20th Century as for their experiences collecting myrmecophiles and termitophiles. This is highly recommended, pleasurable, and informative reading.

H.P.B.

***PLATYDORYCTES*, A NEW DORYCTINAE GENUS FROM BRAZIL (HYMENOPTERA: BRACONIDAE)¹**

Sandra Maria Barbalho, Angélica M. Pentead-Dias²

ABSTRACT: One new Doryctinae genus, *Platydoryctes* and 4 new species (*P. soaresi*, *P. duckensis*, *P. amazonensis* and *P. rafaeli*) are described from Brazil. This new genus is characterized by its dorsoventrally flattened body.

Wasps of the subfamily Doryctinae belong to the cyclostome Braconidae, which have a circular or oval oral opening formed by a concave clypeus and labrum (Sharkey, 1993; Marsh, 1997). They are distinguished from other cyclostome Braconidae by the following characters: fore tibia with a row of spines along the anterior edge (90%); presence of a flange at the apico-lateral edges of propleurum that extends over the ventral-lateral corner of the pronotum (Achterberg, 1993); and dorsal valve of the ovipositor with a double node at apex (Quicke, 1992). They vary considerably in color and size, normally have a cubic head and long ovipositor and possess a type 1 venom apparatus (Edson & Vinson, 1979, Quicke et al, 1992 and Barbalho & Pentead-Dias, 1997). Most are solitary idiobiont ectoparasitoids of Coleoptera larvae; species of this group are found worldwide.

The number of described genera is 140, but this should increase to well over 200 (Marsh, 1993) with more studies in the Neotropical region. Recent studies with the Neotropical fauna of Doryctinae (as part of a major project by the first author) have revealed more undescribed genera.

This paper provides the description of an interesting new genus, with a flat body. Although we have no information on the biology of this genus, its flat body probably is associated with the type of host it attacks, or the microhabitat where the host is found.

This new genus is characterized by its dorsoventrally flattened body and the four new species are included in the same genus mainly because of this character. These new species are not included in *Sharkeyella* Marsh (another flat bodied genus) because of the coarsely and densely hairy ovipositor sheaths found in this genus (see comments).

The subfamily Doryctinae can be identified following keys provided by Sharkey, 1993 and Marsh, 1997 and their genera can be identified following Marsh, 1997. Type specimens are deposited in DCBU Collection (Departamento de Ecologia e Biologia Evolutiva da Universidade Federal de Brazil.

¹ Received May 29, 1999. Accepted August 20, 1999.

² Departamento de Ecologia e Biologia Evolutiva, Universidade Federal de São Carlos, Via Washington Luiz, Km 235, Caixa Postal 676, CEP 13.565-905, São Carlos, SP.

São Carlos, São Paulo, Brazil), INPA Collection (Instituto Nacional de Pesquisas da Amazonia, Manaus, Amazonas, Brazil) and in CNC (Canadian National Collection, Ottawa, Canada).

Platydoryctes Barbalho and Pentead-Dias, NEW GENUS

(Figures 1-17)

Type species *Platydoryctes soaresi* n. spec., Barbalho & Pentead-Dias.

Body dorso-ventrally flattened; occipital carina present and not meeting hypostomal carina; face striate; head 1.2-1.3 times longer than its height; eye width 1.5-3.3 times temple width; first flagellomere length about equal to length of scape and pedicel combined; propleurum smooth; mesonotum not declivous anteriorly or slightly more elevated than pronotum; notauli few developed; scutellum granulate; sternaulus complete and smooth; propodeum rugose; wings hyaline or banded; vein m-cu in fore wing reaching before (Fig. 17) or basad (Fig. 15) with 2RS; first subdiscal cell open at apex, 2 cu-a absent; vein m-cu in hind wing absent; hind coxae with or without tubercle. Body length 3.0-4.1mm

Comments. This genus differs from *Sharkeyella* Marsh, another flat bodied genus, because *Sharkeyella* has T2 with longitudinal striate grooves converging to base of third tergum (in *Platydoryctes* the grooves are parallel or diverge before the third tergum) and has notauli scrobiculate anteriorly and obscured posteriorly by wide rugose area before scutellum (in *Platydoryctes* notauli is absent or few developed). Besides, *Sharkeyella* is characterized by its coarsely and densely hairy ovipositor sheaths. These characters are not present in *Platydoryctes*.

Key to the species of *Platydoryctes*, NEW GENUS,
Barbalho & Pentead-Dias:

1. Frons and vertex smooth; *M+CU* in hind wing longer than *1M* (Fig. 16) *P. duckensis*
Frons and vertex granulate; *M+CU* equal to or shorter than *1M* 2
2. (1) T1 3 times longer than apical width; propodeum with 3 central longitudinal carinae united to form a single carina apically and with a carina on each side (Fig. 13), *r-m* in fore wing absent (Fig. 17) *P. amazonensis*
T1 less than 2 times longer than apical width and propodeum without central longitudinal carinae (Figs 2, 5); *r-m* in fore wing present (Fig. 15) 3
3. (2) Head 1,2 times longer than width; temple smooth and shining *P. soaresi*
Head 2 times longer than width; temple granulate *P. rafaeli*

***Platydorcytes soaresi* Barbalho & Pentead-Dias, NEW SPECIES**

(Figures 1-3, 15)

Holotype: Head. Flat in lateral view; occipital carina present and not meeting hypostomal carina; face striate; vertex granulate; frons granulate; temples smooth; head 1.2 times longer than height; head width 2.3 times eye width; oral opening short, about half of eye height; eye width 1.5 time temple width; malar space 1.2 times oral opening; 22 antennomeres; first flagellomere length about equal to length of scape and pedicel combined.

Mesosoma. Flat in lateral view; pronotum large in dorsal view, about 1/4 of mesoscutum length; propleuron smooth; mesonotum height half of its width; mesonotum only slightly more elevated than pronotum; mesoscutum granulate and with a granulate-rugose area in apical half (Fig. 1); notauli absent; scutellum granulate; sternaulus complete and smooth; propodeum rugose with lateral longitudinal carina slightly impressed (Fig. 2); legs slightly granulate; fore tibia with a row of 5 short spines; hind coxa without distinct basal tubercle.

Fore wings. (Fig. 15) Banded; *m-cu* arising basad *2RS*; *r-m* vein present; first subdiscal cell open at apex, *2cu-a* absent.

Hind wings. (Figure 15) *M+CU* about equal to *1M*; *m-cu* not tubular; *r-m* length 0.4 of *1M*.

Metasoma. (Fig. 3) T1 1.4 times longer than apical width, T1 striate, T2 granulate-striate; T3-4 granulate and remaining terga smooth and shining; ovipositor length 1/3 of metasoma.

Color. Body brown; wings banded, stigma dark brown.

Body length. 3.1 mm.

Male. Unknown.

Distribution. Santa Catarina and São Paulo states, Brazil.

Holotype. 1 female, Fazenda Canchim, EMBRAPA, São Carlos, SP, Brasil, October 10, 1985, A. S. Soares col., (DCBU).

Paratype. 1 female, Seara (= Nova Teutonia), Santa Catarina, Brasil, November 26, 1940, (CNC).

Etymology. This species is named for technician and collector of the holotype Airton Santo Soares from the Department of Ecology and Evolutionary Biology, Universidade Federal de São Carlos.

***Platydorcytes rafaelli* Barbalho & Pentead-Dias, NEW SPECIES**

(Figures 4-6)

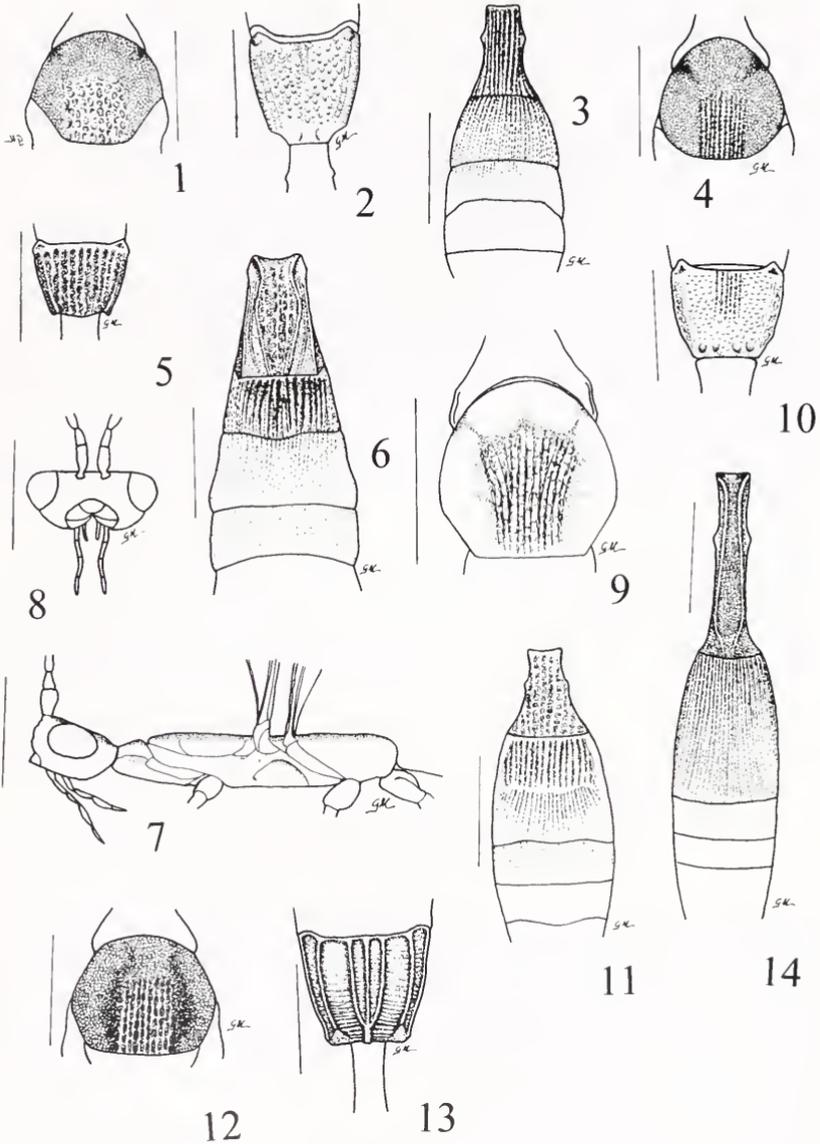
Agrees with the description of *P. soaresi* except as follows: temple granulate; head 1.2 time longer than height; head width 1.6 time eye width; eye width 2.0 times temple width; antennae were broken; mesopleuron granulate; mesoscutum granulate and with a striate area in apical half (Figure 4); hind coxae with basal tubercle; propodeum striate-rugose (Fig. 5); T1 1.5 times longer than apical width; T1 with dorsal carinae extending to the apex of the tergum (Fig. 6); T1-2 striate, remaining terga granulate (Fig. 6); ovipositor longer than metasoma; fore wings hyaline; body brown except propodeum and T1 black. Wings as in Fig. 16. Body length 4,0 mm.

Male. Unknown.

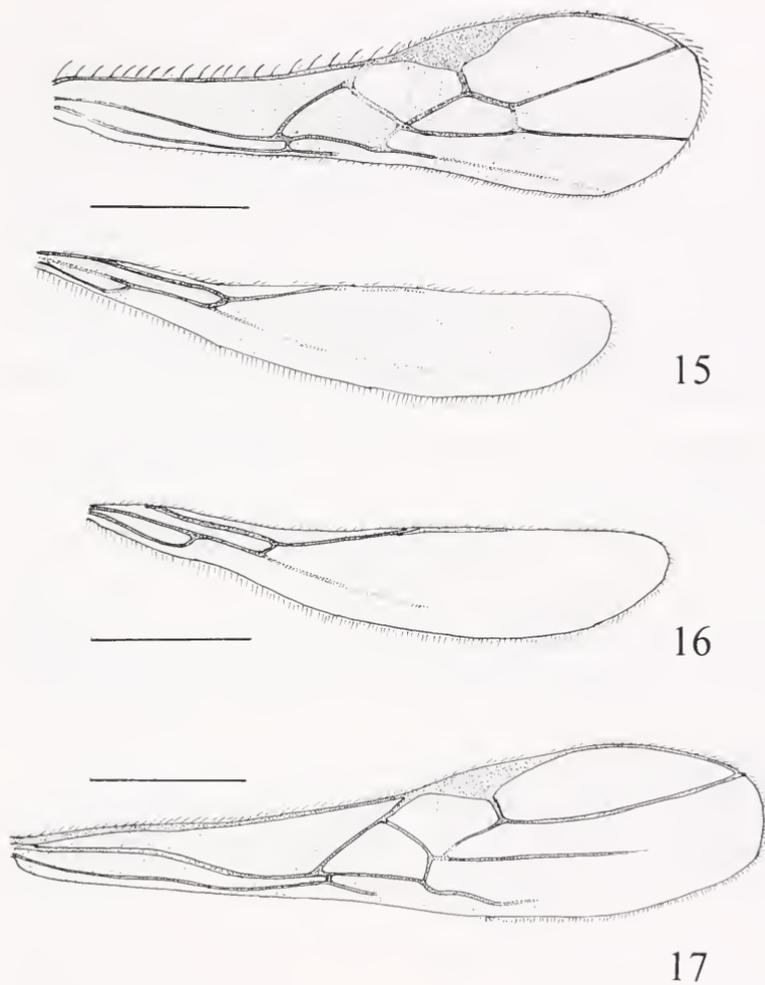
Distribution. Rondônia state, Brazil.

Holotype 1 female, Ariquemes, Rondônia, Brasil; November, 28, 1986, J. A. Rafael col., Malaise trap (INPA).

Etymology. This species is named for entomologist Dr. José Albertino Rafael, from Instituto Nacional de Pesquisas na Amazonia, Manaus, Amazonas.



Platydoryctes soaresi . 1, Mesoscutum; 2, propodeum; 3, metasoma. *P. rafaeli*. 4, mesoscutum; 5, propodeum; 6, metasoma. *P. duckensis* . 7, lateral view of the head and mesosoma; 8, head; 9, mesoscutum; 10, propodeum; 11, metasoma. *P. amazonensis*. 12, mesoscutum; 13, propodeum; 14, metasoma. (scale bars = 0.5mm, except to fig. 9 = 0.6 mm).



Platydoryctes soaresi. 15, wings. *P. duckensis*. 16, hind wing. *P. amazonensis*. 17, fore wing (scale bars = 0.5 mm).

Platydoryctes duckensis Barbalho & Penteado-Dias, NEW SPECIES

(Figures 7-11, 16)

Agrees with the description of *P. soaresi* except as follows: flatter than the holotype and other species (Fig. 7); entire head smooth and shining (Fig. 8); head 1.3 time longer than height; head width 2.1 times eye width; eye width 2 times temple width; 22-23 antennomeres; oral opening 1,8 times longer than malar space; mesoscutum not declivous anteriorly; mesoscutum 2.6 times longer than its height; mesoscutum sculpture as in Figure 9; fore coxae extremely flat; propodeum rugose as in Fig. 10; T1 rugose (Fig. 11), T2 and half of T3 striate, T4 rugose in basal half (Fig. 11); in hind wings *M+CU* longer than *1M* (Fig. 16). Body length 3.2 mm.

Male. Unknown.

Distribution. Amazonas and Rondônia states, Brazil

Holotype. 1 female, Reserva Ducke, Manaus, Amazonas, Brasil, October 13, 1988, J. A. Rafael col., elevated trap, (INPA).

Paratype. 1 female, Ariquemes, Rondônia, Brasil, November, 28, 1986, J. A. Rafael col, Malaise trap, (DCBU).

Etymology. The name *duckensis* refers to the locality Reserva Ducke, near Manaus, Amazonas.

Platydoryctes amazonensis Barbalho & Penteado-Dias, NEW SPECIES

(Figures 12-14, 17)

Agrees with the description of *P. soaresi* except as follows: flatter, more than 22 antennomeres; head 1.3 times longer than height; head width 1.8 time eyes width; eyes width 3.3 times longer than temple; malar space 1.6 longer than oral opening; mesoscutum as in Figure 12; propodeum granulate and with 3 strong central carinae and 2 lateral carinae (Fig. 13); in fore wings *r-m* absent; in hind wings *m-cu* absent (Fig. 17); T1 3 times longer than apical width; T1 with 2 longitudinal carinae extending to the apex of the tergum (Fig. 14); T1 granulate; T2-3 striate, remaining terga smooth (Fig. 14). Body length 4,1 mm.

Although vein *r-m* in fore wing is absent in this species, it is included in this genus because it has all the other characters of the genus.

Male. Unknown.

Distribution. Amazonas state, Brazil.

Holotype. 1 female, Manaus, Amazonas, Reserva Ducke, Brasil, December 20, 1977, Norman Penny col., light trap, (INPA).

Etymology. The name *P. amazonensis* refers to the Brazilian state of Amazonas.

ACKNOWLEDGMENTS

We thank Paul Marsh for the loan of material and help with the project of the first author; CNC (Canadian National Collection) for the loan of specimens; CPPSE (Centro de Pesquisa de Pecuária do Sudeste), EMBRAPA, São Carlos, SP for permits to collect the specimens; FAPESP (Fundação e Amparo à Pesquisa do Estado de São Paulo) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for financial support; Glúcia Marconato for the drawings.

LITERATURE CITED

- Achterberg, C. van.** 1993. Illustrated key to the subfamilies of the Braconidae (Hymenoptera, Braconidae). Zool. Verhand. 283: 1-189.
- Barbalho, S. M. & A. M. Pentead-Dias** 1997. Morfologia do Aparelho de Veneno dos Braconidae Cyclostome (Hymenoptera). Revta. Bras. Zool., 14 (1): 65-71.
- Edson, K. M. & S. B. Vinson** 1979. A comparative morphology of the venom apparatus of female braconids (Hymenoptera, Braconidae). Can. Entomol. 111: 1013-1024.
- Marsh, P. M.** 1993. Description of New Western Hemisphere Genera of the Subfamily Doryctinae (Hymenoptera, Braconidae). Contr. Amer. Entomol. Institute, 28 (1): 1-58.
- Marsh, P.M.** 1997. Subfamily Doryctinae, pp 206-233. In: Wharton, R. A. Marsh, P. M. & Sharkey, M.T. eds. Manual of the New World Genera of the Family Braconidae. Spec. Pub. Int. Soc. Hymen. No. 1, 439 pp.
- Sharkey, M. J.** 1993. Family Braconidae. In: Goulet, H. & J. T. Huber. Hymenoptera of the world: an identification guide to families. Centre for Land and Biol. Resources Research, Ottawa-Ontario, Research Branch Agric. Can. Publ., pp. 362-395.
- Quicke, D. L. J.; Tunstead, J.; Falco, J. V. & P. M. Marsh.** 1992. Venom gland and reservoir morphology in Doryctinae and related braconid wasps (Insecta, Hymenoptera, Braconidae). Zool. Scripta 21: 403-416.
- Wharton, R. A., P. M. Marsh and M. J. Sharkey,** 1997. Manual of the New World Genera of the Family Braconidae. Spec. Pub. Int. Soc. Hymen. No. 1, 439 pp.

BOOKS RECEIVED AND BRIEFLY NOTED

BIODIVERSITY OF THE DOMATIA OCCUPANTS (ANTS, WASPS, BEES, AND OTHERS) OF THE SRI LANKAN MYRMECOPHYTE *HUMBOLDTIA LAURIFOLIA* VAHL (FABACEAE). 1999. K.V. Krombein, B.B. Norden, M.M. Rickson, and F.R. Rickson. Smithsonian Contributions to Zoology, No. 603., Smithsonian Institution Press, Washington, DC. 34 pp. 8¹/₂ x 11. Paper.

Humboldtia laurifolia is a common, and endemic, understory tree in the lowland rain forests of Sri Lanka. Although it is a myrmecophyte, it also *attracts* a diversity of invertebrate associates and possesses a morphology and phenology, including expanded, hollow, self-opening internodes, and a variety of extrafloral nectaries, that facilitate a strong relationship with ants. In this contribution, the authors discuss the variety of organisms interacting with and inhabiting this tree, including, among many others, fourteen taxa of ants, an internode nesting crabronine wasp, an undescribed social xylocopine bee, and several ant predators.

MILLIONS OF MONARCHS, BUNCHES OF BEETLES: HOW BUGS FIND STRENGTH IN NUMBERS. 2000. Gilbert Waldbauer. Harvard University Press. 264 pp. Hard. \$24.95.

In this popularization of insect life, Waldbauer focuses on the group behavior of species that are not as highly organized, socially, or as well known for their social behavior as termites, ants, bees, and wasps. The emphasis in this interesting volume is on ladybird beetles, locusts, mayflies, butterflies, sawfly larvae, tent caterpillars, and others. Why these insects form aggregations and what they get out of their associations are questioned and carefully considered. In addition to the possibility of safety in numbers, many other factors may be involved such as control of temperature and humidity, better food and housing, better chances to mate, and cooperative defense against attacks.

**NEW SPECIES AND A NEW RECORD OF
BORDONTILLA (HYMENOPTERA: MUTILLIDAE)
FROM CHILE¹**

James P. Pitts²

ABSTRACT: *Bordontilla cycloflava*, *B. nigra*, *B. obscura* and *B. xanthomaculata* are newly described from Chile. *Bordontilla patagonica* is newly recorded from Chile. A key to the species of *Bordontilla* is provided.

Fritz and Martinez (1975) described *Bordontilla* as a monotypic genus in the subfamily Sphaerophaminae. This genus includes one of the southern-most mutillids known. *Bordontilla* is characterized by the presence of a fine and distinct curved carina that separates the pronotum from the mesonotum, a strongly convex mesosoma and a prominently tuberculate clypeus. No other information on this genus has been published since the initial work.

Only females of the genus *Bordontilla* have been described. The males may have been described as *Neomutilla* Reed (1898), since only males of *Neomutilla* have been described and these occur in the same region. However, only the collection of a male and female *in copula* or host records will confirm this association. As with most mutillids known today, the natural history and host records are unknown.

Four new species of *Bordontilla* are described, illustrated and discussed below.

MATERIALS AND TERMINOLOGY

Specimens for this study were borrowed from, and are deposited in, the following collections: Canadian National Collections: Ottawa, Ontario (CNCI); J.P. Pitts Collection: Athens, Georgia (JPPC).

T2, T3, etc., denotes the second, third, etc., metasomal tergites respectively, while S2, S3, etc., signifies the second, third, etc., metasomal sternites respectively.

Bordontilla cycloflava, NEW SPECIES (Fig. 1A)

Diagnosis.—This species is readily distinguished from other females of the genus by the following characters: head and mesosoma stramineous,

¹ Received May 28, 1999. Accepted September 6, 1999.

² University of Georgia, Department of Entomology, Athens, Georgia 30602.

metasoma piceous with one medial maculation of T2, the condition of the carina on the dorsal margin of the mesosoma and humeral carina not angulate.

Description of Female.—Coloration of head and mesosoma stramineous. S1-S2 completely and T1 stramineous basally. T2-T5 and S3-S5 piceous. T2 medially with stramineous round maculation. T6 and S6 stramineous. Legs stramineous with infuscated joints. Pubescence golden brown on vertex of head and dorsum of mesosoma. Abdominal pubescence fuscous. Legs with pale pubescence.

Clypeus with posterior border distinctly dentate, median region strongly gibbose, with a deep circular depression laterally and below antennal scape, median anterior region and lateral regions with long pale pubescence. First flagellomere longer than pedicel, and terminal flagellomere longer than preceding segment, with apex obtusely angular. Gena sparsely punctate.

Mesosoma with disk of pronotum, mesonotum, dorsal and lateral faces of propodeum, and metapleura sparsely punctate and nitid. Humeri carinate. A fine carina delimits pronotum from mesonotum and is connected by lateral carina to propodeal spiracle, indistinct just anterior to spiracle. Propodeal spiracle tuberculate. Propodeum without a distinct lateral carina posterior to propodeal spiracle. Propleuron impunctate, with long, pale, dense and decumbent pubescence. Mesopleura impunctate, anteriorly with pale decumbent pubescence.

Metasoma with T1-T2 sparsely punctate and with sparse erect pubescence. T3-T6 with larger punctation and denser pubescence. S1 with median elevated carina, notched medially. S2-S6 with punctation, last with apex weakly truncate. Pygidial area glabrous, nitid and undefined laterally.

Length.—5 mm

Male.—Unknown

Holotype, E: Chile, Malleco, Puren, Contulmo Nat. Mon., 350 m, mixed Evergreen For., FIT, 11.XII.1984-13.II.1985, Coll. S. and J. Peck (CNCI). **Paratypes, 2E:** Chile, Alto de Vilches, 70 km E Talca, 5.XII.1984-20.II.1985, Coll. S. and J. Peck (CNCI and JPPC).

Discussion.—This species is similar to *B. patagonica* with the humeral carina not angulate and the clypeus prominently tuberculate. It is similar to *B. xanthomaculata* in coloration, but differs from this species by the humeral carina, the clypeus more prominently tuberculate and second metasomal tergite with one maculation.

Etymology.—From the Greek *cyclo* “a circle” and the Latin *flava* “yellow,” in reference to the stramineous coloration of the second metasomal segment.

Bordontilla nigra, NEW SPECIES (Fig. 1B)

Diagnosis.—This species is readily distinguishable from other females of the genus by the following characters: head, mesosoma and metasoma concolorous, the dorsum of mesosoma finely striate, appearing dull and humeral carina angulate.

Description of Female.—Coloration of head, mesosoma and metasoma fusco-piceous to piceous. Mandibles and flagellum fuscous. Trochanters, femora basally, tibial

spurs and tarsi infuscated testaceous. Pubescence piceous on vertex of head and dorsum of mesosoma, pale stramineous on front and lateral margins of head, laterally on mesosoma and on legs; T1, all sternites and apical fringe of T2-T5 with pale pubescence; T2-T6 with piceous erect pubescence on disk. Pubescence of legs pale.

Clypeus with posterior border distinctly dentate, median region strongly gibbose, with a deep circular depression laterally and below antennal scape, median anterior region and lateral regions, with long pale setae. First flagellomere as long as pedicel, and terminal flagellomere longer than preceding segment, with apex obtusely angular. Gena punctate and finely striate ventrally.

Mesosoma with disk of pronotum, mesonotum, dorsal and lateral faces of propodeum, and metapleura punctate and finely striate, appearing granulate and dull at low magnification. Humeri with angulate carina. A fine carina delimits pronotum from mesonotum and is connected by lateral carina to propodeal spiracle. Propodeal spiracle tuberculate. Small, glabrous, nitid region on dorsum situated medially from propodeal spiracle. Propleura punctate and finely striate with long, pale, dense and decumbent pubescence. Mesopleura punctate and finely striate, anteriorly with pale decumbent pubescence, posteriorly glabrous and nitid. Latero-posterior region of propodeum punctate, with long pubescence. Legs with dense fuscous pubescence.

Metasoma with T1-T2 sparsely punctate and with sparse erect pubescence. T3-T6 with larger punctation and denser pubescence. S1 with median elevated carina that is notched medially. S2-S6 with sparse punctation, last with apex weakly truncate. Pygidial area glabrous, nitid and undefined laterally.

Length.—6 mm

Male.—Unknown

Holotype, ♀: Chile, Cautin, 15 km NE Villarrica, Flordel Lago, 14.XII.1984-10.II.1985, Coll. S. and J. Peck (CNCI).

Discussion.—This species is similar to *B. xanthomaculata* and *B. obscura* with the angulate humeral carina. The coloration and striations of dorsum and head are different from any described species of *Bordontilla*.

Etymology.—From the Latin *nigra* "black," in reference to the piceous coloration of body.

Bordontilla obscura, NEW SPECIES (Fig. 1D)

Diagnosis.—This species is readily distinguished from other females of the genus by the following characters: head and mesosoma ferruginous and the metasoma piceous, the dorsum of mesosoma and lateral margin of propodeum carinate and humeral carina angulate.

Description of Female.—Head, mesosoma and legs ferruginous. Metasoma piceous. T1 basally and S1 completely infuscated ferruginous. Vertex of head, pronotum, median band on mesonotum, and lateral spot on propodeum infuscated. Legs infuscated, femora and tibial base lighter. Pubescence brown on vertex of head and dorsum of mesosoma and metasoma. All sternites and apical fringe of T2-T5 with pale pubescence. Legs with dense fuscous pubescence.

Clypeus with posterior border moderately dentate, median region moderately gibbose, and laterally below antennal scape with a deep circular depression, median anterior region and lateral regions with long pale setae. First flagellomere as long as pedicel, terminal

flagellomere slightly longer than preceding segment, with apex obtusely angular. Gena sparsely punctate.

Mesosoma with disk of pronotum, mesonotum, dorsal and lateral faces of propodeum, and metapleura sparsely punctate and nitid. Humeri with angulate carina. A fine carina delimits pronotum from mesonotum and is connected by lateral carina to propodeal spiracle. Propodeal spiracle tuberculate. Propodeum with distinct sinuous lateral carina beginning at propodeal spiracle. Propleuron with long pale pubescence, dense and decumbent, impunctate. Mesopleura impunctate, anteriorly with pale decumbent pubescence.

Metasoma with T1-T2 sparsely punctate and with very sparse erect pubescence. T3-T6 with larger punctation and denser pubescence. S1 with median elevated carina, notched medially. S2-S6 with punctations, last with apex weakly truncate. Pygidial area glabrous, nitid and undefined laterally.

Length.—3.5 mm

Male.—Unknown

Holotype, ♀: Chile, Nuble Prov., Las Trancas, 19.5 km ESE, Recinto, 1250 m, 10.XII.1982-3.I.1983, Coll. A. Newton and M. Thayer (CNCI). **Paratype**, 1♀: Chile, Nuble Prov., Las Trancas, 19.5 km ESE, Recinto, 1250 m, 10.XII.1982-3.I.1983, Coll. A. Newton and M. Thayer (JPPC).

Discussion.—This species is similar to *B. xanthomaculata* and *B. nigra* with the humeral carinae angulate and the presence of lateral propodeal carinae. It is similar to *B. patagonica* in coloration, but differs from this species by the angulate humeral carina, the clypeus not as prominently tuberculate, second metasomal sternite smoothly concave (not depressed basally) and the piceous coloration of the metasoma.

Etymology.—From the *obscura* “dark,” in reference to the infuscated regions on the mesosoma.

Bordontilla xanthomaculata, NEW SPECIES (Fig. 1C)

Diagnosis.—This species is readily distinguished from other females of the genus by the following characters: head and mesosoma stramineous and metasoma piceous with two lateral maculations of T2, the condition of the carina on the margin of mesonotum and angulate humeral carina.

Description of Female.—Coloration of head and mesosoma stramineous. S1 completely, T1 and S2 basally stramineous. T2-T6 and S3-S6 piceous. T2 with two stramineous round maculations situated laterally. Legs stramineous with infuscated joints. Pygidial area infuscated stramineous. Pubescence golden brown on vertex of head and dorsum of mesosoma and metasoma. All sternites of metasoma with pale pubescence. Legs with pale pubescence.

Clypeus with posterior border dentate, median region moderately gibbose, and laterally below antennal scape with a circular depression, median anterior region and lateral regions with long pale setae. First flagellomere slightly longer than pedicel, and terminal flagellomere slightly longer than preceding segment, with apex obtusely angular. Gena sparsely punctate.

Mesosoma with disk of pronotum, mesonotum, dorsal and lateral faces of propodeum, and metapleura sparsely punctate and nitid. Humeri with angulate carina. A fine carina delimits pronotum from mesonotum and is connected by lateral carina to propodeal spiracle. Propodeal spiracle tuberculate. Propodeum with indistinct lateral carina posterior to propodeal spiracle. Propleuron impunctate with long, pale, dense and decumbent pubescence. Mesopleura impunctate, anteriorly with pale, decumbent pubescence.

Metasoma with T1-T2 sparsely punctate and with sparse erect pubescence. T3-T6 with larger punctation and denser pubescence. S1 with median elevated carina. S2-S6 sparsely punctate, last with apex weakly truncate. Pygidial area glabrous, nitid and undefined laterally.

Length.—3 mm

Male.—Unknown

Holotype, ♀: Chile, Alto de Vilches, 70 km E Talca, 5.XII.1984-20.II.1985, Coll. S. and J. Peck (CNCI).

Discussion.—This species is similar to *B. obscura* and *B. nigra* by having the humeral carina angulate and the lateral margins of propodeum carinate. Coloration is similar to *B. cycloflava*, but differs from this species by the angulate humeral carina, the clypeus not as prominently tuberculate and second metasomal tergite with two maculations.

Etymology.— From the Greek *xantho* “yellow” and *maculata* “spotted,” in reference to the stramineous maculations of the second metasomal tergite.

Bordontilla patagonica Fritz and Martinez (Fig. 1E)

Bordontilla patagonica Fritz and Martinez, 1975: 129 E

Distribution.—Argentina (Chubut Providence); Chile (Osorno Providence).

New Record.—Chile, Osorno Providence, Puyehue, N. P. Antillanca, 1200m, Nothofagus Tree Line, 16.II.1988, Coll. Lubomir Masner.

Discussion.—The holotype of *B. patagonica* has not been studied. The holotype currently resides in the Antonio Martinez Insect Collection (AMIC) in Salta, Argentina. This specimen, however, fits the description on all accounts.

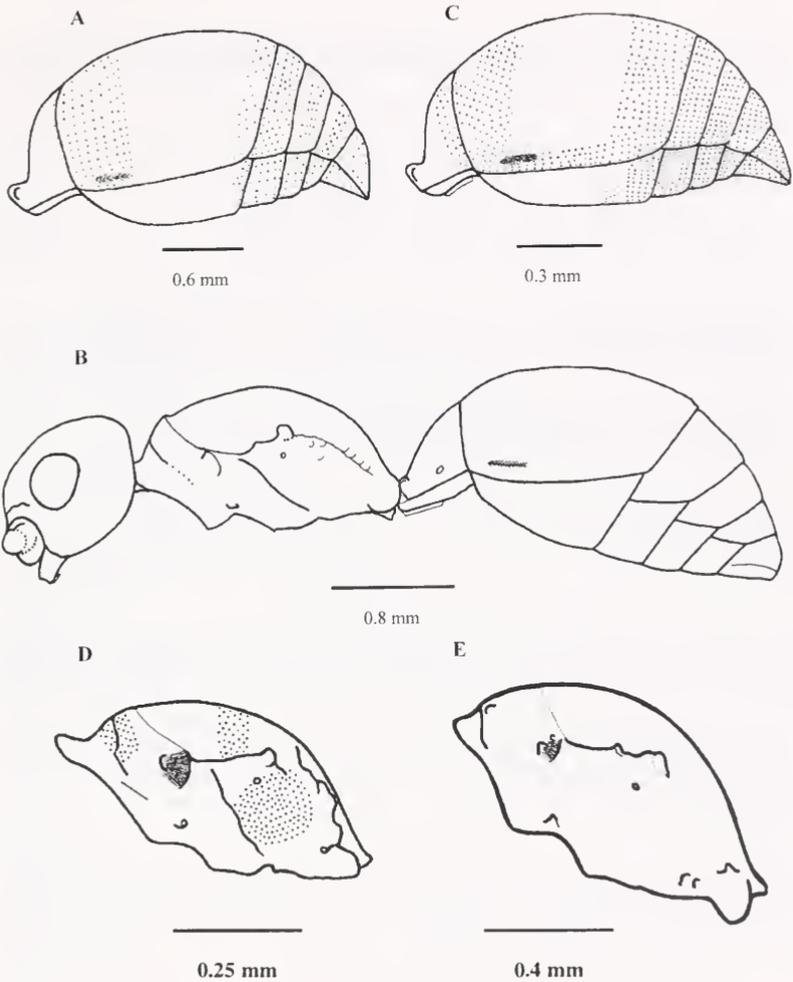


Figure 1. A. *Bordontilla cycloflava*, metasoma lateral view; B. *B. nigra*, lateral view (legs, antennae, and sculpture not shown); C. *B. xanthomaculata*, abdomen lateral view; D. *B. obscura*, thorax lateral view; E. *B. patagonica*, thorax lateral view.

KEY TO FEMALE SPECIES OF *BORDONTILLA*

1. Dorsum of mesosoma striate, with close punctation, appearing dull; mesosoma and metasoma piceous *nigra*, sp. nov.
- 1'. Dorsum of mesosoma nitid, with sparse punctation; mesosoma not concolorous with metasoma 2
2. Mesosoma stramineous; metasomal segments 2-6 not concolorous 3
- 2'. Mesosoma ferruginous; metasomal segments 2-6 concolorous 4
3. Second metasomal segment with 2 stramineous maculations (Fig. 1C); humeral carina distinctly angulate *xanthomaculata*, sp. nov.
- 3'. Second metasomal segment with 1 stramineous maculation (Fig. 1A); humeral carina not angulate *cycloflava*, sp. nov.
4. Mesosoma red, metasoma metallic blue; humeral angles distinctly angulate; mesopleura nitid; propodeum not carinate laterally (Fig. 1E) *patagonica* Fritz and Martinez
- 4'. Mesosoma red with dark spots laterally, metasoma piceous; humeral angles distinctly carinate; mesopleura finely striate; propodeum laterally carinate (Fig. 1D) *obscura*, sp. nov.

ACKNOWLEDGMENTS

I thank Erich Tilgner (University of Georgia, Athens), Tatiana Volkova (University of Georgia, Athens) and Theresa Pitts-Singer (U.S. Forest Service, Athens, GA) for critically reviewing drafts of this paper; John Huber (CNCI) for gracious loan of the specimens; CNCI for a CanaColl grant for travel to the CNCI for study of specimens; Denis Brothers (Peitermaritzburg, South Africa) for answering questions concerning this project. I am grateful for the financial support provided by the University of Georgia, College of Agricultural and Environmental Sciences, Department of Entomology.

LITERATURE CITED

- Fritz, M.A. and A. Martinez.** 1975. Mutillidae Neotropicales. IV. (Hymenoptera) Un genero y especie nuevos de Sphaerophthalminae. *Physis* 34: 129-132.
- Reed, E. C.** 1898. Revision de la "Mutillarias" de la obra de Gay. *Rev. Chilena* 2: 1-4.

VARIABILITY IN THE LARVAE OF *SERRATELLA SERRATA* (EPHEMEROPTERA: EPHEMERELLIDAE)¹

Luke M. Jacobus, W. P. McCafferty²

ABSTRACT: Series of larval specimens of *Serratella serrata* from eastern North America exhibit previously undocumented variability in abdominal characters, especially tubercle armature. A redescription of the species takes this variability into account. Study of the specimens revealed errors in the larval key to the *Serratella* species. The mistakes are noted and corrected.

A character of fundamental importance for the species identification of the larvae of many North American Ephemerellidae has been the relative development and placement of dorsal paired tubercles on the abdomen. This importance is best illustrated by the much used specific keys to larvae in the genera *Caudatella* (Allen and Edmunds 1961a), *Attenella* (Allen and Edmunds 1961b), *Drunella* (Allen and Edmunds 1962), *Serratella* (Allen and Edmunds 1963a), *Eurylophella* (Allen and Edmunds 1963b, Funk and Sweeney 1994), and *Ephemerella* (Allen and Edmunds 1965). Whereas this characterization is presumed to be relatively stable within stated limits, we discovered an unexpected and critical level of variability with respect to such characterization in the common eastern species *Serratella serrata* (Morgan). The discovery has prompted this report and the redescription of the larval stage of *S. serrata* given below. Material examined is deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana.

Series of late instar larvae of *S. serrata* collected from New York, Quebec, and West Virginia exhibited a wide range of variability in abdominal characters, especially in the development of the paired, submedian tubercles on the terga. In the initial description of the larval stage by Morgan (1911), and in a subsequent description by Lestage (1925) (essentially paraphrasing Morgan), these tubercles were described as occurring on terga 4-7. A redescription by Allen and Edmunds (1963a) noted small tubercles sometimes also appearing on terga 3 and 8. Material we have studied demonstrated development of tubercles from tergum 2 to tergum 9. Individual specimens exhibited a series of tubercles on the terga in the following combinations: terga 2-9 (Figs. 1, 2), terga 3-9 (Figs. 3, 4, 5, 6), terga 3-8 (Figs. 9, 10), terga 4-8 (Figs. 7, 8). The smallest tubercles are often best seen in lateral perspective. This armature sometimes appeared more darkly sclerotized than the surrounding integument (Figs. 1, 5, 7), and in some individuals was margined or thickly covered with short, robust, dark setae, referred to as spicules (Figs. 5, 7), while others

¹ Received August 16, 1999. Accepted August 30, 1999.

² Department of Entomology, Purdue University, West Lafayette, IN 47907.

were bare (Figs. 1, 3, 9). The most highly developed tubercles were somewhat hook-like, as seen in lateral view (Fig. 2), while others were smaller to minute and not curved (see especially terga 3 and 9 in Fig. 4).

In addition to structural variability, we also noted stability and variability in abdominal color patterns that have been used in the diagnosis of *S. serrata*. Allen and Edmunds (1963a) described tergum 9 of *S. serrata* with paired sublateral maculae. The specimens we examined also had these maculae; however, most specimens had sublateral maculae present on other terga as well (Figs. 1,3,7,9); in some, maculae were present on terga anteriorly to segment 9, including the first abdominal tergum (Figs. 3,9).

Abdominal terga 5 and 6 on the larvae of *S. serrata* were described by Morgan (1911) as "pale marked with brown pencillings." Traver (1935) also mentioned these pencillings. Later, Allen and Edmunds (1963a) described terga 4-6 as "often pale." The specimens we examined varied in the degree of pencillings present (contrast Fig. 1 and Fig. 5) and also in the situation of pale areas on the terga (contrast Fig. 5 and Fig. 7). Terga 4-7 in our material varied with respect to the pale markings. In some specimens, terga 4 was pale in the posterior half (Figs. 1,3,5); sometimes it was entirely tan or brown (Fig. 7). Terga 5 and 6 most consistently were pale (Figs. 1, 3, 5, 9); however, in one specimen, tergum 5 was dark, and terga 6 and 7 were pale (Fig. 7).

The larval foreleg of *S. serrata*, as figured by Morgan (1913), differed somewhat from the foreleg figured by Allen and Edmunds (1963a). Specimens we examined most closely matched the figure by Allen and Edmunds (1963a); however, there was some variation in setation that would explain the slight discrepancy between the two figures.

In view of these observations, we provide a redescription of the larva of *S. serrata* below. Our description may facilitate more accurate identification of larvae, particularly when only one or few specimens are available in a sample. The description of *S. serrata* is of additional importance, because this species is the type of the genus *Serratella*, which was erected initially as a subgenus by Edmunds (1959) and later given generic status by Allen (1980).

Serratella serrata (Morgan)

Mature Larva. Length: body 5.0-6.0 mm; caudal filaments 1.5-2.0 mm. General color tan to light brown, with varied markings, pale to dark brown. Head: Vertex roughened with no distinct occipital tubercles, but with patches of spicules, often slightly raised. Scape and pedicel of antennae margined with dark brown. Maxillary palpi reduced, three segmented. Thorax: Pronotum with pair of minute submedial tubercles. Legs with femoral, tibial, and tarsal brown bands; femora stout, with long hairlike setae along hind margin; tarsal claws with 3-5 denticles. Abdomen: Gill lamellae on segments 3-7, imbricated, with gills 7 somewhat reduced, often obscured below gills 6; lower fimbriate portion of gills lamelliform. Segments 4-9 with well-developed, dorsoventrally flattened, posterolateral processes; processes brown medially, pale posteriorly, with row of short, robust setae laterally; posterolateral processes of segment 9 most acuminate. Terga vari-

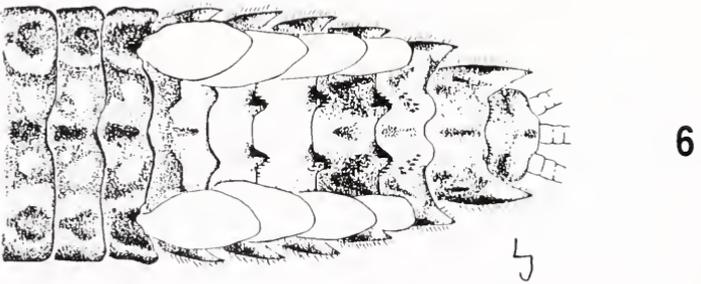
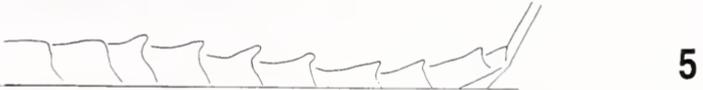
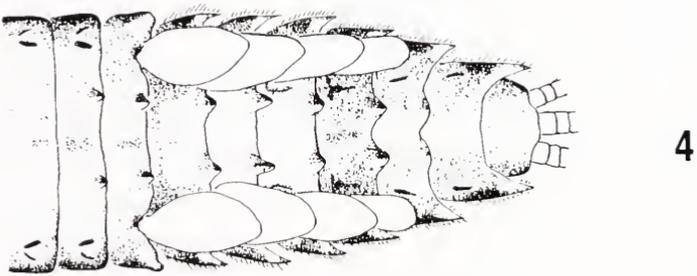
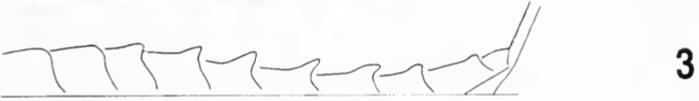
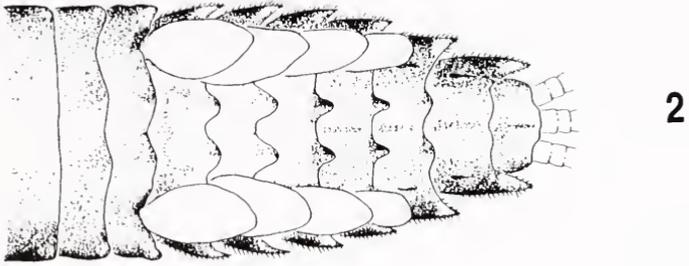
ously marked with dark brown, with sublateral maculae present, most apparent on tergum 9; terga 4-7 with variable large pale regions, usually most prominent on terga 5 and 6; tergum 4 often pale posteriorly only; tergum 7 variable. Paired submedian tubercles, on terga 2-9, 3-7, 3-8, 3-9, 4-8, or 4-7; most prominent and always present on terga 4-7; tubercle shape varies from broadly rounded protuberances to narrowly acute, sometimes slightly hooked processes; in some individuals some or all tubercles without spicules, in some individuals some tubercles with marginal spicules only, and in some individuals some tubercles with surface spicules. Sterna yellowish to light tan, with row of dark dashes in each half. Caudal filaments subequal, pale to brown, with darker median band, without intersegmental setae, with whorls of coarse setae distributed sparsely on apical margins of segments; whorl setae usually longest at approximately two-thirds distance from base to apex of filaments.

Material examined. Five larvae, New York, Sullivan Co., Neversink River below Monticello, 1.5 mi south of SR 17, VII-18-1997, K. Riva-Murray. Six larvae, Quebec, Wakefield, VII-8-1931, L. J. Milne. One larva, West Virginia, Lost River, VIII-12-1930, J. G. Needham.

Remarks. From the redescription above, it is apparent that, depending on what variant is being keyed when using the key of Allen and Edmunds (1963a), larvae of *S. serrata* could be keyed to *S. carolina* (Berner and Allen) on the basis of the dorsal abdominal armature and an incorrect occipital figure citation (see below). It may also be possible that some individuals of *S. serrata* could be keyed to *S. spiculosa* (Berner and Allen). These three species share the presence of occipital spicules and a pair of pronotal tubercles by which they may be distinguished from *S. serratoides* (McDunnough), *S. sordida* (McDunnough), and *S. frisoni* (McDunnough). McDunnough (1931) stated that sternal markings could be used to separate such species as *S. serrata* and *S. serratoides* from each other. We found that the sternal color patterns of the larvae of *S. serrata*, however, varied to such an extent that some individuals might be perceived as *S. serratoides*. If sternal markings were used exclusively, *S. serrata* and *S. serratoides* could be easily confused. In all cases, the presence of pronotal tubercles will separate individuals of *S. serrata* from *S. serratoides*, as noted by Traver (1932).

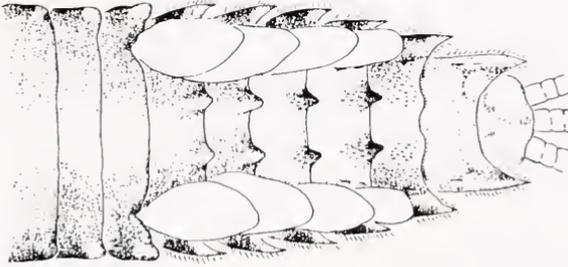
Allen and Edmunds (1963a) described the caudal filaments of *S. serrata* as being "without setae". This could be somewhat misleading because the segments of the caudal filaments indeed have setae on the apical margins, although they do lack intersegmental setae.

Couplet 8 of the Allen and Edmunds' (1963a) larval key to the *Serratella* species refers to figures of larval heads, portraying "paired, submedial, occipital tubercles". The numbering of the figures to which the text of the key refers was evidently inadvertently reversed. Their figure 12 clearly shows occipital tubercles as described in the key and should be labelled as figure 11; consequently, figure 11 should be labelled as 12. We have modified couplets 8 and 9 from Allen and Edmunds (1963a:587) as follows to take into account the new-found variability and figure labelling error reported here. Figures correctly referred to in the following couplets are those of Allen and Edmunds (1963a).





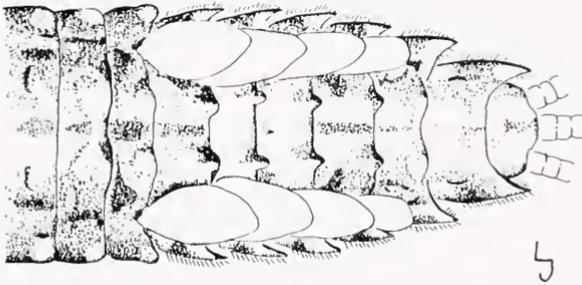
7



8



9



10

5

Figs. 1-10. *Serratella serrata* late instar abdominal variability. 1. Variant 1 (dorsal). 2. Variant 1 (lateral). 3. Variant 2 (dorsal). 4. Variant 2 (lateral). 5. Variant 3 (dorsal). 6. Variant 3 (lateral). 7. Variant 4 (slightly less mature) (dorsal). 8. Variant 4 (slightly less mature) (lateral). 9. Variant 5 (dorsal). 10. Variant 5 (lateral).

- 8 (7). Head with paired, submedian, occipital tubercles (fig. 12) *carolina*
 Head without tubercles (fig. 11) or only roughened (fig. 13) 9
- 9 (8). Head without tubercles, covered with numerous fine spicules as in
 figure 11; maxillary palpi with single segment (fig. 49); tarsal
 claws usually with 6 to 8 denticles (fig. 61) *spiculosa*
 Head roughened and with only patches of spicules as in figure 13;
 maxillary palpi three-segmented (fig. 50); tarsal claws usually
 with 3-5 denticles (fig. 62) *serrata*

ACKNOWLEDGMENTS

We thank A. V. Provonsha (Purdue University) for his expertise and critical eye in checking the figures for this study and G. L. Lester (EcoAnalysts) for the donation of some specimens used in this study. Research was funded in part by a National Science Foundation grant DEB-9901577 to WPM. This study has been assigned Purdue Agricultural Research Program Journal Number 16047.

LITERATURE CITED

- Allen, R. K. 1980. Geographic distribution and reclassification of the subfamily Ephemerellinae (Ephemeroptera: Ephemerellidae). pp. 71-91. In: Flannagan, J. F. and K. E. Marshall, eds. *Advances in Ephemeroptera Biology*. Plenum, New York.
- Allen, R. K. and G. F. Edmunds, Jr. 1961a. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae). II. The subgenus *Caudatella*. *Ann. Entomol. Soc. Am.* 54: 603-612.
- Allen, R. K. and G. F. Edmunds, Jr. 1961b. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae). III. The subgenus *Attenuatella*. *J. Kans. Entomol. Soc.* 34: 161-173.
- Allen, R. K. and G. F. Edmunds, Jr. 1962. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae). V. The subgenus *Drunella* in North America. *Misc. Publ. Entomol. Soc. Am.* 3: 147-179.
- Allen, R. K. and G. F. Edmunds, Jr. 1963a. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae): VI. The subgenus *Serratella* in North America. *Ann. Entomol. Soc. Am.* 56: 583-600.
- Allen, R. K. and G. F. Edmunds, Jr. 1963b. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae). VII. The subgenus *Eurylophella*. *Can. Entomol.* 95: 597-623.
- Allen, R. K. and G. F. Edmunds, Jr. 1965. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae). VIII. The subgenus *Ephemerella* in North America. *Misc. Publ. Entomol. Soc. Am.* 4: 243-282.
- Edmunds, G. F. 1959. Subgeneric groups within the mayfly genus *Ephemerella* (Ephemeroptera: Ephemerellidae). *Ann. Entomol. Soc. Am.* 52: 543-547.
- Funk, D. H. and B. W. Sweeney. 1994. The larvae of eastern North American *Eurylophella* Tiensuu (Ephemeroptera: Ephemerellidae). *Trans. Am. Entomol. Soc.* 120: 209-286.
- Lestage, J. A. 1925. Contribution à l'étude des larves des Éphémères: Ephemerelliden. *Ann. Biol. Lacustre* 13: 227-302.
- McDunnough, J. 1931. The eastern North American species of the genus *Ephemerella* and their nymphs (Ephemeroptera). *Can. Entomol.* 63: 187-197, 201-216.
- Morgan, A. H. 1911. May-flies of Fall Creek. *Ann. Entomol. Soc. Am.* 4: 93-119.
- Morgan, A. H. 1913. A contribution to the biology of mayflies. *Ann. Entomol. Soc. Am.* 6: 371-413.
- Traver, J. R. 1932. Mayflies of North Carolina. *J. Elisha Mitchell Sci. Soc.* 47:85-236.
- Traver, J. R. 1935. Part II systematic. North American mayflies order Ephemeroptera. pp. 237-739. In: J. G. Needham, J. R. Traver and Y.-C. Hsu. *The biology of mayflies*. Comstock, Ithaca, New York.

***PLAUDITUS GRANDIS* (EPHEMEROPTERA: BAETIDAE), A NEW SMALL MINNOW MAYFLY FROM TENNESSEE¹**

N. A. Wiersema², L. S. Long³

ABSTRACT: *Plauditus grandis* new species, is described from adult males and larvae collected from Tennessee. The larvae of *P. grandis* are distinguished from all other North American two-tailed baetids by their large size, distinctive leg setation, narrow labial palpi, tergal patterning, mandibular morphology, absence of hindwingpads, and short median caudal filament. This species appears restricted to the interior low plateau of Tennessee and was usually found with the rarely collected mayfly species, *Paraleptophlebia kirchneri*.

Examination of a large number of specimens recently collected from Tennessee revealed a previously unrecognized species of the small minnow mayfly genus *Plauditus* Lugo-Ortiz and McCafferty (1998). This species is described below as *P. grandis*, in reference to the species comparatively large size among *Plauditus* species.

***Plauditus grandis*, NEW SPECIES**

Larva. Body length: 6.8-8.2 mm, cerci 4.5-5.0 mm. Head: Head capsule with median rows of short, transverse dashes on each side of the medial trunk of the epicranial suture. Labrum as in (Fig. 1) with paired submedial and 6-10 sublateral setae. Maxillae robust and with 2-3 crest setae; palpi two segmented and extending to the galealacinial crest, segment 1 subequal to segment 2. Right mandibular incisors as in Fig. 2. Left mandibular incisors as in Fig. 3. Segment 3 of labial palpi (Fig. 6) narrow, with very slight distolateral point and evenly rounded to weakly concave distal margin; segment 2 with 5-6 dorsal setae. Thorax: Nota of male and female larvae chocolate brown in color with scattered pale and dark areas. Leg coloration and setation similar to (Fig. 5); femora with numerous robust seta adjacent to distal margin and all segments with numerous surface setae. Tarsal claws (Fig. 4) robust and with 11-17 denticles, basal two small. Abdomen: Tergal patterning of mature male larvae usually similar to (Fig. 10); terga of female larva uniform chocolate brown with pale sublateral spots anteriorly and narrow, medial, pale stripe. All terga in both sexes with paired, submedial brown spots, may be difficult to discern. Posterior marginal spines of middle and posterior terga large and rounded apically (Fig. 7). Sterna 2-9 with paired submedial brown spots, submedial oblique markings anteriorly and sublateral brown dashes anteriorly and medially. Gills elongate and symmetrical. Median caudal filament short, about equal in length to basal width of cerci. Cerci with wide band of darkened segments located distal of the midlength.

Male adult. Body length: 7.8-8.2 mm, forewings 6.2-6.6 mm. Head: Dark brown in color; ocelli encircled in medium to dark brown basally. Antennal scape, pedicel and flagella dark to medium brown. Turbinate eyes large with pale orange-brown upper

¹ Received May 14, 1999. Accepted September 9, 1999.

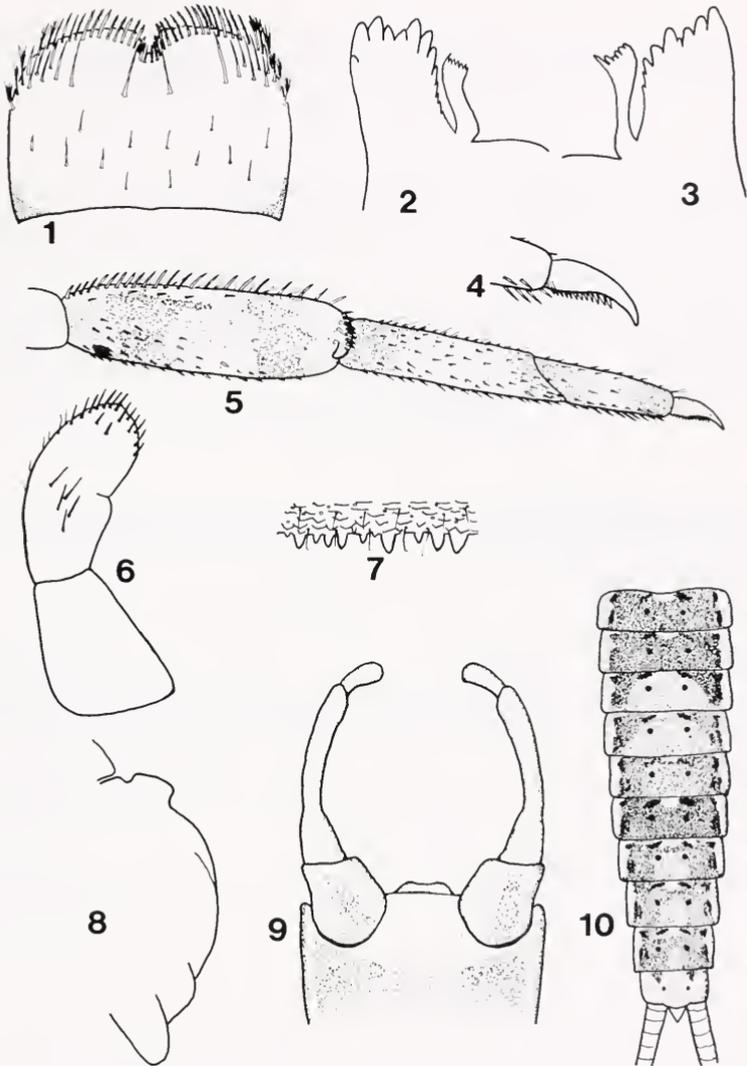
² 4857 Briarbend Drive, Houston, TX 77035.

³ 153 Heritage Creek, Lavergne, TN 37086.

portions and red-brown lower stalks. Thorax: Notae and sterna dark brown with highly contrasting paler areas around sutures; pleura with less extensive dark areas. Anterior process of mesoscutum dorsally oriented with weakly rounded to truncated anterior margin, and moderately to well developed dorsal point usually similar to Fig. 8. Forewings with light brown colored venation, relatively long double marginal intercalaries and often with brown pigmentation in the stigmata area. Forefemora dark brown, tibia paler than tarsi; mid- and hindlegs medium to light brown. Abdomen: All segments medium chocolate brown, posterior segments more intense in color. Sternum 9 with lateral triangular brown markings (Fig. 9). Genitalia as in Fig. 9, with near cylindrical basal forcep segments and segment 3 weakly expanded distally; basomedial process weakly sclerotized and with shallow to deep posterior emargination. Caudal filaments light brown.

Material. HOLOTYPE: Male adult with larval and subimaginal exuviae, TENNESSEE: Rutherford Co., Middle Fork Stones River at Hwy 269 & Short Creek Church, March 21, 1997, L.S. Long (deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana). PARATYPES: 3 male adults with larval and subimaginal exuviae, two exuviae and one genitalia slide mounted in Euparal, same data and deposition as holotype; 1 male and 1 female larvae, TN: Rutherford Co., Dry Fork Creek at Brothers Rd., March 21, 1997, L.S. Long, same deposition as holotype; 1 reared male and 3 larvae, TN: Williamson Co., South Prong Spencer Creek at Liberty Pike and Jordan road, February 19, 1997, L.S. Long, deposited in Florida A&M Entomological Collection. Additional material: TN: Rutherford Co., West Fork Stones River at Panther Creek, March 14, 1998, L.S. Long (female larva in personal collection of NAW); Middle Fork Stones River at Hwy 41 and Hoover's Gap Church, March 21, 1997, L.S. Long (male larva, NAW); Middle Fork Stones River at Lynch & Pruitt, March 14, 1998, L.S. Long (larva slide mounted in CMCP-10, personal collection of LSL).

Diagnosis. Larvae of *P. grandis* are distinguished from all other *Plauditus* species on the basis of their large size; highly distinctive leg coloration and setation; short median caudal filament; narrow labial palpi; tergal and sternal coloration as well as numerous additional features found in the above description. *Plauditus cingulatus* (McDunnough) larvae also have a short median caudal filament similar to *P. grandis*, but are otherwise distinguished by the above features. *Plauditus grandis* males may be confused with *P. futilis* (McDunnough) on the basis of coloration features (abdominal terga olive-brown to clay colored) used in past descriptions and characterization (McDunnough, 1931; Traver, 1935; Jensen, 1969). However, *P. futilis* adult males are smaller in size; have a darkened quadrate-shaped median process between the basal forcep segments without an emarginate posterior margin; longer more robust terminal forcep segments (3.0-3.5 X as long as basal width); and overall paler coloration. Additionally, this is a western species with its eastern limit in the central Hill Country region of Texas and *P. grandis* is likely endemic to Tennessee or the central highlands of the southeastern United States. The coloration and morphology of the male genitalia and sternum 9; large size; overall chocolate brown coloration; and lack of hindwings should distinguish males this species from all known *Acentrella*, *Heterocloea* and *Plauditus* species.



Figs. 1-10. *Plauditus grandis*, n. sp., 1-7, 10 Larva. 1. Labrum (dorsal view). 2. Right mandibular incisors. 3. Left mandibular incisors. 4. Tarsal claw (enlarged). 5. Leg 6. Labial palp (dorsal). 7. Medial posterior margin of abdominal tergum six. 8-9 Adult male. 8. Partial thorax (oriented at 90° angle). 9. Genitalia (ventral). 10. Male larval tergal patterning.

Remarks. The type locality, Short Creek, is a small 2nd order bedrock stream of the Stones River Drainage and is located in the Central Basin of the interior low plateau region of Tennessee. Larvae were collected from clumps of submerged grass along the stream margin at the type locality and from macrophyte beds in shallow run habitats of 1st to 4th order streams within the drainage. *Plauditus grandis* and *Paraleptophlebia kirchneri* Kondratieff & Durfee seem to be endemic to this region and were the only mayfly species collected from temporary streams of the Stones River Drainage. In addition to *P. kirchneri*, *Acentrella ampla* (Traver), *A. turbida* (McDunnough), *Diphetero hageni* (Eaton), *Eurylophella temporalis* (McDunnough), *Plauditus veteris* (McDunnough), and *Stenonema femoratum* (Say) were collected with *P. grandis* from other locations. Based on collection records, emergence would appear to be restricted from February through April.

ACKNOWLEDGMENTS

We would like to thank B. C. Kondratieff (Colorado State University) and R. D. Waltz (Indiana Department Natural Resources) for their helpful critiques of the manuscript version of this publication as well as Howard Boyd and two anonymous reviewers.

LITERATURE CITED

- Jensen, S.L.** 1969. A new species of *Pseudocloeon* from Idaho (Ephemeroptera: Baetidae). Pan-Pac. Entomol. 45: 14-15.
- Lugo-Ortiz, C.R., and W.P. McCafferty.** 1998. A new North American genus of Baetidae (Ephemeroptera) and key to *Baetis* complex genera. Entomol. News 109: 345-353.
- McDunnough, J.** 1931. New species of North American Ephemeroptera. Can. Entomol. 63: 82-93.
- Traver, J.R.** 1935. Part II. Systematic, pp. 239-739 In: J.G. Needham, J.R. Traver and Y.C. Hsu [eds.], The biology of mayflies with a systematic account of North American species. Comstock Publ. Co., Ithaca, New York.
-
-

BOOKS RECEIVED AND BRIEFLY NOTED

A REVISION OF THE GENUS *Theope*: ITS SYSTEMATICS AND BIOLOGY (Lepidoptera: Riodinidae: Nymphidiini). 1999. Jason P.W. Hall. Scientific Publishers, Gainesville, FL. 127 pp. 10 color plates. 8½ x 11. Paper. \$32.50.

A thorough study of the complex Neotropical metalmark butterfly genus *Theope*. Included are descriptions of all species, distribution maps, illustrations of genital characters, keys to species, and notes on biologies. Two new species and two new subspecies are described: 15 lectotypes are designated. The 10 color plates illustrate all species.

LEPTOHYPHES ZALOPE (EPHEMEROPTERA: LEPTOHYPHIDAE): A POLYTYPIC NORTH AND CENTRAL AMERICAN SPECIES¹

D. E. Baumgardner², W. P. McCafferty³

ABSTRACT: Reared larval to adult associations along with the study of extensive type materials and new collections from North and Central America indicate that the little stout crawler mayfly *Leptohyphes zalope* has been described under numerous synonymys, including *L. apache*, n. syn., *L. ferruginus*, n. syn., *L. hispidus*, n. syn., *L. lumas*, n. syn., *L. piraticus*, n. syn., *L. succinus*, n. syn., and *L. zelus*, n. syn. Variation in coloration and size of larvae and adults as well as head spiculation in larvae grades among and within populations of *L. zalope*. Somewhat variable head patterning in the larvae is obscured in pre-emergent larvae, but is otherwise diagnostic, together with the presence of a three-segmented maxillary palpi and a basal process on the outer ventral lamellae of the operculate gill. Adults have a slightly bulbous terminal forceps segment, and somewhat variable but apparently distinctive coloration. The species is wide ranging from the southwestern United States throughout much of Mexico, and Central America to Costa Rica.

The last comparative study of species of *Leptohyphes* Eaton was by Lugo-Ortiz and McCafferty (1995a), wherein six species of *Leptohyphes* along with species of *Haplohyphes* Allen and *Tricorythodes* Ulmer from Central America were treated. McCafferty (1996) listed another 21 species of *Leptohyphes* from Mexico and the USA, bringing the total, previous to the present study, to 36 species known from North and Central America. More specific distributions in Central America, Mexico, and the USA may be found, respectively, in McCafferty and Lugo-Ortiz (1996a), McCafferty and Lugo-Ortiz (1996b) and McCafferty (1997). The genus is clearly of Neotropical origin (e.g., McCafferty et al. 1992, McCafferty 1998), and no species of the genus are known from Canada (McCafferty and Randolph 1998).

Although *Leptohyphes* mayflies are common in streams throughout the southwestern USA, Mexico, Central America, and much of South America, species taxonomy has remained problematic mainly because the vast majority of species have been known only as larvae or only as adults. In fact, among North and Central American species, only three species have been known as both larvae and adults, and only two of those associations were authenticated by rearing. In addition to the lack of stage correlation in species of *Leptohyphes*, some larval characteristics historically used to distinguish the many species known only as larvae have proven to be variable and gradational among and between populations. Discrepancies in the original descriptions and figures of several species have also been cause of concern. For example, Allen variously

¹ Received June 5, 1999. Accepted August 26, 1999.

² Department of Entomology, Texas A & M University, College Station, TX 77843.

³ Department of Entomology, Purdue University, West Lafayette, IN 47907.

described the size of the mature larvae of *L. apache* Allen as 5.5-6.5mm (Allen 1967) and as 4.5-5.5mm (Allen 1978); and Allen (1978, Fig. 36) assigned the exact same illustration to depict *L. zelus* Allen as had been used earlier to depict *L. lumas* Allen and Brusca by Allen and Brusca (1973, Fig. 25). In the adults, many species apparently have structural similarities, such as involve the wings and male genitalia, leaving only color pattern differences to distinguish them. Also, Traver (1958) had incorrectly drawn details of male genitalia. Additional discrepancies from the literature were discussed by Lugo-Ortiz and McCafferty (1995a), or were revealed in the present study and are discussed later in this paper.

In order to better understand species makeup within *Leptohyphes*, the present study initially entailed a detailed examination of the type material of several species described only as larvae by Allen (1967, 1978) and Allen and Brusca (1973). This phase of the study revealed that seven species names were equivalent, including *L. apache*, *L. ferruginus* Allen and Brusca, *L. hispidus* Allen and Brusca, *L. lumas*, *L. piraticus* Allen, *L. succinus* Allen, and *L. zelus*. The study therefore also confirmed the former synonymy by Allen (1978) of *L. lumas* with *L. hispidus*, as well as the former synonymy by Lugo-Ortiz and McCafferty (1995a) of *L. zelus* with *L. lumas*. *Leptohyphes apache* is the senior name among the above.

Another important aspect of the present study involved larva to adult rearings. In Texas, several samples of *Leptohyphes* larvae that fell within the larval morphological definition that is associated with all the above mentioned names (= *L. apache*) were reared. Adults of the reared materials appeared to possibly match the structural characteristics that had been described for *L. beneri* Traver and *L. zalope* Traver from Mexico, and *L. priapus* Traver from Costa Rica (Traver 1958). We thus compared our reared adults with adult types of those three species. Adults clearly matched the types of *L. zalope*, thus revealing the senior synonym applicable to a widespread polytypic species. This was a discovery that had not been anticipated. The conclusions could not have been made merely by comparing type material, at the exclusion of rearings, because *L. apache* (under any of the synonymous names) had been known only as larvae (Allen 1967, 1978; Allen and Brusca 1973), and *L. zalope* had been known only as adults (Traver 1958).

A new synonymy of *L. zalope* is presented below, along with diagnoses of the larval and adult stages, and data on synonymies, distribution, and variability of the species. Collections (and their acronyms) housing materials used in this study include The California Academy of Science, San Francisco (CAS); Florida A & M University, Tallahassee (FAMU); Purdue Entomological Research Collections, West Lafayette, Indiana (PERC); Texas A & M University, College Station (TAMU); Wilbur R. Enns Entomology Museum, University of Missouri, Columbia (UMC); and the University of North Texas, Denton (UNT).

Leptohyphes zalope Traver

Leptohyphes zalope Traver 1958:85.

Leptohyphes apache Allen 1967:352. NEW SYNONYM.

Leptohyphes ferruginus Allen and Brusca 1973:88. NEW SYNONYM.

Leptohyphes hispidus Allen and Brusca 1973:88. NEW SYNONYM.

Leptohyphes lumas Allen and Brusca 1973:91. NEW SYNONYM.

Leptohyphes piraticus Allen 1978:554. NEW SYNONYM.

Leptohyphes succinus Allen 1978:555. NEW SYNONYM.

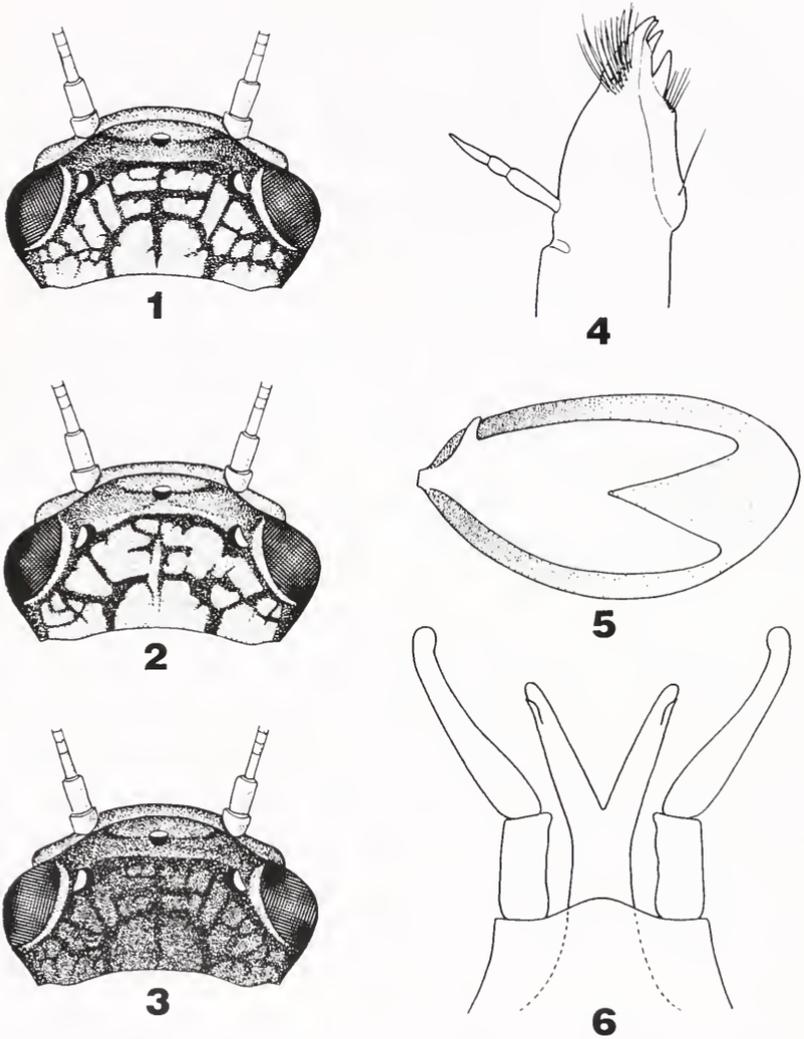
Leptohyphes zelus Allen 1978:557. NEW SYNONYM.

Larval diagnosis. Mature body length: 4.0-7.5mm. Mature caudal filaments length: 3.5-7.0mm. Coloration generally light brown to brown to reddish brown, with somewhat darker markings. Vertex penciling (in all but very early instar and very late instar larvae) ranging as that shown in Figures 1-3, with semicircle at middle third of posterior margin, with longer, more or less straight, oblique lines originating at bases of semicircle and diverging anteriorly, medial straight longitudinal line dissecting the semicircle and beyond anteriorly, and short transverse line anterior to semicircle extending between divergent long oblique lines originating from bases of semicircle; variants with lines incomplete or broken, although semicircle usually recognizable; occasionally vertex appearing entirely variegated or granular; pre-emergent larvae usually with unicolorous dark or dark granular head capsule, and linear markings usually indistinct or difficult to detect. Tarsal claws with row of denticles. Middle abdominal terga not elevated; terga 6 and/or 7 without groupings of highly elongate bristles. Maxillary palpi three segmented (Fig 4). Outer ventral lamellae of gills on abdominal segment 2 (operculate gill set) with well-developed basal beak-like process as in Figure 5.

Male adult diagnosis. Body length: 3.0-5.5mm. Forewing length 4.0-6.0mm. Hindwing length 0.5-1.0mm. Cerci length 10.0-17.0mm. Coloration ranging from cream to yellow or gray to light to dark reddish brown. Head and pronotum overshadowed with black stippling giving a gray cast. Mesonotum ranging from shiny yellow-brown to light reddish brown to dark chestnut brown. Forefemora gray with dark black stippled longitudinal bands. Foreclaws similar and blunt. Wings similar to Figures 1 and 3 in Traver (1958). Abdomen distinctly lighter than thoracic nota, with cream to yellow to gray to reddish brown background color overshadowed by fine black stippling giving gray cast. Genitalia as in Figure 6, with apices of forceps rounded and slightly bulbous, with penes more or less Y shaped, and with each penal lobe with short linear incision subapically in dorsolateral aspect, giving rise to narrower dorsolateral process appressed to tip of penal lobe.

Female adult diagnosis. Body length: 3.5-6.0mm. Forewing length: 5.0-7.0mm. Hindwings absent. Cerci length 4.0-12mm. Body coloration and markings similar to male, although contrast between thoracic nota and abdominal terga often not as pronounced.

Type material examined. *Leptohyphes apache*: HOLOTYPE larva: ARIZONA, Navajo Co, N Fk White R at White River, Fort Apache Indian Reservation, VII-5-1964, R. K. Allen (CAS); PARATOPOTYPES: 14 larvae, one slide (CAS); PARATYPES: ARIZONA, 1 larva, Navajo Co, stream 8 mi N White R, VI-25-1951, S. J. Preece (FAMU), 2 slides (CAS); four larvae, White R 4 mi N White River, VI-15-1951, S. J. Preece (FAMU), 2 slides (CAS); 2 larvae, Yavapai Co, Beaver Cr at Beaver Creek Rangers Stat, VII-4-1964, R. K. Allen (CAS); 2 larvae, Greenlee Co, San Francisco R, at Clifton, VII-4-1964, R. K. Allen (CAS). NEW MEXICO, 11 larvae, four slides, Taylor Cr, Santa Fe Natl For VIII-26-1937, C. M. Tarzwell (CAS). UTAH, 1 larva, Virgin R, Zions Natl Prk, VI-1947, G. F. Edmunds (PERC), 3 slides (CAS).



Figs. 1-6. *Leptohyphes zalope*. 1. Middle instar larval vertex (typical pattern). 2. Middle instar larval vertex (common variant pattern). 3. Pre-emergent instar larva vertex (dark variant). 4. Larval maxilla. 5. Larval gill lamellae of abdominal segment 2 (ventral view, lateral lamellae top). 6. Male adult genitalia.

Leptohyphes bernerii: HOLOTYPE male adult: MEXICO, Metlac, XII-25-1940, H. H. Hobbs (FAMU). ALLOTYPE: same data as holotype. PARATYPES: 22 males, 8 females, same data as holotype.

Leptohyphes ferruginus: HOLOTYPE larva: MEXICO, Veracruz, R San Marcos, at Apapantilla, 3 mi SE Villa A Camacho, XI-12-1968, R. K. Allen (CAS). PARATOPOTYPES: 2 larvae, 4 slides (CAS).

Leptohyphes hispidus: HOLOTYPE larva: MEXICO, Veracruz State, stream 5 mi S Ciudad Mendoza, XI-7-1968, R. K. Allen (CAS). PARATOPOTYPES: 42 larvae (CAS), 1 larva (PERC). PARATYPES: 14 larvae, 2 slides, MEXICO, Veracruz State, R Jamapa, 3 mi NE Coscomatepec, XI-8-1968, R. K. Allen (CAS).

Leptohyphes lumas: HOLOTYPE larva: MEXICO, Chiapas State, stream 7 mi N Arriaga on Hwy 190, VII-20-1966, R. K. Allen (CAS). PARATOPOTYPES: 16 larvae (CAS), 1 larva (PERC). PARATYPES (all R. K. Allen, all CAS): MEXICO, 7 Larvae, Chiapas State, stream 7 mi N Arriaga on Hwy 190, X-23-1968, 3 larvae, stream at Santa Isabel, 12 mi above Arriaga on Hwy 190, X-23-1968, 3 larvae, R Teapa nr Ishuatán, VII-18-1966; 2 larvae, Oaxaca State, R Grande, 3 mi S Gualatao, XI-6-1968; 1 larva, Tabasco, R. Grifalva at Teapa, VII-18-1966; 1 larva, Chiapas, R. Huitlá, 14 mi N Tapachula, XI-1-1968; 7 larvae, Veracruz State, R Jamapa, 3 mi NE Coscomatepec, XI-1-1968, 2 larvae, R. Jamapa, 3 mi NE Coscomatepec, VII-14-1966, 2 larvae, R Tecolapan, Santiago Tuxtla on Hwy 180, VII-16-1966, 5 larvae, R San Marcos, at Apapantilla, 3 mi SE Villa A. Camacho, XI-12-1968.

Leptohyphes piraticus: HOLOTYPE larva, 3 slides: HONDURAS, Dept Choluteca, small stream, Choluteca, ca 16 mi E Jicaro-Galán, Pan Am Hwy, X-10-1964, J. S. Packer (FAMU).

Leptohyphes priapus. HOLOTYPE male adult, slide mounted: COSTA RICA, Río Pedregosa, II-1939, D. L. Rounds (PERC). PARATYPES: 13 male adults and four female adults, same data and deposition as holotype.

Leptohyphes succinus: HOLOTYPE larva: TEXAS, Hays Co, San Marcos R, IV-3-1973, M. Peters (CAS). PARATYPES (all M. Peters, all CAS): 4 larvae, same data as holotype; 8 larvae, same data as holotype, except VI-6-1973; 1 larva, TEXAS, Kerr Co, North Fork Guadalupe R, 4 mi W Hunt, VIII-1973, Guadalupe R. SH 16 crossing, VII-27-1973; 1 larva, 3 slides.

Leptohyphes zalope: HOLOTYPE male adult: MEXICO, 4 mi S of Río Papagayo Bridge on Río Zalope, I-4-1948, S. Mulaik (PERC). PARATYPES: 3 male adults, same data and deposition as holotype.

Leptohyphes zelus: HOLOTYPE larva: HONDURAS, Dept Comayagua, 3 mi N Taulabe on Hwy 1, large river, X-20-1964, J. S. Packer (FAMU). PARATOPOTYPES: 5 larvae, 2 slides (CAS). PARATYPES: GUATEMALA: 44 larvae, R Latoma at km 182 on CA 2, VII-24-1966, R. K. Allen (CAS). HONDURAS (all J. S. Packer, except where noted): 1 larva, Comayagua, steam 5 mi S on Hwy 1 at bridge, X-17-1964, 1 larva, R Humuya 1 mi N Comayagua at bridge, X-17-1964, (CAS); 1 larva, Dept Cortes, R Chamelecon, X-18-1964 (FAMU), 3 larvae, R Blanco 2 mi N Carcol at bridge on Hwy 1, X-18-1964, (CAS); 4 larvae, Dept. Francisco, Morazán, 10 mi E Guaimaca on Hwy 3, small stream XI-6-1964 (FAMU), 1 larva, stream nr La Venta at jct Hwy 3 & R Choluteca, XI-7-1964, Morazán, stream 6.5 mi from jct Hwy 3 & 5 on Hwy 5, XI-7-1964, (CAS); 1 larva, Dept. Olancho, stream 1 mi W Campamento, Galera turn-off on Hwy 3, XI-7-1964 (CAS); 2 larvae, Dept. El Paraíso, small stream ca 3 km E Danli, VIII-29-1964 (CAS), 5 larvae, stream ca 8 km E Danli, VIII-29-1964 (CAS, FAMU); 1 larva, 50 km E Danli, trib R. Guayambre at jct Hwy 14, IX-3-1964 (FAMU); 4 larvae, R Clarrita at San Morano on Hwy to Escuela Agricola, X-29-1968, R. K. Allen (CAS).

Other material examined. (All larvae, unless otherwise indicated.) ARIZONA: Gila

Co. San Carlos R at San Carlos, VII-20-1970, Salt R on Hwy 288, VII-20-1970 (CAS), East Verde R on rd 406, 10 mi E Payson, VII-19-1970 (CAS, FAMU), East Verde R on Hwy 87, VII-18-19-1970 (CAS); Yavapai Co. Oak Cr at Red Rock Crossing, VII-17-18-1970, Oak Cr nr Cornville, VII-18-1970 (CAS), Verde R at Verde Valley, VII-18-1970 (CAS, FAMU). BELIZE: Cayo District, Roaring Cr, riffle, VI-20-1974 (PERC), 13 mi SE Belmopan nr Caves Branch R, I-4-1996 (UMC); Stann Cr District, Dry Cr, 5.7 mi Middlesex on Hummingbird Hwy, I-11-1996 (UMC); Toledo District, Agvacate Cr, 3.9 mi SW Blue Creek Village, I-9-1996, Golden Stream at golden Stream Village, I-10-1996 (UMC). COSTA RICA: Alajuela Prov, R Pizote ca 5 km N Dos Dioses, III-9-1986, R La Paz Pequena, 7.8 km N Vara Blanca, III-3-1986, P N Rincon de la Vieja, Quebrada Provision, III-4-1986 (FAMU); Cartago Prov, R Platanillo, 2.2 km E Tayutic, I-30-1986 (FAMU); Guanacaste Prov, R Los Ahogados, 11.3 km ENE Quebrada Grande, III-7, VI-26-1986 (FAMU); Limón Prov, R Uatisi, W Uatisi, II-2-1986 (FAMU); Punterenas Prov, 10 km N San Vito, at quarry waterfall, III-16-1969 (PERC), R Bellavista, ca 1.5 km NW Las Alturas, VI-15-17-1986, R Ceibro, rt 2, ca 6 km W rd to Buenos Aires, II-2-1986 (FAMU). EL SALVADOR: R Mizata, 27 mi W La Libertad, X-28-1968 (CAS). GUATEMALA: R Latoma at KM 182 on Hwy 2, X-24-1968 (CAS). MEXICO: Chihuahua State, small stream S Pecheco, I-22-1987, R Gavilán, Los Amarillos, VI-23-1987, Arroyo Lalo Varela, trib R Gavilán, VI-22-1987, R Piedras, Verdes nr Pacheco, VI-22-1987 (PERC); Nuevo León State, Cabezones R at Hwy 85, 15 mi N Linares, V-15-1995, Pobillo R, at St Hwy 115, V-15-1995 (TAMU); San Luis Potosí State, Naranjo R at Hwy 80, town of Naranjo, V-18-1995; Tamaulipas State, R Guayalejo (Tamasi) off Hwy 347 nr San Igancio, V-26-1993, Branch of Chihue R at Hwy 101, ca 12 mi S Jaumavae, between km marker 91 & 92, V-17-1995 (TAMU). NEW MEXICO: Catron Co, San Francisco R at Glenwood, VII-21-1970 (CAS); Grant Co, East Fork Gila R on Hwy 527, VI-21-1970, Gila R nr Clifton, Hwy 180, VII-21-1970 (CAS). TEXAS: Bandera Co, Medina R, V-1977, McCafferty et al. (PERC), Medina R at TX 16, 1 mi N Medina, III-8-1997 (TAMU); Bell Co, Little R at FM 2184 NE Holland, SW Rodgers IV-9-1993 (adults) (TAMU); Caldwell Co, San Marcos R, 6 mi NE luling off Hwy 80, VIII-9-1970 (CAS); Comal Co, Guadalupe R at end of Pk Rd 31 in Guadalupe St Prk, X-14, XII-23-1994 (UNT); Hays Co, San Marcos R at Cheatam St in San Marcos II-22-1997 (2 males reared) (TAMU), San Marcos R at Co Rd 101 (Caners Crossing), 1 mi below confluence with Blanco R, in San Marcos city limits, at Hays/Caldwell county line (males and females reared) (TAMU); Kendall Co, Guadalupe R, V-1977, McCafferty et al. (PERC); Kimble Co, Llano R at Texas Tech Field Stat, IV-11-1992 (UNT), Junction South Llano R at Hwy 956, X-13-1996 (TAMU); Menard Co, San Saba R st FM 864 low water bridge, IV-11-1992 (UNT), X-22-1992 (TAMU); Victoria Co, Guadalupe R at Riverside Prk, VIII-24-1997 (adults) (TAMU), VIII-20-1997 (larvae & adults) (TAMU).

Distribution. *Leptohyhes zalope* has been known from Arizona, New Mexico, Texas, and southern Utah in the north to Costa Rica in the south. The distribution patterns shown by the species (under its various synonyms) in Arizona, New Mexico, and Texas were reviewed respectively by Lugo-Ortiz and McCafferty (1995b), McCafferty et al. (1997), and Lugo-Ortiz and McCafferty (1995c). In Texas, the species was previously reported as *L. succinus* from Hays and Kerr Counties (Allen 1978) and from Bandera and Kendall Counties (Lugo-Ortiz and McCafferty 1995c). It is newly reported herein from Bell, Caldwell, Comal, Kimble, and Victoria Counties. In Central America, the species has been reported under various synonyms from Belize, El Salva-

dor, Costa Rica, Guatemala, and Honduras. In Mexico, it has been known from the states of Chiapas, Chihuahua, Guerrero, Oaxaca, Tabasco, and Veracruz. It is newly reported herein from the states of Nuevo León, San Luis Potosí, and Tamaulipas, indicating a general distribution throughout much of Mexico. The species distribution of *L. zalope* from the United States to southern Central America is similar to that of *L. packeri* Allen and certain other species in other families of mayflies, including *Americabaetis pleurus* (Lugo-Ortiz and McCafferty), *Baetodes deficiens* Cohen and Allen, *Callibaetis floridanus* Banks, *C. montanus* Eaton, *C. pictus* (Eaton), and *Cloeodes excogitatus* Waltz and McCafferty (Baetidae); *Caenis diminuta* Walker (Caenidae); *Stenonema mexicanum* (Ulmer) (Heptageniidae); *Isonychia sicca* Walsh (Isonychiidae); and *Thraulodes brunneus* Koss and *T. speciosus* Traver (Leptophlebiidae).

DISCUSSION

Coloration and size of *L. zalope* larvae and adults vary. This is evident to some degree even within populations, sometimes with larger or freshly molted individuals tending to be darker. Abdominal color pattern of larvae was not found to be species specific, although it had been suggested as a specific character previously for some of the synonyms. For example, the abdominal color pattern described for *L. hispidus* by Allen (1978, Fig. 42) was found to be present, partially present, or entirely absent within populations. Both *L. ferruginus* and *L. piraticus* larvae were described as being red, although this color is no longer evident in the preserved type material. Many of the mature specimens of synonyms tend to take on the reddish cast. Type material of *L. lumas* and *L. ferruginus* were taken at the same time from the same locale on the Río San Marcos in Veracruz, Mexico, evidently only differing in general ground coloration. In addition, what Allen (1978) identified as *L. ferruginus* was reported by him from the type locality of *L. piraticus* in Honduras.

Extensive samples demonstrated that when *L. zalope* larvae approach the final molt, patterns on the head capsule are more difficult to detect and sometimes no longer evident as the head becomes much darker. For example, the holotype of *L. hispidus* was based on such a pre-emergent form of *L. zalope*. The remainder of the type series, however, consisted of larvae with characteristic head patterns (Figs. 1, 2). Of all the material examined, middle instar dark forms without distinct patterns were never found. The figure of *L. hispidus* (Allen and Brusca 1973, Fig. 23) is of a pre-emergent larva and explains why Lugo-Ortiz and McCafferty (1995a) continued to consider it a distinct species, although they had recognized the equivalency of *L. lumas* and *L. zelus*.

Reddish color morphs and inconsistent patterning within a single species of mayflies are known within larval populations of other families, for example, *Rhithrogena impersonata* (McDunnough) (Heptageniidae) and *Ephemerella needhami* McDunnough (Ephemerellidae). Sometimes reddish

morphs predominate, but often they are a small proportion of the population. Flowers and Hilsenhoff (1975) showed that the red color becomes more intense and any patterning is more inconsistent in older larvae of reddish morphs of *R. impersonata*. Usually highly diagnostic patterning of the larvae of *Baetis intercalaris* McDunnough (Baetidae) is occasionally absent in certain populations (Waltz et al. 1996), and otherwise distinctive markings are entirely absent in about 5 percent of large populations of *E. needhami* (W. P. McCafferty and A. V. Provonsha, unpublished).

Although adult coloration varies in intensity, consistent features appear to include the longitudinally banded smoky forelegs; the brighter and often darker coloration of the mesonotum as compared especially to the abdomen; and the fine over-stippling on the abdomen that gives it a gray cast no matter what the intensity of ground color (although the stippling is more difficult to detect when the ground color is darker). The main reason we do not consider *L. priapus* (known only as adults) to be a junior synonym of *L. zalope*, despite its evident structural similarities (Traver 1958), is the lack of the foreleg banding and absence of the black stippling on the abdomen in the type material of the latter. *Leptohyphes bernerii*, which was another possible candidate for synonymy because of similar adult male foreclaws, genitalia, and wings, was not considered equivalent because of the concolorous body and other markings, including the apparent lack of fine over-stippling on the abdomen.

In general the only putative difference between *L. succinus* and the other synonyms was body size of larvae. The *L. succinus* type series is in the upper end of body size range (6.0-7.0mm) now known for *L. zalope*; however, Allen (1967) had originally considered larger individuals as *L. apache*, as noted above.

The presence of head spicules in the larvae was found to be a highly variable character that was used by Allen (1978) to separate a number of species of *Leptohyphes*. Even within the type series of *L. apache*, spicules were found to be present, present and sparse, or mostly absent and difficult to detect. The presence of fine spicules (along with reddish color) was used by Allen (1978) to distinguish *L. piraticus* (known only from a single type specimen) from other species, including *L. apache*. The fact that the presence and absence of head spicules can be stable characteristics in distinguishing species of Ephemerellidae (e.g., Allen and Edmunds 1963) may have influenced Allen's attempts to use such characters for distinguishing species of *Leptohyphes*.

Allen (1978) incorrectly indicated that *L. succinus* and *L. apache* lacked what he referred to as the "basal spine" on the operculate gill. Our examination of type material of both of the latter revealed the presence of this characteristic, which is actually a narrow, often pointed fleshy outgrowth, or process, on gill 2. Allen (1978) correctly indicated the presence of this larval characteristic in *L. ferruginus*, *L. hispidus*, *L. lumas*, *L. piraticus*, and *L. zelus*. However,

it is important to note that the structure in question is not an outgrowth of the operculate part of gill 2, as was shown by Figure 2 of Allen (1978), but is actually a colorless outgrowth of the outer ventral lamellae of the gill 2 (see Fig. 5 herein). This discrepancy has also been pointed out by Wang et al. (1998). The process can be difficult to detect because it can be nearly transparent. It is for this reason that close examination is required for accurate detection.

As indicated above, Allen (1978) synonymized *L. lumas* and *L. hispidus*; however, previous to this study, the types of *L. lumas* could not be found at CAS, although they were reportedly there. This was one reason the latter synonymy could not be confirmed prior to this time, for example, by Lugo-Ortiz and McCafferty (1995a). After examining a series of Allen material at CAS labeled as *L. hispidus*, it became apparent that it represented the lost type series of *L. lumas* because it possessed the precise locale labels and number of specimens given under the original description of *L. lumas*. Obviously, Allen, upon synonymizing *L. lumas* with *L. hispidus*, inappropriately removed the original identification labels from the *L. lumas* series and replaced them with *L. hispidus* identification labels. We have restored the correct historical labeling in the materials residing at CAS.

The combination of larval characteristics given under the diagnosis above should serve to distinguish *Leptohyphes zalope* larvae in North and Central America. Further studies of *Leptohyphes*, however, are expected to clarify further the species makeup and diagnoses. It is certainly possible, for example, that even more species names of *Leptohyphes* will eventually fall as synonyms of *L. zalope*, once additional examinations of type materials and additional rearings take place.

Based on larval morphology, Allen (1978) placed, in addition to those now known to be equivalent to *L. zalope*, the following species into what he referred to as the *apache* group of *Leptohyphes*: *L. alleni* Brusca, *L. brunneus* Allen and Brusca, *L. castaneus* Allen, *L. dolani* Allen, *L. michaeli* Allen, *L. mirus*, *L. murdochi* Allen, *L. nanus* Allen, *L. packeri* Allen, *L. paraguttatus* Allen, *L. pilosus* Allen and Brusca, *L. quercus* Kilgore and Allen, *L. robacki* Allen, *L. sabinas* Traver, *L. spiculatus* Allen and Brusca, *L. vescus* Allen, and *L. vulturnus* Allen. We do not know if this is a natural grouping at this time or how many of these species are actually valid.

Although they all apparently share similar claw denticulation and abdominal morphology, such characteristics could very possibly prove to be symplesiomorphies.

The male genitalia of *L. zalope*, and others with similar genitalia (e.g., *L. bernerii* and *L. priapus*), must be examined carefully in order to interpret them correctly. Depending on the slide mount, the short subapical incision of the penial lobes may not be apparent because the divided tip is normally closely appressed (Fig. 6). On the other hand, if the lobe is severely flattened out in a

slide preparation, the tip of the penial lobe can appear to be bifid and divergent. The latter was found to be the case with the examined slide mounts on which Traver (1958) based her Figures 4 and 5, which inaccurately showed the penial lobe tips as being highly divided. The forceps of *L. zalope* are rounded and slightly bulbous apically (Fig. 6). An apparent distinguishing feature in the forceps of *L. berneri* is evident if one were simply referring to Figure 4 of Traver (1958). In that figure of the genitalia of *L. berneri*, Traver showed the terminal forceps segment as being bluntly pointed and quite different from forceps of both *L. zalope* and *L. priapus* (Traver 1958, Fig. 5). Our examination of Traver's types, however, revealed that they were all exactly as that shown for *L. priapus* in her Figure 5, and Figure 6 of *L. zalope* herein. The male genitalia therefore would appear to be of limited use in certain specific diagnoses.

Based on wings with similar venation, and development of the hindwing costal process, genitalia described above and referred to as the *perterseni* type by Traver (1958), and foreclaws that are similar and blunt in the male adult, species closely related to *L. zalope* in North and Central America do indeed include *L. berneri* and *L. priapus*. There remains a possibility that these three species are synonymous as alluded to above, because the adult color differences presently used to distinguish them may eventually prove to be variable and gradational.

ACKNOWLEDGMENTS

We thank A. Provonsha (Purdue University) for illustrations, discussing analyses, and reviewing an early draft. We thank the following for the loan of specimens: B. Henry (University of Texas-Pan American, Edinburg), J. Kennedy (UNT), V. Lee (CAS), J. Peters (FAMU), R. Sites (UMC), and N. Wiersema (Houston). We thank D. Bowles (Texas Parks and Wildlife) and B. Henry for more recent field assistance. We thank G. Edmunds (University of Utah) for the donation of certain materials, including types. We also thank C. Lugo-Ortiz (Albany Museum, South Africa) for reviewing the draft manuscript. Research at Purdue was funded in part by a NSF grant to the second author. Funding for field collections was provided in part by a grant from the University of Texas-Pan American Faculty Research Council, 1992, and funding for publication was provided by the Purdue University Agricultural Research Program. The Paper has been assigned Purdue ARP No. 15938.

LITERATURE CITED

- Allen, R. K. 1967. New species of New World Leptohiphinae (Ephemeroptera: Tricorythidae). *Can. Entomol.* 99: 350-375.
- Allen, R. K. 1978. The nymphs of North and Central America. *Leptohyphes* (Ephemeroptera: Tricorythidae). *Ann. Entomol. Soc. Am.* 71: 537-558.
- Allen, R. K. and R. C. Brusca. 1973. New species of Leptohiphinae from Mexico and Central America (Ephemeroptera: Tricorythidae). *Can. Entomol.* 105: 83-95.
- Allen, R. K. and G. F. Edmunds, Jr. 1963. A revision of the genus *Ephemerella* (Ephemeroptera: Ephemerellidae) VI. The subgenus *Serratella* in North America. *Ann. Entomol. Soc. Am.* 56: 583-600.

- Flowers, R. W. and W. L. Hilsenhoff.** 1975. Heptageniidae (Ephemeroptera) of Wisconsin. *Gr. Lakes Entomol.* 8:201-218.
- Lugo-Ortiz, C. R. and W. P. McCafferty.** 1995a. Contribution to the taxonomy of the Leptohephidae (Insecta: Ephemeroptera) of Central America. *Stud. Neotrop. Fauna Environ.* 30: 165-176.
- Lugo-Ortiz, C. R. and W. P. McCafferty.** 1995b. Annotated inventory of the mayflies (Ephemeroptera) of Arizona. *Entomol. News* 106: 131-140.
- Lugo-Ortiz, C. R. and W. P. McCafferty.** 1995c. The mayflies (Ephemeroptera) of Texas and their biogeographic affinities. Pages 151-236. In: *Current directions in research on Ephemeroptera*. L. Corkum and J. Ciborowski (eds.). Can. Schol. Press, Toronto.
- McCafferty, W. P.** 1996. The Ephemeroptera species of North America and index to their complete nomenclature. *Trans. Am. Entomol. Soc.* 122: 1-54.
- McCafferty, W. P.** 1997. Ephemeroptera. Pages 89-117. In: *Nomina Insecta Nearctica, a checklist of the insects of North America. Volume 4: Non-holometabolous orders*. R. W. Poole and P. Gentili (eds.). Entomol. Infor. Serv., Rockville, Maryland.
- McCafferty, W. P.** 1998. Ephemeroptera and the great American interchange. *J. N. Am. Benthol. Soc.* 17: 1-20.
- McCafferty, W. P., R. W. Flowers, and R. D. Waltz.** 1992. The biogeography of Mesoamerican mayflies. Pages 173-193. In: *Biogeography of Mesoamerica: proceedings of a symposium*. S. P. Darwin and A. L. Weldon (eds.). Tulane Stud. Zool. Bot., Suppl. Publ. No. 1, New Orleans.
- McCafferty, W. P. and C. R. Lugo-Ortiz.** 1996a. Los Efemerópteros (Ephemeroptera) de América Central. *Rev. Nicaragüense Entomol.* 35: 19-28.
- McCafferty, W. P. and C. R. Lugo-Ortiz.** 1996b. Ephemeroptera. Pages 133-145. In: *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento*. Univ. Nacional Autónoma de México, México, D.F.
- McCafferty, W. P., C. R. Lugo-Ortiz, and G. Z. Jacobi.** 1997. Mayfly fauna of New Mexico. *Gr. Basin Natural.* 57: 283-314.
- McCafferty, W. P. and R. P. Randolph.** 1998. Canada mayflies: A faunistic compendium. *Proc. Entomol. Soc. Ontario* 129: 47-97.
- Traver, J. R.** 1958. Some Mexican and Costa Rican mayflies. *Bull. Brooklyn Entomol. Soc.* 53: 81-89.
- Waltz, R. D., D. E. Baumgardner, and J. H. Kennedy.** 1996. An atypical larval color form of *Baetis intercalaris* (Ephemeroptera: Baetidae) from Pennsylvania and the Kiamichi river Basin of southeastern Oklahoma. *Entomol. News* 107: 83-87.
- Wang, T.-Q., R. W. Sites, and W. P. McCafferty.** 1998. Two new species of *Leptohephes* (Ephemeroptera: Leptohephidae) from Ecuador. *Fla. Entomol.* 81: 68-75.

BOOKS RECEIVED AND BRIEFLY NOTED

MITES. ECOLOGY, EVOLUTION, AND BEHAVIOUR. 1999. D.E. Walter and H.C. Proctor. Univ. New South Wales Press, Sydney, Australia. 322 pp. Hard. \$95.00.

A comprehensive natural history of mites and an overview of mite behavior, evolution, and ecology. 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).

DISTRIBUTION AND TAXONOMIC CONTRIBUTIONS TO THE EPHEMEROPTERA FAUNA OF MEXICO AND CENTRAL AMERICA¹

N.A. Wiersema², D.E. Baumgardner³

ABSTRACT: New records for 16 species of mayflies are reported for Belize, Costa Rica and the Mexican states of Chihuahua, Nuevo Leon and Tamaulipas. The presence of *Apobaetis indeprensus* in Tamaulipas represents a new genus record for Mexico. *Fallceon fortipalpus* is reported from Tamaulipas, representing the first report in Mexico and first record other than its type locality in Costa Rica. *Cloeodes excogitatus* is reported in Nuevo Leon and Tamaulipas representing the first known locations in Mexico. A new species, *Cloeodes waltzi*, is described from a distinctive larva collected from the Rio Corona in Tamaulipas, Mexico.

At present there are records of 184 mayfly species within 43 genera and 11 families reported for Mexico and Central America (Domiquez et al. 1996; Lugo-Ortiz and McCafferty 1996a; McCafferty and Lugo-Ortiz 1996ab; Wiersema 1998; Waltz and McCafferty 1999), 121 in Mexico and 106 in Central America. Examination of recent collections from Chihuahua, Nuevo Leon and Tamaulipas, Mexico and Costa Rica and Belize revealed many significant new records within the mayfly families Beatidae, Caenidae, and Leptohyphidae as well as a highly distinctive new species described below as *Cloeodes waltzi* new species. Specimens upon which these reports are based are deposited in the following institutional collections: Brackenridge Field Laboratory of the University of Texas at Austin (BFL); Texas A&M University at College Station (TAMU); Purdue Entomological Research Collection (PERC); Wilber Enns Museum at the University of Missouri (UM).

BAETIDAE

Apobaetis indeprensus Day—MEXICO: Tamaulipas, spring at head of Rio Mante, ca., 10 mi., W of Mante, V-17-1995, D.E. Baumgardner and B.C. Henry (male adult, TAMU). This represents the first report of this species outside the USA. Prior to this report *A. indeprensus* had its known southern limit in Texas (McCafferty and Davis 1992; Wiersema 1998).

Baetodes velmae Cohen & Allen—COSTA RICA: San Jose Prov., Cerro de la Muerte, Rio Savegre at San Gerado de Dota, 09°33'N, 083°48'W, VIII-7-8-1995, C.R. Nelson (larvae, BFL). *Baetodes velmae* was previously known from Panama (Cohen and Allen 1978; Flowers 1987), thus its presence in

¹ Received May 14, 1999. Accepted September 15, 1999.

² 4857 Briarabend Drive, Houston, TX 77035.

³ Department of Entomology, Texas A&M University, College Station, TX 77843-2475.

southern Costa Rica was to be expected.

Callibaetis floridanus Banks—BELIZE: Cayo District, Belmopan at Belmopan Airstrip, I-11-1996 J.C. Abbott (adult female, TAMU). *Callibaetis floridanus* ranges from Pennsylvania (Wiersema, unpublished) in the north-eastern United States to Costa Rica in Central America, but has not previously been reported from Belize.

Callibaetis puntillus McCafferty & Provonsha—BELIZE: Cayo District, Belmopan at Belmopan Airstrip, I-11-1996 J.C. Abbott (adult female, TAMU). This species was previously known from Texas in the United States to Chiapas, Mexico, thus its presence in northern Central America was expected.

Camelobaetidius arriaga (Traver & Edmunds)—BELIZE: Cayo District, Caves Branch River on Hummingbird Belmopan, 13 mi SE, I-4-1996, J.C. Abbott (male adult NAW). The adult male reported above is typical of the form originally characterized under the name of *C. arriaga* (distinctly elongate basal forcep segments and dark blue-black coloration covering the posterior half or margin of most abdominal segments) by Traver and Edmunds (1968). However, an additional adult male from the Belmopan Airstrip was collected by John Abbott a week later which is typical of the form characterized under the name *C. chiapas* (Traver & Edmunds). McCafferty (1996) placed *C. chiapas* and *C. jenseni* (Traver & Edmunds) as junior synonyms of *C. arriaga*. Unfortunately, of the eight species of *Camelobaetidius* known from southern Mexico and Central America only *C. warreni* (Traver and Edmunds) is known from both adults and larvae. *Camelobaetidius arriaga*, *C. chiapas*, and *C. jenseni* are only known as adults, where as *C. kondratieffi* Lugo-Ortiz & McCafferty, *C. musseri* (Traver & Edmunds), *C. similis* Lugo-Ortiz & McCafferty, and *C. sinaloa* (Allen & Murvosh) are only known as larvae. Thus the status of the various aforementioned species will remain unclear until the larval and adult stages are correctly associated.

Camelobaetidius kondratieffi Lugo-Ortiz & McCafferty—COSTA RICA: Puntarenas Prov., Rio Bellavista, Las Alturas Biological Station, VIII-15-1995, C.R. Nelson (larva, BFL). This species was previously known from Guatemala and Belize (Lugo-Ortiz and McCafferty 1996a).

Camelobaetidius similis Lugo-Ortiz & McCafferty—MEXICO: Tamaulipas, Branch of Rio Chihue at Hwy. 101, ca. 12 mi. S of Jaumave, between kilometer 91 & 92, V-17-1995, D.E. Baumgardner & B.C. Henry., (larva, TAMU). This species was previously known from only its type locality in Guerrero, Mexico (Lugo-Ortiz and McCafferty 1995a). The presence of *C. similis* in Tamaulipas, Mexico represents a significant northern extension of its known range. Additionally, this is only the third larva of this species reported to have been collected.

Cloeodes excogitatus Waltz & McCafferty—MEXICO: Nuevo Leon, Rio Pabillo at St. Hwy 115, near Linares, V-15-1995, D.E. Baumgardner & B.C. Henry (larvae, TAMU). Tamaulipas, Rio Pilon at bridge off Hwy 85, near Villa

Mainero, V-16-1995, D.E. Baumgardner & B.C. Henry (larvae, TAMU). The location records reported here represents the first known locations of *C. excogitatus* in Mexico. Previous to this report *C. excogitatus* was known from Arizona (Waltz and McCafferty 1987; Lugo-Ortiz and McCafferty 1995b), an unknown locality in Mexico (Lugo-Ortiz and McCafferty 1994), and recently in Texas (Baumgardner and Wiersema 1999) and northern California (Waltz et al. 1998).

Cloeodes waltzi, NEW SPECIES

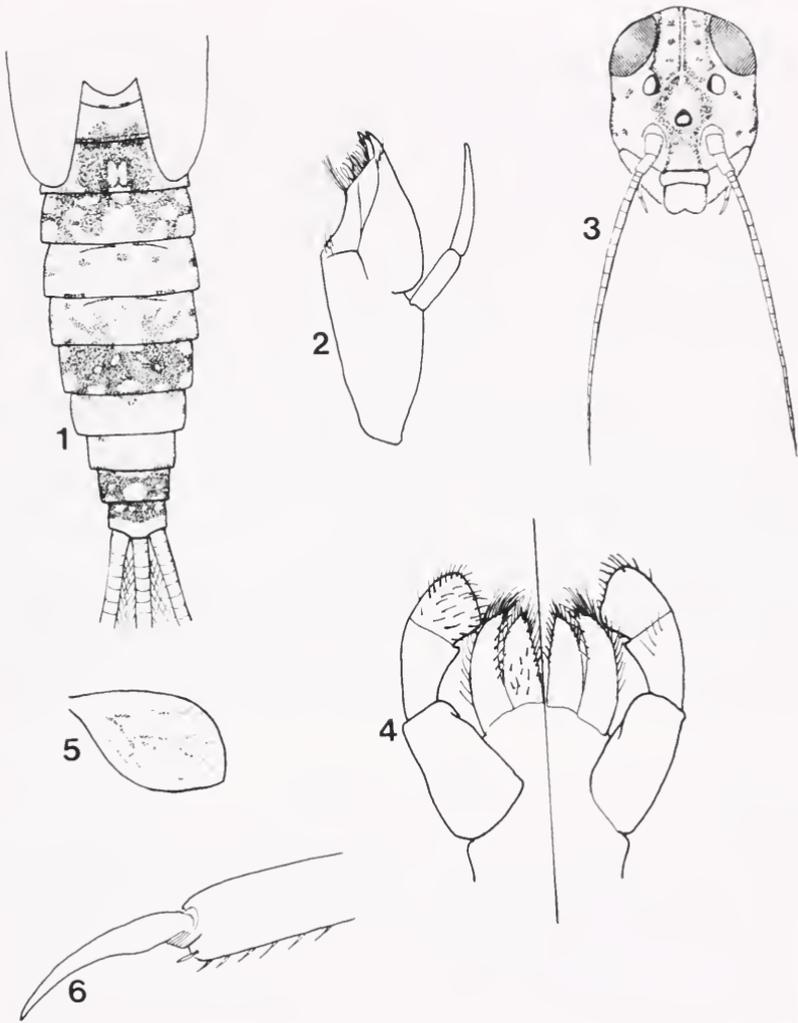
(Figs. 1-6)

Larva. Lengths: body 5.2 mm (female); median caudal filament 2.0 mm; cerci 2.2 mm. Head: (Fig. 3) Coloration pale yellowish, with distinct dorsal patterning of 3-4 brown spots on each side of the epicranial suture, as well as distinct frontal patterning. Frons not developed into intra-antennal process. Antennae about half as long as larval body. Labrum with deep medial emargination along nearly parallel anterior margin; paired submedial and 2-3 lateral elongate, simple setae. Right mandibular denticulation 3(1)+1+3 with well developed tuft of setae near the molar region. Left mandibular incisors damaged, but apparently with 3(1)+1+3 denticulation. Segment 2 of labial palpi (Fig. 4) with 4-5 dorsal setae, segment 3 narrowly truncate apically. Paraglossae with 4-5 dorsal, inner marginal setae medioapically and 5-6 ventral inner marginal setae; glossae robust, with 14-16 inner marginal setae. Maxillae with 3 galealaciniae crest setae; palpi (Fig. 2) elongate and two segmented. Thorax: Pronotum with brown patterning on each side of wide medial pale area. Meso- and metathoracic nota with patterning of light and dark areas. Thoracic sterna entirely pale yellowish except for dark brown coloration adjacent to intersegmental areas of metathoracic coxae. Mesonotal crest [convex medial longitudinal suture of mesonotum] well developed in anterior half. Hindwingpads absent. Femora with large brown area medially and two lanceolate setae distally, tibia with an arc of fine, hairlike setae basally and darkened distally with one lanceolate subtended setae, tarsi with short row of fine, hair-like setae and darkened basally; tarsal claws elongate and narrow (Fig. 6). Abdomen: Terga (Fig. 1) with distinct patterning of light and dark areas. Anterior margin of abdominal sterna 2-8 with darkened, transverse bands and paired lateral brown spots; transverse bands increasing in size and connecting to the lateral spots posteriorly; sternite 9 entirely brown in the anterior three-fourths. Gills elongate and rounded medially with broken tracheation (Fig. 5), gill seven extending to middle of segment 9. Posterior lateral spines elongate and widely spaced. Caudal filaments with narrow, subdistal band of darkened segments.

Adult. Unknown.

Material. HOLOTYPE: female larva (body and headcapsule in alcohol, mouthparts and mesothoracic leg mounted on slide in euparal) MEXICO: Tamaulipas, Rio Corona at Hwy 85, ca. 15 mi north of Victoria, V-16-1995, D.E. Baumgardner & B.C. Henry (PERC).

Etymology. We are honored in naming this species after Robert D. Waltz in recognition of his extensive contributions to our understanding of the diverse and complex family Baetidae.



Figs. 1-6. *Cloeodes waltzi*, n. sp., 1-6 Larva. 1. Tergal patterning. 2. Maxillae. 3. Head capsule. 4. Labium (right dorsal, left ventral). 5. Gill five. 6. Tarsal claw.

Diagnosis. The larvae of *C. waltzi* are at once distinguished from all other *Cloeodes* Traver species found in North and Middle America by the possession of apically truncate labial palpi; elongate two segmented maxillary palpi; elongate antennae; elongate and narrowed tarsal claws; distinctly patterned head capsule; and tergal patterning. The tergal patterning and labial palps are reminiscent of the Brazilian species *C. hydration* Lugo-Ortiz & McCafferty (1996b). However, no relationship can be ascertained at this time. *Cloeodes* species have additionally been found in Africa (Waltz and McCafferty 1994), Australia (Lugo-Ortiz and McCafferty 1998), Cuba (Kluge 1991), and Madagascar (Lugo-Ortiz et al. 1999) since the world revision presented by Waltz and McCafferty (1987).

Fallceon fortipalpus Lugo-Ortiz & McCafferty—MEXICO: Tamaulipas, Rio Pilon at bridge off Hwy 85, at Villa Mainero, V-16-1995, D.E. Baumgardner & B.C. Henry (2 larvae TAMU, some parts on slide in euparal). Previous to this report, *F. fotipalpus* was only known from its type locality in Costa Rica (Lugo-Ortiz et al. 1994).

Fallceon longifolius (Kluge)—BELIZE: Cayo District, Caves Branch River on Hummingbird Belmopan, 13 mi SE, I-4-1996, J.C. Abbott (17 adult males, TAMU and NAW); Cayo District, Macal River on road to Coracal Augustine, 10 mi S, I-6-1996, J.C. Abbott (2 adult males, TAMU). This species was previously only known from southeastern Cuba and Hidalgo, Mexico (Lugo-Ortiz et al. 1994).

Fallceon quilleri Dodds—MEXICO: Tamaulipas, spring (at local park) at Hidlago Ave.?, 1 kilometer W of Juamave off Hwy 101, V-16-1995, D.E. Baumgardner & B.C. Henry (6 adult males, TAMU); Branch of Rio Chihue at Hwy 101, ca. 12 mi S of Juamave V-17-1995 D.E. Baumgardner & B.C. Henry (larva, TAMU). BELIZE: Cayo District, Caves Branch River on Hummingbird Belmopan, 13 mi SE, I-4-1996, J.C. Abbott (3 adult males, TAMU). This widespread species is known from as far south as Costa Rica in Central America (McCafferty and Lugo-Ortiz 1996b) and as far north as the Black Hills of South Dakota in North America (McCafferty 1990), but previous to now was not reported from Tamaulipas, Mexico.

Paracloeodes minutus (Daggy)—BELIZE: Cayo District, Caves Branch River on Hummingbird Belmopan, 13 mi SE, I-4-1996, J.C. Abbott (15 adult males, TAMU). This common trans-continental species ranges from California to North Carolina (Wiersema, unpublished) in the United States, as far north as Ontario, Canada and as far south as Costa Rica, but has not previously been reported from Belize.

CAENIDAE

Caenis latipennis Banks—MEXICO: Chihuahua, Rio Chuviscar, off rd. to Namiquipa, Hwy 160, X-22-1995, D.E. Bowles (3 males, TAMU). Nuevo Leon, Rio Pobillo at Hwy 115, nr Linares, V-15-1995, D.E. Baumgardner & B.C. Henry (male, TAMU). Tamaulipas, Rio Chorretas at Las Norias, XII-23-1971 (9 males and 36 females, TAMU). This widespread and common small square-gill mayfly was previously reported only from the states of Chiapas and Nuevo Leon in Mexico (McCafferty and Lugo-Ortiz 1996b).

Caenis punctata McDunnough—MEXICO: Nuevo Leon, Rio Pilon at unnamed rd., across from General Teran off Hwy 35, V-15-1995, D.E. Baumgardner & B.C. Henry (larva, TAMU). This represents the first report of this principally eastern North American species in Mexico.

LEPTOHYPHIDAE

Leptohyphes dicinctus Allen & Brusca—BELIZE: Stann Creek District, North Stann Creek, 2.7 mi SE Middlesex on Hummingbird Hwy, I-11-1996, R.W. Sites (6 larvae, UM). This species was previously known only from Guerrero, Mexico. With respect to diagnosis these larvae lack the row of long posterior marginal "spines" on tergum 6, as described in Allen (1978).

Leptohyphes vescus Allen—MEXICO: Tamaulipas, Rio Guayalejo off Hwy 247, nr San Ignacio, V-26-1993, B.C. Henry (larvae, TAMU); spring (at local park) at Hidalgo Ave?, near Juamave on Hwy 101, V-16-1995, D.E. Baumgardner & B.C. Henry (2 males, TAMU). *Leptohyphes vescus* was described and has been known only from Texas.

ACKNOWLEDGMENTS

We would like to thank Charles Riley Nelson (Brigham Young University), David Bowles (Texas Parks and Wildlife Department), Robert Sites (Wilber Enns Museum, University of Missouri), Brad Henry (University of Texas Pan-America) and John Abbott (University of Texas at Austin) for the loan or gift of some of the material used in this study. We would also like to thank Brad Henry and Boris Kondratieff (Colorado State University) for their helpful critique of the manuscript version of this publication. We finally thank Howard Boyd and two anonymous reviewers for their helpful notes on the submitted version. The collecting trip of Brad Henry and Dave Baumgardner into Mexico was made possible through a Faculty Research Grant, Faculty Research Council, UTPA.

LITERATURE CITED

- Allen, R.K. 1978. The nymphs of North and Central American *Leptohyphes* (Ephemeroptera: Tricorythidae). Ann. Entomol. Soc. Am. 71: 537-558.
- Baumgardner, D.B. and N.A. Wiersema. 1999. Additions to the inventory of Texas mayflies (Ephemeroptera). Entomol. News 110: 70-71.
- Cohen, S.D. and R.K. Allen. 1978. Generic revisions of mayfly nymphs. III. *Baetodes* in North and Central America (Baetidae). J. Kansas Entomol. Soc. 51: 253-269.

- Domiquez, E., C. Molineri and W.L. Peters.** 1996. Ephemeroptera from Central and South America: New species of the *Farrodes bimaculatus* group with key for the males. *Stud. Neotrop. Fauna & Environm* 31: 87-101.
- Flowers, R.W.** 1987. The adult stage of three Central American *Baetodes* (Ephemeroptera: Baetidae) with notes on the genus. *Aq. Insects* 9: 1-10.
- Kluge, N.Y.** 1991. Cuban mayflies of family Baetidae (Ephemeroptera) 1. *Callibaetis*, *Cloodes*, and *Paraclodes*. *Zool. Zh.* 12: 128-136 [in Russian]
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1994. New records of Ephemeroptera from Mexico. *Entomol. News* 105: 17-26.
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1995a. Taxonomy of the North and Central American species of *Camelobaetidius* (Ephemeroptera: Baetidae). *Entomol. News* 106: 178-192.
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1995b. Annotated inventory of the mayflies (Ephemeroptera) of Arizona. *Entomol. News* 106: 131-140.
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1996a. New Central American and Mexican records of Ephemeroptera species. *Entomol. News* 107: 303-310.
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1996b. *Cloodes hydaton*, n. sp. (Ephemeroptera: Baetidae): an extraordinary, drought tolerant mayfly from Brazil. *Entomol. News* 106: 29-35.
- Lugo-Ortiz, C.R. and W.P. McCafferty.** 1998. First report and new species of the genus *Cloodes* (Ephemeroptera: Baetidae) from Australia. *Entomol. News* 109: 122-128.
- Lugo-Ortiz, C.R., W.P. McCafferty, and J.-L. Gattolliat.** 1999. The small minnow mayfly genus *Cloodes* Traver (Ephemeroptera: Baetidae) in Madagascar. *Proc. Entomol. Soc. Wash.* 101: 208-211.
- Lugo-Ortiz, C.R., W.P. McCafferty and R.D. Waltz.** 1994. Contribution to the taxonomy of the Panamerican genus *Fallceon* (Ephemeroptera: Baetidae). *J. New York Entomol. Soc.* 102: 46-475.
- McCafferty, W.P.** 1990. Biogeographic affinities of the Ephemeroptera of the Black Hills, South Dakota. *Entomol. News* 101: 193-199.
- McCafferty, W.P.** 1996. The Ephemeroptera species of North America and index to their complete nomenclature. *Trans. Am. Entomol. Soc.* 122: 1-54.
- McCafferty, W.P. and J.R. Davis.** 1992. New and additional records of small minnow mayflies (Ephemeroptera: Baetidae) from Texas. *Entomol. News* 103: 199-209.
- McCafferty, W.P. and C.R. Lugo-Ortiz.** 1996a. Los efemerópteros (Ephemeroptera) de America Central. *Rev. Nica. Entomol.* 35: 19-28.
- McCafferty, W.P. and C.R. Lugo-Ortiz.** 1996b. Ephemeroptera. pp. 133-145. In J.E. Llorente-Bousquets, A.N. García-Aldrete and E. González-Soriano (eds.). *Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento.* Universidad Nacional Autónoma de México, México DF.
- Traver, J.R. and G.F. Edmunds.** 1968. A revision of the Baetidae with spatulate-clawed nymphs (Ephemeroptera). *Pac. Insects* 10: 629-677.
- Waltz, R.D. and W.P. McCafferty.** 1987. Revision of the genus *Cloodes* Traver (Ephemeroptera: Baetidae). *Ann. Entomol. Soc. Am.* 80: 191-207.
- Waltz, R.D. and W.P. McCafferty.** 1994. *Cloodes* (Ephemeroptera: Baetidae) in Africa. *Aq. Insects* 16: 165-169.
- Waltz, R.D., P. Ode, and J. Lee.** 1998. *Cloodes excogitatus* (Ephemeroptera: Baetidae) in northern California. *Entomol. News* 109: 215-216.
- Waltz, R.D. and W.P. McCafferty.** 1999. Additions to the taxonomy of *Americabaetis* (Ephemeroptera: Baetidae): *A. lugoi* n. sp., adult of *A. robacki*, and key to larvae. *Entomol. News* 109: 39-44.
- Wiersema, N.A.** 1998. *Camelobaetidius variabilis* (Ephemeroptera: Baetidae), a new species from Texas, Oklahoma and Mexico. *Entomol. News* 110: 21-26.

ALTERED PHOTOCYCLIC REGIMES INFLUENCE THE DURATION OF MATERNAL CARE IN A BURROWER BUG (HETEROPTERA: CYDNIIDAE)¹

Scott L. Kight²

ABSTRACT. Female burrower bugs, *Sehirus cinctus* (Heteroptera: Cydnidae), terminate egg care after a predictable interval when eggs do not hatch. This study examined the influence of light/dark (L:D) cycling on the termination of care. Females kept under rapidly cycling light/dark periods (15L:3D) did not differ from controls (15L:9D), with both groups terminating care 8 days after anticipated hatch. In contrast, females kept under slowly cycling light/dark periods (15L:15D) remained responsive for 2 additional days. In terms of the number of light/dark cycles experienced, however, females under slowly cycling light/dark periods (15L:15D) were similar to controls (15L:9D), with both groups terminating care 8 photocycles after anticipated hatch. In contrast, females kept under rapidly cycling light/dark periods (15L:3D) remained responsive for 2 additional photocycles. The results of this study suggest that insect subsocial behavior is influenced by metabolic and photocyclic cues.

Sehirus cinctus Palisot (Heteroptera: Cydnidae) is a subsocial burrower bug that exhibits well-defined maternal behavior. Females guard eggs and first-instar nymphs in small burrows, responding defensively to intruders by shielding the offspring with their bodies (Sites & McPherson 1982; Kight 1996). Immediately after eggs hatch, females forage and provision the burrow with host plant fruits (*Prunella vulgaris*: Labeaceae). Several days later, nymphs disperse and maternal behavior ends.

The primary cues governing the termination of care are associated with egg hatching (Kight 1997). However, when mature eggs are experimentally replaced with immature stimulus eggs, females continue brooding past the normal period of care, but consistently terminate care after a predictable period of time (Kight 1997). Under such conditions, the cues normally associated with egg hatching are absent, and termination of parental care appears to be governed by a time-sensitive endogenous process.

The duration of maternal behavior could be influenced by an internal clock, external cues, or a combination of both (reviewed by Saunders 1982). Because the cycling of day and night provide a readily available cue, the predictable duration of care among egg-replaced female *S. cinctus* could be a function of cumulative photoperiod (Goryshin & Tyshchenko 1974; Gibbs 1975; Veerman & Vaz Nunes 1984). Studies of cumulative photoperiod effects have most often examined induction or termination of diapause (Williams & Adkisson 1964; Goryshin & Tyshchenko 1973; Veerman & Vaz Nunes

¹ Received June 17, 1999. Accepted September 15, 1999.

² Department of Biology and Molecular Biology, Montclair State University, Upper Montclair, New Jersey 07043.

1987; Hardie 1990; Numata 1992; Vaz Nunes & Hardie 1993, 1994), although a similar mechanism could potentially govern the termination of care in some insects.

In this study I examine the hypothesis that light/dark cycling influences the duration of care in egg-replaced *Sehirus cinctus* females.

MATERIALS AND METHODS

Adult *Sehirus cinctus* were collected in Monroe County, Indiana, USA and housed in mixed-sex groups at 25°C and a 15L:9D light/dark photocytle in ventilated petri dishes containing moist sand and fed fruits of the host plant *Prunella vulgaris*. After oviposition, experimental subjects were transferred to individual enclosures and placed in environmental chambers with adjustable photoperiod.

Control. Immediately after oviposition, control females were isolated at 25°C in 15L:9D chambers. Shortly before hatching, mature eggs were replaced with immature eggs recently laid by donor females. Females do not discriminate between their own eggs and strange eggs placed in the nest (Kight 1995); hence, this cross-fostering technique was useful for examining the duration of maternal behavior when mothers do not experience egg hatching. Subjects were observed for 10 days after their own (removed) eggs hatched (PH = post-hatch).

Altered Photocycles. To examine the influence of light/dark cycling on maternal care, a group of egg-brooding females was held at 25°C, with a 15L:3D photoperiod (fast-cycle 18h females). A similar group was held at 25°C and 15L:15D (slow-cycle 30h females). Shortly before hatching, mature eggs in both treatment groups were replaced with immature eggs recently laid by donor females. In the 10 days after their own (removed) eggs hatched, subjects kept on 18h cycles experienced 13 light/dark cycles, whereas those under 30h cycles experienced 8 light/dark cycles.

I measured maternal responsiveness in all treatment groups with a daily behavioral assay of each female's response to disturbance (Kight 1996). Daily trials were conducted over a range of four hours to ensure that all insects were under scotophase during observations. Subjects were gently touched five times with a dissecting probe on the posterolateral margin of the abdomen at 30 s intervals. Females responded in one of three ways: defense (moving toward the probe), retreat (moving away from the probe), or stasis (no response). By assigning a numeric value to each response (+1 defense, 0 stasis, -1 retreat), a daily score was calculated ranging from -5 (always retreating) to +5 (always defending). All subjects were tested in this manner for 10 days PH.

Each treatment group contained 20 females. Data were analyzed using nonparametric statistical procedures (Siegel & Castellan 1988) with $\alpha = 0.05$.

RESULTS

Maternal response scores (Fig. 1) of control (15L:9D) females never differed significantly from those of fast-cycle (15L:3D) females (Wilcoxon-Mann-Whitney Test, $N=20$, $P>0.0856$ for all days), but were significantly lower than those of slow-cycle (15L:15D) females on day eight PH (Wilcoxon-Mann-Whitney Test, $N=20$, $P=0.0212$) and marginally lower on day nine PH ($P=0.0661$).

There was, however, a pronounced difference between the photocyclic extremes (Fig. 1). Maternal response scores of fast-cycle (18h) females began to fall on day eight PH, and were significantly lower than those of slow-cycle (30h) females after and including day nine PH (Wilcoxon-Mann-Whitney Test, $P \leq 0.0197$ for days nine to ten PH).

Duration of maternal responsiveness was therefore influenced by the rate of light/dark cycling in that females experiencing abnormally long (30h) cycles remained responsive for 24 to 48h longer than either control females or females under short (18h) cycles.

When data were examined in terms of the number of *experienced* light/dark cycles, both slow-cycle (30h) females and control females experienced approximately 7 cycles PH before terminating care (Fig. 2). Fast-cycle (18h) females, however, remained responsive for 9 cycles PH—two more than controls and slow-cycle (30h) females. Thus fast-cycle (18h) females remained maternal for more cycles than expected from control data.

DISCUSSION

The life history of *Sehirus cinctus* may demand reliable mechanisms to determine duration of care. Reproduction is synchronized with availability of the host plant, which flowers for only several weeks each spring (Kight 1995). Pre-reproductive females feed on developing host plant fruits, and by the time oviposition occurs fruits have matured and fallen from the plants. When eggs hatch, fruits remain available, but *Prunella vulgaris* is rapidly displaced by other spring annuals and the source of provisions diminishes (Kight 1996). Should eggs fail to hatch, females could suffer reduced fitness if a replacement clutch is not initiated before the food source disappears.

There is evidence in other species that internal mechanisms govern the duration of care given to offspring. For example, female burying beetles, *Necrophorus vespilloides*, respond maternally to conspecific stimulus larvae only during the anticipated hatching period of their own young (Müller & Eggert 1990). Stimulus larvae presented to the mother either too early or too late are killed by her, but larvae introduced at the time of hatching elicit maternal care from her. Similar behavior is found in male house mice, *Mus domesticus*, which generally attack and kill stimulus pups, but show inhibi-

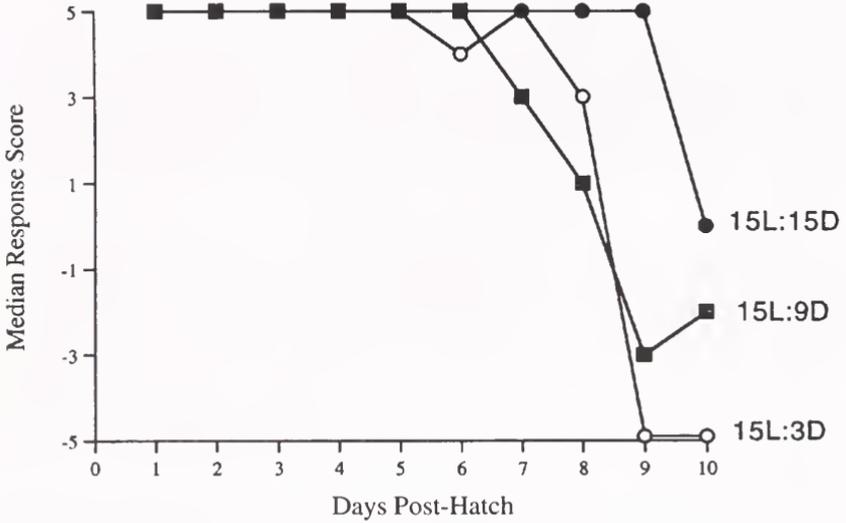


Figure 1. Median maternal response scores of cross-fostered brooding mothers kept under different photocyclic regimes.

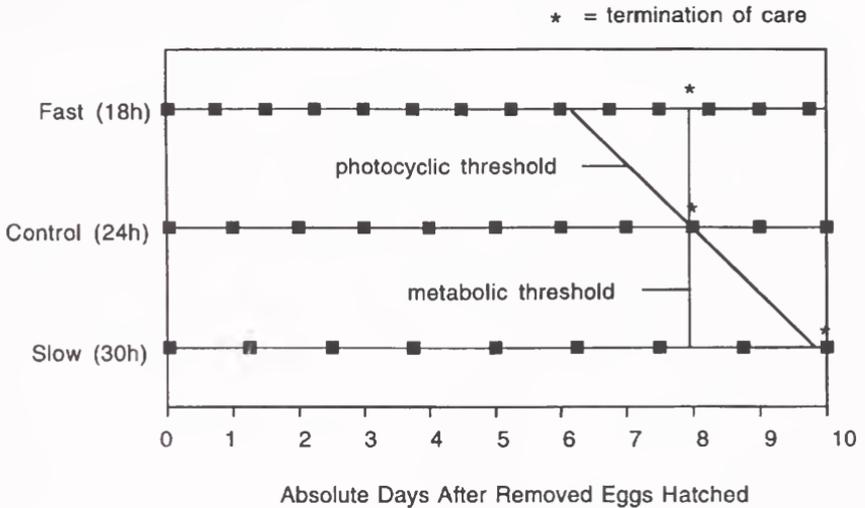


Figure 2. Time-line of experienced photoperiods for brooding females kept under cycles of different length. Distance between squares is one cycle. Photocyclic threshold (diagonal line) refers to the predicted minimum number of light/dark cycles prior to termination of care. Metabolic threshold (vertical line) refers to the predicted minimum number of absolute days prior to the termination of care. Asterisks indicate when termination actually occurred.

tion of infanticidal behavior at a predictable time after mating. Moreover, the interval between ejaculation and inhibition of infanticide in mice coincides with the gestation period of potentially sired young (Perrigo et al. 1990). This interval can be shortened or lengthened by placing mice under non-24 h light/dark cycles (Perrigo et al. 1990, 1992).

The results of the present study indicate that the duration of egg care in *Sehirus cinctus* is similarly influenced by light/dark cycles. In terms of absolute time, females experiencing 18h or 24h cycles terminated care 24-48 h earlier than females experiencing 30h cycles. However, if females based the termination of care exclusively on the number of light/dark cycles experienced, 18h cycle females should terminate care earlier than controls, but this did not occur.

One possible explanation is that the mechanism is metabolically compensated—females may terminate care when sufficiently hungry. At 25°C, threshold metabolic demand (hunger) would have occurred in control females 7 absolute days after their own (removed) eggs hatched. Fast-cycle (18h) females continued brooding for 9 cycles and 7 days PH, which is consistent with the metabolic demand hypothesis: females became sufficiently hungry at 7 days PH, regardless of the number of cycles perceived. This hypothesis is supported by evidence that maternal females terminate care earlier when housed at warmer ambient temperatures (Kight & Cseke 1998) and anecdotal observations of egg-replaced females leaving the burrow to gather single fruits for their own consumption, always within 24 h of termination of care. Metabolic demand and maternal motivation may be competing processes.

Slow-cycle (30h) females, however, remained responsive for 7 cycles but 9 days PH, indicating that metabolic demand is not sufficient for the termination of care. Because all treatment groups were housed at the same ambient temperature, slow-cycle (30h) females had metabolic demands similar to fast-cycle (18h) and control females at 7 days PH. That slow-cycle females remained maternal for additional absolute time indicates that a minimum number of photocycles must also be experienced prior to termination of care, although it is possible that metabolic demand would eventually circumvent this minimum under more extreme photocyclic conditions (i.e. longer cycles or constant light/dark).

An alternative explanation for these findings is that slow-cycle females would reach a metabolic threshold less quickly if metabolic expenditure decreases at night. If, for example, maternal females were more vigilant during the day, slow-cycle females, which did not experience as many photocycles as the other groups by day 7 PH, would have expended less cumulative energy. Brooding females in all treatment groups, however, were generally slow to

respond to the initial experimental stimulus of each daily trial but responded immediately to subsequent stimuli, suggesting that daytime metabolic expenditure is minimal prior to disturbance.

The results of this study indicate that egg-replaced burrower bugs kept at 25°C do not terminate care until both 7 absolute days and 7 photocycles PH have passed. While these events occur simultaneously under natural circumstances, both conditions were met before termination of care even when absolute time and photocycle were experimentally uncoupled (Fig. 2).

Because post-hatching maternal provisioning of food is important for offspring survival, reproductively successful females should not terminate care early. *S. cinctus* thus appears to have evolved a mechanism to prevent maladaptively premature termination of care. The present study represents the first demonstration that insect parental behavior is influenced by cumulative light/dark cycling.

ACKNOWLEDGMENTS

The manuscript benefitted from readings by P. Clark, J. Jenkins, B. Possidente, W. Rowland, J. Smallwood and D. Vanderklein.

LITERATURE CITED

- Gibbs, D. 1975. Reversal of pupal diapause in *Sarcophaga argyrostoma* by temperature shifts after puparium formation. *J. Ins. Physiol.* 21, p. 1179-1186.
- Goryshin, N.I. & Tyshchenko, G.F. 1973. The accumulation of photoperiod information in the cabbage moth *Barathra brassicae* L. (Lepidoptera, Noctuidae) during diapause induction. *Ent. Obozr.* 52, p. 249-255.
- Goryshin, N.I. & Tyshchenko, V.P. 1974. The place of the memory link in the mechanism of photoperiod reaction in insects. *Zhurnal Obshchei Biologii* 35, p. 518-530.
- Hardie, J. 1990. The photoperiodic counter, quantitative day-length effects and scotophase timing in the vetch aphid *Megoura viciae*. *J. Ins. Physiol.* 36, p. 939-950.
- Kight, S.L. 1995. Do maternal burrower bugs, *Sehirus cinctus* Palisot (Heteroptera: Cydnidae), use spatial and chemical cues for egg-discrimination? *Can. J. Zool.* 73, p. 815-817.
- Kight, S.L. 1996. Concaveation and maintenance of maternal behavior in a burrower bug (*Sehirus cinctus*): A comparative perspective. *J. Comp. Psych.* 110:69-76.
- Kight, S.L. 1997. Factors influencing maternal behavior in a burrower bug, *Sehirus cinctus*, (Hemiptera: Cydnidae). *Anim. Behav.* 53:105-112
- Kight, S.L. & Cseke, J.J. 1998. The effects of ambient temperature on the duration of maternal care in a burrower bug (Heteroptera: Cydnidae). *J. Kans. Ent. Soc.* 71:185-187.
- Müller, J.K. & Eggert, A.K. 1990. Time-dependent shifts between infanticidal and parental behavior in female burying beetles: a mechanism of indirect mother-offspring recognition. *Behav. Ecol. Sociobiol.* 27, p. 11-16.
- Numata, H. 1992. Temporal variation in the photoperiodic induction and termination of adult diapause in the bean bug, *Riptortus clavatus*. *J. Ins. Physiol.* 38, p. 447-452.
- Perrigo, G., Bryant, W.C. & Vom Saal, F.S. 1990. A unique neural timing system prevents male mice from harming their own offspring. *Anim. Behav.* 39, p. 535-539.
- Perrigo, G., Belvin, L. & Vom Saal, F.S. 1992. Time and sex in the male mouse: Temporal regulation of infanticide and parental behavior. *Chronobiol. Int.* 9, p. 421-433.

- Saunders, D.S. 1982. *Insect Clocks*, 2nd ed. Pergamon Press, Oxford.
- Siegel, S. & Castellan, N.J. Jr. 1988. *Nonparametric Statistics for the Behavioral Sciences*. New York, McGraw Hill.
- Sites, R.W. & McPherson, J.E. 1982. Life history and laboratory rearing of *Sehirus cinctus cinctus* (Hemiptera: Cydnidae), with description of immature stages. *Ann. Ent. Soc. Am.* 75, p. 210-215.
- Vaz Nunes, M. & Hardie, J. 1993. A model for the photoperiodic counter in the aphid *Megoura viciae*. *J. Ins. Physiol.* 39, p. 173-182.
- Vaz Nunes, M. & Hardie, J. 1994. The photoperiodic counter in the black bean aphid, *Aphis fabae*. *J. Ins. Physiol.* 40, p. 827-834.
- Veerman, A. & Vaz Nunes, M. 1984. Photoperiod reception in spider mites: photoreceptor, clock and counter. *Photoperiodic Regulation of Insect and Molluscan Hormones*. pp. 48-64. Ciba Foundation Symposium 104. Pitman, London.
- Veerman, A. & Vaz Nunes, M. 1987. Analysis of the operation of the photoperiodic counter provides evidence for hourglass time measurement in the spider mite *Tetranychus urticae*. *J. Comp. Physiol. (A)* 160, p. 421-430.
- Williams, C.M. & Adkisson, P.L. 1964. Physiology of insect diapause. XIV. An endocrine mechanism for the photoperiodic control of pupal diapause in the oak silkworm, *Antheraea pernyi*. *Biol. Bull. Mar. Biol. Lab., Woods Hole*. 128, p. 497-507.

BOOKS RECEIVED AND BRIEFLY NOTED

THE BIOMECHANICS OF INSECT FLIGHT. FORM, FUNCTION, EVOLUTION. 2000. Robert Dudley. Princeton University Press. 476 pp. Hard. \$49.50.

Beginning from an overview of insect flight biomechanics, this author goes on to explain insect morphology, wing motions, aerodynamics, flight energetics, and flight metabolism within a modern phylogenetic setting. Drawing on biomechanical principles, he describes and evaluates flight behavior and the limits to flight performance, and develops evolutionary explanations of insect flight. He analyzes the origins of flight in insects, the roles of natural and sexual selection in determining how insects fly, and the relationship between flight and insect size, pollination, predation, dispersal, and migration. The main focus of the text is the author's explanation of functional design from evolutionary and ecological perspectives. Also noteworthy is the synthesis of literature (over 100 pp.) on insect flight.

THE TIGER BEETLE GENUS OXYCHEILA (INSECTA: COLEOPTERA: CICINDELIDAE). 1999. J. Wiesner. COLEOPTERA. Schwanfelder Coleopterologische Mitteilungen. Schwanfeld, Germany. 81 pp. 4 color plates. 8¹/₂ x 11. Paper.

A complete systematic revision of the genus. 46 species are included. For each species, the following are presented: synonymies, type specimen or status, diagnosis, description or re-description, distribution, localities, ecology, and etymology. 55 diagnostic figures. 48 specimens illustrated on 4 color plates.

CANTHARIDIN ATTRACTION IN *PYROCHROA* (COLEOPTERA: PYROCHROIDAE)¹

Gianluca Nardi², Marco A. Bologna³

ABSTRACT: A new case of probable cantharidin attraction in beetles of the genus *Pyrochroa* is recorded. Observed feeding on blister beetle tissues is related to possible cantharidin transfer during copulation as demonstrated in other pyrochroine Pyrochroidae.

Cantharidin is a toxic terpenoid present in the haemolymph and tissues of Meloidae and Oedemeridae beetles, with probable intraspecific attractive function, at least in blister beetles, and representing a feeding deterrent against vertebrates (except in a few cases, e.g. toads) and predaceous arthropods. Nevertheless, cantharidin is strongly attractive to several species of insects of different orders, particularly other tenebrionoid Coleoptera. A recent review on canthariphily was published by Dettner (1997).

The first records of cantharidin attraction in pyrochroine Pyrochroidae were published for three Nearctic species by Young (1984a, 1984b): *Schizotus cervicalis* Newman, *Neopyrochroa femoralis* (LeConte), and *N. flabellata* (Fabricius). This phenomenon was observed in two Palaearctic species: *Pyrochroa serraticornis serraticornis* (Scopoli) by Bologna and Havelka (1985, without subspecies association), and *Schizotus pectinicornis* (Linnaeus) by Holz et al. (1994).

The new observation of attraction concerns one male of *P. s. serraticornis* from Latium, Cisterna di Latina, Italy (Latina Province, UTM 33TUG198068, April 8 1991, G. Nardi leg., 2:15 PM), found on a dead male of *Meloe (Meloe) proscarabaeus* Linnaeus used as bait under hazel trees (*Corylus avellana* Linnaeus). This blister beetle was collected in the same locality a few days earlier (April 2 1991, G. Nardi leg.).

The single previous record of this *Pyrochroa* species, published by Bologna and Havelka (1985: Latium Apennines), reported a male displaying courtship behavior on a *Meloe (Meloe) violaceus* Marsham male, which itself was simultaneously in homospecific courtship. The new record concerns a male of *P. serraticornis* feeding on the first abdominal sternites of the blister beetle; feeding continued for one hour in a rearing box.

The cantharidin assumption was recorded in males of *N. flabellata* and *S. pectinicornis* (cf. Dettner, 1997 for a review and detailed literature). Males store cantharidin chiefly in the reproductive apparatus and can secrete it through

¹ Received March 11, 1999. Accepted April 6, 1999.

² Via Galileo Galilei, 14, 04012 Cisterna di Latina (LT), Italy. e-mail: l_nardi@hotmail.com

³ Dipartimento di Biologia, Università degli Studi "Roma Tre", Viale G. Marconi 446, 00146 Roma, Italy. e-mail: bologna@bio.uniroma3.it

a cephalic exocrine gland. Females, during courtship, check the presence of this substance in this gland and copulate with a male having a higher load of cantharidin; most of this stored substance is transferred during copulation into the female spermatheca. Females can transfer cantharidin to the eggs and consequently larvae are protected against predators.

Pyrochroidae of the subfamily Pedilinae (considered as a distinct family by some authors), and other beetles of the families Anthicidae, Endomychidae, Staphylinidae and Chrysomelidae also have been recorded in the field feeding on Meloidae and Oedemeridae tissues (cf. Dettner, 1997 for a review on the significance of this behavior).

Based on the new feeding record in *P. serraticornis*, and the presence of the cephalic gland at least in the closely related *P. coccinea* (Linnaeus) (Schütz and Dettner, 1992), we suspect that cantharidin transfer during copulation also occurred in *Pyrochroa*. This phenomenon could also be particularly significant because fire-colored beetles of this genus have repellent glands with unknown chemical products, and could represent model species in mimicry complexes with other beetles such as Elateridae (Liberto, 1993) and Lycidae (Bologna and Nardi, unpubl.).

LITERATURE CITED

- Bologna, M. A. and P. Havelka. 1985. Nuove segnalazioni di attrazione della cantaridina dei Meloidae su Coleotteri e Ditteri. Boll. Assoc. Romana Entomol. 39 (1984): 77-82.
- Dettner, K. 1997. Inter- and Intraspecific Transfer of Toxic Insect Compound Cantharidin: 115-145. In: Dettner K. et al. (eds.), Vertical Food Web Interactions. Ecol. Studies, 130.
- Holz, C., G. Streil, K. Dettner, J. Dütemeyer and W. Boland. 1994. Intersexual Transfer of a Toxic Terpenoid during Copulation and its Paternal Allocation to Developmental Stages: Quantification of Cantharidin in Cantharidin-Producing Oedemerids (Coleoptera: Oedemeridae) and Canthariphilous Pyrochroids (Coleoptera: Pyrochroidae). Z. Naturforsch. 49c: 856-864.
- Liberto, A. 1993. Osservazioni sistematiche ed eco-etologiche su *Anostirus (Parastirus) cerruini* Binaghi (Coleoptera, Elateridae). Boll. Assoc. Romana Entomol. 47 (1992): 81-85.
- Schütz, C. and K. Dettner. 1992. Cantharidin-secretion by elytral notches of male Anthicid species (Coleoptera: Anthicidae). Z. Naturforsch. 47c: 290-299.
- Young, D. K. 1984a. Field studies on cantharidin orientation by *Neopyrochroa flabellata* (Coleoptera: Pyrochroidae). Great Lakes Entomol. 17: 133-135.
- Young, D. K. 1984b. Field records and observations of Insects associated with cantharidin. Great Lakes Entomol. 17: 195-199.

SOCIETY MEETING OF OCTOBER 27, 1999**(Academy of Natural Sciences, Philadelphia)****Jamie Cromartie, Richard Stockton College of New Jersey****Dan Otte, Academy of Natural Sciences****THE AES LIBRARY: FROM LINNEAUS TO THE WORLD WIDE WEB**

The meeting was held in The Ewell Sale Stewart Library of the Academy of Natural Sciences, which holds the books, journals and other collections of the AES. For the presentation, Jamie Cromartie and library director Dan Elliott selected about fifty volumes. These ranged from early works by Linnaeus and Fabricius, through rare, beautifully illustrated books by John Abbott and others, to recent catalogs and field guides. Dr. Cromartie pointed out several themes in the display, including the discovery and naming of familiar and unfamiliar species, particularly of moths and butterflies.

A series of books and journals laid out the story of the Rare Skipper, *Problema bulenta*, originally figured by Abbott, but not seen by scientists again until the 1920's. It has recently been found in New Jersey. Another theme was works of noted lepidopterists. Among them were the published papers of novelist Vladimir Nabokov on American butterflies, including his description of the Karner blue. Other authors highlighted were scientists at the Academy or affiliated with AES. The books and journals also showed the evolution of scientific publication in insect systematics, culminating in a collection of Lepidoptera web sites, available on the terminals in the library.

Links to these pages can be found at <http://www.stockton.edu/~cromartw/lepidoptera.html>

The catalog of the ANSP library can be searched online at <http://www.acnatsci.org/library/>

To more fully show the power and potential of the web as a tool for scientific study of biodiversity, Dr. Otte gave a demonstration of the Orthoptera Species File Online, found at <http://viceroi.eeb.uconn.edu/orthoptera>

"The Orthoptera Species File (OSF) is a taxonomic database of the world's orthopteroid insects. It contains full synonymic and taxonomic information for over 25,000 species and genera (all taxa described prior to 1998) of the Tettigonioidea (katydids and hagrids), Grylloidea (crickets), Acridomorpha (locusts and grasshoppers: Acridoidea + Eumastacoidea + Trigonopterygoidea + Pneumoroidea + Pamphagoidea), Tetrigoidea (pygmy grasshoppers), and Tridactyloidea (sand crickets), as well as images and sounds for many species. A database for the Gryllacridoidea will become available in the second half of 1999. This site also includes a searchable database of entomologists working on the Orthoptera."

William J. Cromartie,
Corresponding Secretary

When submitting papers, all authors are requested to (1) provide the names of two qualified individuals who have critically reviewed the manuscript *before* it is submitted and (2) suggest the names and addresses of two qualified authorities in the subject field to whom the manuscript may be referred by the editor for final review. All papers are submitted to recognized authorities for final review before acceptance.

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.

Illustrations: For maximum size and definition, full page figures, including legends, should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4 1/2 x 6 1/2 inches. Authors will be charged for all text figures and half-tones at the rate of \$20.00 each, regardless of size.

Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in The Entomologist's Library on books dealing with taxonomy, systematics, morphology, physiology ecology, behavior and similar aspects of insect life and related arthropods. Books on applied, economic and regulatory entomology, on toxicology and related subjects will not be considered.

Study notices, want items and for sale notices are published in The Entomologist's Market Place .

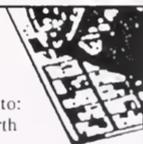
Page charges: For society members, a charge of \$20.00 is made for each published page of an article, plus costs of all illustrations. For non-society members, the page charge is \$25.00 per page. If any charges are not paid within 120 days of billing, authors will be charged an additional \$5.00 per page. Papers may be published ahead of their regularly scheduled time at a cost of \$35.00 per page.

Unemployed and retired amateur and scientist members of the American Entomological Society who are without institutional support or are not subsidized by grants and who are without funds for publishing may apply for financial assistance at the time their manuscript is submitted. Such application must include an explanation of the author's status (unemployed or retired). Page charges for these individuals are negotiable, with a minimum of \$10.00 per page.

Reprints: (without covers) may be ordered when corrected page proofs are returned to the editor. Schedule of reprint costs will appear on order form.

This publication is available
in microform from University
Microforms International.

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.



The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at \$1.00 per line, payable in advance to the editor. Notice of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

The following books are available from Kendall/Hunt Publishing:

An Introduction to the Aquatic Insects of North America edited by Richard W. Merritt and Kenneth W. Cummins (1995/880 pages/wire coil/\$69.95*/ISBN 0-7872-3241-6 or 1995/880 pages/otabind/\$78.69*/ ISBN 0-7872-3240-8). **Aquatic Insects**, with readings written by 41 experts, will quickly become your standard reference book. It includes features such as: comprehensive coverage of behavior, collecting, biomonitoring, and taxonomy; well-illustrated keys to major life stages of North American aquatic insects; and tables at the end of every identification chapter with summaries at the generic level of the ecology, habits, and distribution of the order or family of aquatic insects.

Immature Insects, Volumes I and II, edited by Frederick W. Stehr (**Volume I**: 1987/768 pages/casebound/\$136.44*/ISBN 0-84034639-5 and **Volume II**: 1991/992 pages/casebound/ 241.44*/ ISBN 0-8403-4639-5). **Immature Insects** provides information on the biology and ecology of the families and selected important species. The two volume set also gives you a means to identify insects ranging from the most common to the extremely rare through use of the abundant illustrations, descriptions, and/or keys to selected species. **Immature Insects** is the only reference that extensively covers updated information necessary to identify immature insects. These books also describe techniques necessary for the collecting, rearing, killing, preserving, storing, and studying of insects. Both books also include an introduction defining how terms are used in the book, a complete glossary, and an extensive index.

For more information or to place an order, call Jill Crow at 1-800-228-0564.

*All prices are subject to change.

FOR SALE: Quality insect pins, black enamelled, stainless steel. Best prices guaranteed. Call for free samples. Phone: 1(800) 484-7347 Ext. 1324. Fax: (352) 371-6918. E-mail: morpho@afn.org or write to **Morpho Ventures**, P.O.BOX 12454, Gainesville, Florida 32604.

FOR SALE: Baltic amber pieces with insects, spiders, plants. Material for scientific work, as well as better pieces for display and teaching. O. Holden, Junkerg. 37, S-126 53 Hegersten, Sweden, fax: 01146-8-7268522.

FOR SALE: Light traps, 12 volt DC or 110 volt AC with 15 watt or 20 watt black lights. Traps are portable and easy to use. Rain drains and beetle screens protect specimens from damage. For a free brochure and price list, contact Leroy C. Koehn, 207 Quail Trail, Greenwood, MS 38930-7315. Telephone 601-455-5498.

FOR SALE: Tropical butterflies and beetles, A1 quality with data, including ORNITHOPTERA WITH PERMITS. Also entomology pins. Ianni Butterfly Enterprises - P.O. Box 81171, Cleveland, OH 44181. (440) 888-2310. Fax: (440) 888-8129. Email: butrffly@en.com

ENTOMOLOGICAL NEWS

- New and rare microcaddisflies (Trichoptera: Hydropsychidae) from the eastern United States *S.C. Harris, A.D. Huryn* 77
- Distribution of *Microstylum morosum* and *M. galactodes* (Diptera: Asilidae): significant range extensions
R.J. Beckemeyer, R.E. Charlton 84
- A new genus and three new species of the tribe Spathophorini (Heteroptera: Coreidae) *Henry Brailovsky* 97
- A review of the leafhopper genus *Acrulogonia* (Homoptera: Cicadellidae) with descriptions of new species
C. Godoy, M.W. Nielson 107
- A new species of *Schildola* (Homoptera: Cicadellidae) from Costa Rica
C. Godoy, M.W. Nielson 116
- An annotated list of planthoppers (Hemiptera: Fulgoroidea) of Guana Is., British West Indies
Charles R. Bartlett 120
- A new species of *Paracloeodes* (Ephemeroptera: Baetidae) from Mexico
R.P. Randolph, W.P. McCafferty 133
- Acentrella feropagus*, new species (Ephemeroptera: Baetidae): formal new name for North American *A. laponica* sensu Morihara and McCafferty
J.A. Tercedor, W.P. McCafferty 137
- A new combination for two North American small minnow mayflies (Ephemeroptera: Baetidae)
N.A. Wiersema 140
- Baetiella* (Ephemeroptera: Baetidae) in Hong Kong, with description of a new species
X. Tong, D. Dudgeon 143

ENTOMOLOGICAL NEWS is published bi-monthly except July-August by The American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pa. The October and March meetings are held at the Department of Entomology, University of Delaware, Newark, Delaware.

Society Members who reside outside the local eastern Pennsylvania, southern New Jersey, and Delaware area are urged to attend society meetings whenever they may be in the vicinity. Guests always are cordially invited and welcomed.

Officers for 1997-1998: President: Jon K. Gelhaus; Vice-President: Susan P. Whitney; Recording Secretary: Charles R. Bartlett; Corresponding Secretary: William J. Cromartie; Treasurer: Howard P. Boyd.

Publications and Editorial Committee: Howard P. Boyd, Chr., D. Otte, and Norman E. Woodley.

Previous editors: 1890-1920 Henry Skinner (1861-1926); 1921-1944 Philip P. Calvert (1871-1961); 1945-1967 R.G. Schmieder (1898-1967); 1968-1972 R.H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

Subscriptions: *Private subscriptions for personal use of members of the Society, domestic and foreign: \$10.00 per year postpaid. Subscriptions for non-members \$25.00. Subscriptions for institutions such as libraries, laboratories, etc., domestic: \$20.00 per year postpaid; foreign: \$22.00 per year post-paid. Communications and remittances regarding subscriptions should be addressed to ENTOMOLOGICAL NEWS, The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa. 19103-1195, U.S.A.*

Back issues of most numbers may be obtained by writing to the office of The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

Membership dues: \$15.00 per year (regular); \$10.00 per year (student).

Manuscripts and all communications concerning same should be addressed to the editor: Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A. Manuscripts will be considered from any authors, but papers from members of the American Entomological Society are given priority. It is suggested that all prospective authors join the society. All manuscripts should follow the format recommended in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, Sixth Edition, and should follow the style used in recent issues of ENTOMOLOGICAL NEWS. Three doublespaced, typed copies of each manuscript are needed on 8½ x 11 paper. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible. Articles longer than eight printed pages may be published in two or more installments, unless the author is willing to pay the entire costs of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Editorial Policy: Manuscripts on taxonomy, systematics, morphology, physiology, ecology, behavior and similar aspects of insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Papers on applied, economic and regulatory entomology and on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields.

(Continued on inside of back cover)

Postmaster: *If undeliverable, please send form 3579 to Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A.*

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088, U.S.A.

NEW AND RARE MICROCADDISFLIES (TRICHOPTERA: HYDROPTILIDAE) FROM THE EASTERN UNITED STATES¹

Steven C. Harris², Alexander D. Huryn³

ABSTRACT: Two new species of microcaddisflies, *Hydroptila tomah* from Maine, and *Oxyethira mcgregori* from Alabama, are described, illustrated and compared to congeners. New illustrations of *H. strepha* and *O. dualis*, closest relatives of the new species, are included for comparison. Both new species appear to be uncommon, based on small numbers collected and a limited range.

Although the caddisfly fauna of both the northeastern and southeastern United States has been fairly well studied, new species continue to be found. This paper describes two new species; one in the genus *Hydroptila* from a single locality in Maine, and another in the genus *Oxyethira* from a few scattered localities in northern Alabama and southern Tennessee. Both species are apparently rare, being represented by one and four specimens respectively. Terminology used in the descriptions follows that of Marshall (1979). Type material will be deposited at the National Museum of Natural History, Smithsonian Institution (NMNH) and at the University of Tennessee (UT).

Hydroptila tomah, NEW SPECIES

(Fig. 1)

Hydroptila nr *strepha*. Huryn and Harris. In review.

In a study of the caddisflies inhabiting the Tomah Stream in southeastern Maine, one of the 27 species of microcaddisflies was identified as a close relative of *Hydroptila strepha* Ross (Huryn and Harris. In review). On comparison with the type of *H. strepha*, this specimen, although similar, was determined to represent an undescribed species.

Diagnosis. A recent review of the five eastern species in the *strepha* group by Sykora and Harris (1994) provided a stable framework for the placement of the new species. This review allowed us a greater degree of confidence in determining that a single specimen represented a new species. *Hydroptila tomah* is most similar to *H. strepha* (fig. 2), particularly in the shape of the inferior appendages. The new species is distinguished by the elongate posterodorsal

¹ Received July 16, 1999. Accepted August 30, 1999.

² Department of Biology, Clarion University, Clarion, PA 16214.

³ Department of Biological Sciences, University of Maine, Orono, ME 04469.



lobes of segment IX, which are noticeably shorter in *H. strepha*, and by the sickle-shaped phallus which is straight in *H. strepha*.

Description. Male. Length 2.8 mm. 27 antennal segments. Brown in alcohol. Venter of abdominal segment VII with short apicomeral process. Segment VIII annular. Segment IX in lateral view deeply emarginate posterolaterally, rounded anterolaterally; in dorsal view deeply incised posteriorly forming pair of elongate lateral lobes, emarginate anteriorly. Segment X truncate laterally; narrow dorsally with slightly flared apex, small median lobe on posterior margin. Subgenital plate a narrow shelf in lateral aspect; in ventral view broadly rounded distally, with pair of stout, median setae. Inferior appendage in lateral view narrow, curving downward distally to enlarged, clublike apex, basally with rounded lateral projection; ventrally with broad base, narrow and gently tapering distally to slightly out-turned apex, mesal margins straight. Phallus tubular basally, distally narrow and sickle-shaped, ejaculatory duct protruding apically and contiguous, thin paramere at midlength encircling shaft.

Female and larva. Unknown.

Type material. Holotype, male. Maine, Washington County, Tomah Stream @ floodplain, N45°28.28', W67°35.58', 1-2 July 1997. A. Hurny (NMNH).

Etymology. Named for the type locality.

Oxyethira mcgregori, NEW SPECIES

(Fig. 3)

Oxyethira dualis Morton. Harris, O'Neil and Lago 1991: 245.

In the course of identifying a series of microcaddisflies from high altitude springs in California, a number of *O. dualis* were identified. To verify the identifications, the California specimens were compared with a small series of the same species from Alabama. On close comparison, it was determined that the material from Alabama, thought to be *O. dualis*, instead represented a similar, but undescribed new species.

Diagnosis. *Oxyethira mcgregori* is very similar in overall appearance to *O. dualis* (fig. 4). The phallus is nearly identical in both species with a distinctive series of short spines at the apex. It is this character which is most easily seen and which can lead to misidentification. The new species is readily separated, however, by the lack of a dorsal bridge from segment IX, which is readily apparent in *O. dualis*. The presence or absence of this character is used in Kelley (1982) to broadly separate the species groups of *Oxyethira*. Since *O. dualis* has been reported from much of North America, the separation of a new species in the southeast suggests what is now being called *O. dualis* may represent a complex of species.

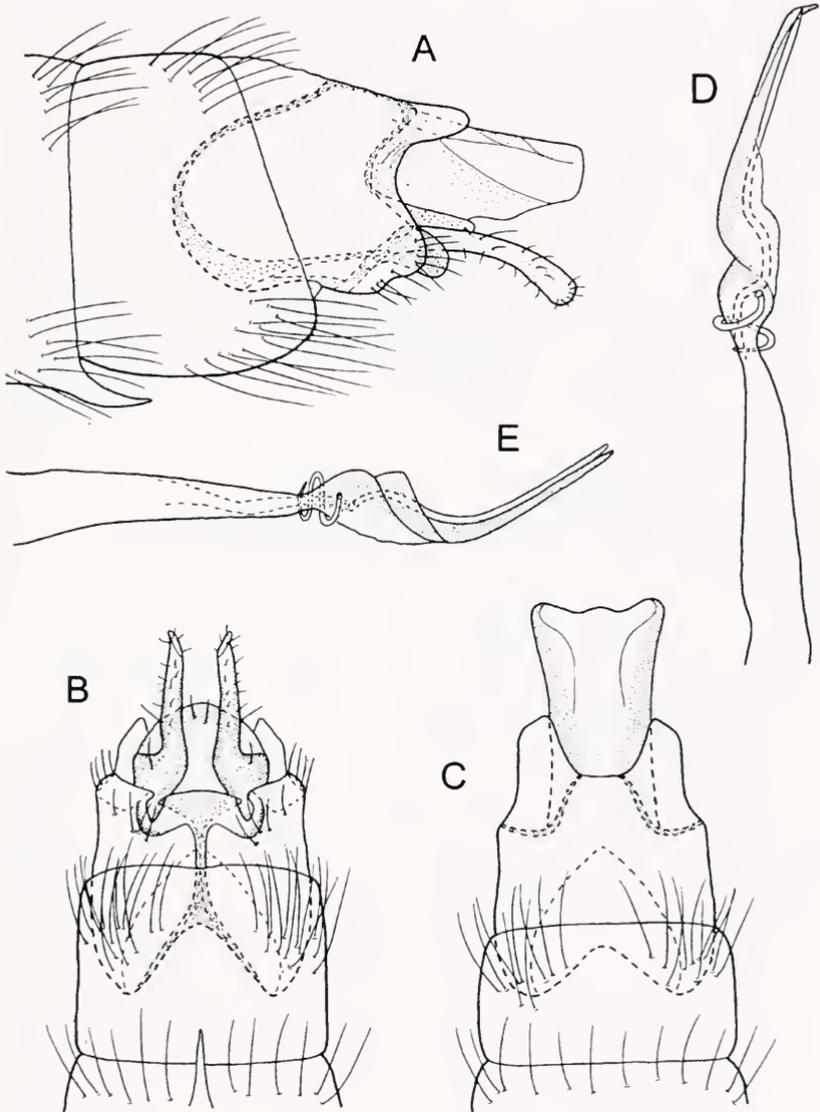


Figure 1. *Hydroptila tomah*, n.sp., male genitalia. A. Lateral view; B. Ventral view; C. Dorsal view; D. Phallus, ventral view; E. Phallus, lateral view.

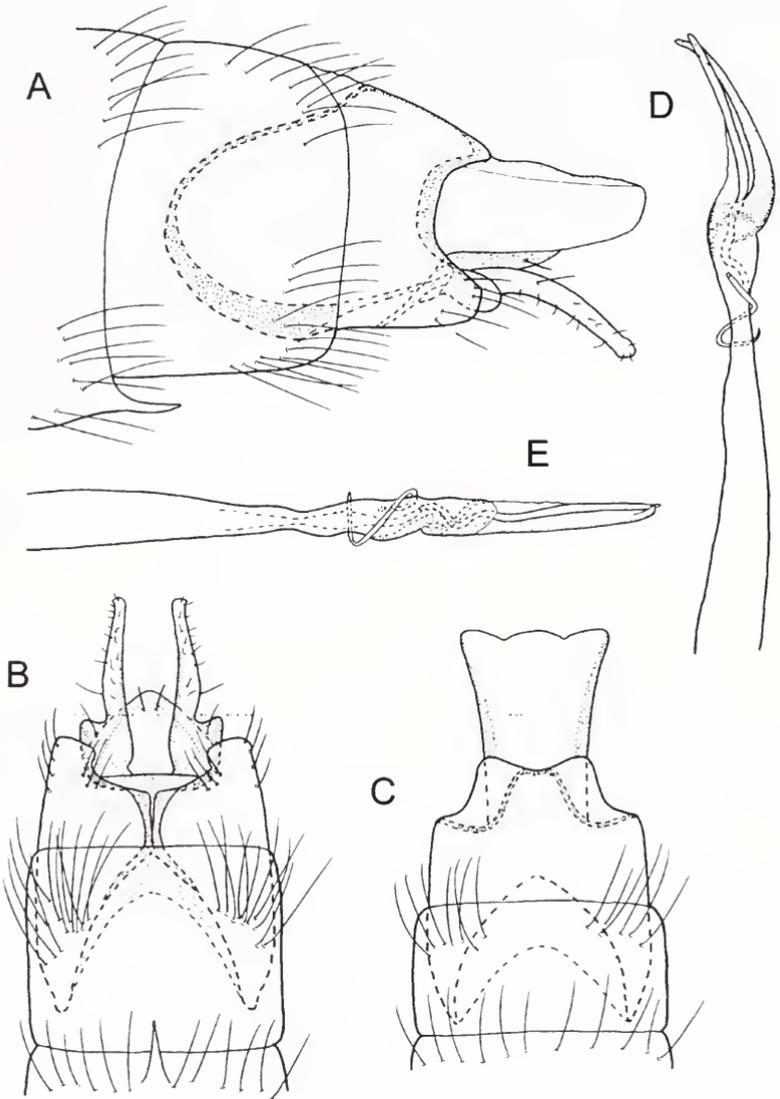


Figure 2. *Hydroptila strepha* Ross, male genitalia, drawn from type. A. Lateral view; B. Ventral view; C. Dorsal view; D. Phallus, ventral view; E. Phallus, lateral view.

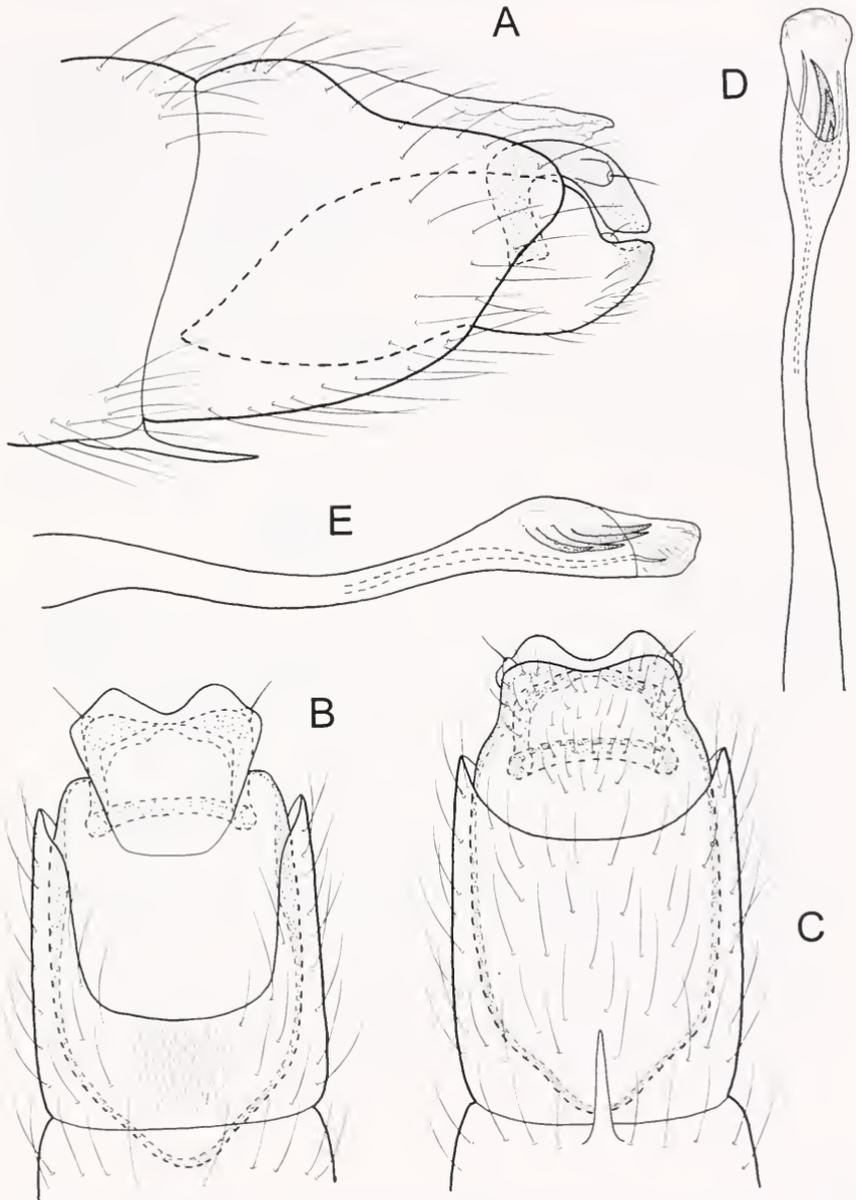


Figure 3. *Oxyethira mcgregori* n.sp., male genitalia. A. Lateral view; B. Dorsal view; C. Ventral view; D. Phallus, ventral view; E. Phallus, lateral view.

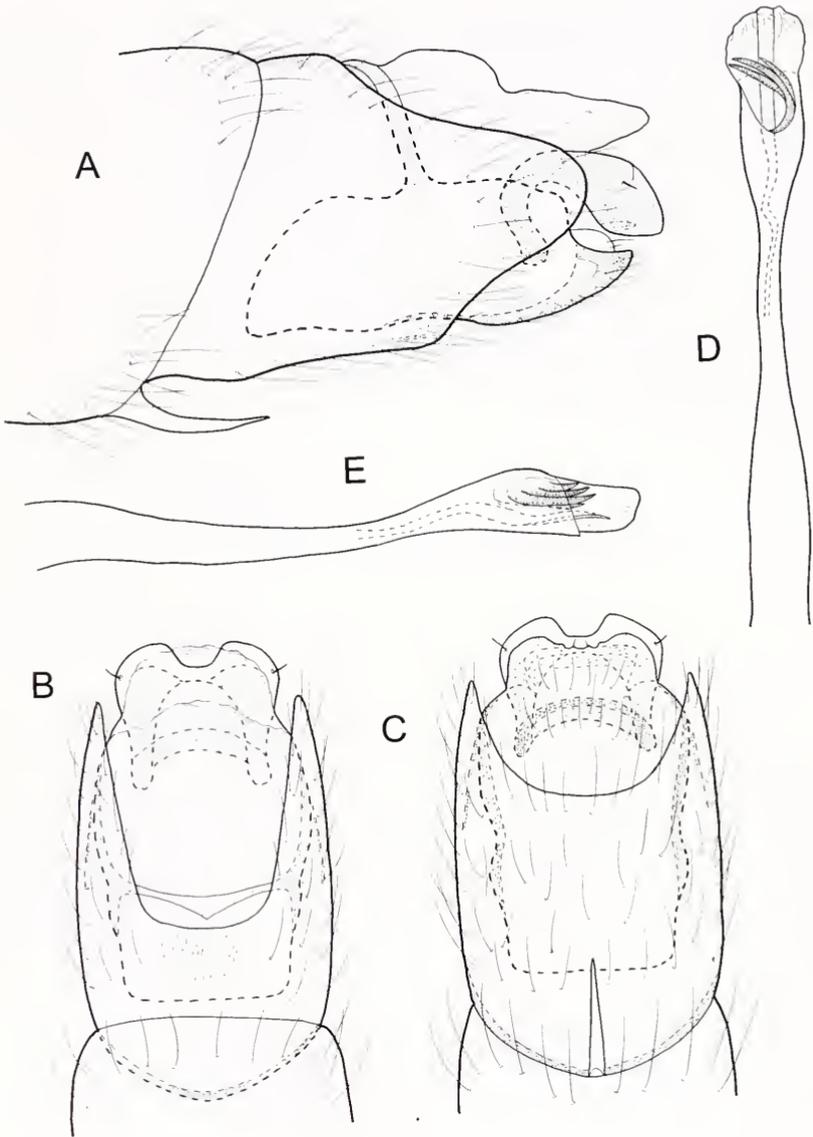


Figure 4. *Oxyethira dualis* Morton, male genitalia, drawn from California specimen. A. Lateral view; B. Dorsal view; C. Ventral view; D. Phallus, ventral view; E. Phallus, lateral view.

Description. Male. Length 2.2-2.4 mm. 32 antennal segments. Brown in alcohol. Venter of abdominal segment VII with short apicomeral process. Segment VIII tapering to rounded lobe in lateral aspect; shallowly emarginate on posterior margin ventrally, margin deeply emarginate dorsally. Segment IX compressed dorsoventrally, lacking any anterodorsal bridge, narrowing posteroventrally; in dorsal and ventral view tapering anteriorly, posteriorly terminating in pair of truncate lobes. Segment X membranous, tapering posteriorly. Subgenital plate strongly arched in lateral aspect, truncate posteriorly. Phallus tubular, wide basally and apically; apex bearing series of four short spines, ejaculatory duct protruding distally as narrow process.

Female and larva. Unknown.

Type material. Holotype, male. Alabama, Lauderdale County, Cowpen Creek @ Co. Hwy. 8, 18 June 1983, S. Harris (NMNH). Paratypes, Alabama, Lauderdale Co., Shoal Creek @ Co. Hwy. 8, 18 June 1983, 2 males (NMNH); Tennessee, Knox Co., Stroud Spring on Northshore Drive, 3 miles W jct. Norell Rd., 25 June 1972, D. Etnier, 1 male (UT).

Etymology. Named for Stuart McGregor, colleague and friend of the senior author, who was born and raised in north Alabama.

ACKNOWLEDGMENTS

Partial funding to support the study of the Tomah Stream came from the Maine Department of Inland Fisheries and Wildlife (MDIFW) and the U.S. Department of Fish and Wildlife, Office of Endangered Species (Section 6). David Etnier of the University of Tennessee kindly provided the specimens of *O. mcgregori* from Tennessee, Marilyn Myers of the University of California-Berkeley provided *O. dualis* material from California, and Kathleen Zeiders of the Illinois Natural History Survey made available the type of *H. strepha*.

LITERATURE CITED

- Harris, S.C., P.E. O'Neil and P.K. Lago. 1991. Caddisflies of Alabama. Bull. Geol. Surv. Ala. 142: 1-442.
- Huryn, A. D. and S. C. Harris. In review. High species richness of caddisflies (Trichoptera) at a river-floodplain complex in Maine. Northeast. Nat.
- Kelley, R.W. 1982. The micro-caddisfly genus *Oxyethira* (Trichoptera: Hydroptilidae): Morphology, biogeography, evolution and classification. Ph.D. dissertation, Clemson Univ. 436p.
- Marshall, J.E. 1979. A review of the genera of the Hydroptilidae (Trichoptera). Bull. Brit. Mus. Nat. Hist.(Entomol). 39: 135-239.
- Sykora, J.L. and S.C. Harris. 1994. Five new species of *Hydroptila* from eastern United States (Insecta: Trichoptera: Hydroptilidae). Ann. Carnegie Mus. 63: 67-75.

DISTRIBUTION OF *MICROSTYLUM MOROSUM* AND *M. GALACTODES* (DIPTERA: ASILIDAE): SIGNIFICANT RANGE EXTENSIONS¹

R. J. Beckemeyer^{2,3}, R. E. Charlton^{4,5}

ABSTRACT: *Microstylum morosum*, long listed as endemic to Texas, is documented for Kansas (nine counties), Oklahoma (13 counties), Arizona (two counties), New Mexico and Colorado (one county each). The species' range is shown to extend 450 miles north of the northern-most Texas county of record. *Microstylum galactodes*, known to occur in Texas and Kansas, is newly documented for Oklahoma (four counties). *M. galactodes* is also reported here from nine counties in Kansas, seven counties in New Mexico, three counties in Arizona, and three counties in Colorado; nearly all of these are newly documented counties for the species. A number of counties are also added to the lists originally published in Bromley's (1934) summary of Texas Asilidae, bringing the counts to 30 Texas counties for *M. galactodes* and 20 Texas counties for *M. morosum*.

Microstylum Macquart is a robber fly genus of "About one hundred species ... most ... occur[ring] in South and Central Africa, Madagascar, India, Ceylon, China, the Malay States, and certain of the East Indies" (Bromley, 1927). E. W. Fisher (pers. commun., 1999) notes that there are currently 127 species of *Microstylum* listed for the Old World in various regional catalogs. (Also see Hull, 1962 for additional data on world-wide distribution.) Four species of *Microstylum* have been described from North America (Martin, 1960): two from the southwestern United States, and two from Mexico. The two species found north of the Mexican border are *M. galactodes* Loew and *M. morosum* Loew. The taxon *M. pollens* Osten Sacken (Texas) listed by Hull (1962) and others is considered a color variant of *M. morosum* by Martin and Wilcox (1965).

The keys to the genera of Asilidae in Wood (1981) can be used to identify *Microstylum*; keys to separate the two species that occur in the U.S. appear in Back (1909), Bromley (1934) and Martin (1960). These are large insects. Bromley (1934) lists the lengths of *M. galactodes* as 30-34 mm and *M. morosum* as 35-50 mm, however we find that the larger *M. galactodes* and smaller *M. morosum* do overlap in size. The two species are easily distinguished. *M.*

¹ Received August 25, 1999. Accepted October 4, 1999.

² Department of Biology, Southwestern College, Winfield, Kansas 67156-2499.

³ Address correspondence to: Roy J. Beckemeyer, 957 Perry, Wichita, KS 67203-3141, Email to: royb@southwind.net

⁴ Department of Entomology, Kansas State University, Manhattan, Kansas 66506.

⁵ Contribution No. 99-476-J of the Kansas Agricultural Experiment Station.

galactodes having milky white wing membranes, the body reddish-brown, and the head and thoracic dorsum evenly covered with whitish pruinescence, *M. morosum* having black to brown wings, black to brown body, and with thoracic pruinescence restricted to the lateral margins. Figure 1 illustrates a typical specimen of each species.

Back (1909) and Martin (1960) gave the range of *M. galactodes* as Texas, New Mexico and Kansas, and that of *M. morosum* as Texas only. James (1941) listed *M. galactodes* for Colorado. Martin and Wilcox, in the chapter on Asilidae in Stone et al. (1965), extended the ranges for both *M. galactodes* and *M. morosum* to include Arizona.

Having collected *M. morosum* recently in Kansas, the authors became interested in more accurately portraying the distribution of *Microstylum* north of the Mexican border. We present records here, gathered with the generous assistance of a number of museums and collectors, that document the widespread southwestern U.S. distribution of *Microstylum*. Both *M. galactodes* and *M. morosum* have been found to occur in the states of Arizona, Colorado, Kansas, New Mexico, Oklahoma, and Texas. We list and map all counties of record we could find for these states. We also list the Mexican states for which records were found.

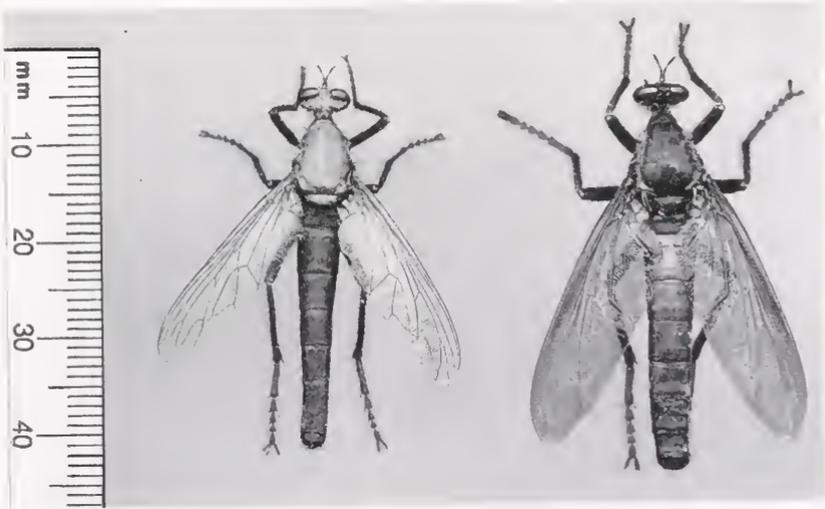


Figure 1. Specimens of *Microstylum galactodes* (left, Crane Co., TX) and *M. morosum* (right, Riley Co., KS) from the Kansas State University Collection. Specimens were scanned using a flatbed scanner at 300 dots per inch by R. E. Charlton.

DISTRIBUTIONAL RECORDS FOR *MICROSTYLUM MOROSUM*

Sources of Records: AM-NMSU - Arthropod Mus., New Mexico St. Univ. (D. B. Richman); Back - E. A. Back, 1909; Bromley - S. W. Bromley, 1934; CAS - Cal. Acad. Sci. (E.W. Fisher); CRN - C. Riley Nelson, personal collection, Provo, UT; CSU - Col. St. Univ. (B. Kondratieff); DB-NMSU - Dept. Biol., New Mexico St. Univ. (G. S. Forbes); EEM - Enns Entomol. Mus., Univ. of Missouri-Columbia (K. Simpson); EWF - Eric W. Fisher personal collection; Hine - J.S. Hine, 1918; James - M. T. James, 1941; KU - The Snow Entomol. Mus., Univ. of Kans.; KSU - Kans. St. Univ. Mus. Entomological and Prairie Arthropod Res. (R. E. Charlton); Martin & Wilcox - Martin & Wilcox, 1965; OSU - Entomol. & Plant Pathology Dept., Okla. St. Univ. (D. Arnold & R. Grantham); RJBa - R. J. Bauernfeind personal collection, Manhattan, KS; RJBe - R. J. Beckemeyer personal collection, Wichita, KS; RG - R. Grantham personal collection, Stillwater, OK; RLH - R. L. Huber personal collection, Prairie Village, KS; Smith - Smith et al., 1962; SWD - S.W. Dunkle personal collection, Plano, TX; TAM - Tex. A & M Univ. Coll. (D. Oswald & E. G. Riley).

Texas

Microstylum morosum was described by Loew in 1872 from specimens collected in Dallas, Texas. It is a magnificent animal (Figure 2.), "...probably the largest asilid occurring in North America." (Bromley, 1934). As long as 50 mm (Bromley, 1934), it has a "stiltlike neck" and dark brown wings. Bromley (1934) described it as a "...'green-eyed monster'...[with]...an antedeluvian [sic] appearance...", as it has emerald green eyes when alive.

Back (1909) provided data for a number of specimens from Dallas County, including the male and female types. He also listed a specimen from Victoria



Figure 2. *Microstylum morosum* in life. Photo by R. J. Elzinga of Kansas State University.

County, Texas (June 5). Hine (1918) collected the species from the Trans-Pecos (“...forty miles south and slightly west of Pecos, the nearest town being Toyahvale...[in Reeves County]”). In his review of Texas Asilidae, Bromley (1934) said that *M. morosum* was “...rather common in the open woodlands and adjoining cotton fields in the bottom lands along the Trinity and Bosque Rivers...[and occurs in] Dallas, McLennan, Bosque, Madison, Victoria, Travis, Mills, [and] Brewster Counties, June 28 - Aug. 26.” Records for a number of additional Texas counties have been gathered from various collections and these are summarized at the end of this paper.

Kansas

Smith et al. (1962) noted that *M. morosum* was the “...largest and least-common species...” of the asilids listed in their popular book on Kansas insects. However, they did not list any specific Kansas localities or specimens. The occurrence of the species in Kansas went unrecorded in later publications and catalogs.

We document the occurrence of *M. morosum* at the northern end of its range for nine counties in Kansas and for one county in Colorado. These records constitute a significant northern range extension for *M. morosum*. Five counties (Chautauqua, Cowley, Montgomery, Geary and Riley, Kansas) are located in the Osage Plains physiographic region; Sumner County is in the Arkansas River Lowlands; Barber and Comanche Counties in Kansas are in the Mixed Grass Prairie region (Schoewe, 1949). Meade County, Kansas and Baca County, Colorado are in the High Plains Short Grass Prairie.

Barber County and Comanche County are located on the Kansas-Oklahoma border. The Red Hills physiographic region in which Barber County is located is characterized by rolling hills with exposed rocky slopes. Vegetation “...is mixed grass prairie with an overstory of red cedar forming a savannah-like aspect” (Zimmerman and Patti, 1988). A single specimen was collected from Barber County by R. J. Bauernfeind of Kansas State University on 25 July, 1990, and is in his collection. The Kansas University (KU) collection contains three specimens from Schwartz Canyon in Comanche County, collected 4 July 1991 by G. A. Salsbury. Ron Huber (pers. commun., 1999) has specimens from both Barber and Comanche Counties in his personal collection: “KS: Comanche Co., Schwartz Canyon, 13 mi S. & 16 mi E. of Coldwater, 7/4/91 leg G. Salsbury & R. Huber, 2 m 6f, Sec. 14, T 34, R 16”, and “KS: Barber Co., 14.5 mi W. Medicine Lodge on Hwy 160, hilltop just W of MP 211, leg R. Huber, 7/6/91, 1f”. The Colorado State University collection also contains specimens of *M. morosum* from both Barber and Comanche Counties.

There is a single specimen of *M. morosum* in the KU collection taken in Caldwell, Kansas (Sumner County) by Stallings and Turner, 19 July 1953, and a second Sumner County specimen collected by G. A. Salsbury, 16 Aug. 1979 labeled “edge of woods”. R. L. Huber (pers. commun., 1999) has a fe-

male specimen in his personal collection taken in Caldwell, Kansas 6/19/52 leg Stallings & Turner. Sumner County is on the Oklahoma border.

Chautauqua and adjacent Montgomery Counties are also located along the Kansas-Oklahoma border east of Cowley County. The collection locale for the most recently-collected specimen from Chautauqua County was along a gravel road 1.5 miles east of the Cowley/Chautauqua County line and 5 miles north of the Oklahoma border (R8E, T34S, Section 15). This site is within the Osage Cuestas subregion of the Osage Plains. The Osage Cuestas, also known as the "cross timbers", are comprised of a forest-prairie mosaic with blackjack and post oak on the ridges and tall grasses or cultivated fields in the lowlands. One specimen was collected while it was flying in the lee of a roadside hedge row in the company of numerous dragonflies (Odonata: Anisoptera: Libellulidae: *Tramea lacerata*). It was taken in the early afternoon of VII-30-1994 by the senior author, and is in his collection. The Kansas University collection contains a single specimen from Chautauqua County taken in Sedan, Kansas, July 25, 1951 by Robert E. Beer and three specimens from Montgomery County, one with acridid prey, collected by Beamer and Lawson August 3, 1923.

Geary County and Riley County are both located at the northern edge of the Flint Hills physiographic subregion of the Osage Plains, and are bounded to the north by the edge of the glaciated region. In the Flint Hills, the upland vegetation is dominated by tall grasses, with riparian forests along the streams. The KSU collection contains one specimen from Geary County, collected by J. Schesser on August 12, 1955. Of the five KSU specimens collected from Riley County, the first was collected by R.C. Smith in Manhattan, Kansas on 15 July, 1921. There are two specimens that were collected by T. E. Hall in July 1929 labeled "Riley Co." These specimens from Geary and Riley Counties that were collected prior to 1962 are likely the source of the account by Smith et al. (1962). The fourth Riley County specimen is one collected by N. Marston on July 4, 1964.

The junior author has observed *M. morosum* on the Konza Prairie in Riley county in recent years; most of his sightings were of males perched atop the scattered small bushes on rocky prairie hillsides. The fifth Riley County specimen is a voucher specimen collected from the Konza Prairie by Brian Kopper (14-VII-1997). The KU collection contains three additional specimens from Riley County taken in 1909.

Cowley County, in the southern portion of the Flint Hills, adjoins Sumner County on the east; Ron Huber (pers. commun., 1999) has a female specimen in his collection that was collected from Cowley County (Cambridge, Kansas) 12 July 1975 by D. Stallings.

The Kansas University collection contains two specimens of *M. morosum* from Meade County, Kansas ("2500 ft., F. X. Williams, VII-10-1911"), at the eastern edge of the short-grass prairie.

Colorado

In addition to the specimens of *M. morosum* from Barber and Comanche Counties in Kansas, the Colorado State University collection has specimens from Baca County (B. Kondratieff, pers. commun., 1999), the southeastern-most county in Colorado. The species had not been previously reported from that state.

Oklahoma

M. morosum has not previously been reported for the state of Oklahoma; it was recorded from a total of 13 counties in the course of this study. Most of the records were provided by Richard Grantham (pers. commun., 1999) of the Oklahoma State University Department of Entomology and Plant Pathology. Specimens in the OSU collection were from counties across the northern tier of Oklahoma, with a single county in the south-central part of the state (Mayes County) also represented. Most of the records were from the 1930's or the 1960's:

Alfalfa County (Byron: 11 Aug. 1931); Cimarron County (Black Mesa: 24 June 1933, 2 specimens 22 June 1966; Kenton: 24 June 1933); Garvin County (Lindsay: 27 July, 1976); Grant County (Medford: 8 Aug. 1931); Kay County (Blackwell: 2 specimens, 12 Aug. 1931); Mayes County (Locust Grove: 12 July 1963); Nowata County (Lenapah: 1 Aug. 1931); Osage County (Grainola: 1 Aug. 1931; Fairfax, 28 & 30 July 1932); Pawnee County (Watchorn: 11 July 1930; Pawnee: 12 & 13 July 1932); Payne County (Lake Carl Blackwell: 3 Aug. 1960, 5 specimens 13 Aug. 1960; Stillwater: 12 July 1969).

In addition, Dr. Grantham has 2 specimens of *M. morosum* taken 30 June 1999 from Black Mesa in Cimarron County in his personal collection. Ron Huber (pers. commun., 1999) has a single female specimen of *Microstylum morosum* from Oklahoma in his personal collection. It was taken in Grant County and was collected 19 July 1953 from Wakita, Oklahoma by D. Stallings. Three additional records for *M. morosum* in Oklahoma were found in the Department of Biology collection at New Mexico State University (DB-NMSU) by Greg Forbes (pers. commun., 1999). The Oklahoma records from NMSU are: "Jackson Co., Elmer 28 vii 1983, 1f, H. Reed, J Nelson; Wagoner Co., 18 viii 1976, 1m (on ground) D. C. Arnold; Love Co., 9 mi west Marietta, 18 vii 1971, 1f, K. Mennealy". Jackson and Love Counties are on the Oklahoma/Texas border. Wagoner County is in northeastern Oklahoma just east of Tulsa. These records fill in the gap between Texas and Kansas and indicate that *M. morosum* very likely occurs through most of Oklahoma.

New Mexico

The DB-NMSU collection also contains a specimen from New Mexico

which constitutes the first report of *M. morosum* for this state: "Union Co., Clayton, 10 vii 1962, 1f, David Hine." Union County is directly south of Baca County, Colorado.

Arizona

Finally, Dr. Eric Fisher (pers. commun., 1999) reports records of *M. morosum* from Arizona in the California Academy of Sciences collection: Santa Cruz County ("Santa Rita Mtns., VII-9-1924, A Nichol...") and Cochise County ("Douglas, VII-3-1924, E. Bal..."), both in southeastern Arizona. Prior publications have listed only "Arizona" with no specific locality information.

Summary

These records indicate that *M. morosum* has a much greater north-south range than previously indicated in the literature. Its range extends through Kansas and Oklahoma to 60 miles south of the Nebraska border. The Kansas localities range from 325 to 465 miles north of Dallas county which was the northernmost Texas county of record. The species also appears to occur across nearly the breadth of the state, from the tall-grass prairie region of eastern Kansas to the high plains at least as far as Baca County, Colorado and Union County, New Mexico, just west of the Kansas-Colorado border.

DISTRIBUTIONAL RECORDS FOR *MICROSTYLUM GALACTODES*

Microstylum galactodes was described by Loew in 1866 from three male and six female specimens from New Mexico. Back (1909) listed the species as occurring in Kansas, Texas and New Mexico, but did not reference specific localities other than citing "Pecos River, Texas". Bromley (1934) called *M. galactodes* a "...large, striking species...", and Kondratieff (pers. commun., 1999) comments that "A mating pair in flight is a sight to behold."

Texas

Bromley (1934) noted that *M. galactodes* "Occurs in the central and western portions of...[Texas]", and he went on to list "Pecos, Brewster, Frio, Bexar, Webb, Jim Hogg, Brown, Jeff Davis, Presidio, Brooks, Starr, [and] Ector Counties."

The KSU collection contains 16 specimens from Texas; four of these are from counties not mentioned by Bromley (1934): one specimen from Kleberg County ("Kingsville, Tex., 7-6-21, F. M. Hull (?"); two specimens from Tarrant County ("May, Tx, 27-VII-31, R. H. Painter collector"); one specimen from "Crane Co., Tx., June 21, 1958, R. H. Painter and F. M. Painter collectors." Additional county records for Texas gathered in preparing this paper are summarized at the end of the paper.

Colorado

James (1941) listed *M. galactodes* from Colorado ("Las Animas [County], July 12, 1931 [Leonard Sweetman]"). However, the species' occurrence in the state was not recorded in later publications. The Colorado State University collection contains specimens of *M. galactodes* from Baca, Bent and Las Animas Counties, all in extreme southeastern Colorado. It also contains specimens from Potter County in the panhandle of Texas, and from Val Verde County, which lies on the Texas border with Mexico. Ron Huber (pers. commun., 1999) has a male specimen from Baca County, Colorado ("...Picture Canyon, W of Cranshaw, 7/12/91 leg M. Kippenham, B. Kondratieff et al...") in his personal collection.

New Mexico

Back (1909) did not include any specific locality data for *M. galactodes* in New Mexico, listing only the state. The Texas A&M collection contains 2 specimens of *M. galactodes* from Lea County, the southeastern-most county in New Mexico, and 7 specimens from Eddy County. The Enns Entomology Museum of the University of Missouri-Columbia, contains one specimen of *M. galactodes* from Las Cruces [Dona Ana County], collected 12 July 1917 by R. C. Shannon (K. Simpson, pers. commun., 1999). The Department of Biology collection at New Mexico State University contains a number of specimens collected by G. S. Forbes from Dona Ana County. Dr. Forbes (pers. commun., 1999) has also supplied to the authors some interesting notes on the habitats used by *M. galactodes* in New Mexico:

"NM: Dona Ana Co.: Upper Box Canyon, 0.8 mi. SW Picacho Pk. 4200'

Habitat large sandy arroyo between sandstone hills, adjoining desert scrub to NW. Major shrubs include. mesquite, tarbush (*Flourensia*), creosotebush, littleleaf sumac, and soaptree yucca. Most specimens perched on large mesquites or on littleleaf sumac in the canyon. One individual of *M. galactodes* was a prey item of *Promachus giganteus* Hine.

29 vi 1982 1m, G. Forbes (GSF)

6 vii 1982 1m, 1f, GSF

18 vii 1982 1f, GSF

7 vii 1983 2m, 1f, GSF

...

Afton Lava, 20 mi. W Mesilla Dam (about 25 mi. SW Las Cruces)

Habitat creosotebush-tarbush scrub on NE side of Afton lava flows; was collected from both of these shrubs.

21 vi 1983 2m, 2f, (1 pair in cop) GSF

26 vi 1983 2m, 3f, GSF

...

Jornada Experimental Range, 3.5 mi. N. USDA HQ.....Adults perched on *Opuntia imbricata* (tree cholla)...f, 2 July 1999 (GSF), perched on mesquite and tobosa grass"

...

"Socorro Co., NM: White Sands Missile Range, 33 deg. 36.01' N, 106 deg. 39.83' W, about 10 mi. W of the Trinity Site, in black grama grassland, sandy soil, with *Yucca elata*

common. One f. perched on yucca stalk caught, others seen. 1 July 1999, J. Van Zee and S. Bird, collectors."

The DB-NMSU collection also contains one specimen from De Baca County, New Mexico: "SE end Sumner Lake, 9 vii 1986, 1 m, GSF", and several from Eddy County: "Rt. 128 at Co. Rd. 787, ca. 1 mi. E WIPP [Waste Isolation Pilot Project...10 mi. E Jct. of Rt. 31 and Rt. 128...about 28 mi. SE Carlsbad] site turnoff, 10 vi 1989, 1m, 1f, GSF; Los Mendanos, nr. WIPP site, T22S R13E, sec. 15, 12 vii 1978, 2f, T. Marr & W. Whitford; 32 deg. 23' N, 103 deg. 51.4' W, 1f, DeLorme, McHugh, Schaffner (Texas A&M) 17 Aug. 1979". The Arthropod Museum of New Mexico State University (D. B. Richman, pers. commun., 1999) contains one specimen of *M. galactodes* from Chaves County ("Bottomless Lakes State Park, Plot #8 pitfall trap. July 18, 1985. Janet Swain Collector"). The KU collection contains the following New Mexico specimens: one specimen labeled "White Sands, NM [Otero County] VI-27-40 L. J. Lipovsky", one specimen labeled "Roswell New Mexico [Chaves County] 6-26-32 R. H. Beamer", and two specimens labeled "Malaga N.M. 7-11-36" [Eddy County], one collected by D. R. Lindsay, the other by J. H. Beamer. Greg Forbes (pers. commun., 1999) states that he "...wouldn't be surprised..[to find]...*M. galactodes*...in all the southern counties of NM at lower elevations. It seems to occur in a wide range of plant communities and soil types: black grama grasslands in sandy soils, tobosa grass playas and tarbush playas in heavy soils, and open desert scrub in deep sand."

Kansas

The KSU collection contains three specimens of *M. galactodes* from Kansas ("Hamilton Co., Kansas '28, Aug 6., elevation 4000 ft., R. H. Painter Collector"), one with an acridid prey. Hamilton County is in the High Plains physiographic region, which was characterized historically as a short-grass prairie, although recent years have seen the introduction of irrigation for cultivated crops. The area is one of little vertical relief. The KU collection contains specimens from 6 other Kansas Counties, most of them also in the short-grass prairie region. Among the specimens collected by F. X. Williams in 1911 in western Kansas were the following: one from "Grant Co. 2800 ft. ... VII-27-1911", one from "Kiowa Co. Kan. 2250 ft. ...VII-1-1911", one labeled "Stanton Co. Kan. 3000 ft. ... VII-30-1911", and one from "Meade Co. Kan. 2500 ft. ... VII-10-1911". The KU collection also contains two specimens from "Morton Co. Ks. 7-22-24 O. O. Bare" and two from Finney County labeled "Garden City Kans. Aug '95 H. W. Menke" (the labels on these specimens appear to be quite old and we believe the specimens to date from 1895). The Biology Department collection at NMSU (G. Forbes, pers. commun., 1999) contains a single specimen taken from Seward County, (on the Oklahoma border and

directly west of Meade County) Kansas: "10.5 mi. N. Liberal, 21 vii 1984, lf. R. & C. Huber." Finally, Ron Huber (pers. commun., 1999) has one specimen in his collection from Comanche County: "...Schwartz Canyon, 13 mi. S. & 16 mi. E. of Coldwater, 7/4/91, leg G. Salsbury & R. Huber, lf, Sec. 14, T 34, R 16". This single *M. galactodes* was taken together with a number of specimens of *M. morosum*.

The specimens of *Microstylum* that we have in hand thus indicate that in Kansas *M. galactodes* is the more western species and *M. morosum* the more eastern, though their ranges do overlap in the southwestern quarter of Kansas. *Microstylum galactodes* in Kansas occurs mostly in the short grass prairies. There is obviously a need for more collecting and observation to better understand the detailed distributions of the two species.

Oklahoma

There are 8 specimens of *M. galactodes* from Oklahoma in the KSU collection. Seven specimens are from Randlett in Cotton County ("15-VII-31, R. H. Painter collector"). Cotton County is on the Texas-Oklahoma border. The eighth specimen was collected in Woodward, Oklahoma, in July, 1925 by G. K. Teripening. Woodward County is in northwestern Oklahoma. The OSU collection contains a number of specimens of *M. galactodes*, most from Cimarron County, the extreme western county in the Oklahoma panhandle. Richard Grantham (pers. commun., 1999) reported the following: Cimarron County (Kenton: 6 June (2 specimens), 29 & 30 June 1933; Boise City: 2 specimens 10 July 1933; 15N, 13 W of Boise City: 2 specimens dated 14 July 1971; Black Mesa: 21 July 1983); Harmon County (Vinson: 9 July 1934). These records span the western portion of the state from south to north, and are the first records published that document specific localities for this species in Oklahoma.

Arizona

Finally, the KU collection contains a specimen of *M. galactodes* labeled "Mustang Mt. Ar. 6-12-33 R. H. Beamer". The Mustang Mountains are located in Santa Cruz County, Arizona, near the Mexican border. E. W. Fisher (pers. commun., 1999) reports specimens of *M. galactodes* from Cochise County (Wilcox, VII-1-1968) and Yavapai County, Arizona (Peebles Valley, 130 km east of the California/Arizona state line - this appears to be the western-most record for *Microstylum*).

DISCUSSION

While we list a number of previously unpublished county records for both species of *Microstylum* occurring north of the Mexican border, the exact distributions, particularly through the northern and western extent of their ranges,

remain to be definitized. There are indications that *M. morosum* may occur in a larger variety of habitats than *M. galactodes*, which seems to occur most often in short grass prairies and scrub lands. *M. galactodes* appears to be the more common of the two species. The records gathered for this paper yield a ratio of the number of specimens of *M. galactodes* to specimens of *M. morosum* of 1.8:1. Both species seem to be somewhat local in distribution where they do occur. G. Forbes (pers. commun., 1999) found *M. galactodes* in the Las Cruces, New Mexico area "...at only 5 sites in a number of years of collecting" and B. Kondratieff (pers. commun., 1999) observes that "...*M. galactodes* can be very common in certain areas of eastern Colorado." *Microstylum galactodes* appears to be restricted to the western third of Kansas and Oklahoma while *M. morosum* is found across both states nearly to their eastern borders.

Date ranges for *M. morosum* records are from 5 June through 26 August, with 80% of the records occurring in the period from the first of July through

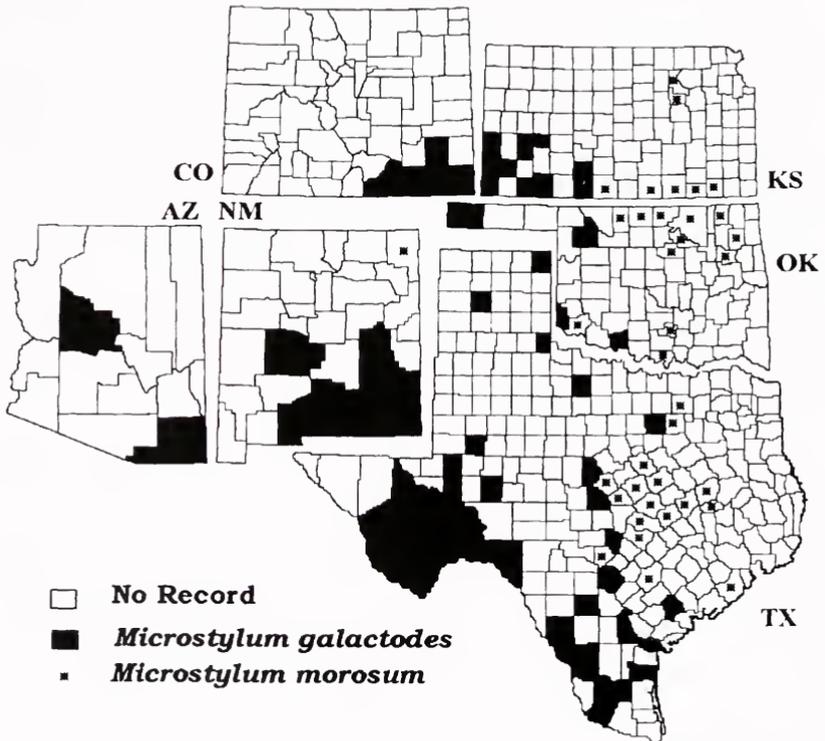


Figure 3. The recorded distribution of *Microstylum morosum* (counties denoted by an asterisk) and *M. galactodes* (shaded counties) in Arizona, Colorado, Kansas, New Mexico, Oklahoma, and Texas.

mid-August. Date ranges for *M. galactodes* are 6 June through 17 August, with 88% of the records cited occurring between mid-June and the end of July. Figure 3 illustrates the distributions by county in Arizona, Colorado, New Mexico, Texas, Oklahoma and Kansas as indicated by the records cited here. We have also listed in the summary below the few records that we came across for the occurrence of *M. galactodes* and *M. morosum* in Mexico. The fact that these are large, conspicuous, and rather spectacular insects should be helpful in filling in the gaps in our understanding of their distribution. We hope that this paper will provide inspiration and information to encourage insect collectors to search for and to further document the occurrence and biology of these impressive predators.

SUMMARY OF COUNTY AND STATE RECORDS

***Microstylum galactodes*:** UNITED STATES: ARIZONA: State, no county listed (Martin & Wilcox); Cochise (EWF); Santa Cruz (KU); Yavapai (EWF). COLORADO: Baca (CSU, RLH); Bent (CSU); Las Animas (James; CSU). KANSAS: State, no county listed (Back); Comanche (RLH); Finney (KU); Grant (KU); Hamilton (KSU); Kiowa (KU); Meade (KU); Morton (KU); Seward (DB-NMSU); Stanton (KU). NEW MEXICO: State, no county listed (Back); Chaves (AM-NMSU, KU); De Baca (DB-NMSU); Dona Ana (DB-NMSU, EEM); Eddy (DB-NMSU, KU, TAM); Lea (TAM); Otero (KU); Socorro (DB-NMSU). OKLAHOMA: Cimarron (OSU); Cotton (KSU); Harmon (OSU); Woodward (KSU). TEXAS: State "Pecos River" (Back); Baylor (KU); Bexar (Bromley, TAM); Blanco (CRN); Brewster (Bromley, KU, TAM); Brooks (Bromley, TAM); Brown (Bromley, KSU); Childress (TAM); Crane (KSU); Dimmitt (CRN); Ector (Bromley, KSU); Frio (Bromley); Jeff Davis (Bromley); Jim Hogg (Bromley, TAM); Kleberg (KSU); Lipscomb (TAM); Live Oak (KU); Martin (TAM); Pecos (Bromley, DB-NMSU, KU, TAM); Potter (CSU); Presidio (Bromley); Reagan (TAM); Reeves (KU); San Patricio (TAM); San Saba (DB-NMSU); Starr (Bromley, TAM); Tarrant (KSU); Terrel (DB-NMSU); Val Verde (CRN, CSU, DB-NMSU); Victoria (KU); Webb (Bromley). MEXICO: COAHUILA (TAM); DURANGO (KU, TAM).

***Microstylum morosum*:** UNITED STATES: ARIZONA: State, no county listed (Martin & Wilcox); Cochise (CAS); Santa Cruz (CAS). COLORADO: Baca (CSU). KANSAS: State, no county listed (Smith); Barber (CSU, RLH, RJBa); Chautauqua (RJBe, KU); Comanche (CSU, KU, RLH); Cowley (RLH); Geary (KSU); Meade (KU); Montgomery (KU); Riley (KSU, KU); Sumner (KU, RLH). NEW MEXICO: Union (DB-NMSU). OKLAHOMA: Alfalfa (OSU); Cimarron (OSU, RG); Garvin (OSU); Grant (OSU, RLH); Jackson (DB-NMSU); Kay (OSU); Love (DB-NMSU); Mayes (OSU); Nowata (OSU); Osage (OSU); Pawnee (OSU); Payne (OSU); Wagoner (DB-NMSU). TEXAS: Bell (TAM); Bosque (Bromley); Brazoria (TAM); Brewster (Bromley); Collin (TAM); Coryell (TAM); Dallas (Back, Bromley); Gonzales (KU); Kendall (CSU); Lampasas (SWD); Leon (SWD); Madison (Bromley, TAM); McLennan (Bromley, KU, TAM); Milam (TAM); Mills (Bromley, DB-NMSU, KSU); Reeves (Hine); Robertson (SWD); Travis (Bromley, CRN); Victoria (Back, Bromley, DB-NMSU); Williamson (TAM). MEXICO: CHIHUAHUA (DB-NMSU); COAHUILA (TAM).

ACKNOWLEDGMENTS

This manuscript could not have been prepared without the help of the museum curators and collectors who so generously provided records and notes. Students of *Microstylum* are

exuberant and enthusiastic about these insects; Boris Kondratieff's (pers. commun., 1999) comment: "What a sweet genus" is typical. We thank R. J. Lavigne for reviewing a very early draft of the manuscript. Eric Fisher reviewed a later version of the manuscript prior to submission and provided Arizona collection records. R. J. Elzinga graciously allowed us to use his photograph of *M. morosum*. We are especially grateful to R. Grantham and D. Arnold of Oklahoma State University, B. Kondratieff of Colorado State University, J. D. Oswald and E. G. Riley of Texas A&M, D. B. Richman (The Arthropod Museum) and G. Forbes (Jornada Experimental Range) of New Mexico State University, R. Brown of Kansas State University, B. Ratcliffe of the University of Nebraska-Lincoln, and K. Simpson of the University of Missouri-Columbia for reviewing the specimens of *Microstylum* in their institutional collections and providing us with the pertinent distributional data. Dr. Forbes was especially generous with data from his field notes regarding habitat information for *M. galactodes*. Ron Huber of Prairie Village, Kansas provided records of specimens from his important personal collection. Sid Dunkle of Plano, Texas and C. Riley Nelson of Provo, Utah provided Texas records from their personal collections. Thanks to R. Brooks and S. Ashe of Kansas University for allowing R. E. Charlton to review the specimens of *Microstylum* in the Snow Entomological Museum. Finally, thanks to the two reviewers of the submitted manuscript for their suggestions for improving the paper.

LITERATURE CITED

- Back, E. A.** 1909. The robber-flies of America, north of Mexico, belonging to the subfamilies Leptogastrinae and Dasypogoninae. Trans. Am. Entomol. Soc. 35:137-400 + plates II-XII.
- Bromley, S.W.** 1927. The genus *Microstylum* in Madagascar (Diptera: Asilidae). Trans. Am. Entomol. Soc. 53:201-207.
- Bromley, S. W.** 1934. The robber flies of Texas (Diptera, Asilidae). Ann. Entomol. Soc. Am. 27:74-113.
- Hine, J. S.** 1918. Notes on robber flies from southwest Texas, collected by the Bryant Walker Expedition, with a description of a new species of *Erax*. Occas. Pap. No. 61 Mus. Zool., Univ. Mich., Ann Arbor, MI. 7 pp.
- Hull, F.M.** 1962. Robberflies of the world. The genera of the family Asilidae. U.S. Nat. Mus. Bull. 224. Part 1:1-430, Part 2:431-907, + figures 1-2536.
- James, M. T.** 1941. The robber flies of Colorado (Diptera, Asilidae). J. Kans. Entomol. Soc. 14(1):27-36, 14(2):37-53.
- Martin, C. H.** 1960. A new species of *Microstylum* (Diptera: Asilidae) from Mexico. J. Kans. Entomol. Soc. 33(1):44-45.
- Martin, C. H. & J. Wilcox.** 1965. Family Asilidae, pp. 360-401 In: Stone, A., C. W. Sabrosky, W. W. Wirth, R. H. Foote, & J. R. Coulson, Eds. A catalog of the Diptera of America north of Mexico. Agr. Hdbk. No. 276, USDA, Wash. D.C.
- Schoewe, W. H.** 1949. The geography of Kansas. Trans. Kans. Acad. Sci. 52:261-331.
- Smith, R. C., E. G. Kelly, G. A. Dean, H. R. Bryson, & R. L. Parker.** 1962. Insects in Kansas. Rev. Edition, D. E. Gates and L. L. Peters, Eds. Kans. St. Univ., Manhattan, KS.
- Wood, G. C.** 1981. Asilidae. Chapter 42, pp. 549-573 In: McAlpine, J.F., B. V. Peterson, G. E. Shewell, H. J. Teskey, J. R. Vockeroth, and D. M. Wood, Eds. Manual of Nearctic Diptera. Volume 1. Res. Br. Agr. Canada. Monog. No. 27. Can. Govt. Pub. Center. Quebec, Canada.
- Zimmerman, J. L. & S. T. Patti.** 1988. A guide to bird finding in Kansas and western Missouri. Univ. Press Kans., Lawrence, KS.

A NEW GENUS AND THREE NEW SPECIES OF THE TRIBE SPATHOPHORINI (HETEROPTERA: COREIDAE)¹

Harry Brailovsky²

ABSTRACT: *Egerniella*, new genus, and two new species, *E. delectabilis* from Ecuador and Peru, and *E. immaculata* from Peru, and *Himellastella formosa* a new species from Brazil are described, illustrated, and assigned to the tribe Spathophorini (Coreidae). The new genus resembles and is most closely related to the Neotropical genera *Himellastella* and *Paralycambes*.

The tribe Spathophorini has been the subject of two recent papers (Brailovsky 1998, Brailovsky & Barrera 1998). Recently I had the opportunity to study additional material, including a striking new genus and an undescribed species of *Himellastella* Brailovsky and Barrera.

The new genus has been placed in couplet 6 of the Brailovsky and Barrera (1998) key:

- 6 Mesosternum elevated; humeral angles sharp but hardly produced laterally; posterolateral border of pronotum almost smooth or only with upper half finely nodulose *Lycambes* Stål
- 6' Mesosternum flat; humeral angles produced laterally into a medium or large-sized and acute spine; posterolateral border of pronotum abruptly crenate or nodulose 7
- 7 Humeral angles markedly produced laterally into a sharp and large spine (Figs. 8-9); middle femur unarmed; hind femur length reaching anterior margin of abdominal sternite VII; plica not visible *Egerniella*, new genus
- 7' Humeral angles produced laterally into medium-sized angulate triangle (Fig. 6); middle femur ventrally armed; hind femur short, not extending beyond anterior margin of abdominal sternite VI; plica present *Paralycambes* Kormilev

Acronyms used: Carnegie Museum of Natural History, Pittsburgh, Pa. (CMN), Joe E. Eger, Private Collection (JEE), Texas A & M University, College Station (TAMU), and Instituto de Biología, Universidad Nacional Autónoma de México (UNAM).

All measurements are given in millimeters.

Egerniella Brailovsky, NEW GENUS

Description. Head. Wider than long, barely pentagonal, non-declivent, dorsally flat; tylus unarmed, apically globose, raised, extending anteriorly to and laterally higher than juga and antenniferous tubercles; juga unarmed, shorter than tylus; space between antenniferous tubercles filled by tylus, and space between them smaller than width of one tubercle; antenniferous tubercles unarmed, border entire, continuous, almost semicircular, not prominent; antennal segment I robust, cylindrical, thickest, slightly curved outward, barely flattened, longer than head; segments II and III cylindrical, flattened, sulcate;

¹ Received June 25, 1999. Accepted September 16, 1999.

² Instituto de Biología, UNAM, Departamento de Zoología, Apdo Postal 70153, México D.F., 04510, México. e mail: coreidae@servidor.unam.mx

segment IV fusiform; antennal segment IV the longest, III shortest, and II shorter than I; ocelli close to eyes; distance between ocelli 2.9 to 3.7 times the diameter of one ocellus; preocellar pit deep; eyes globose, protuberant, upper margin located almost at same level of vertex and frontal area; postocular tubercle and mandibular plate absent; buccula rectangular, raised, short, entire, not projecting beyond antenniferous tubercles, meeting posteriorly and closed; rostrum reaching middle third of metasternum; rostral segment III shortest, I shorter than II and IV, and II longer or subequal than IV; ventral surface behind buccula without tubercle.

Thorax. Pronotum. Wider than long, trapeziform, slightly declivent, with posterior border subequal to base of scutellum in width; collar wide; anterolateral angles obtuse; humeral angles markedly produced laterally into a sharp and large spine; anterior margin smooth, curved; anterolateral margins obliquely straight, nodulose; posterolateral margins abruptly spinate and tuberculate; posterior border almost straight and posterior margin with irregular transversal ridge; triangular process broad, apically subacute; calli entire, not elevated. Prosternum sunken, posterior margin in front of area between fore legs produced into narrow acute projection; mesosternum flat or barely convex, anterior margin in front of area between fore legs produced into a broad and blunt keel, posterior margin between middle legs bilobed, each lobe well separated from mesial line and in the same relative position as the arms of anterior margin of metasternum; metasternum broad, squarish, anterior margin with two small arms, separated along midline; each arm almost touching the two lobes of the posterior margin of mesosternum; posterior margin of metasternum straight, lateral angles projected into short subacute plate lying against metacoxa, and at middle third entirely flat (Fig. 5); metathorax laterally not expanded, in dorsal view with metapleura and acetabulae not visible; anterior lobe of metathoracic peritreme weakly globose and almost fused with the tiny posterior lobe; evaporative area poorly developed.

Legs. Hind coxae separated, distance between them 2.2 to 2.4 times the diameter of one coxa, and apically without tubercle; fore femur slender, ventrally with one subdistal spine; middle femur slender, unarmed; hind femur incrassate reaching anterior border of abdominal sternite VII; dorsal surface smooth, ventrally with one row of strong spines and tubercles running from middle third to apex; fore and middle tibiae unarmed, sulcate, widened distally; hind tibia almost straight, flattened, shorter than length of hind femur, with outer margin sulcate and not expanded, inner margin not expanded, apically armed with a slender and relatively long spine.

Scutellum. Longer than wide, triangular, flat, shorter than clavus; disc without triradiate ridge; apex acute not elevated; lateral margins emarginate.

Hemelytra. Macropterous, reaching apex of abdomen; clavus and claval suture not covered by the scutellum; costal margin emarginate; apical margin obliquely straight, with apical angle narrowly long, extending beyond middle third of hemelytral membrane.

Abdomen. Gradually narrowing; connexival segments scarcely elevated; posterior angle of segments IV to VII projected into short and acute spine; segments II and III entire, without spine; abdominal sterna without medial furrow; abdominal spiracles slightly elliptical to circular, close to anterior border; abdominal sternite II visible, slender, short, rectangular, without tubercle; abdominal sternite III not expanded laterally.

Female genitalia. Abdominal sternite VII with fissura, this with inner margin overlapping; plica not visible; gonocoxae I subtriangular, short, exposed, closed in caudal view, straight in lateral view, with upper border rounded to subacute; paratergite VIII triangular, spiracle visible; paratergite IX squarish, longer than paratergite VIII.

Male. Unknown.

Integument. Body surface shiny, with clavus, corium, prosternum, mesosternum, and metasternum dull; surface including antennal segments and legs sparsely clothed with short decumbent to suberect setae; head, collar, calli, prosternum, mesosternum, metasternum, middle third of propleura, mesopleura, metapleura, connexival segments, and abdominal sterna not

punctate; posterior lobe of pronotum, acetabulae, anterior and posterior margin of propleura, and posterior margin of metapleura strongly punctate; clavus and corium densely and finely punctate; scutellum transversely striate.

Etymology. Named for Joe E. Eger, distinguished American heteropterist, specialist of Scutelleridae, and collector of the type series.

Discussion. *Egerniella* Brailovsky new genus, *Himellastella* Brailovsky & Barrera, and *Paralycambes* Kormilev, share the following characters: head ventrally smooth, without tubercle behind buccula, hind femur gradually incrassate, triangular process on pronotum well developed, mesosternum flat, metathorax not expanded laterally, scutellum longer than wide, and humeral angles laterally produced. In *Egerniella* and *Paralycambes*, the middle third of the metasternum is flat, in *Himellastella* it is conspicuously produced into two large conical lobes freely directed downward (Figs. 1-3). *Egerniella* differs from *Paralycambes* in the following characters: humeral angles markedly produced laterally into a sharp and large spine, middle femur unarmed, hind femur length reaching anterior margin of abdominal sternite VII, and plica not visible. In *Paralycambes* the humeral angles are produced laterally into an acute medium-sized angulate triangle; middle third of femur ventrally armed, hind femur short not extending beyond anterior margin of abdominal sternite VI, and plica present (Brailovsky 1998, and Brailovsky & Barrera 1998).

Type species.- *Egerniella delectabilis* Brailovsky, new species.

Egerniella delectabilis Brailovsky, NEW SPECIES

Figures 5, 8

Description. Female. Dorsal coloration. Head shiny yellow, with postocular surface and two narrow longitudinal stripes running laterally to middle line from ocellar tubercle to near antenniferous tubercles shiny brown; ocelli reddish; antennal segments I to IV shiny chestnut orange; pronotum shiny black with collar, calli, three broad longitudinal stripes and posterior border shiny yellow; humeral angles with the spine shiny chestnut orange to shiny black; calli sprinkled with brown reflections; scutellum shiny red with lateral margins ochre and shiny yellow longitudinal median stripe; apex creamy yellow; clavus black with vein and commissure dull yellow; exocorium dull red, with costal margin dull yellow, endocorium dull black with veins and apical margin dull yellow; hemelytral membrane dark ambarine with veins and basal angle black; connexival segments II to V shiny chestnut orange, and VI and VII shiny chestnut orange with inner margin and posterior third of segment VII black; dorsal abdominal segments black. **Ventral coloration.** Head shiny yellow; rostral segments I to III dirty yellow and IV black with basal third dirty yellow; prosternum, mesosternum, and anterior third of metasternum black; posterior third of metasternum shiny chestnut orange; propleura shiny yellow with broad chestnut red longitudinal stripe close to outer third; mesopleura and metapleura shiny red to shiny chestnut orange with posterior margin and large and broad spot shiny yellow; anterior lobe of metathoracic peritreme pale orange yellow; fore acetabula shiny yellow; middle and hind acetabulae shiny yellow with posterior third shiny chestnut red; fore and middle legs dirty yellow with sulcate section of tibiae irregularly black; hind leg with coxa, trochanter and femur shiny chestnut orange and femoral spines black; tibia with basal half shiny brown, and

distal half and tarsi dirty yellow; abdominal sterna shiny brown with following areas shiny yellow; sternite II, pleural sterna II to VII, middle third of sterna III to V, middle third of anterior margin of sternite VI, and inner face of paratergite VIII and IX.

Variation. 1- Rostral segment IV yellow with apex black. 2- Middle third of head behind buccula black. 3- Middle third of abdominal sterna II and VII shiny black. 4- Paratergite VIII entirely yellow.

Measurements. Head length 1.36, width across eyes 2.04, interocular space 1.00, interocellar space 0.42, preocular distance 0.82; length of antennal segments: I, 3.24, II, 2.44, III, 2.08, IV, 3.60; length of rostral segments: I, 0.65, II, 0.75, III, 0.55, IV, 0.72. Pronotum: Total length 3.36, width across frontal angles 1.68, width across humeral angles 5.20. Scutellar length 1.80, width 1.44. Total body length 12.95.

Male. Unknown.

Type material. Holotype: ♀, Ecuador: Provincia Napo, vic Puerto Misahuali, 1-2'-4.2"S-77-39'-49.2"W, 550-630m, 6-19-IX-1998, J. E. Eger (TAMU). Paratypes. 1 ♀, same data as for holotype (UNAM). 1 ♀, Peru: Huanuco Department, Tingo Maria National Park, Tingo Maria, 660m, 11-17-IV-1987, J. E. Eger (TAMU).

Etymology. Named for Latin "*delectabilis*", meaning delightful or agreeable.

Egerniella immaculata Brailovsky, NEW SPECIES

Figure 9

Description. Female. Dorsal coloration. Head shiny chestnut yellow with ocellar tubercle brown; ocelli red; postocular surface black; antennal segment I chestnut yellow (antennal segments II to IV mutilated); pronotum shiny chestnut yellow with posterior transversal ridge reddish brown; scutellum bright red with lateral margins ochre and bright yellow longitudinal median stripe; apex creamy yellow; clavus black with vein and claval commissure dull yellow; exocorium dull red with costal margin dull yellow, exocorium dull black with veins and apical margin dull yellow; hemelytral membrane dark ambarine with veins and basal angle black; connexival segments II to VII shiny chestnut orange with inner margin of VII black. **Ventral coloration.** Head, rostral segments (apex of IV black), thorax, and abdomen shiny chestnut yellow; prosternum, mesosternum, and anterior half of thoracic metasternum black; posterior half of metasternum shiny chestnut orange; anterior lobe of metathoracic peritreme dark orange; fore and middle leg yellow; hind leg with coxa and trochanter shiny chestnut brown, femur with dorsal surface shiny chestnut yellow, and ventrally, including the spines and tubercles, shiny brown to black, tibia yellow with basal third black, and tarsi yellow; abdominal sternite VII yellow with shiny black longitudinal stripe running throughout fissura; genital plates shiny yellow with outer margin of paratergite VIII and IX, and caudal margin of gonocoxae I bright black.

Measurements. Head length 1.34, width across eyes 2.00, interocular space 0.98, interocellar space 0.44, preocular distance 0.86; length of antennal segments: I, 3.08, II to IV mutilated; length of rostral segments: I, 0.65, II, 0.72, III, 0.55, IV, 0.67. Pronotum: Total length 3.48, width across frontal angles 1.80, width across humeral angles 6.12. Scutellar length 1.88, width 1.44. Total body length 13.78.

Male. Unknown.

Type material. Holotype: ♀, Peru: Huanuco Department, Tambillo Grande Canyon, 13 km S Tingo Maria, 930m, 3-V-1988, J. Ch. de Vela (TAMU).

Etymology. Named from the Latin "*im*", meaning not, and "*maculate*", meaning spot, to reflect the unspotted abdominal sterna III to VI.

Key to the Species of *Egerniella*

- 1 Pronotum shiny black with collar, calli, posterior border, and three broad longitudinal stripes shiny yellow; propleura, mesopleura and thoracic metapleura bright red to shiny chestnut orange with yellow marks; abdominal sterna III to VI not entirely yellow *delectabilis* sp.n.
- 1' Pronotum shiny chestnut yellow with posterior transverse ridge reddish brown; propleura, mesopleura and thoracic metapleura yellow; abdominal sterna III to VI entirely yellow *immaculata* sp.n.

Himellastella formosa Brailovsky. NEW SPECIES

Figures 1, 4, 7, 10

Description. Male. Dorsal coloration. Head shiny chestnut orange; antennal segment I shiny chestnut orange, and segments II to IV shiny red; pronotum shiny chestnut orange, with humeral angles shiny reddish brown, posterior margin and triangular process yellow, and two creamy yellow enamel-like spots located on middle third, one behind calli, the other on posterior margin; scutellum shiny chestnut orange, with apex creamy yellow; clavus dull yellow with punctures orange; corium dull yellow with reddish brown stripes between veins; hemelytral membrane dark ambarine, with veins and basal angle darker; connexival segments III to V yellow and VI-VII yellow with inner margin orange red; dorsal abdominal segments orange red with yellow longitudinal stripe running throughout middle third of segments V to VII. **Ventral coloration.** Including rostral segments (apex of IV black), fore and middle legs, and genital capsule shiny chestnut orange; metasternum shiny orange red; propleura with small protuberance, and mesopleura and metapleura with large and broad creamy yellow hardened protuberance; hind leg shiny chestnut orange with posterior margin of femur and basal third of tibia shiny chestnut red; anterior lobe of metathoracic peritreme pale orange; pleural margin of abdominal sterna II to VII yellow to creamy yellow.

Structure. Thorax. Pronotum. Humeral angles markedly produced laterally into a large sharp spine, with medium-sized and broad marginal spines and tubercles; triangular process broad, nodulose, conspicuously elongate, extending far from the middle third of scutellum (Fig. 7). Middle third of metasternum remarkably produced into two large lobes, freely directed downward (Fig. 1). Genital capsule simple, semiglobose; posteroventral edge with median broad projection, protruding as a large quadrate plate, with angles almost straight (Fig. 4).

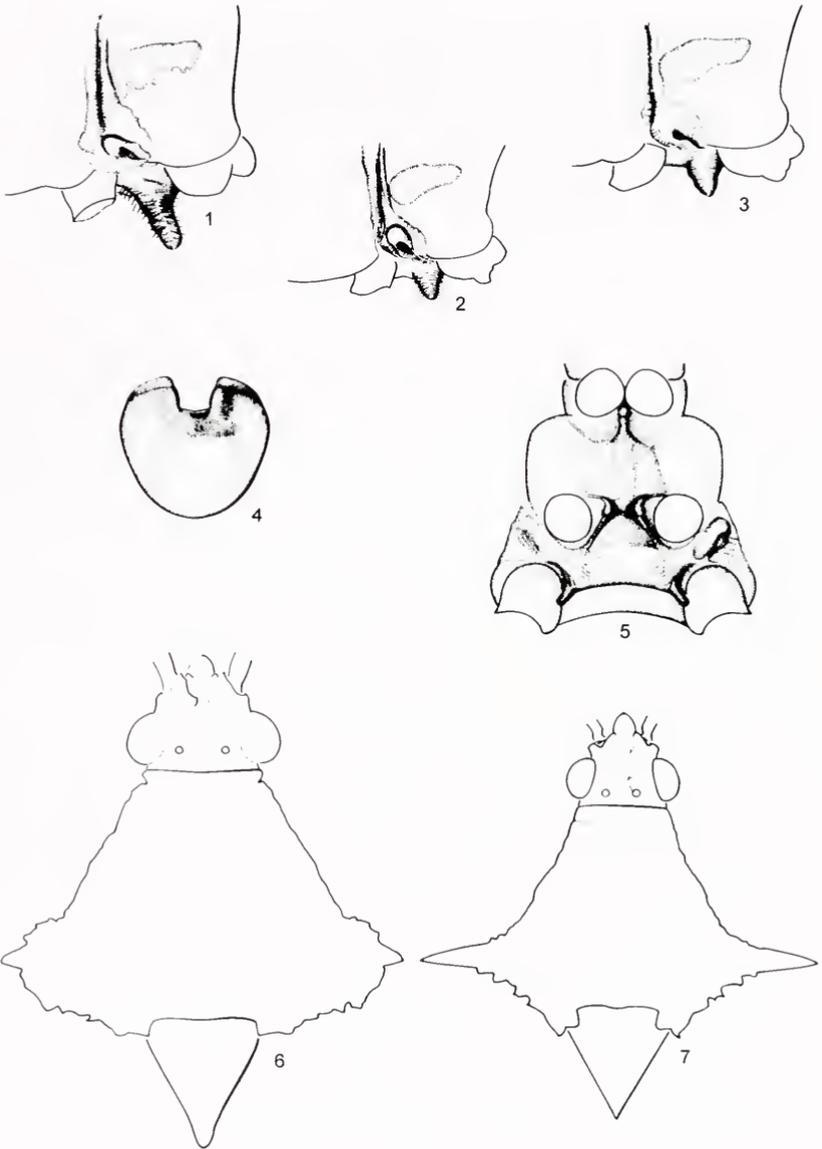
Measurements. Head length 1.84, width across eyes 2.24, interocular space 1.16, interocellar space 0.60, preocular distance 1.14; length of antennal segments: I, 4.30, II, 3.20, III, 2.60, IV, 4.95. Pronotum: Total length 5.00, width across frontal angles 2.35, width across humeral angles 8.20. Scutellar length 2.20, width 1.80. Total body length 21.65.

Female. Unknown.

Type material. Holotype: ♂, Brazil: Tonantins, Amazon River, VIII-1923, S. Klages (CMN).

Discussion. This species resembles *H. conica* Brailovsky & Barrera, in having two creamy yellow enamel-like spots on the pronotal disc and one on the propleura. *Himellastella aploa* Brailovsky & Barrera, the other previously known species, lacks creamy yellow spots.

Himellastella formosa new species, can be distinguished by its long size, longer than 21.00 mm, the triangular process of pronotum extends far from the middle third of scutellum, and the lobes of the middle third of metasternum are remarkably produced (Fig. 1). In *H. conica*, the body size is shorter



Figures. 1-4. *Himellastella* spp. 1-3 Metathorax in lateral view. 1. *H. formosa* sp. n. 2. *H. aploa* Brailovsky and Barrera. 3. *H. conica* Brailovsky and Barrera. Fig. 4. Male genital capsule of *H. formosa* sp. n. Fig. 5. Mesothorax and metathorax in ventral view of *Egerniella delectabilis* sp. n. Figs. 6-7. Head, pronotum and scutellum in dorsal view. 6. *Paralycambes misionensis* Kormilev. 7. *Himellastella formosa* sp. n.

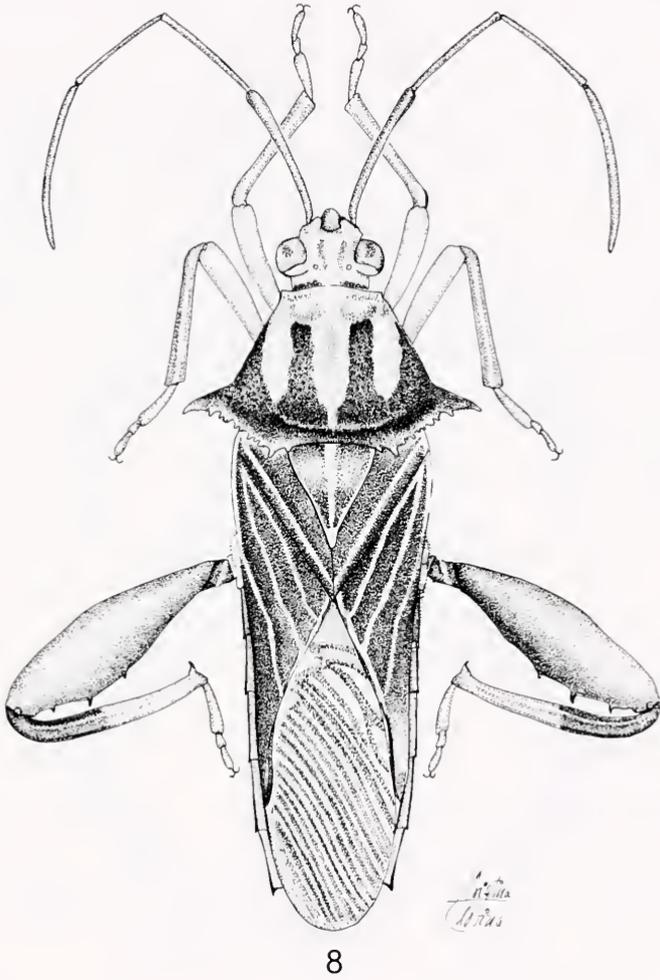
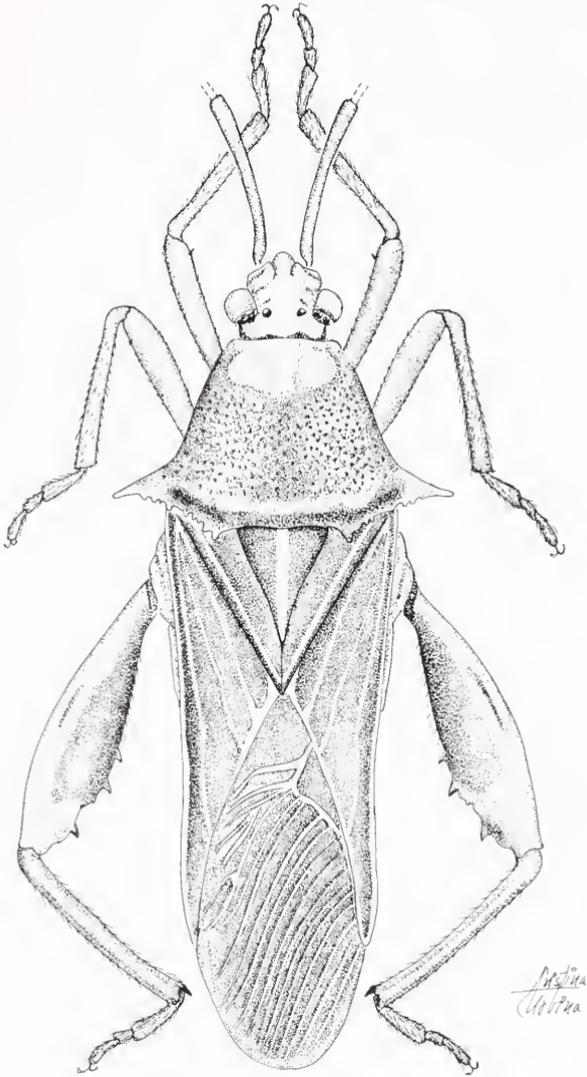


Figure 8. Dorsal view of *Egerniella delectabilis* sp. n.



9

Figure 9. Dorsal view of *Egerniella immaculata* sp. n.

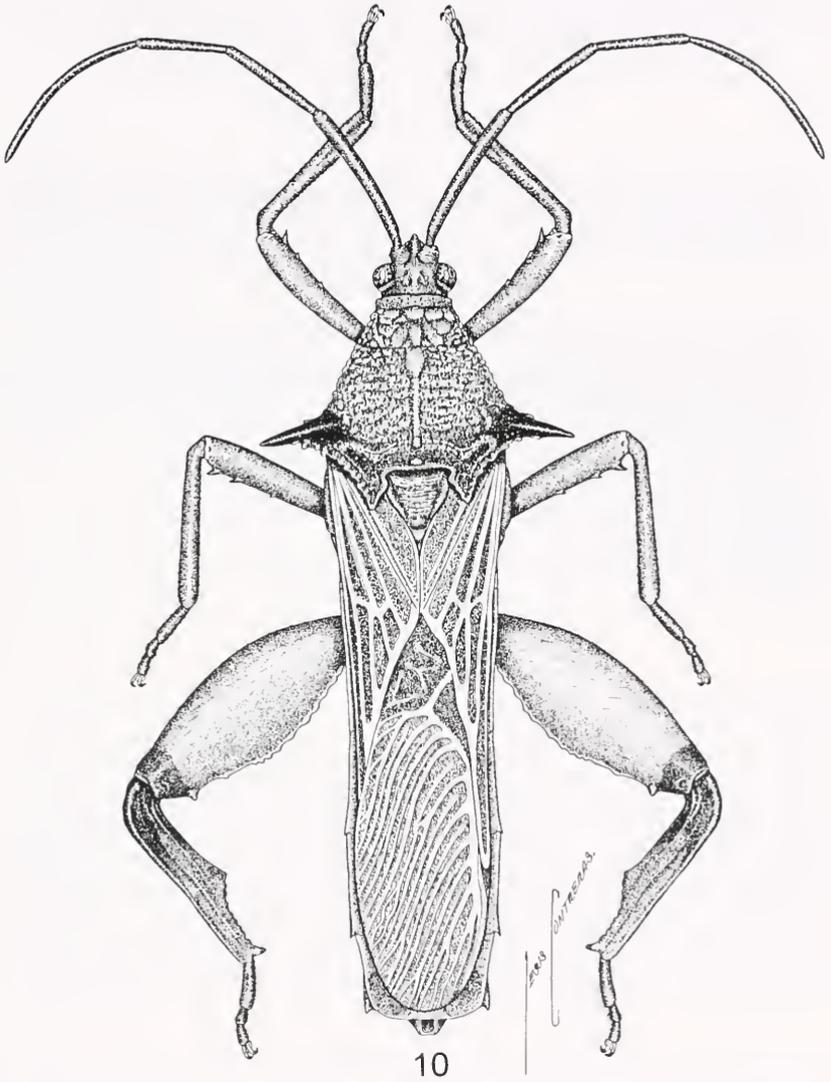


Figure 10. Dorsal view of *Himellastella formosa* sp. n.

than 19.00 mm, the triangular process never reaches the middle third of scutellum, and the lobes of the metasternum are conical, stout, and smaller (Fig. 3).

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

ACKNOWLEDGMENTS

Sincere thanks and appreciation to the following colleagues and institutions for the loan of specimens and other assistance relevant to this study: John L. Rawlins and Robert L. Davidson (CMN), Joe E. Eger (JEE), and Joseph C. Schaffner (TAMU). Thanks to Ernesto Barrera (UNAM), Cristina Urbina, and Jesus Contreras for the illustrations.

LITERATURE CITED

- Brailovsky, H.** 1998. A new species of *Paralycambes* Kormilev from South America (Hemiptera: Heteroptera: Coreidae: Meropachydinae). J. New York Entomol. Soc. 106: 57-63.
- Brailovsky, H. and E. Barrera.** 1998. A new genus, two new species, and synonymical notes on the tribe Spathophorini (Heteroptera: Coreidae: Meropachydinae), with a key to genera of the tribe. Proc. Entomol. Soc. Wash. 100: 746-754.

A REVIEW OF THE LEAFHOPPER GENUS *ACRULOGONIA* (HOMOPTERA: CICADELLIDAE) WITH DESCRIPTIONS OF NEW SPECIES¹

Carolina Godoy², M. W. Nielson³

ABSTRACT: The genus *Acrulogonia* was established by Young (1977) who included eleven species: *A. chocona*, *A. defectiva*, *A. fuscinula*, *A. incompta*, *A. ordinaria*, *A. pararesima*, *A. reclusa*, *A. resima*, *A. mucidula*, *A. smidti* and *A. sparsa*. In this paper we present a key to species and describe two new species from Costa Rica: *A. sexspinosa* and *A. tecta*. The latter is also present in Panama and Nicaragua. *A. ordinaria* is here reported from Costa Rica for the first time. The genus ranges from Nicaragua to Bolivia.

The genus *Acrulogonia* was described and illustrated by Young (1977), who described nine species: *A. chocona*, *A. defectiva*, *A. fuscinula*, *A. incompta*, *A. ordinaria*, *A. reclusa*, *A. resima*, *A. sparsa* and *A. pararesima*. Young also placed *Tattigoniella mucidula* Jacobi and *Poeciloscarta smidti* Metcalf in this genus. *Acrulogonia* occurs in Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Peru, Bolivia, French Guiana, Guayana and northeastern Brazil. *A. pararesima* and *A. ordinaria* occur in Panama and Costa Rica, the latter being a new record for Costa Rica. *A. ordinaria* has been collected from 700-1700 m in February and June. In this paper we describe two new species from Costa Rica: *A. sexspinosa* from Costa Rica and *A. tecta* from Costa Rica and Nicaragua.

Acrulogonia

Type-species: *Poeciloscarta smidti* Metcalf

Medium-size leafhoppers. Color pale brown to dark brown, sprinkled with small spots and occasionally with pale vermiculations, and, in some species, with large pale orange to bright orange spots on the forewings.

Head weakly produced, anterior margin broadly rounded in dorsal view; clypeus slightly flattened medially, clypellus with profile of its ventral aspect slightly more horizontal than remainder of contour of face. Thorax with pronotal width equal to or less than transocular width of head; forewing with membrane absent or limited to inner apical cell or to inner two apical cells, texture translucent to opaque; hindlegs with femoral setal formula 2:1:1 or 2:1:1:1.

Male genitalia: pygofer scarcely to moderately produced with posterodorsal

¹ Received May 28, 1999. Accepted September 9, 1999.

² Instituto Nacional de Biodiversidad, Apartado Postal 22-3100 Santo Domingo, Heredia, Costa Rica.

³ Monte L. Bean Museum, Brigham Young University, Provo, UT 84602 USA.

process varying interspecifically in position from anteapical to apical and with additional process in some species, macrosetae varying from two to twenty, limited to apical half of pygofer; aedeagus symmetrical, shaft elongate, apex abruptly curved at right angle to long axis of shaft, shaft usually with at least one pair of processes.

MATERIAL AND METHODS

The details of preparations of genital structures of leafhoppers for dissections and study are given by Oman (1949). We have followed his method with some modifications. A system was devised in which the abdomens of 10 leafhoppers were cleared simultaneously. Abdomens were removed, placed in ten percent potassium hydroxide and left to soak overnight at room temperature. The following day individual abdomens were washed in water before examination and eventual preservation in glycerin in microvials.

Specimens are deposited in the following collections:

CAS: California Academy of Sciences, San Francisco, USA

INBio: Instituto Nacional de Biodiversidad, Santo Domingo, Heredia, Costa Rica.

NHM: The Natural History Museum, London, UK

UCR: University of Costa Rica, San Pedro, San José, Costa Rica.

USNM: United States National Museum, Washington, USA

USU: Utah State University, Logan, USA.

MEN: Museo Entomológico, León, Nicaragua.

Acrulogonia sexspinos NEW SPECIES

Figs. 1-6

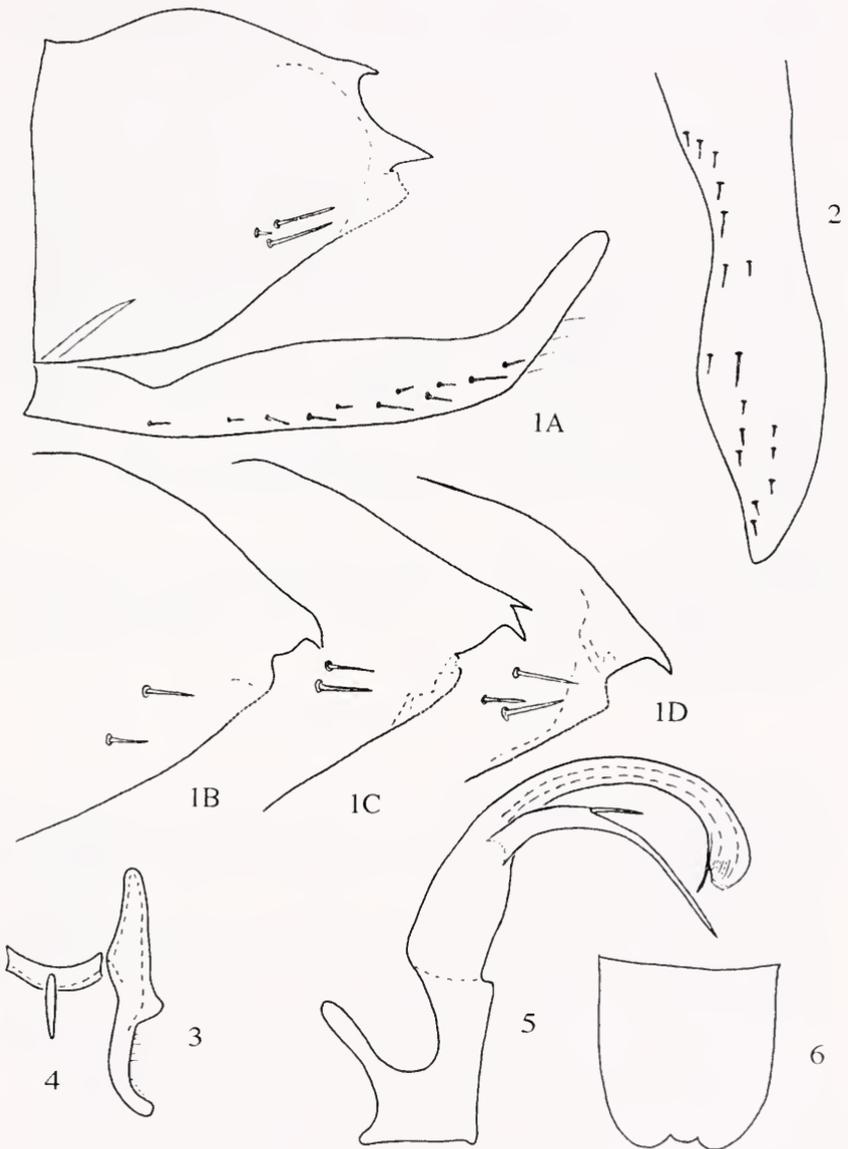
Length: Male 9.2-11.2 mm, female 10.0-11.5 mm.

Color of dorsum entirely brown, sprinkled with small pale spots. Crown irregularly dotted with beige, pronotum with beige small spots and with or without pair of orange lateral markings, scutellum brown with beige dots. Forewings opaque, with proximal irregular orange markings, proximal area of corium, discal cells and subapical cell with small pale and beige spots; face brown with a median and lateral longitudinal pale stripes.

Head weakly produced, with median length of crown slightly more than one half interocular width and approximately one-third transocular width, without carina at transition from crown to face, ocelli located on line between anterior eye angles, each slightly closer to adjacent anterior eye angle than to median of crown; crown in lateral view slightly concave medially across ocelli, lateral clypeal sutures extending onto crown and attaining ocelli; clypeus slightly flattened medially, muscle impressions distinct.

Thorax with pronotal width less than transocular width of head, disc rugose and punctate. Forewings with membrane limited to inner two apical cells. Hindlegs with femoral setal formula 2:1:1, length of first tarsomere greater than combined length of second and third tarsomeres.

Male genitalia: Pygofer variable with or without an anteapical dorsal process with a simple or bifid apex, process with two or three macrosetae near middle (Figs. 1A-1D). Plates elongate, triangular, narrowed in basal half, weakly fused basally, not extending posteriorly beyond pygofer apex, broadened near base and anteapically, with multiseriata setae (Fig. 2). Style without preapical lobe, extending farther posteriorly than apex of connective (Fig. 3). Connective Y-shaped with arms divergent, stem keeled (Fig. 4). Aedeagus symmetrical, shaft elon-



Figs. 1-6. *Acrulogonia sexspinosa*, n. sp. 1 A, B, C, D. Pygofer, lateral view; 2. Plate, ventral view; 3. Style dorsal view; 4. Connective dorsal view; 5. Aedeagus, lateral view; 6. Female abdominal sternum VII.

gate, curved dorsally with short acute pair of ventral processes arising before apex, shaft with one pair of processes arising ventrally slightly before middle of shaft extending apically anteriorly with elongate slender acute dorsal process arising at midlength (Fig. 5).

Female abdominal sternum VII, with rounded median lobe (Fig. 6).

Holotype male: COSTA RICA, Puntarenas, Peninsula de Osa, Rancho Quemado Apr 1991, J. C. Saborio, LS 292500, 511000 (INBio).

Paratypes: 1 ♂, 3 ♀ same data as holotype except, 200 m Jun 1992, F. Quesada, 1 ♂ Apr 1991; 1 ♂ Mar 1992; 3 ♂, 2 ♀ Set. 1991 (INBIO, NHM, USNM); 1 ♀ same locality and collector, Jul 1992; 2 ♂, May 1992, F. Quesada & G. Varela; 1 ♂ P. N. Corcovado, Sendero a Rio Claro, Jan-Mar 1992, Malaise trap LS 508300-270500 (INBIO, CAS); 2 ♂ Est. Sirena, 0-100 m, Nov 1989, G. Fonseca, 270500-508300; 2 ♂ same data, 50 m, IV-VIII 1989; 1 ♂ same locality 17 Jun a 4 Sep 1991, Malaise trap; 3 ♂ Fila Madre, 3 Km. SO de Cerro Rincón, 545-710 m, 25-26 May 1995, A. Picado. LS 273300-520000; 1 ♀ same locality, Dic 1989-Mar 1990, Hanson (UCR); 1 ♂, 1 ♀ Cerro Rincón 200 m S del Hito, 744 m, Dic 1989-Mar 1990 (UCR); 8 ♂, 1 ♀ Cerro Rincón 200 m S del Hito, 744 m, Sep 1990 (UCR, USU); 2 ♂, 2 ♀ Golfo Dulce, 3 km SW. Rincón, 10m, Mar-May-1989, Hanson (UCR); 11 ♂ Quepos Manuel Antonio, Apr 1991, G. Varela, LS 370900-448800; 1 ♂ Pen. Osa, Bosque Esquinas, 200 m. Jun 1994, J. F. Quesada, 302400-545250; 3 ♂ Est. Agujas, Sendero Zia, Rio Agujas, 300 m. 2-15 Jan 1996, A. Azofeifa. T. Foso. LS 276750-526550; 2 ♀ P. N. Corcovado, Est. Sirena, 17 Jun-4 Set 1991, LS 270500-508800; 3 ♀ same locality, 50 m, Apr-Aug 1989 (INBio).

Remarks.

Acrulogonia sexspinosa is similar to *A. pararesima* but the former can be separated by its aedeagus, which has a pair ventral processes at the apex extending anteriorly, each with a bifid tapering acute process. This species has been collected from 0-750 m in the wet lowlands.

Acrulogonia tecta NEW SPECIES

Figs. 7-13

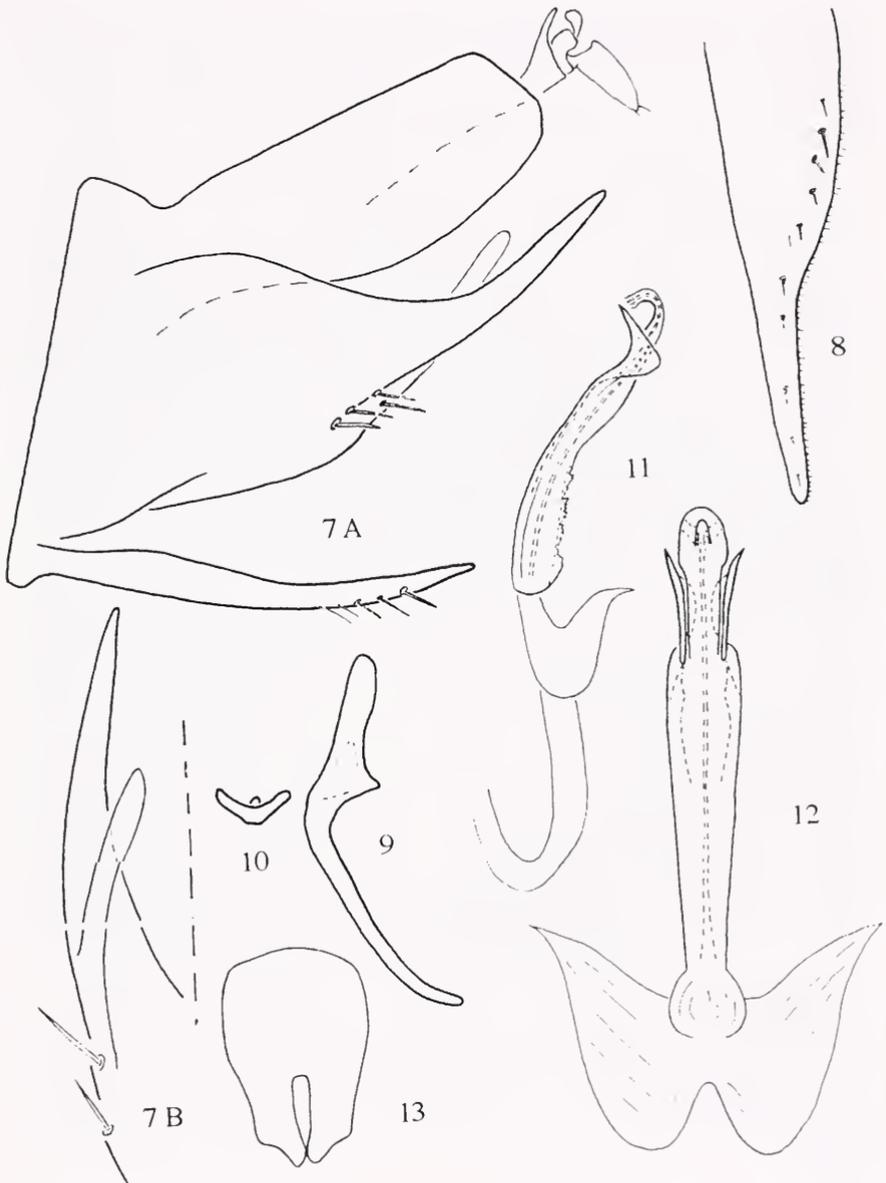
Length: Male 6.3-8.0 mm, female 6.5-7.7 mm.

Color of dorsum entirely brown, sprinkled with small pale yellow spots. Crown, pronotum, and scutellum brown sprinkled with small pale spots. Forewings translucent with red veins, claval area with small pale spots, remainder sprinkled with small pale yellow spots; face brown with median and lateral longitudinal pale stripes.

Head weakly produced, with median length of crown slightly more than one half interocular width and approximately one-third transocular width, without carina at transition from crown to face, ocelli located on line between anterior eye angles, each slightly closer to adjacent anterior eye angle than to median of crown, lateral clypeal sutures extending onto crown and attaining ocelli; clypeus slightly flattened medially, muscle impressions distinct.

Thorax with pronotal width less than transocular width of head. Forewings slightly opaque with membrane limited to inner two apical cells. Hindlegs with femoral setal formula 2:1:1, length of first tarsomere greater than combined length of second and third tarsomeres.

Male genitalia: Pygofer abruptly narrowed posteriorly, strongly produced into an acute process which is directed caudadorsally, with four macrosetae on ventral margin near its midlength (Fig. 7A); with a less sclerotized ventral process, arising externally but directed internally, that does not exceed the length of the pygofer (Fig. 7B). Plates slender and triangular, narrowed in apical half, weakly fused basally, not extending posteriorly nearly as far as pygofer apex, with uniseriate setae in basal two-thirds of their length (Fig. 8). Style without



Figs. 7-13. *Acrulogonia tecta*, n. sp. 7 A. Pygofer, lateral view; 7 B. Pygofer, lateral view apex, ventral view; 8. Plate, ventral view; 9. Style dorsal view; 10. Connective dorsal view; 11. Aedeagus, lateral view; 12. Aedeagus, caudoventral view; 13. Female abdominal sternum VII

preapical lobe, extending farther posteriorly than apex of connective (Fig. 9). Connective U-shaped with arms divergent, stem keeled (Fig. 10). Aedeagus symmetrical, shaft elongate, in lateral view apex curved dorsally, except apical portion, shaft with one pair of lanceolate processes arising ventral laterally slightly beyond midpoint of shaft (Fig. 11), in caudoventral view these processes not extending to apex (Fig. 12).

Female abdominal sternum VII with posterior margin deeply emarginate (Fig. 13).

Holotype: Male: COSTA RICA, Guanacaste, Estación Pitilla, 9 Km. S Sta Cecilia, 700 m. May 1991. P. Rios, L-N 330200, 380200 (INBio).

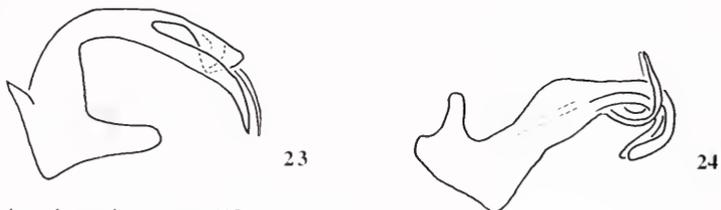
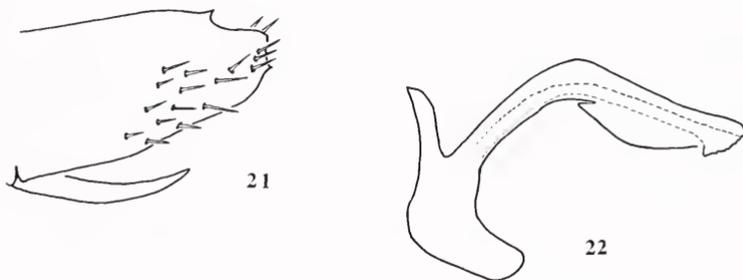
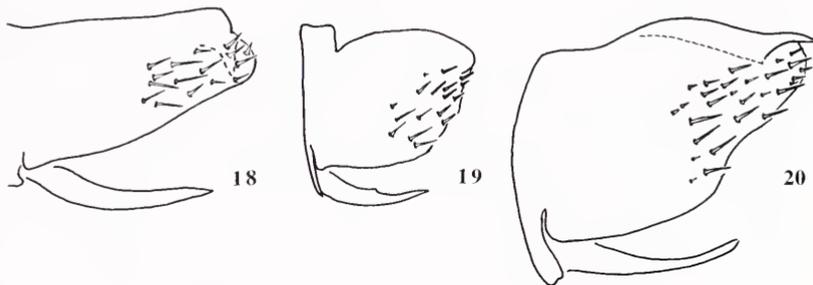
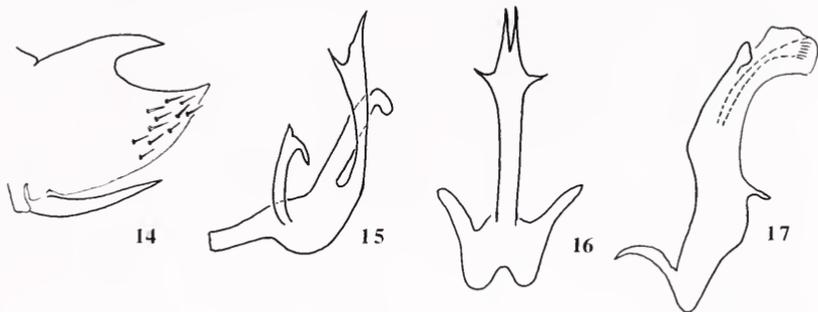
Paratypes: COSTA RICA, 4 ♂, 1 ♀, same data as holotype; 1 ♂, 1 ♀, Jul 1991; 1 ♂, 2 ♀ May 1994; 1 ♂ Apr 1995; 2 ♂, 6 ♀, Oct. 1993; 1 ♀, Oct 1994, ypt; 2 ♂ Jun 1994, ypt; 8 ♂, 5 ♀, Jan 1994, Malaise trap; 1 ♀, Feb 1995, ypt; 1 ♀, Aug 1994, ypt; 1 ♀, Jun 1991, Malaise trap; 1 ♂ Nov 1989, Col. C. Moraga & P. Rios; 2 ♀ same locality, Mar 1991; 1 ♀, Jul 1995; 1 ♂, 1 ♀, 29 Mar-5 Apr 1995 C. Moraga, Malaise trap; 1 ♂ 22 Aug 1993; 1 ♂ Aug 1994; 1 ♂ May 1991; 1 ♂, 2 ♀, 31 Mar-29 Apr 1992, S. Rojas; 2 ♀ K. Taylor; 1 ♂ Nov 1988 GNP Biodiversity Survey; 2 ♀, Jul 1988 (INBio); 3 ♂, 5 ♀ II curso parataxon, May 1990 (INBio, NHM, USNM, USU); 1 ♀, May 1992, F. Araya; 1 ♀, Jan-Apr 1992, Malaise trap; 1 ♂ Aug 1994, J. Acosta, Y. Umaña; 1 ♂ Jul 1991 (CAS); 1 ♂ Apr 1989, I. Gauld (UCR); 2 ♀, Sep 1989, I. Gauld (UCR); 2 ♂ Sendero Nacho, May 1994, P. Rios. Other material, COSTA RICA, Guanacaste 1 ♂ Z. P. Tenorio, Tierras Morenas, Rio San Lorenzo, 1050 m. 28 Mar-21 Apr 1992, A. Marin; 1 ♂ 18 Mar-26 Apr 1995, G. Rodriguez; 1 ♂ Est. Cacao SW side Volcan Cacao, 1000-1400 m. 1988-1989, Malaise trap, GNP Biodiv. Survey, 323300-375700; 1 ♀ Jan-Abr 1992, Malaise trap, 1000-1400 m, May 1991, Elfin Rainforest 91; 2 ♂ *Prov. Alajuela*, Res. Fores. San Ramón, 5 Km N Col. Palmareña, Rio San Lorencito, 900 m, Mar 1990, Curso Carabidae, 244500-470700, 7 Mar-16 Apr 1995, Malaise trap; 1 ♂ Sector Colonia Palmareña 9 Km S. O. de Bajo Rodriguez, 700 m, 9 Sep-18 Oct 1995, G. Carballo, Malaise trap; 2 ♀, 21 Oct. 3 Nov 1994; 1 ♂, 2 ♀, same locality and colector, 15-28 Nov 1994; 1 ♂ same locality and colector, Set 1995; 2 ♀, Nov 1994; 1 ♂, 1 ♀, same locality, 620 m, 22 Jun-23 Jul. 1994, Fam. Hurtado G., Malaise trap; *Prov. San Jose*; 1 ♂ Est. Las Nubes de Santa Elena, Fca. de Olman Bonilla, 1450 m. 1 Oct. 1995, A. Picado L-S 372500-507700. *Prov. Cartago*, 1 ♂ Quebrada Segunda Tapantí, 1150 m. Aug 1994, G. Mora, Malaise trap., LN 194000-560000; 1 ♂, 1 ♀, P. N. Tapantí, A. C. Amistad, 1300 m. Nov 1993, G. Mora, Malaise trap., LN 194000-559800; 1 ♀, Jul 1991; 1 ♂ R. Grande de Orosí desde sendero La Pava hasta La Catarata, 1300-1700, Aug 1995, R. Delgado, Malaise trap., LN 191500-560400; 1 ♀, Dic. 1995, G. Mora; 3 ♀ Turrialba, Grano de Oro, Chirripo, A.C. Amistad, 1120 m, Oct. 1993, P. Campo, LN 200250-595900. *Prov. Puntarenas*, 1 ♂ Est. Altamira, Sendero Educativo Gigantes del Bosque, 1150-1400, 1-15 Nov 1994, M. Segura, Malaise trap. 331700-572100 (INBio), NICARAGUA, 2 ♂, Zelaya, Rio Las Latas, 2 Jun. 1977, 220 m. 11° 04' N, 88° 33' W, J. M. Maes & B. Hernández (MEN).

Remarks:

Acrulogonia tecta is similar to *A. ordinaria* but the former can be separated by the form of the male pygofer which abruptly narrows and has a pair of ventral processes (*A. ordinaria* has just one dorsal process); also, the aedeagus of *A. tecta* has just one pair of ventral lateral processes whereas *A. ordinaria* has two pairs of processes. *A. tecta* has been collected from 200 to about 1400m elevation.

KEY TO MALES IN THE GENUS *ACRULOGONIA*

1. Plate not extending to apex of pygofer 2
- Plate extending beyond apex of pygofer 10
2. Pygofer with a conspicuous dorsal process extending posteriorly from near middle of dorsal margin (fig. 14) *fuscinula* Young
- Pygofer lacking dorsal process or small process arising near caudal margin of pygofer 3
3. Pygofer process slender, extending posteriorly beyond pygofer apex which is narrowed and not or only slightly wider than the process 4
- Pygofer process not as above, or if so then pygofer apex not narrowed, broader than process 7
4. Aedeagus with pair of lateral processes near base (fig. 15) *chocona* Young
- Aedeagus without lateral processes near base (with ventral process slightly more distally, or not) 5
5. Aedeagus with pair of slender apical processes extending beyond apex of shaft (fig. 16) *mucidula* (Jacobi)
- Aedeagus without processes extending beyond apex of shaft 6
6. Forewing with two or three orange spots on corium; aedeagus with pair of lanceolate lateral processes arising dorsally at midlength of shaft (fig. 11) .. *tecta* n. sp.
- Forewing without orange spots on corium; aedeagus with pair of short aciculate processes arising on ventral margin of shaft near base, and pair of variable dorsal process arising subapically (fig. 17) *incompta* Young
7. Dorsal pygofer process strongly decurved in lateral view (fig. 18) *resima* Young
- Dorsal pygofer process not strongly decurved 8
8. Pygofer relatively short and broad, aedeagus with retrorse lateral processes on apical half of shaft (fig. 19) *defectiva* Young
- Pygofer longer and more slender, aedeagus without such processes 9
9. Dorsal pygofer process well developed, extending posteriorly to or beyond pygofer apex (fig. 20) *ordinaria* Young
- Dorsal pygofer process weak, short, not attaining pygofer apex (fig. 21) *smidti* (Metcalf)
10. Aedeagus with median ventral keel in apical half (fig. 22) *reclusa* Young
- Aedeagus without median ventral keel 11
11. Aedeagus in lateral view with one pair of subapical processes (fig. 23) *sparsa* Young
- Aedeagus in lateral view with two pairs of subapical processes 12
12. Forewing with two pale red suboval spots broadly bordered with black on corium near costa; aedeagal processes simple, without rami (fig. 24) *pararesima* Young
- Forewing with numerous white dots and two large orange spots on the lateral corium, few orange spots near base of clavus; aedeagal processes bifid (fig. 5) *sexpinosa* n. sp.



legend opposite, on page 115.

ACKNOWLEDGMENTS

The authors thank Humberto Lezama (UCR) for loans of specimens and Paul Hanson and Paul Freytag for comments on the manuscript and one anonymous reviewer for their suggestions which improved the content of the paper. This research was financed by the Norwegian Agency for Development Cooperation (NORAD) through the project "Contribution to Knowledge and Sustainable Use of Biodiversity in Costa Rica". This research was also possible thanks to the Cooperation Agreement between the Ministry of Environment and Energy (MINAE) and INBio in order to accomplish the National Biodiversity Inventory.

LITERATURE CITED

Young, D. A. 1977. Taxonomic Study of the Cicadellinae. Part 2. New World Cicadellini and the genus *Cicadella*. North Carolina Agric. Exp. Stn. Tech. Bull. 239. 1135 pp.

Fig. 14. *Acrulogonia fuscinula* Young: Pygofer lateral view (modified from Young, 1977). Fig. 15. *Acrulogonia chocona* Young: Aedeagus, lateral view (modified from Young, 1977). Fig. 16. *Acrulogonia mucidula* (Jacobi): Aedeagus, caudoventral view (modified from Young, 1977). Fig. 17. *Acrulogonia incompta* Young: Aedeagus lateral view (modified from Young, 1977). Fig. 18. *Acrulogonia resima* Young: Pygofer lateral view (modified from Young, 1977). Fig. 19. *Acrulogonia defectiva* Young: Pygofer lateral view (modified from Young, 1977). Fig. 20. *Acrulogonia ordinaria* Young: Pygofer lateral view (modified from Young, 1977). Fig. 21. *Acrulogonia smidti* (Metcalf): Pygofer lateral view (modified from Young, 1977). Fig. 22. *Acrulogonia reclusa* Young: Aedeagus, lateral view (modified from Young, 1977). Fig. 23. *Acrulogonia sparsa* Young: Aedeagus, lateral view (modified from Young, 1977). Fig. 24. *Acrulogonia pararesima* Young: Aedeagus lateral view (modified from Young, 1977).

A NEW SPECIES OF *SCHILDOLA* (HOMOPTERA: CICADELLIDAE) FROM COSTA RICA¹

Carolina Godoy², M. W. Nielson³

ABSTRACT: The genus *Schildola* was established by Young (1977) and included five species: *S. abrupta*, *S. corrugis*, *S. ductilis*, *S. morio* (Melichar), and *S. opaca*. In this paper we describe one new species from Costa Rica, *Schildola bivirga*. The genus ranges from Costa Rica to Peru.

The genus *Schildola* was described and illustrated by Young (1977), who described four species: *S. abrupta*, *S. corrugis*, *S. ductilis* and *S. opaca*. Young also placed *Microgoniella (Microscita) morio* Melichar in this genus. *S. opaca* is reported from Colombia, Panama and Costa Rica; in the latter it has been collected from 100 to 1700 meters elevation. *S. abrupta* occurs in Ecuador, and *S. corrugis*, *S. ductilis* and *S. morio* are reported from Peru. In this paper we describe one new species, *Schildola bivirga*. Nothing is known about the biology of these leafhoppers.

Genus *Schildola* Young

Schildola Young, 1977. Type-species *Schildola opaca* Young, 1977.

Length male 7.6 - 8.7 mm, female 7.6-10.7 mm. Color dark reddish black to black with white, ivory or orange spots. Hindleg with femoral setal formula 2:1:1, 2:0:0, 2:1:0.

Male genitalia: Pygofer short or moderately produced, apical margin broadly or narrowly convex, setae few to many, their location variable, pygofer processes absent. Plate short, triangular, not extending posteriorly as far as pygofer apex. Style extending posteriorly beyond apex of connective, with preapical lobe. Connective short, narrowly Y-shaped. Aedeagus slightly decurved, variable from short to elongate, without processes. Paraphyses biramous, symmetrical or not.

Female abdominal sternum VII with posterior margin transverse, rounded, emarginate on central part of posterior margin.

MATERIAL AND METHODS

The details of preparations of genital structures of leafhoppers for dissections and study are given by Oman (1949). We have followed his method with some modifications. A system was devised in which the abdomens of 5 leafhoppers were cleared simultaneously. Abdomens were removed, placed in ten percent potassium hydroxide and left to soak overnight at room temperature.

¹ Received May 28, 1999. Accepted August 30, 1999.

² Instituto Nacional de Biodiversidad, Apartado Postal 22-3100 Santo Domingo, Heredia, Costa Rica.

³ Monte L. Bean Museum, Brigham Young University, Provo, UT 84602 USA.

The following day individual abdomens were washed in water before examination and eventual preservation in glycerin in microvials.

Specimens are deposited in the following collections:

CAS: California Academy of Sciences, San Francisco, USA.

INBio: Instituto Nacional de Biodiversidad, Santo Domingo, Heredia, Costa Rica.

NHM: The Natural History Museum, London, UK.

UCR: University of Costa Rica, San Pedro, San José, Costa Rica.

USU: Utah State University, Logan, USA.

Schildola bivirga, NEW SPECIES

Figs 1-8

Length: Male 7.8 - 8.5 mm, female 7.6 mm.

Color generally dark brown to black. Crown, pronotum and scutellum shiny black with a transverse red spot at crown apex. Forewings with a transverse orange spot with paler leg joints.

Head weakly produced, with median length of crown slightly more than one half interocular width and approximately one-third transocular width, anterior margin very broadly rounded in dorsal view, without carina at transition from crown to face, surface convex, glabrous; antennal ledges not protuberant; face slightly flattened in profile, clypeus shiny.

Thorax with pronotal width greater than transocular width of head, weakly rugulose. Forewings with veins elevated and with pits, with supernumerary crossvein forming extra anteapical cell (Fig. 1). Hindlegs with femoral setal formula 2:1:0, first tarsomere with length equal to combined length of two more distal tarsomeres and with setae of plantar surface arranged in two parallel rows.

Male genitalia: Pygofer moderately produced, with dorsal obtuse angle and with apical margin narrowly convex, setae few (Fig. 2). Plates short, triangular, with multiseriata macrosetae (Fig. 3). Style with apex truncate. Connective Y-shaped (Fig. 4). Aedeagus symmetrical, slightly decurved, border serrate ventrally from midlength to apex in lateral view (Fig. 5); in caudoventral view shaft elongate, apex with pair of serrate folds (Fig. 6). Paraphyses symmetrical, with rami directed posteroventrally (Fig. 7).

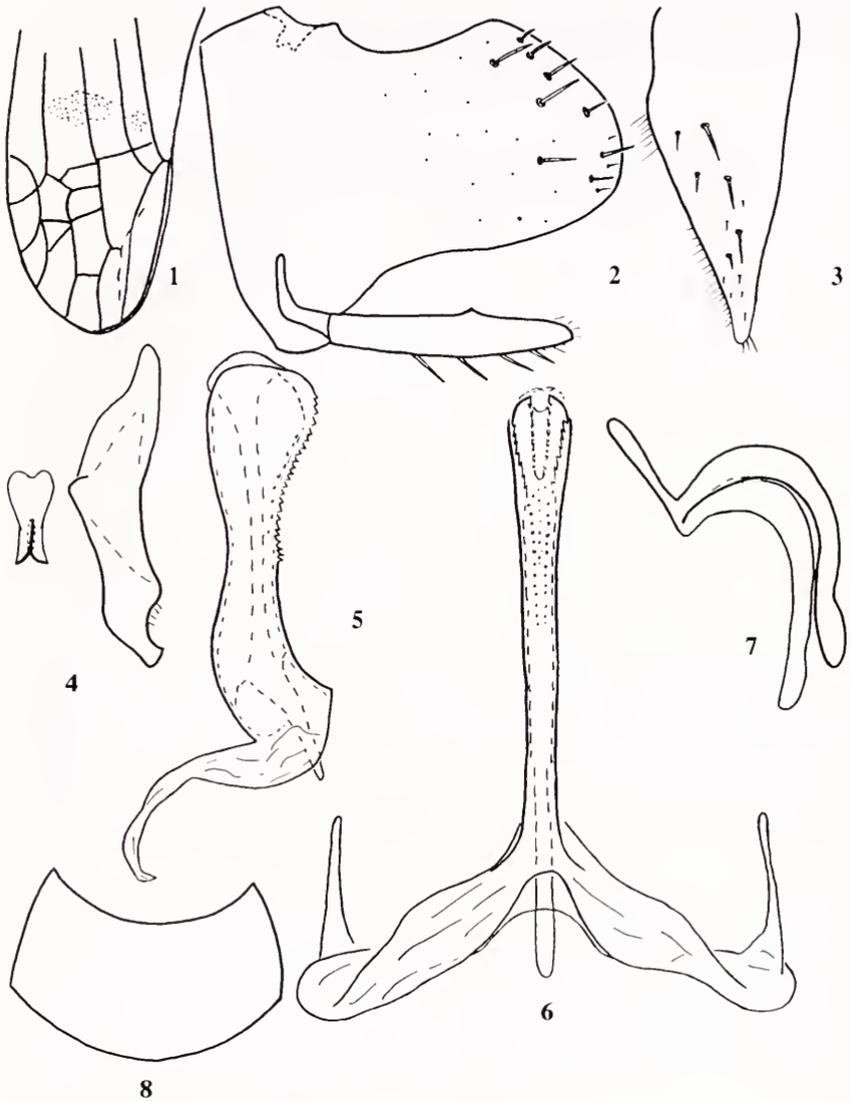
Female abdominal sternum VII rounded, emarginate on central half of posterior margin (Fig. 8).

Holotype male: COSTA RICA, Prov. Cartago, La Cangreja, 1900 m. VII-1991, Col. P. Hanson y C. Godoy (INBio)

Paratypes: 5 ♂♂, same data as holotype; 3 ♂♂, same data except 19-IX 1992, 1 ♂, same data except VIII-IX 1991, 1 ♂, same data except II 1992 (UCR). 1 ♂, Prov. Cartago, R. Grande de Orosi desde Puente R. Dos Amigos hasta la Represa, 1400-1800 m, X 1995, R. Delgado. LN 186600-562000. T. (INBio). 2 ♂♂, R. Grande de Orosi desde Sendero La Pava hasta La Catarata, 1300-1700 m, XI 1995, R. Delgado. LN 191500-560400. T. Malaise (INBio); 3 ♂♂, 4 Km NE Cañon, Genesis II, 2300 m, X-XII 1995, C. Godoy & P. Hanson (1 CAS, 1 NHM, 1 USU); 1♂, same data except VIII 1996 (UCR).

Remarks:

Schildola bivirga is similar to *S. opaca*, but differs by having a black head with a transverse red spot at the apex of the crown and without spots on the pronotum, the presence of one spot on each wing, and by the serrate ventral



Figs. 1-8. *Schildola bivirga*, n. sp.: 1. Anterior forewing apex; 2. Pygofer and plate, lateral view; 3. Plate, ventral view; 4. Style and connective dorsal view; 5. Aedeagus, lateral view; 6. Aedeagus, caudoventral view; 7. Paraphyses; 8. Female abdominal sternum VII.

margin on the aedeagus in lateral view; in *S. opaca*, the ventral margin of the aedeagus is smooth but the apex has tiny protuberances. In Young's (1977) key this species would go to couplet 3, but is black with orange spots. This species has been collected from 1300 m to 2300 meters.

ACKNOWLEDGMENTS

The authors thank Humberto Lezama (UCR) for loans of specimens, and Paul Hanson and Paul Freytag for comments on the manuscript and one anonymous reviewer for suggestions which improved the content of the paper. This research was financed by the Norwegian Agency for Development Cooperation (NORAD) through the project "Contribution to Knowledge and Sustainable Use of Biodiversity in Costa Rica". This research was also made possible thanks to the Cooperative Agreement between the Ministry of Environment and Energy (MINAE) and INBio in order to carry out the National Biodiversity Inventory.

LITERATURE CITED

- Young, D. A. 1977. Taxonomic study of the Cicadellinae. Part 2. New World Cicadellini and the genus *Cicadella*. North Carolina Agric. Exp. Stn. Tech. Bull. 239. 1135 pp.

AN ANNOTATED LIST OF PLANTHOPPERS (HEMIPTERA: FULGOROIDEA) OF GUANA ISLAND (BRITISH WEST INDIES)¹

Charles R. Bartlett²

ABSTRACT: Twenty-seven species of planthoppers (Hemiptera: Fulgoroidea) are reported from Guana Island (British Virgin Islands), 26 for the first time. The full geographic range of each species is summarized. Local biogeography and *alpha* taxonomy needs for Guana species are discussed. Most planthoppers found on Guana (63%) are also known from Puerto Rico, but many species (59%) have never been reported from outside the Puerto Rican Bank.

Guana is a small privately owned island of 299 hectares situated north of Tortola in the Virgin Islands of the British West Indies. Guana Island is in unusually good ecological condition (Heatwole et al. 1981, Mayer and Chipley 1992), and consists principally of steeply hilly terrain, reaching an elevation of 246 m, covered principally by dry scrub woodland. The flora consists of over 300 species (Mayer and Chipley 1992). There is a small area of flat land with principally grassy vegetation plus a salt pond fringed with mangroves and *Sporobolus* grasses. Guana Island has been subject to a wide array of biological investigations (e.g., Mayer and Chipley 1992, Becker and Miller 1992, Evenhuis and Miller 1994, Roth 1994), although there are no previous studies on the auchenorrhynchos Homoptera. Geologically, Guana is a portion of the Puerto Rican Bank, which was connected to Puerto Rico by dry land during the Pleistocene glacial maxima (Heatwole and MacKenzie 1967, Lazell 1996). Puerto Rico became separated from the Virgin Islands approximately 8,000-10,000 years ago (Heatwole and MacKenzie 1967). The vegetation, climate and geology of the Puerto Rican Bank has been recently described by Heatwole et al. (1981). The planthoppers (Fulgoroidea) of Guana, therefore, are expected to be a relictual subset of the Puerto Rican fauna. The objective of this work is to document the planthoppers of Guana Island in a zoogeographic context.

The insects of Puerto Rico are relatively well known (reviewed by Maldonado Capriles 1996). Caldwell and Martorell (1951) provide keys to the fulgoroid fauna except Kinnaridae provided by Ramos (1957). Wolcott (1950), with additions summarized by Maldonado Capriles and Navarro (1967), lists the species of Puerto Rico, including some not treated by Caldwell and Martorell (1951) or Ramos (1957). The only fulgoroid species previously reported from Guana was the flatid *Melormenis basalis* (Walker, 1851) by Medler (1990).

¹ Received August 12, 1999. Accepted October 8, 1999.

² Department of Entomology and Applied Ecology, University of Delaware, Newark, DE 19717-1303.

All other fulgoroids are reported from Guana for the first time.

MATERIALS AND METHODS

Fulgoroids were surveyed during three collecting expeditions by the author (1993, with J. Cryan, 1994 and 1997) in cooperation with The Conservation Agency (Jamestown, Rhode Island). All surveys were conducted during October at times when The Conservation Agency was granted general access to the island for scientific research. Additional specimens from the Virgin Islands were obtained on loan from the Bernice P. Bishop Museum (BPBM, Honolulu, Hawaii) and M. Ivie (Montana State University). Collecting methods included sweeping or beating vegetation, visual inspection of plants, and malaise trapping.

For each species recorded, all specimens examined are reported and a summary of the entire geographic range is provided. The reported range of each species within the Caribbean islands is arranged geographically from west to east, with the Lesser Antilles divided into the Virgin Islands (VI), Leeward Islands (LI), and Windward Islands (WI) following Bent (1977). Synonymy is reported only for species with changes in nomenclature since Metcalf's Catalog of the Homoptera (Metcalf 1936, 1943, 1945, 1948, 1954a, 1954b, 1957, 1958), or for species reported under a different name by Caldwell and Martorell (1951). Junior synonyms are followed by the citation that resulted in the nomenclatural change. Voucher specimens of all species have been deposited primarily in the collection of North Carolina State University, Raleigh; with representative collections at the BPBM and the University of Delaware (Newark, Delaware).

A discovery curve (species accumulation curve) was calculated to evaluate the completeness of the survey and estimate the number of undetected planthopper species on Guana Island. The discovery curve was created by treating each specimen collected as an observation, and randomizing the sequence of observations with a SAS (SAS Institute 1989) program, and plotting observations by cumulative species. Total planthopper species richness was predicted using Chao's (1984) abundance based estimator of species richness, $S_{chao} = S_{obs} + \frac{F_1^2}{2F_2}$, where S_{obs} = number of observed species, F_1 = number of species observed by exactly one specimen, F_2 = number of species observed by exactly two specimens. The variance was computed using the Chao (1987) estimator of standard deviation.

RESULTS

A total of 27 fulgoroid species (or subspecies) among nine fulgoroid families was found on Guana Island. All taxa are listed in Table 1; the five new

species will be described elsewhere. Chao's (1984) estimator of species richness (\pm standard deviation) calculates as 27.1 ± 0.142 , and the discovery curve (Figure 1) exhibits a clear leveling-off, suggesting that a high percentage of Guana Island planthopper species were detected.

Of the 27 species, 17 (63%) are also known from Puerto Rico. The species that have **not** been recorded from Puerto Rico are *Bothriocera eborea* Fennah, 1943, *Colpoptera maculifrons flavifrons* Osborn, 1935, *Acanalonia depressa* Melichar, 1901, *Sayiana viequensis* Caldwell, 1951, *Flatoidinus spinosus* Caldwell, 1951, and five new species. *Colpoptera maculifrons*, however, is represented on Puerto Rico by the nominate form (*C. m. maculifrons* Muir, 1924) and two other subspecies (*C. m. maculata* Dozier, 1931, and *C. m. carinata* Dozier, 1936). Also, the Puerto Rican acanaloniid *Acanalonia brevifrons* Muir, 1924, is closely related to *A. depressa* (see **Discussion**). Of Guana Island's 27 species, 16 (59%, excluding *Neomegamelanus elongatus reductus*, see **Discussion**), have not been reported from outside the Puerto Rican Bank (Puerto Rico and the Virgin Islands).

Other than the aforementioned fulgoroid, no other Auchenorrhyncha has been previously reported from Guana Island. Among non-fulgoroid Auchenorrhyncha, a single treehopper species (*Deiroderes inermis* Ramos, 1957), and a single cicada species (*Proarna hilaris* (Germar, 1834)) was found on Guana Island. There were no cercopids found during the present study on Guana Island.

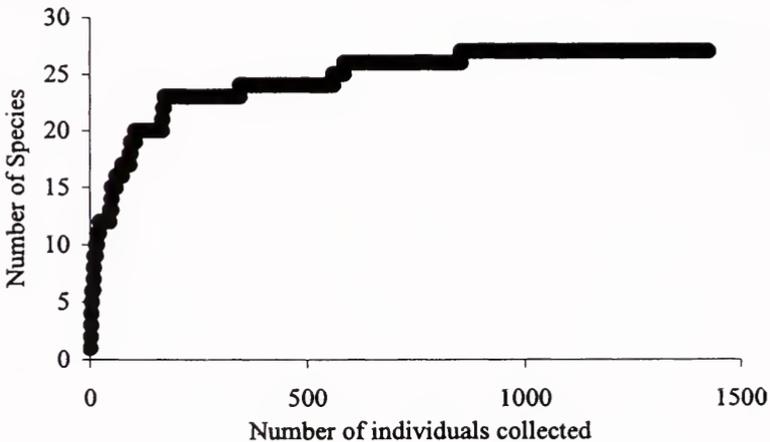


Fig. 1. Discovery curve for Guana Island planthopper species.

Table 1: Fulgoroidea of Guana Island, British Virgin Islands.

Species	Island: Specimens examined	Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is.)	References:
Cixiidae			
<i>Bothriocera eborea</i> Fennah, 1943	Guana: 18 Tortola: 52	VI: Tortola, Jost Van Dyke; LI: St. Kitts , Nevis, Montserrat; WI: Dominica, Martinique, St. Lucia, St. Vincent	Fennah 1943, 1945, 1949; Caldwell and Martorell 1951
<i>Oliarus slossonae</i> Van Duzee, 1912 = <i>Oliarus borinquensis</i> Caldwell, 1951: Mead and Kramer : 1982: 424-426.	Guana: 86 Little Thatch: 1 Tortola: 2 Great Camanoe: 1 St. John: 2	Cuba, Puerto Rico; VI: St. Thomas; USA: Florida (but not Mississippi or Texas. Mead and Kramer 1982}	Caldwell and Martorell 1951, Mead and Kramer 1982
<i>Oliarus viequensis</i> Caldwell, 1951	Guana: 2 (♀) Aneгада: 3	Hispaniola, Puerto Rico, Vieques ; VI: St. John; LI: Antigua; USA: FL	Caldwell and Martorell 1951, Mead and Kramer 1982
<i>Pintalia alta</i> Osborn, 1935	Guana: 83 Tortola: 258 Beef: 1	Puerto Rico ; VI: St. Thomas	Caldwell and Martorell 1951
Delphacidae			
<i>Neopunana carabensis</i> (Caldwell, 1951) = <i>Punana carabensis</i> Caldwell, 1951: Asche, 1983: 128	Guana: 168 Tortola: 10 St. John: 5 Great Camanoe: 2 Frenchman's Cay: 2 Gt. St. James: 1	Puerto Rico, Vieques; VI: St. Thomas	Caldwell and Martorell 1951
<i>Neopunana</i> n. sp.1	Guana: 2		
<i>Neopunana</i> n. sp.2	Guana: 3		
<i>Neopunana</i> n. sp.3	Guana: 3		
<i>Saccharosydne saccharivora</i> (Westwood, 1833)	Guana: 5	Cuba, Jamaica, Hispaniola, Puerto Rico, Vieques; LI: Antigua, Guadeloupe; WI: St. Lucia, Barbados, Grenada , Trinidad; Venezuela, USA: Florida, Georgia, Hawaii; British Honduras, Venezuela	Anonymous 1833, Westwood 1833, Crawford 1914, Van Duzee 1917, Spooner 1920, Wolcott 1927, 1936, 1950; Caldwell and Martorell 1951, Box 1953, CIE 1956, Fennah 1959, Metcalfe 1969, Bruner et al. 1975

Species	Island: Specimens examined	Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is.	References:
<i>Anchidelphax havanensis</i> (Crawford, 1914) = <i>Delphacodes havanensis</i> (Crawford, 1914): Fennah, 1965: 97	Guana ♂ macropter: 4 ♀ brachypter: 8 ♀ macropter: 1	Cuba , Jamaica, Puerto Rico.; Caja de Muertos, Vieques; VI: St. Thomas, St. Croix; WI: Martinique, St. Lucia, Barbados	Crawford 1914, Muir 1918, Osborn 1929, 1935; Wolcott 1936, 1950; Muir and Giffard 1924, Caldwell and Martorell 1951, Fennah 1959, 1965; Miskimen and Bond 1970
<i>Neomegamelanus elongatus reductus</i> (Caldwell, 1951) = <i>Megamelanus elongatus reductus</i> (Caldwell, 1951): McDermott 1952: 50-52.	Guana: 13	Puerto Rico, Vieques .	Caldwell and Martorell 1951
<i>Toya venilia</i> (Fennah, 1959) = <i>Delphacodes venilia</i> Fennah, 1959: Fennah, 1965: 96	Guana: 28 Necker: 14	?Puerto Rico, ?Vieques; LI: Montserrat	Fennah 1959, 1965
Derbidae			
<i>Sayiana viequensis</i> Caldwell, 1951	Guana: 24 Anegada: 1	Vieques	Caldwell and Martorell 1951
Achilidae			
<i>Catonia arida</i> Caldwell, 1951	Guana: 139 Tortola: 1 Virgin Gorda: 1 Necker: 1 St. John: 1	Puerto Rico , Caja de Muertos	Caldwell and Martorell 1951
<i>Catonia cinerea</i> Osborn, 1935	Guana: 64 Tortola: 6 Virgin Gorda: 1	Puerto Rico , Caja de Muertos, Vieques; VI: St. Croix	Osborn 1935, Wolcott 1936, 1941, 1950; Caldwell and Martorell 1951
<i>Catonia</i> sp. near <i>major</i> Fennah, 1950	Guana: 27 Tortola: 2	LI: Antigua	Fennah 1950
Tropiduchidae			
<i>Tangella schaumii</i> (Stål, 1859)	Guana: 1 St. John: 1	Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, St. John , Jost Van Dyke	Stål 1859, Fennah 1949. Caldwell and Martorell 1951

Species	Island: Specimens examined	Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is.	References:
<i>Tangia viridis</i> (Walker, 1851) = <i>Neurotmeta viridis</i> (Walker, 1851): Fennah, 1965: 100-101	Guana: 97 St. Thomas: 1 St. John: 1	Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas , Tortola, Virgin Gorda, St. Croix	Osborn 1935, Wolcott 1936, 1941, 1950; Fennah 1949, Caldwell and Martorell 1951, Miskimen and Bond 1970
Flatidae			
<i>Flatoidinus spinosus</i> Caldwell, 1951	Guana: 2	VI: St. John , St. Thomas, Tortola	Caldwell and Martorell 1951
<i>Melormenis basalis</i> (Walker, 1851) [nec. Caldwell, 1951] = <i>Melormenis antillarum</i> (Kirkaldy, 1909): Fennah, 1965: 107	Guana: 55 Tortola: 8 Virgin Gorda: 2 Great Camanaoe: 1 St. John: 2	Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, Jost Van Dyke, Tortola, Virgin Gorda, St. Croix; LI: Anguilla, St. Bartholomew, St. Kitts, Nevis, Montserrat, Antigua; Hawaii (type locality "West Indies" (Walker 1851), but stated as unknown by Fennah (1965))	Melichar 1902, 1923; Beatty 1947, Wolcott 1923, 1941, 1950; Caldwell and Martorell 1951, Fennah 1949, 1965; Miskimen and Bond 1970; Asche 1997.
<i>Petrusa epilepsis</i> (Kirkaldy, 1906) = <i>Petrusa marginata</i> (Linne, 1767): Metcalf, 1957: 337-342.	Guana: 268 Tortola: 28 Anegada: 1 St. John: 6 St. Thomas: 1 Scrub: 5	Cuba, Hispaniola, Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, Jost Van Dyke, Tortola, Virgin Gorda, St. Croix; LI: St. Bartholomew, St. Kitts, Nevis, Montserrat, Antigua; WI: Grenada; Brazil, Columbia (type locality unknown)	Melichar 1902, 1923; Myers 1928; Wolcott 1923, 1936, 1941, 1950; Fennah 1941, 1949; Beatty 1947, Caldwell 1950, Caldwell and Martorell 1951, Miskimen and Bond 1970
<i>Pseudoflatoides albus</i> Caldwell, 1951	Guana: 17 Tortola: 6 Frenchman's Cay: 1	Puerto Rico	Caldwell and Martorell 1951
Issidae			
<i>Thionia argo</i> Fennah, 1949	Guana: 92 Virgin Gorda: 4 St. John: 1 Scrub: 1	Puerto Rico, Vieques Is., Culebrita; VI: St. Thomas, Jost Van Dyke , St. Croix	Fennah 1949, Caldwell and Martorell 1951

Species	Island: Specimens examined	Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is.	References:
<i>Coloptera maculifrons flavifrons</i> Osborn, 1935	Guana: 3 Tortola: 3	Mona; VI: St. Thomas, St. Croix ; LI: Antigua	Osborn 1935, Beatty 1947, Wolcott 1950, Miskimen and Bond 1970
Acanaloniidae			
<i>Acanalonia depressa</i> Melichar, 1901	Guana: 79 Tortola 2 Virgin Gorda: 1 Great Camanoe: 2 St. John: 1 Beef: 1	VI: St. Thomas, St. John , Anegada, St. Croix	Melichar 1901, Caldwell and Martorell 1951
Kinnaridae			
<i>Prosotropis</i> ♀♀ (<i>poss. marmorata</i> Fennah, 1942)	Guana: 2 St. John: 1		
<i>Quilessa fasciata</i> Fennah, 1945	Guana: 131 Tortola: 1 Little Thatch: 1 Virgin Gorda: 3 Cas Cay (St. Thomas): 1 Anegada 10	Puerto Rico	Ramos 1957

DISCUSSION

Although it is satisfying that Chao's (1984) estimator of species richness was only slightly higher than the observed species richness, it would be optimistic to claim that all species were detected. It should be noted that these data were not collected for the express purpose of estimating planthopper species richness, and that abundant species were not consistently collected at every encounter. Although additional planthopper species almost certainly occur, these data clearly suggest that a high percentage of species have been detected.

A variety of taxonomic problems were revealed in this study. One particular difficulty was with the forms related to *Acanalonia depressa*: *A. brevifrons* (type locality: Puerto Rico) and *A. impressa* Metcalf and Bruner, 1930 (type locality: Cuba). *Acanalonia impressa* appears to be an endemic Cuban form. Caldwell and Martorell (1951) and Fennah (1949) make conflicting statements as to the geographical limits of *A. brevifrons*. Caldwell and Martorell (1951) report *A. brevifrons* from St. Croix, St. Thomas, and tentatively Anegada, but

curiously do not report Puerto Rico (*A. brevifrons* was described from a single Puerto Rican male; Muir 1924) and do not report *A. depressa* in the Virgin Islands. Fennah (1949), however, reports *A. depressa* from Jost Van Dyke, St. Thomas and St. Croix, but limits *A. brevifrons* to Puerto Rico. The published morphological distinctions between *A. depressa* and *A. brevifrons* concern their relative size and subtle differences in the shape of the head and tegmina (Fennah 1949), but genitalic comparisons have never been made. Fennah (1949) suggested that *A. impressa* and *A. brevifrons* should be subspecies of *A. depressa*. The status of these species clearly requires reexamination.

The delphacid *Neomegamelanus elongatus reductus* was described from Puerto Rico and Vieques Island by Caldwell (in Caldwell and Martorell 1951) as a Caribbean subspecies of the otherwise mainland *N. elongatus* (Ball, 1905) (found on the coastal eastern United States, Connecticut to Florida, McDermott 1952, Cummins et al. 1988). Other than geography, no useful morphological distinctions between these subspecies were presented. Comparison of chrotic and phallic features of *Neomegamelanus elongatus elongatus* and *N. elongatus reductus* suggests that there are not sufficient differences to justify subspecific status, although a detailed examination was beyond the scope of the present work. For the purposes of this study *Neomegamelanus elongatus reductus* was not considered a form unique to the Puerto Rican Bank.

Two species found on Guana had some notable differences from described forms. The kinnarid *Quilessa fasciata* lacked the diagnostic markings on the forewings noted by Ramos (1957), and had additional processes on the aedeagal complex. These differences are probably insufficient to consider this form a separate species, but may merit subspecific status. The achilid *Catonia* nr. *major* (from Antigua) showed color and genitalic differences compared to Fennah's (1950) description (this species is only recorded from the holotype), and probably represents a new species.

Zoogeographically, more than half of the species encountered on Guana Island are apparently endemic to the Puerto Rican Bank. Of the remaining species, three others are found also in the Leeward Islands (*Toya venilia*, *Catonia* nr. *major*, and *Colpoptera maculifrons flavifrons*), three were distributed widely within the Caribbean (*Bothriocera eborea*, *Melormenis basalis* and *Anchidelphax havanensis*; the former two largely restricted to the Lesser Antilles), one ranges to northern South America (*Petrusa epilepsis*), three range to the continental United States (*Oliarus slossonae*, *O. viequensis*, and *Neomegamelanus elongatus*), and one is found in both Central America and southeastern United States (*Saccharosydne saccharivora*). It appears odd that more species have an affiliation to North America than to Central America. Modern ideas concerning the origin of the Caribbean fauna (e.g., Rosen 1985, Lieberr 1988) suggest that biological affinities should be strongest with Central America. Ramos (1988: 68) also suggested that the Caribbean Auche-

norrhyncha has "little or no affinity to North or South America." The eastern position of the Puerto Rican Bank (relative to the other Greater Antilles and Central America) and long period of time required for vicariance, however, would most certainly obscure biogeographic affinities at the species level.

The issid *Colpoptera maculifrons* Muir, 1924 has five subspecies (including the nominate form) that collectively occur throughout the Caribbean islands. The nominate form along with *C. m. carinata* Dozier and *C. m. maculata* Dozier are recorded from Puerto Rico, with the latter form also recorded from Mona Island (Dozier 1931, Caldwell and Martorell 1951). *Colpoptera maculifrons dominicana* Fennah, 1955, is known only from Hispaniola; *C. m. angustior* Fennah from the Leeward Islands (Antigua, Nevis, St. Kitts, Montserrat) and St. Croix; and *C. m. grenada* Fennah from Grenada (Windward Islands) (Fennah 1955).

The cixiid *Oliarus slossonae* was abundant on agave (*Agave missionum*, Agavaceae) on Guana, a host plant also reported for it on St. Thomas (Mead and Kramer 1982). Perhaps significantly, agave is not reported as a host elsewhere in its range (Mead and Kramer 1982), suggesting that *Oliarus slossonae* may represent a species complex.

The delphacid *Toya venilia* was common on Guana (and nearby islands, R. Denno, pers. comm.) in the grass *Sporobolus virginicus* (Poaceae) near a salt pond. Individuals of this species are commonly brachypterous, with an 85.7% (24 of 28) brachyptery rate among the Guana specimens examined in this study. *Toya venilia* was described from Montserrat (Leeward Islands), the only locality where this species has been unquestionably recorded in the past. Puerto Rican and Vieques Island records are based on Fennah's (1959: 262) assertion that "It appears to be this species which Caldwell and Martorell [1951: 183] have reported from Puerto Rico under the name *Delphacodes nigra*".

A total of 27 species and subspecies of planthoppers (including five new species) were recorded from Guana Island. Most planthoppers found on Guana also occur on Puerto Rico (17 of 27 species, 63%), mostly endemic to the Puerto Rican Bank (16 of 27 species, 59%). The relatively high degree of endemism observed is consistent with the high degree of endemism observed among Auchenorrhyncha in the Greater Antilles by Ramos (1988). It should be noted, however, that this observation is based on substantially incomplete information because many smaller Caribbean islands have no published reports of fulgoroidea, and our knowledge of the planthoppers of Jamaica and Hispaniola is quite poor (Ramos 1988). Further surveys of Caribbean Fulgoroidea are needed to more confidently assess planthopper zoogeography.

ACKNOWLEDGMENTS

I am grateful to the Jarecki family, W. Lu and J. D. Lazell of The Conservation Agency, and the staff of Guana Island who made this research possible. I also thank M. A. Ivie (Montana

State University), K. Arakaki and S. Miller (Bernice P. Bishop Museum) for loans of specimens, and S. McKamey (United States National Museum), D. W. Tallamy, and J. A. Hough-Goldstein for valuable comments on the manuscript. Field work for this study was primarily supported by The Conservation Agency, with additional support from the Department of Entomology and Applied Ecology, University of Delaware.

LITERATURE CITED

- Anonymous.** 1833. A notice of the ravages of the cane fly, a small winged insect, on the sugar canes of Grenada, including some facts on its habits. *Mag. Nat. Hist.* 6: 407-409.
- Asche, M.** 1983. Aufgliederung der Asiracinen - Gattung *Punana* Muir, 1913: *Equasystatus* gen. nov. aus Ecuador und *Neopunana* gen. nov. von den Karibischen Inseln (Homoptera Auchenorrhyncha Fulgoromorpha Delphacidae). *Marburger Entomol. Publ.* 1(8): 127-166.
- Asche, M.** 1997. A review of the systematics of Hawaiian planthoppers (Hemiptera: Fulgoroidea). *Pac. Sci.* 51(4): 366-376.
- Ball, E. D.** 1905. Some new Homoptera from the south and southwest. *Proc. Biol. Soc. Wash.* 18: 117-120.
- Beatty, H. A.** 1947. The insects of St. Croix, V.I. *J. Agric. Univ. P.R.* 28: 114-172.
- Becker, V. O. and S. E. Miller.** 1992. The butterflies of Guana Island, British Virgin Islands. *Bull. Allyn Mus.* 136: 1-9.
- Bent, R. M.** 1977. A modern secondary geography of the West Indies (second edition). Jamaica Publ. House, Kingston, Jamaica. 248 pp.
- Box, H. E.** 1953. List of sugar-cane insects. Commonwealth Instit. Entomol., London. 101 pp.
- Bruner, S. C., L. C. Scaramuzza, and A. R. Otero.** 1975. Catalogo de los insectos que atacan a las plantas economicas de Cuba. Academia de Ciencias de Cuba, Instituto de Zoologia. La Habana 2da. edición ampliada y revisada 1975. 394 pp.
- Caldwell, J. S.** 1950. Three new Antillean Fulgoroidea with distributional notes on a few others (Homoptera). *Am. Mus. Novit.* 1460: 1-4
- Caldwell, J. S., and L. F. Martorell.** 1951 [dated 1950]. Review of the Auchenorychous [sic] Homoptera of Puerto Rico. Part II. The Fulgoroidea except Kinnaridae. *J. Agric. Univ. P.R.* 34(2): 133-269.
- Chao, A.** 1984. Non-parametric estimation of the number of classes in a population. *Scand. J. Stat.* 11: 265-270.
- Chao, A.** 1987. Estimating the population size for capture-recapture data with unequal catchability. *Biometrics* 43: 783-791.
- Commonwealth Institute of Entomology (CIE).** 1956. Distribution maps of insect pests. Map. No. 62. *Saccharosydne saccharivora* (Westw.). Queen's Gate, London.
- Crawford, D. L.** 1914. A contribution toward a monograph of the homopterous insects of the family Delphacidae of North and South America. *Proc. U.S. Natl. Mus.* 46: 557-640, plates 45-49.
- Cummins, J. D., S. W. Wilson, P. D. Calvert and J. H. Tsai.** 1988. *Neomegamelanus dorsalis* (Homoptera: Delphacidae): Descriptions of immatures. *J. N.Y. Entomol. Soc.* 96(3): 260-265.
- Dozier, H. L.** 1931. New and interesting West Indian Homoptera. *Am. Mus. Novit.* 510: 1-24.
- Dozier, H. L.** 1936. *Colpoptera carinata* sp. nov. Dozier. p. 99. In: G. N. Wolcott. "Insectae Borinquenses." A revision of "Insectae Portoricensis" *J. Agric. Univ. P.R.* 20(1): 1-600.
- Evenhuis, N. L. and S. E. Miller.** 1994. Bee flies of the British Virgin Islands (Diptera: Bombyliidae). *Fla. Entomol.* 77(3): 382-384.
- Fennah, R. G.** 1941. Notes on the flatid genus *Ormenis* in the British Lesser Antilles and Trinidad, with descriptions of new species (Homoptera: Fulgoroidea). *Proc. Entomol. Soc. Wash.* 43(9): 191-210.

- Fennah, R. G.** 1942. New or little-known West Indian Kinnaridae (Homoptera: Fulgoroidea). Proc. Entomol. Soc. Wash. 44(5): 99-110.
- Fennah, R. G.** 1943. New species of *Bothriocera* Burm. (Homoptera: Cixiidae) from the Lesser Antilles. Psyche 50: 9-17
- Fennah, R. G.** 1945. The Cixiini of the Lesser Antilles (Homoptera: Fulgoroidea). Proc. Biol. Soc. Wash. 58: 133-146.
- Fennah, R. G.** 1949. On a small collection of Fulgoroidea (Homoptera) from the Virgin Islands. Psyche 56(2): 51-65.
- Fennah, R. G.** 1950. A generic revision of the Achilidae (Homoptera: Fulgoroidea) with descriptions of new species. Bull. Br. Mus. (Nat. Hist.) Entomol. 1(1): 1-170.
- Fennah, R. G.** 1955. Lanternflies of the family Issidae of the Lesser Antilles (Homoptera: Fulgoroidea). Proc. U.S. Natl. Mus. 105(3350): 24-47.
- Fennah, R. G.** 1959. Delphacidae from the Lesser Antilles (Homoptera: Fulgoroidea). Bull. Br. Mus. (Nat. Hist.) Entomol. 8(6): 245-265.
- Fennah, R. G.** 1965. New species of Fulgoroidea (Homoptera) from the West Indies. Trans. R. Entomol. Soc. Lond. 117(4): 95-126.
- Germar, E. F.** 1834. Observations sur plusieurs espèces du genre, *Cicada*, Latr. Rev. Ent. Silbermann 2: 49-82.
- Heatwole, H. and F. Mackenzie.** 1967. Herptogeography of Puerto Rico. IV. Paleogeography, faunal similarity and endemism. Evolution 21: 429-438.
- Heatwole, H., R. Levins, and M. D. Byer.** 1981. Biogeography of the Puerto Rican Bank. Atoll Res. Bull. 251: 1-55, plus 9 figures.
- Kirkaldy, G. W.** 1906. Two new Homoptera from Africa, and synonymical notes. Can. Entomol. 38: 154-156
- Kirkaldy, G. W.** 1909. Hemiptera: new and old. - No. I. Can. Entomol. 41: 30-32.
- Lazel, J.** 1996. Guana Island: A natural history guide. The Conservation Agency Occ. Pap. 1: 1-20.
- Liebherr, J. K.** 1988. The Caribbean: fertile ground for zoogeography. Pp. 1-14. In: J. K. Liebherr (ed.). Zoogeography of Caribbean insects. Cornell Univ. Press, Ithaca, NY.
- Linne, C.** 1767. Hemiptera. Pp. 703-712. In: Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio duodecima, reformata. Tomus II. 824 pp.
- Maldonado Capriles, J.** 1996. The status of insect alpha taxonomy in Puerto Rico after the scientific survey. Pp. 201-216. In: J. C. Figueroa Colon (ed.). The scientific survey of Puerto Rico and the Virgin Islands: An eighty-year reassessment of the islands' natural history. Ann. N.Y. Acad. Sci., Vol. 776.
- Maldonado Capriles, J. and C. A. Navarro.** 1967. Additions and corrections to Wolcott's insects of Puerto Rico. Caribb. J. Sci. 7(1-2): 45-64.
- Mayer, G. C. and R. M. Chipley.** 1992. Turnover in the avifauna of Guana Island, British Virgin Islands. J. Anim. Ecol. 61: 561-566.
- McDermott, B. T.** 1952. A revision of the genus *Megamelanus* and its allies (Homoptera, Fulgoroidea, Delphacidae). J. Kans. Entomol. Soc. 25: 41-49.
- Mead, F. W. and J. P. Kramer.** 1982. Taxonomic study of the planthopper genus *Oliarus* in the United States (Homoptera: Fulgoroidea: Cixiidae). Trans. Amer. Entomol. Soc. 107: 381-569.
- Medler, J. T.** 1990. Types of Flatidae (Homoptera). XIV. Walker and Distant types in the British Museum (England, UK). Orient. Insects 24: 127-195.
- Melichar, L.** 1901. Monographie der Acanaloniiden und Flatiden (Homoptera). Ann. K.K. Naturh. Hof. 16: 178-258.
- Melichar, L.** 1902. Monographie der Acanaloniiden und Flatiden (Homoptera) (Fortsetzung.). Ann. K. K. Naturh. Hof. 17: 1-123.

- Melichar, L.** 1923. Homoptera, fam. Acanaloniidae, Flatidae et Ricaniidae. *Genera Insectorum* 182: 1-185.
- Metcalf, Z. P.** 1936. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 2, Cixiidae. Smith College, Northhampton, MA. 269 pp.
- Metcalf, Z. P.** 1943. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 3, Araeopidae (Delphacidae). Smith College, Northhampton, MA. 552 pp.
- Metcalf, Z. P.** 1945. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 4, Derbidae. Smith College, Northhampton, MA. 212 pp.
- Metcalf, Z. P.** 1948. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 10 Achilidae. Smith College, Northhampton, MA. 85 pp.
- Metcalf, Z. P.** 1954a. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 11 Tropiduchidae. N.C. State Univ., Raleigh. viii + 176 pp.
- Metcalf, Z. P.** 1954b. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 14 Acanaloniidae. N.C. State Univ., Raleigh. vii + 64 pp.
- Metcalf, Z. P.** 1957. General Catalogue of the Homoptera. Fascicle IV, Fulgoroidea, Part 13, Flatidae and Hypochthonellidae. N.C. State College, Raleigh. viii + 565 pp.
- Metcalf, Z. P.** 1958. General Catalogue of the Homoptera. Fascicle IV, Fulgoroidea, Part 15, Issidae. Waverly Press Inc., Baltimore, MD. vii + 561 pp.
- Metcalf, Z. P. and S. C. Bruner.** 1930. Cuban Fulgorina. 1. The families Tropiduchidae and Acanaloniidae. *Psyche* 37(4): 395-424.
- Metcalf, J. R.** 1969. Studies on the biology of the sugar cane pest *Saccharosydne saccharivora* (Westw.) (Hom.: Delphacidae). *Bull. Entomol. Res.* 59: 393-408.
- Miskimen, G. W. and R. M. Bond.** 1970. The Insects of St. Croix, United States Virgin Islands. *Sci. Survey Porto Rico Virgin Islands* 13(1): 1-114.
- Muir, F. A. G.** 1918. Homopterous Notes II. *Proc. Hawaii. Entomol. Soc.* 3: 414-429.
- Muir, F. A. G.** 1924. New and Little Known Fulgorids from the West Indies (Homoptera). *Proc. Hawaii. Entomol. Soc.* 5(3): 461-472
- Muir, F. A. G. and W. M. Giffard.** 1924. Studies in North American Delphacidae. *Bull. Exp. Stn. Hawaii. Sugar Planters' Assoc., Entomol. Ser.* 15: 1-53
- Myers, J. G.** 1928. Notes on Cuban Fulgoroid Homoptera. *Studies on Cuban Insects* 1: 13-28.
- Osborn, H.** 1929. Notes on Porto Rican Homoptera. *J. Dept. Agric. Porto Rico* 13(3): 81-112.
- Osborn, H.** 1935. Insects of Porto Rico and the Virgin Islands. Homoptera (excepting the Sternorhynchi). *Sci. Survey Porto Rico Virgin Islands* 14(2): 111-260.
- Ramos, J. A.** 1957. A review of the auchenorrhynchous Homoptera of Puerto Rico. *J. Agric. Univ. P.R.* 41(1): 38-117.
- Ramos, J.A.** 1988. Zoogeography of the auchenorrhynchous Homoptera of the Greater Antilles (Hemiptera), pp. 61-70. In: J.K. Liebherr (ed.), *Zoogeography of Caribbean insects*. Cornell Univ. Press, Ithaca, NY.
- Rosen, D. E.** 1985. Geological hierarchies and biogeographic congruence in the Caribbean. *Ann. Mo. Bot. Gard.* 72: 636-659.
- Roth, L. M.** 1994. Cockroaches from Guana Island, British West Indies (Blattaria: Blattellidae: Blaberidae). *Psyche* 101: 45-52.
- SAS Institute.** 1989. SAS user's guide: Statistics. SAS Institute, Cary, NC.
- Spooner, C. S.** 1920. Some notes on the occurrence of Delphacinae (Hemip. Homop.). *Entomol. News* 31: 44-46
- Stål, C.** 1859. Novae quaedam Fulgorinorum formae speciesque insigniores. *Berlin. Entomol. Z.* 3: 313-327.
- Van Duzee, E. P.** 1912. Hemipterological gleanings. *Bull. Buffalo Soc. Nat. Sci.* 10: 477-512.
- Van Duzee, E. P.** 1917. Catalogue of the Hemiptera of America North of Mexico (excepting the Aphididae, Coccidae and Aleurodidae). *Tech. Bull. Univ. Calif. Agric. Exp. Stn. Univ. Calif. Press, Berkeley*, Vol. 2, pp. i-xiv, 1-902.

- Walker, F.** 1851. List of the specimens of Homopterous insects in the collection of the British Museum. 2: 261-636.
- Westwood, J. O.** 1833. Additional observations upon the insect which infests the sugar canes in Grenada. Mag. Nat. Hist. 6: 409-413.
- Wolcott, G. N.** 1927. Entomologie d'Haiti. Service Technique du Department de l'Agriculture et de l'Enseignement Professionnel. Port-Au-Prince, Haiti. 440 pp.
- Wolcott, G. N.** 1936. Insectae Borinquenses. A revised annotated checklist of the insects of Puerto Rico. J. Agric. Univ. P.R. 20(1): 1-600.
- Wolcott, G. N.** 1941. A supplement to "Insectae Boringuenses". J. Agric. Univ. P.R. 25(2): 33-158.
- Wolcott, G. N.** 1950 [dated 1948]. The insects of Puerto Rico. J. Agric. Univ. P.R. 32(1): 1-224.

A NEW SPECIES OF *PARACLOEODES* (EPHEMEROPTERA: BAETIDAE) FROM MEXICO¹

R.P. Randolph, W. P. McCafferty²

ABSTRACT: *Paracloeodes lugoï*, n. sp., is described from Morelos, Mexico. Structure of the labrum, mandibles, and labial palps distinguishes the larval stage of *P. lugoï* from all other known species of *Paracloeodes*. The adult stage of the new species is unknown.

Previously only one species of *Paracloeodes* (Ephemeroptera: Baetidae), *P. minutus* (Daggy), was known from North America, including the U.S. (see Daggy 1945, Day 1955, McCafferty and Waltz 1990) and Mexico (Lugo-Ortiz and McCafferty 1994). Six additional species are known from Middle and South America, including one species each from Cuba (Kluge 1991) and Puerto Rico (Traver 1938), and four species from South America (Lugo-Ortiz and McCafferty 1996). *Paracloeodes minutus* is also known from Costa Rica (McCafferty and Lugo-Ortiz 1996). Herein we describe a distinctive new North American species of *Paracloeodes* from Morelos, Mexico. Material of the new species is deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana.

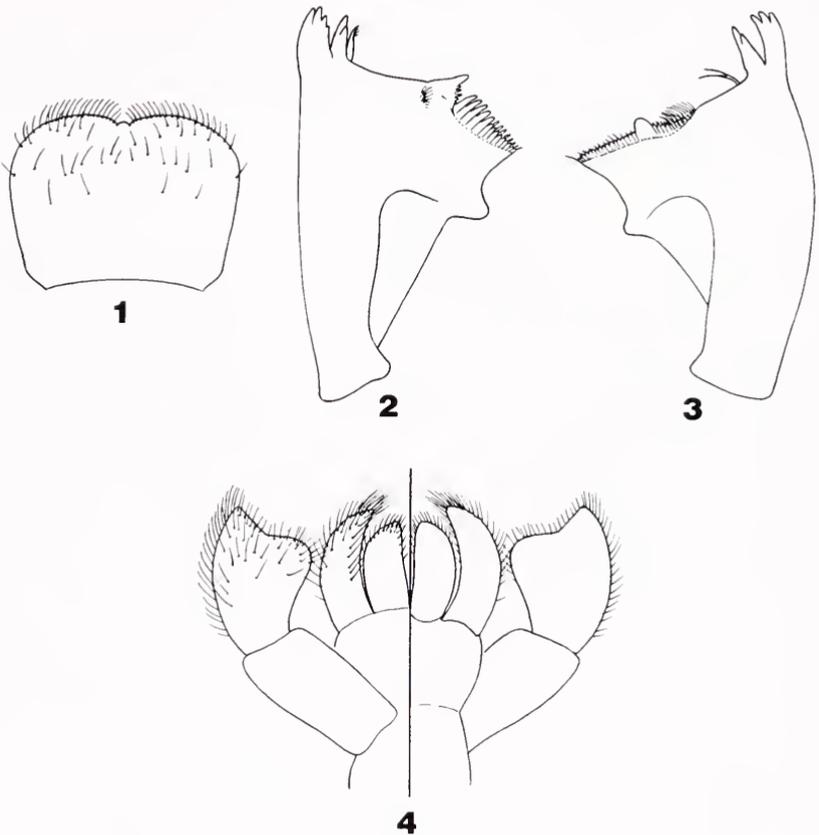
Paracloeodes lugoï Randolph and McCafferty, NEW SPECIES

Larva. Body length: 5.5 mm. Caudal filaments length: 2.0 mm. Head: Coloration light brown with no discernable pattern; frontal keel present between antennae. Antennae approximately 1.5x length of head capsule. Labrum (Fig. 1) rounded anteriorly, with margin of medial notch convex, with lateral margins converging posteriorly, and with long, simple setae scattered dorsally; anterior margin with row of long, fine simple setae. Left mandible (Fig. 2) with incisors fused at midlength; outer set of incisors with four denticles, inner set of incisors with two denticles; prosthema stout; small tuft of setae at base of triangular process of mola; molar triangular process obliquely directed medially, with four denticles medially. Right mandible (Fig. 3) with incisors cleft to base; outer set of incisors with three denticles, inner set of incisors with two denticles; prosthema bifid; tuft of setae present at base of mola; mola with one long, simple seta protruding from medial margin. Maxillae [similar to Fig. 17, Lugo-Ortiz and McCafferty (1996)] with three denticles at apex of galealaciniae; palps two segmented, with simple setae scattered over surface, more concentrated near apex; segment 2 slightly longer than basal segment. Labium (Fig. 4) with glossae and paraglossae with long, fine simple setae concentrated at apices; glossae with numerous fine, simple setae scattered over surface and with row of stout setae medially; paraglossae with long, fine simple setae on outer margin and single row of long, fine simple setae medially; distal palp segment subtriangular, reduced in size, with long, fine simple setae scattered over surface, more concentrated near apex; junction of medial projection of segment 2 and apex of palp forming distinct obtuse angle medially; segment 2 with medial margin nearly straight and evenly tapering basally, broadly joined to segment 1, with long, fine simple setae scattered over surface of segment 2; palp segment 1 subequal in size to

¹ Received June 5, 1999. Accepted September 29, 1999.

² Department of Entomology, Purdue University, West Lafayette, IN 47907.

remainder of palp. Thorax: Prothorax with pair of submedian bilobed markings; meso- and metathorax brown with no discernable pattern. Forelegs with row of stout setae dorsally, and row of small, spatulate setae just below row of stout setae, ventrally with scattered long, stout, simple setae and long, fine, simple setae; femora with cluster of long, fine, simple setae and two stout setae distally; tibiae and tarsi with long, fine, simple setae scattered on dorsal surface and long stout setae ventrally; tarsi with few very fine setae ventrally; tarsal claws with barely discernable row of minute denticles basally. Hindwingpads absent. Abdomen: Terga brown with darker brown patterning throughout; terga 1-2 brown; terga 3-6 brown with pair of submedian darker brown spots near posterior margin and with anteromedial darker brown spot on each tergum; tergum 6 with anterolateral corners light brown; terga 7-9 lighter brown with anteromedial dark spot and paired submedial posteriorly directed dark markings; tergum 9 bordered laterally and posteriorly with dark pigment; tergum 10 mostly light brown, with anteromedial dark spot; posterior tergal spines approximately 1.5x longer than basal width.



Figs. 1-4. *Paracloeodes lugoi*, n. sp., larva. 1. Labrum (dorsal). 2. Left Mandible. 3. Right Mandible. 4. Labium (left-ventral; right-dorsal).

Paraprocts with twenty marginal spines, with medial spines largest; triangular process with 14 uniform spines; body of paraproct with long, simple setae scattered over surface. Gills on segments 1-7, asymmetrical, with outer margin straight; gill margins weakly serrate, with long, fine, simple setae at each serration; gill trachea distinct. Sterna uniformly brown, with long, fine, simple setae scattered over surface. Caudal filaments uniformly brown with numerous long, fine, simple setae medially, terminal filament subequal to cerci and with numerous, long, fine, simple setae laterally.

Adult. Unknown.

Material examined. Holotype: Larva, MEXICO, Morelos State, Río Cuautla at Cuautla, elev. 4600', temp. 70° F, XI-13-1968, R. K. Allen, [mouthparts, legs, tergum 3-4, gills 3-4, paraprocts mounted on slide (medium: Euparal)].

Etymology. We are honored to name this species after C. R. Lugo-Ortiz for his recent and prolific contributions to global baetid taxonomy.

Diagnosis. Larvae of *Paracloeodes lugoi* differ from all South American forms (see Lugo-Ortiz and McCafferty 1996) by the absence of hindwingpads and presence of a uniquely shaped labial palp (Fig. 4). *Paracloeodes lugoi* larvae are most similar to the North and Central American species *P. minutus* but can be separated from that species on the basis of the distinctive shape of the labial palps (Fig. 4), the convex shape of the labrum (Fig. 1), and the bifid prostheca on the right mandible (Fig. 3). The medial projection of labial palp segment 2 in *P. lugoi* is larger in relation to the apex of the palp (Fig. 4) than that of *P. minutus* [Fig. 12, Day (1955)]. The angle formed by this projection and the apex in *P. lugoi* is considerably greater than the approximate right angle found in *P. minutus*. The base of labial palp segment 2 in *P. lugoi* is relatively broad, evenly broadening distally. In *P. minutus*, the base of segment 2 is narrower and the medial margin is concave [Fig. 12, Day (1955)]. The labrum of *P. lugoi* (Fig. 1) is considerably more convex anteriorly than the labra of specimens of *P. minutus* we have examined. The prostheca of the right mandible (Fig. 3) of *P. lugoi* is apically bifid, whereas that of *P. minutus* is serrate medially. In addition, the molar triangular process of the left mandible in *P. lugoi* (Fig. 2) is obliquely directed, rather than being perpendicularly prominent as in *P. minutus*.

ACKNOWLEDGMENTS

We thank G. F. Edmunds, Jr. (Salt Lake City, Utah) for the donation of the material for our study. We also thank A.V. Provonsha (West Lafayette, Indiana) for the figures. This paper has been assigned Purdue Agricultural Research Program Journal Number 16008. Research was supported by NSF grant DEB-9901577.

LITERATURE CITED

Daggy, R. H. 1945. New species and previously undescribed naiads of some Minnesota mayflies (Ephemeroptera). *Ann. Entomol. Soc. Am.* 38: 373-396.

- Day, W. C. 1955.** New genera of mayflies from California. Pan-Pac. Entomol. 31: 121-137.
- Kluge, N. Y. 1991.** Cuban mayflies of the family Baetidae (Ephemeroptera) 1. Genera *Callibaetis*, *Cloeodes* and *Paracloeodes*. Zool. Zh. 12: 128-135. [In Russian].
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1994.** New records of Ephemeroptera from Mexico. Entomol. News 105: 17-26.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1996.** The genus *Paracloeodes* (Insecta: Ephemeroptera: Baetidae) and its presence in South America. Annl. Limnol. 32: 161-169.
- McCafferty, W. P. and C. R. Lugo-Ortiz. 1996.** Los efemerópteros (Ephemeroptera) de América Central. Rev. Nica. Entomol. 35: 19-28.
- McCafferty, W. P. and R. D. Waltz. 1990.** Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Trans. Am. Entomol. Soc. 116: 769-799.
- Traver, J. R. 1938.** Mayflies of Puerto Rico. J. Ag. Univ. Puerto Rico 22: 5-42.

***ACENTRELLA FEROPAGUS*, NEW SPECIES
(EPHEMEROPTERA: BAETIDAE): FORMAL NEW
NAME FOR NORTH AMERICAN *A. LAPPONICA*
SENSU MORIHARA AND McCAFFERTY¹**

J. Alba-Tercedor², W. P. McCafferty³

ABSTRACT: A new name *Acentrella feropagus*, new species, is proposed for the North American baetids that were previously known as *Acentrella lapponica* or *Baetis lapponicus* and which had been described in the larval stage by Morihara and McCafferty. The species is apparently confined to northern Canada and Alaska. Characteristics of the femora and tibiae as well as labial palps may be used to differentiate larvae of *A. feropagus* from those of the European species *A. lapponica*.

Bengtsson (1912) originally described the species *Acentrella lapponica* Bengtsson from Sweden. McDunnough (1936) first recorded the species in North America, based on the study of alate specimens collected from the Canadian tundra. The identification was confirmed by Bengtsson. Thereafter McDunnough's identification of the material was not questioned, and the distribution of the species has been considered as circumpolar (see McCafferty 1985).

In the revision of the North American larvae of the genus *Baetis* sensu lato, Morihara and McCafferty (1979) included a detailed description of the larvae of *A. lapponica*. Morihara and McCafferty (1979), however, pointed out some apparent differences between the larvae from North America and European larvae (see Müller-Liebenau 1970), commenting, for example, that, "... in N. A. the large dorsal setae of the femora and tibiae are more robust and shorter than those in European forms."

Morihara and McCafferty (1979) took a very conservative approach in their study with respect to naming new species. For example, although they described several unnamed species, those species were not named until later by others [see review by McCafferty and Silldorff (1998)]. During the preparation of a recent paper on the genus *Acentrella* (Alba-Tercedor and El Alami 1999), it became apparent that differences noted in North American larvae by Morihara and McCafferty (1979) were of species-level significance, and that *A. lapponica* sensu Morihara and McCafferty was a new species. That species is formally named herein.

¹ Received August 27, 1999. Accepted September 29, 1999.

² Departamento de Biología Animal y Ecología, Facultad de Ciencias, Universidad de Granada, 18071-Granada, Spain.

³ Department of Entomology, Purdue University, West Lafayette, IN 47907.

Acentrella feropagus, NEW SPECIES

Baetis lapponicus (Bengtsson), Morihara and McCafferty, 1979:149.

Material examined. HOLOTYPE: mature larva on slide: Canada, Northwest Territories, Keewatin, Bothia, VII-28-1977 (3WF229 S9) (deposited in the Canadian National Collection, Ottawa), identified in 1979 by D. Morihara as *Baetis lapponicus*. Additional larval material was examined from the Murchison River drainage system of the District of Keewatin, Northwestern Territories (Nunavut), collected by J. Collins in 1976 and 1977, and residing at the Freshwater Institute, Winnipeg, Manitoba.

Etymology. The epithet *feropagus*, literally "wild country" in Latin, is a noun in apposition in reference to the northern wilderness of North America from where the species is known.

Diagnosis. Larvae of the new species can easily be distinguished from those of *A. lapponica* by the shorter and more robust setae of the femora and tibiae, as was pointed out by Morihara and McCafferty (1979) (compare figures 9-14 with Müller-Liebenau, 1970: figures 46e, f, g). Moreover, there are clear differences between the two species in the shape of the apical segment of the labial palpi (compare figures 1-2 with Müller-Liebenau, 1970: figures 46d, and Jacob, 1991: figure 3a.). *Acentrella feropagus* larvae may be differentiated from other North American species of *Acentrella* by using the key provided by McCafferty et al. (1994) and substituting the name *feropagus* for *lapponica*. We do not know of differences in the adult stages of *A. feropagus* and *A. lapponica*.

Distribution. We provisionally consider all materials previously identified and reported as *A. lapponica* in North America to be *A. feropagus*. As such, the distribution includes Alaska (Harper and Harper 1981) and Newfoundland (Labrador), Northwest Territories, and Quebec in Canada [see recent review in McCafferty and Randolph (1998)].

ACKNOWLEDGMENTS

We are indebted to D. Cobb (Freshwater Institute, Winnipeg, Manitoba) for providing Canadian material for study. This paper has been assigned Purdue University Agricultural Research Program Journal No. 16062.

LITERATURE CITED

- Alba-Tercedor, J. and M. El Alami. 1999. Description of the nymphs and eggs of *Acentrella almohades* sp. n. from Morocco and southern Spain (Ephemeroptera: Baetidae). *Aquat. Insects* 21: 241-247.
- Bengtsson, S. 1912. Neue Ephemeriden aus Schweden. *Entomol. Tidskr.* 33: 107-117.
- Harper, F. and P. P. Harper. 1981. Northern Canadian mayflies (Insecta: Ephemeroptera), records and descriptions. *Can. J. Zool.* 59: 1784-1789.

- Jacob, U. 1991. Ephemeroptera: zur Systematik der europäischen Baetidae auf Gattungsebene. Verh. Westd. Entomol. 1991: 271-290.
- McCafferty, W. P. 1985. The Ephemeroptera of Alaska. Proc. Entomol. Soc. Wash. 87: 381-386.
- McCafferty, W. P. and R. P. Randolph. 1998. Canada mayflies: a faunistic compendium. Proc. Entomol. Soc. Ontario 129: 47-97.
- McCafferty, W. P. and W. L. Silldorff. 1998. Reared association and equivalency of *Baetis adonis* and *B. caelestis* (Ephemeroptera: Baetidae). Entomol. News 109: 261-265.
- McCafferty, W. P., M. J. Wagle, and R. D. Waltz. 1994. Systematics and biology of *Acentrella turbida* (Ephemeroptera: Baetidae). Pan-Pac. Entomol. 70: 301-308.
- McDunnough, J. 1936. A new arctic baetid (Ephemeroptera). Can. Entomol. 68: 32-34.
- Morihara, D. K. and W. P. McCafferty. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). Trans. Am. Entomol. Soc. 105: 139-221.
- Müller-Liebenau, I. 1970. Revision der europäischen Arten der Gattung *Baetis*, 1815 (Insecta, Ephemeroptera). Gewäss. Abwäss. 48/49 (1969): 1-214.

A NEW COMBINATION FOR TWO NORTH AMERICAN SMALL MINNOW MAYFLIES (EPHMEROPTERA: BAETIDAE)¹

N. A. Wiersema²

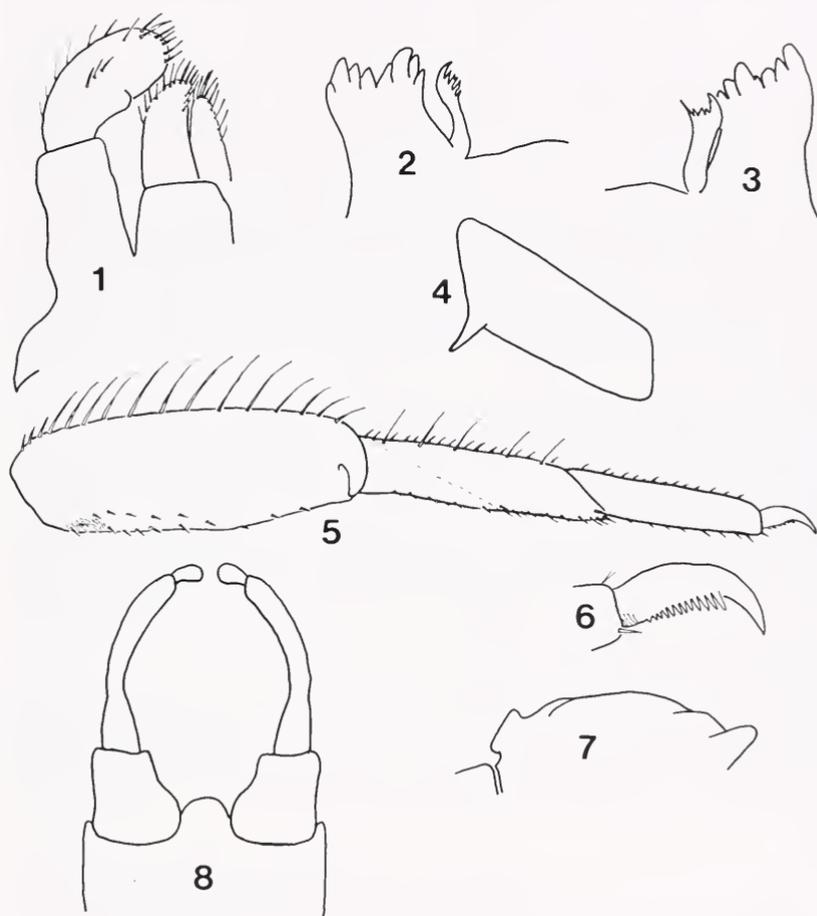
ABSTRACT: *Acentrellaalachua*, n. comb., and *A. parvula*, n. comb., are transferred from the genus *Plauditus*.

The small minnow mayfly genus *Plauditus* Lugo-Ortiz & McCafferty (1998) was recently established for a small group of North American species originally described in *Pseudocloeon* Klapálek or *Cloeon* Leach. Lugo-Ortiz and McCafferty (1998) transferred 12 such North American species into *Plauditus*. However, a recent survey of these species revealed that two species would be more appropriately transferred to *Acentrella* Bengtsson. Species emendations are as follows: *Acentrellaalachua* (Berner), **n. comb.**, *Acentrella parvula* (McDunnough), **n. comb.**

The following combination of characteristics indicate that *A.alachua* and *A. parvula* are more appropriately placed in *Acentrella* as opposed to *Plauditus*, *Heterocloeon* or any other *Baetis* complex genus: possession of minute hindwingpads (Fig. 4); tergal surfaces lacking scales and or scale bases; gills with smooth margins; the compact nature of the labium with narrow palpi which possess evenly rounded (Fig. 1) or slightly truncated apices; short, wide, apically cleft mandibular incisors without serrations on the inner margin of the right incisors (Figs. 2 & 3); relatively long dorsal femoral and often present tibial setae (Fig. 5), compared to *Plauditus* and *Heterocloeon* species; highly reduced posterior marginal abdominal tergal spines with sharply pointed and occasionally multidentate apices (similar to Fig. 14 Waltz and McCafferty 1987); distinctive genital forceps of the male adult (Fig. 8) and moderate to well developed anterior process of the mesoscutum (Fig. 7). I would note that the development of the anterior process of the mesoscutum demonstrates considerable specific variability within the three previously mentioned genera. The anterior process of the mesoscutum is one of a number of features, which indicates a close relationship among *Acentrella*, *Heterocloeon*, and *Plauditus* as well as additional genera. With respect to mandibular morphology, *Plauditus* species possess elongate and narrow mandibular incisor which are not discreetly cleft apically and with the inner margins of the right incisors serrate. The mandibular incisors of *Acentrella* species on the other hand are shorter and more robust in appearance, often apically cleft, and usually lack serrations

¹ Received August 23, 1999. Accepted October 20, 1999.

² 4857 Briar bend, Houston, TX 77035.



Figs. 1-8. *Acentrella parvula* 1. Labium (dorsal half). 2. Right mandibular incisors. 3. Left mandibular incisors. 4. left metathoracic notum. 5. Leg. 6. Tarsal claw. 7. Partial thorax (adult, lateral view). 8. Genitalia (ventral).

on the inner margins of the right incisors. Serrations along the inner margins of the right mandibular incisors are also found in species of *Heterocloeon*, *Baetis* species and other genera. Finally, the male genitalia of *A. alachua* and *A. parvula* possess a number of distinctive characteristics, one of which may prove to be a generic autapomorphy for *Acentrella* (e.g. enlarged, wide-based basal forcep segments with a broadly rounded, inner-medial emargination). Basal forcep segments of this form are not found in *Plauditus* or *Heterocloeon* species, but are typical of the following *Acentrella* species for example: *A. sibirica* (Kazlauskas), see Fig. 6 in Park et al. 1996; *A. sinaica* Bogoescu, see Fig. 42b in Müller-Liebenau 1970; *A. lapponica* Bengtsson, see Fig. 42a in Müller-Liebenau 1970; *A. insignificans* (McDunnough), see Plate 3, Fig. 7 in McDunnough 1926; and *A. turbida* (McDunnough). On the basis of numerous synapomorphic features found in *Liebebiella* Waltz & McCafferty (1987) and *Acentrella* it is possible the adult males of *Liebebiella* will also have similar genitalia.

On the basis of the highly reduced, strap-like hindwingpads, mandibular incisor morphology, highly reduced labrum, and long femoral and tibial setation of the larvae, and the genitalia of the adult male, *A. parvula* and *A. alachua* seem to be closely related to *A. turbida*. *Acentrella insignificans* is also very similar to *A. parvula*, *A. alachua* and *A. turbida*. However, *A. insignificans* larvae retain much larger hindwingpads and thus usually have small hindwings in the adults. It is also possible that the reduced tibial setation found in *A. parvula* and *A. alachua* is an adaptation for life in slower-flowing waters than is typical for some other *Acentrella* species.

ACKNOWLEDGMENTS

I would like to thank W. L. and J. G. Peters (Florida A&M University) for the loan of additional larvae of *A. alachua* from Florida. I would also like to express my appreciation to W. P. McCafferty (Purdue University) and B. C. Kondratieff (Colorado State University) for their critiques of the manuscript version of this publication, as well as two anonymous reviewers for their helpful notes.

LITERATURE CITED

- Lugo-Ortiz, C. R., and W. P. McCafferty. 1998. A new North American genus of Baetidae (Ephemeroptera) and key to *Baetis* complex genera. *Entomol. News* 109: 345-353.
- McDunnough, J. 1926. New Canadian Ephemeridae with notes IV. *Can. Entomol.* 58: 296-303.
- Müller-Liebenau, I. 1970 (1969). Revision der europäischen arten der gattung *Baetis* Leach, 1815 (Insecta, Ephemeroptera). *Gewässer und Abwässer* 48/49, 1-214.
- Park, S. Y., Y. J. Bae, and I. B. Yoon. 1996. Revision of the Baetidae (Ephemeroptera) of Korea (1) historical review. *Acentrella* Bengtsson and *Baetiella* Uéno. *Entomol. Res. Bull. (KEI)*, 22: 55-66.
- Waltz, R.D. and W.P. McCafferty. 1987. Systematics of *Pseudocloeon*, *Acentrella*, *Baetiella*, and *Liebebiella*, new genus (Ephemeroptera: Baetidae). *J. New York Entomol. Soc.* 95: 553-568.

BAETIELLA (EPHEMEROPTERA: BAETIDAE) IN HONG KONG, WITH DESCRIPTION OF A NEW SPECIES¹

Xiaoli Tong^{2,3}, David Dudgeon²

ABSTRACT: A new species of *Baetiella* (Ephemeroptera: Baetidae), *B. trispinata*, from Hong Kong, China is described and illustrated based on adult and larval material. The first adult description of *B. pseudofrequenta* (Müller-Liebenau) and new distributional records for *B. bispinosa* (Gose) and *B. pseudofrequenta* in China are provided.

Baetiella Uéno is a poorly defined genus distributed in the Palearctic and Oriental Regions. The genus frequently has been considered as a subgenus of *Pseudocloeon* (e.g., Kazlauskas, 1963; Braasch, 1978; Kluge, 1983), a synonym of *Pseudocloeon* (e.g., Gose, 1980; Müller-Liebenau, 1985), or treated as *Baetis* (e.g., Kazlauskas, 1963; Braasch, 1978; Müller-Liebenau, 1985). Waltz and McCafferty (1987) gave a generic diagnosis for *Baetiella* and listed 12 species within the genus. The genus is now clearly known to be distinct from *Pseudocloeon* (Lugo-Ortiz, McCafferty and Waltz, 1999). Waltz and McCafferty (1997) added three species to the genus that had been placed in *Baetis* (*Tenuibaetis*) by Kang et al. (1994). In this paper, a new species of *Baetiella*, *B. trispinata*, from Hong Kong, China is described based on adult and larval material. The first adult description of *Baetiella pseudofrequenta* and new distributional records for *B. bispinosa* (Gose) and *B. pseudofrequenta* (Müller-Liebenau) in China are also provided.

Abbreviations used for deposition of types are as follows: the insect collection of the South China Agricultural University, Guangzhou, P. R. China (SCAU); Department of Ecology & Biodiversity, The University of Hong Kong (HKU); the insect collection of the Agriculture and Fisheries Department of Hong Kong Government (AFDHK); the collection of Florida A & M University, Tallahassee, Florida (FAMU); and Purdue Entomological Research Collection, West Lafayette, Indiana (PERC).

***Baetiella bispinosa* (Gose, 1980)**

Pseudocloeon bispinosus Gose, 1980: 211.

Neobaetiella macani Müller-Liebenau, 1985: 108.

Neobaetiella imanishii Müller-Liebenau, 1985: 108, fig. 19.

Baetiella bispinosa (Gose): Waltz and McCafferty, 1987: 563.

¹ Received July 14, 1999. Accepted September 24, 1999.

² Department of Ecology & Biodiversity, The University of Hong Kong, Pokfulam Road, Hong Kong SAR, China.

³ Present address: College of Resources and Environment, South China Agricultural University, 510642, Guangzhou, Guangdong Province, P. R. China.

Larva. Adequately described and illustrated by Müller-Liebenau (1985).
Adult. Unknown.

Material examined. CHINA: Hong Kong: 4 larvae, Lantau Island, Shek Mun Kap, 17-XII-1996, Xiaoli Tong, in HKU; 1 larva, Hok Tau, 18-X-1998, Xiaoli Tong, in AFDHK. CHINA: Guangdong Province: 1 larva, Nankunshan Nature Reserve, near the Middle School, 16-IX-1994, Xiaoli Tong, in SCAU; 2 larvae, Nankunshan Nature Reserve, Stone River, 11-III-1995, Xiaoli Tong, in SCAU; 11 larvae, Yangshan, Chengjia Nature Reserve, Lutian, 15-VII-1996, Xiaoli Tong, in SCAU.

Distribution: Japan; China: Guangdong, Hong Kong and Taiwan.

Baetiella pseudofrequenta (Müller-Liebenau, 1985)

(Figs. 15-20)

Baetis pseudofrequentus Müller-Liebenau, 1985: 98.

Baetis (*Tenuibaetis*) *pseudofrequentus* Müller-Liebenau: Kang et al., 1994: 26.

Baetiella pseudofrequenta (Müller-Liebenau): Waltz and McCafferty, 1997: 136.

Larva. Adequately described and illustrated by Müller-Liebenau (1985) and Kang et al. (1994).

Male adult (in alcohol, reared from larvae in the laboratory). Body length 4.1 mm, forewing 4.4 mm; cerci 10.0 mm. Turbinate eyes well developed (Figs. 19-20), orange with light cream margins apically. Antennae shorter than head capsule; flagella gray; pedicels light yellow; scapes light yellow with rust colored markings basely. Meso- and metanota pale or gray-yellow dorsally and dark brown laterally; thorax ventrally dark brown. Forewings (Fig. 18) hyaline; longitudinal veins and paired marginal intercalaries gray; pterostigma areas with 5-7 slanting veinlets. Hindwings (Fig. 15) with acute costal process and two longitudinal veins. Forefemora straw colored with rust preapical markings (Fig. 17); foretibiae and foretarsi gray. Length of foreleg segments (mm): femora 7.80, tibiae 1.00, tarsal segments 0.08, 0.38, 0.29, 0.18, and 0.12. Other legs gray or light gray-yellow. Abdominal terga 1-6 translucent, whitish to light yellow dorsally and with rust colored markings laterally; terga 7-8 light brown-green; terga 9-10 whitish; terga 1-9 with single purple-red transverse streak posteriorly. Genital forceps (Fig. 16) with basal segments 1-2 whitish; terminal segments 3-4 gray-brown. Cerci gray with purplish annulations at apex of each segment.

Female adult (in alcohol, reared from larvae in the laboratory). Body length 3.5 mm; forewing 4.4 mm; cerci 7.8 mm. Vertex light yellow or yellow. Pronotum with red-brown streak anteriorly, a pair of oblique red-brown dashes submedially. Thorax except foreleg as in male. Abdominal terga 1-10 whitish to yellow dorsally, light brown-green tinted rust laterally. Cerci as in male.

Material examined. CHINA: Hong Kong: 2 larvae, Shing Mun, 12-XI-1996, Xiaoli Tong, in HKU; 4 larvae, Tai Po Kau Forest Stream, 19-XI-1996, Xiaoli Tong, in SCAU; 91 larvae, Lam Tsuen River near Tong Min Tsuen, 6-I-1997, Xiaoli Tong, in SCAU; 36 larvae, Pak Ngau Shek, 13-I-1997, Maria Salas, in HKU; 2 larvae, Ma Po Mei near Lam Kam Road, 7-X-1997, Xiaoli Tong, in HKU; 56 larvae, 5 male adults and 4 female adults, Ha Wan Yiu, 4-XI-1997, Xiaoli Tong, in SCAU; 2 larvae, Tan Shan River near Ng Uk, 13-II-1998, Xiaoli Tong, in AFDHK; 4 larvae, Tan Chuk Han, 18-III-1998, Xiaoli Tong, in HKU; 14 larvae, Ho Chung, 1-

IV-1998, Xiaoli Tong, in HKU; 2 male and 2 female adults, Nam Chung River, near Luk Keng Lam Uk, 5-III-1999, Xiaoli Tong, in SCAU.

Distribution. China: Hong Kong and Taiwan.

Baetiella trispinata Tong & Dudgeon, NEW SPECIES

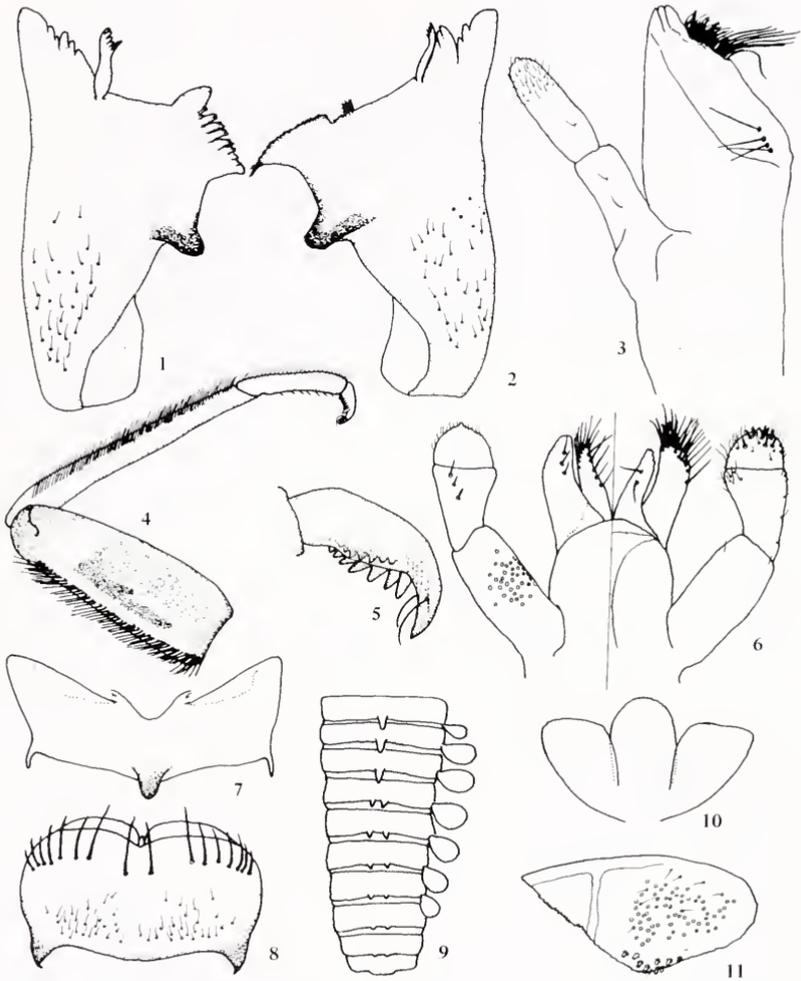
(Figs. 1-14, 21-22)

Larva. Body length 4.6-5.4 mm; cerci 5.0-7.0 mm. Head: Head capsule yellow-brown. Labrum (Fig. 8) approximately 2.0 times wider than long, deeply cleft anteromedially, dorsally with submedial pair of long, robust, simple setae and anterior submarginal row of 7-8 long, robust, simple setae. Hypopharynx as in Figure 10. Left mandible (Fig. 1) with incisors with 6 denticles; marginal lateral denticle enlarged. Right mandible (Fig. 2) with incisors with 6 denticles; marginal lateral denticle enlarged. Maxillae (Fig. 3) with 4 denticles on galealacinae and 4-5 fine, simple setae on medial hump; maxillary palpi 2 segmented; terminal segment with small apical tip. Labial palpi (Fig. 6) 3 segmented; terminal segment conical, with tiny apical tip.

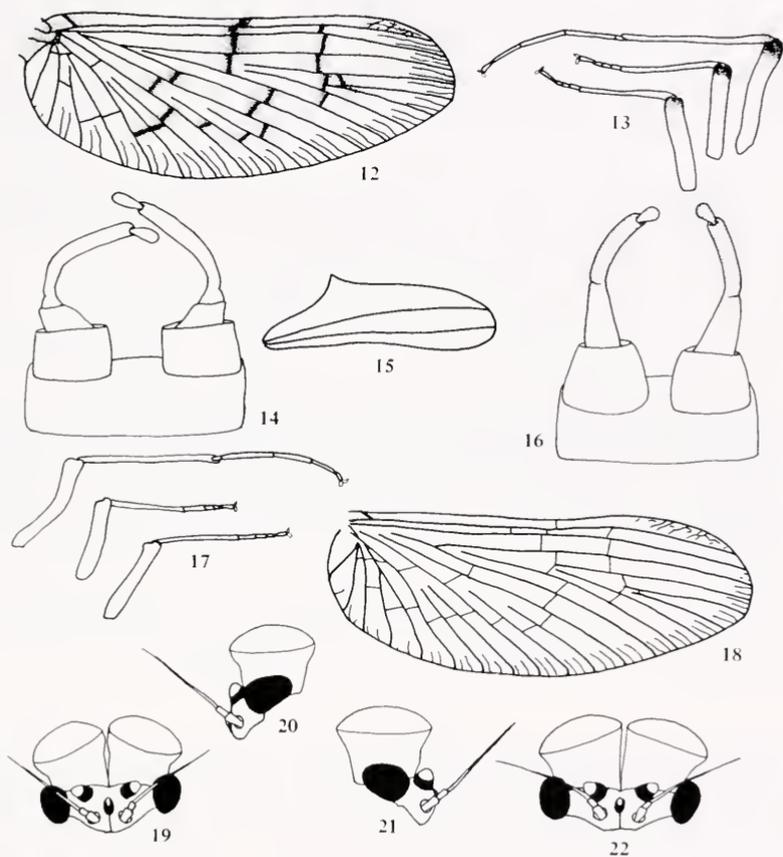
Thorax: Thorax yellow-brown, with irregular brown markings medially; mesonotum with two longitudinal, yellow narrow stripes on both sides near median line. Pro- and mesonota with numerous tubercles. Metanotum (Fig. 7) with single long tubercle medially. Hindwing pads (Fig. 7) reduced, approximately 2-3 times longer than wide. Legs (Fig. 4) paler than thorax, femora with brown longitudinal markings on dorsal surface and with row of long, relatively robust, simple setae dorsally; tibiae with row of dense, fine, simple setae dorsally; tarsi with row of sparse, fine, simple setae dorsally. Tarsal claws (Fig. 5) with subapical pair of long, fine, simple setae and 2 rows of 7-8 denticles (one of the rows vestigial). All legs lacking coxal gills. **Abdomen:** Generally yellow-brown, with medium brown to brown markings. Segments 2-6 with pair of oblique brown dashes anteriorly, segments 7-9 with pair of small specks in anterior half. Posterior margins of terga 1-3 with single median dorsal tubercles; terga 4-9 with paired dorsal tubercles posteriorly, decreasing in size towards abdomen, on tergum 9 dorsal tubercles reduced (Fig. 9). Gills whitish and untracheated, present on segments 1-7; gill surface with numerous pores, margin smooth with fine, simple setae. Paraprocts as in Figure 11. Cerci yellow-brown; median terminal filament reduced to one segment.

Male adult (in alcohol, reared from larvae in the laboratory). Body length 4.0-4.8 mm, forewing 4.4-4.8 mm, cerci 11.5 mm. Head yellow-brown. Antennae approximately 1.5 times length of head capsule; flagella pale brown; scapes yellow-brown; pedicels red-brown. Upper portion of compound eyes orange, extremely large (Figs. 21-22); lower portion black. Ocelli whitish with black basal rings. Thorax light brown. Forewings (Fig. 12) hyaline, basal portions and pterostigma areas tinted with brown; longitudinal veins and paired marginal intercalaries light brown, with distinctly brown pigmented areas adjoining and including crossveins. Hindwings absent. Legs (Fig. 13) whitish, femora with brown marking apically; foretibiae with light brown basal macula. Length of foreleg segments (mm): femora 1.00, tibiae 1.50, tarsal segments 0.08, 0.50, 0.45, 0.27, and 0.15. Abdominal segments 1-6 opaque, cream; segments 7-10 light brown; terga 1-9 with single pale brown streak posteriorly. Genital forceps (Fig. 14) whitish, arched. Cerci whitish. **Female adult** (in alcohol, reared from larvae in the laboratory). Body length 4.4 mm, forewing 5.0 mm. Head yellow-brown; flagella light purple-red; scapes light yellow; pedicels purple-red. Pronotum light yellow-brown with 3 longitudinal brown markings. Abdominal terga 1-7 and 10 yellow-brown; terga 8-9 yellow. Other characters as in male except for the usual sexual differences.

Material examined. Holotype: Mature male larva (in alcohol), CHINA, Hong Kong: Ma Po Mei, Lam Tsuen River near Lam Kam Road, 29-X-1997, Xiaoli Tong, in SCAU. Paratypes (in



Figs. 1-11. Larva of *Baeñiella trispinata*, new species. 1. Left mandible. 2. Right mandible. 3. Maxilla. 4. Foreleg. 5. Tarsal claw. 6. Labium. 7. Metanotum. 8. Labrum. 9. Abdominal terga. 10. Hypopharynx. 11. Paraproct.



Figs. 12-14, 21-22. Adult of *Baetiella trispinata*, new species. 12. Forewing. 13. Legs. 14. Genitalia. 21. Head, lateral view. 22. Head, anterior view.

Figs. 15-20. Adult of *Baetiella pseudofrequenta* (Müller-Liebenau) 15. Hindwing. 16. Genitalia. 17. Legs. 18. Forewing. 19. Head, anterior view. 20. Head, lateral view.

alcohol), CHINA, Hong Kong: 1 female, 2 male adults and 7 larvae, locality and date as holotype, in SCAU; 1 larva, Ng Tung Chai, 25-II-1997, Xiaoli Tong, in AFDHK; 2 larvae, Shing Mun, 27-VIII-1997, Xiaoli Tong, in HKU; 2 larvae, Ma Po Mei, Lam Tsuen River near Lam Kam Road, 22-X-1997, Xiaoli Tong, in HKU; 9 larvae, Lantau Island, Pui O, near Water Station, 23-VI-1998, Xiaoli Tong, 5 in PERC, 4 in FAMU; 2 larvae, Tai Po Kau Forest Stream, 25-II-1999, Xiaoli Tong, in SCAU. CHINA, Guangdong Province: 6 larvae, Nankunshan Nature Reserve, near the Middle School, 16-IX-1994, Xiaoli Tong, in SCAU; 2 larvae, Nankunshan Nature Reserve, Stone River, 11-III-1995, Xiaoli Tong, in PERC; 3 larvae, Yangshan, Chengjia Nature Reserve, Lutian, 15-VII-1996, Xiaoli Tong, in SCAU.

Etymology. The epithet *trispinata* is from the Latin words: *tri-* meaning three and *spinatus* meaning having spines, thus referring to abdominal terga 1-3 of the larvae having 3 median dorsal tubercles.

Distribution. China: Hong Kong and Guangdong Province.

Remarks. The larva of *Baetiella trispinata* can be distinguished from all other species of *Baetiella* by the following combination of characters: (1) posterior margin of metanotum having a single long tubercle medially; (2) hindwing pads present; (3) legs lacking coxal gills; (4) abdominal terga 1-3 having a single median dorsal tubercle and terga 4-9 having a pair of dorsal tubercles posteriorly, decreasing in size towards abdominal end; (5) the gills present on abdominal segment 1-7; and (6) median terminal filament reduced to one segment.

ACKNOWLEDGMENTS

We thank W. P. McCafferty (Purdue University, West Lafayette, USA) for reviewing the manuscript, and two anonymous reviewers for their helpful comments.

LITERATURE CITED

- Braasch, D.** 1978. Baetidae (Ephemeroptera) in Mittelasien I. Entomol. Nachr. 22: 17-23.
- Gose, K.** 1980. The mayflies of Japan. Key to the families, genera, and species. Part 7. Kaiyuo to Seibutsu 2: 211-215.
- Kang, S.-C., H.-C. Chang, and C.-T. Yang.** 1994. A revision of the genus *Baetis* in Taiwan (Ephemeroptera, Baetidae). J. Taiwan Mus. 47: 9-44.
- Kazlauskas, R.** 1963. New and little known mayflies from the USSR. Entomol. Rev. 42:582-593.
- Kluge, N. Yu.** 1983. New and little known mayflies of the family Baetidae (Ephemeroptera) from the Primor'ye. Entomol. Rev. 62: 53-68.
- Lugo-Ortiz, C. R., W. P. McCafferty and R. D. Waltz.** 1999. Definition and reorganization of the genus *Pseudocloeon* (Ephemeroptera: Baetidae) with new species descriptions and combinations. Trans. Am. Entomol. Soc. 125: 1-37.
- Müller-Liebenau, I.** 1985. Baetidae from Taiwan with remarks on *Baetiella* Ueno, 1931 (Insecta, Ephemeroptera). Arch. Hydrobiol. 104: 93-110.
- Waltz, R. D. and W. P. McCafferty.** 1987. Systematics of *Pseudocloeon*, *Acentrella*, *Baetiella*, and *Liebebiella*, new genus (Ephemeroptera: Baetidae). J. New York Entomol. Soc. 95: 553-568.
- Waltz, R. D. and W. P. McCafferty.** 1997. New generic synonymies in Baetidae (Ephemeroptera). Entomol. News 108: 134-140.

When submitting papers, all authors are requested to (1) provide the names of two qualified individuals who have critically reviewed the manuscript *before* it is submitted and (2) suggest the names and addresses of two qualified authorities in the subject field to whom the manuscript may be referred by the editor for final review. All papers are submitted to recognized authorities for final review before acceptance.

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.

Illustrations: For maximum size and definition, full page figures, including legends, should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4 1/2 x 6 1/2 inches. Authors will be charged for all text figures and half-tones at the rate of \$20.00 each, regardless of size.

Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in The Entomologist's Library on books dealing with taxonomy, systematics, morphology, physiology ecology, behavior and similar aspects of insect life and related arthropods. Books on applied, economic and regulatory entomology, on toxicology and related subjects will not be considered.

Study notices, want items and for sale notices are published in The Entomologist's Market Place .

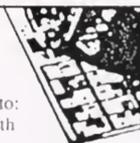
Page charges: For society members, a charge of \$20.00 is made for each published page of an article, plus costs of all illustrations. For non-society members, the page charge is \$25.00 per page. If any charges are not paid within 120 days of billing, authors will be charged an additional \$5.00 per page. Papers may be published ahead of their regularly scheduled time at a cost of \$35.00 per page.

Unemployed and retired amateur and scientist members of the American Entomological Society who are without institutional support or are not subsidized by grants and who are without funds for publishing may apply for financial assistance at the time their manuscript is submitted. Such application must include an explanation of the author's status (unemployed or retired). Page charges for these individuals are negotiable, with a minimum of \$10.00 per page.

Reprints: (without covers) may be ordered when corrected page proofs are returned to the editor. Schedule of reprint costs will appear on order form.

This publication is available
in microform from University
Microforms International.

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.



The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at \$1.00 per line, payable in advance to the editor. Notice of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

The following books are available from Kendall/Hunt Publishing:

An Introduction to the Aquatic Insects of North America edited by Richard W. Merritt and Kenneth W. Cummins (1995/880 pages/wire coil/\$69.95*/ISBN 0-7872-3241-6 or 1995/880 pages/otabind/\$78.69*/ ISBN 0-7872-3240-8). **Aquatic Insects**, with readings written by 41 experts, will quickly become your standard reference book. It includes features such as: comprehensive coverage of behavior, collecting, biomonitoring, and taxonomy; well-illustrated keys to major life stages of North American aquatic insects; and tables at the end of every identification chapter with summaries at the generic level of the ecology, habits, and distribution of the order or family of aquatic insects.

Immature Insects, Volumes I and II, edited by Frederick W. Stehr (**Volume I**: 1987/768 pages/casebound/\$136.44*/ISBN 0-84034639-5 and **Volume II**: 1991/992 pages/casebound/ 241.44*/ ISBN 0-8403-4639-5). **Immature Insects** provides information on the biology and ecology of the families and selected important species. The two volume set also gives you a means to identify insects ranging from the most common to the extremely rare through use of the abundant illustrations, descriptions, and/or keys to selected species. **Immature Insects** is the only reference that extensively covers updated information necessary to identify immature insects. These books also describe techniques necessary for the collecting, rearing, killing, preserving, storing, and studying of insects. Both books also include an introduction defining how terms are used in the book, a complete glossary, and an extensive index.

For more information or to place an order, call Jill Crow at 1-800-228-0564.

*All prices are subject to change.

FOR SALE: Quality insect pins, black enamelled, stainless steel. Best prices guaranteed. Call for free samples. Phone: 1(800) 484-7347 Ext. 1324. Fax: (352) 371-6918. E-mail: morpho@afn.org or write to **Morpho Ventures**, P.O.BOX 12454, Gainesville, Florida 32604.

FOR SALE: Baltic amber pieces with insects, spiders, plants. Material for scientific work, as well as better pieces for display and teaching. O. Holden, Junkerg. 37, S-126 53 Hegersten, Sweden, fax: 01146-8-7268522.

FOR SALE: Light traps, 12 volt DC or 110 volt AC with 15 watt or 20 watt black lights. Traps are portable and easy to use. Rain drains and beetle screens protect specimens from damage. For a free brochure and price list, contact Leroy C. Koehn, 207 Quail Trail, Greenwood, MS 38930-7315. Telephone 601-455-5498.

FOR SALE: Tropical butterflies and beetles, A1 quality with data, including ORNITHOPTERA WITH PERMITS. Also entomology pins. Ianni Butterfly Enterprises - P.O. Box 81171, Cleveland, OH 44181. (440) 888-2310. Fax: (440) 888-8129. Email: butrflly@cn.com

- Larva, pupa, and adults of *Glossosoma nigrion* (Trichoptera: Glossosomatidae), with a review of the eastern North American species of *Glossosoma* D. Wymer, J.C. Morse 149
- Description of male *Belostoma foveolatum* (Heteroptera: Belostomatidae) and new records of *B. costalimai* and *B. stollii* José Ricardo Inacio Ribeiro 159
- A new species of *Cotinus* (*Cotinus*) (Coleoptera: Melolonthidae) and a key for the identification of Mexican species C. Deloya, S. Ibañez-Bernai, C. Nogueira 171
- A new species of *Leptonema* of the *occidentale* group (Trichoptera: Hydropsychidae) from Madagascar Oliver S. Flint, Jr. 177
- A new Oriental *Blera* (Diptera: Syrphidae) F. Christian Thompson 181
- A new species of *Babycurus* (Scorpiones: Buthidae) from northern Oman Graeme Lowe 185
- First report of *Calleida* (*Calleida*) *purpurea* (Coleoptera: Carabidae) in Minnesota and a note on its occurrence on pasque flower Paul P. Tinerella 193
- First record of the genus *Psephenops* (Coleoptera: Psephenidae) from Mexico, with a description of a new species R. Arce-Pérez, R. Novelo-Gutiérrez 196
- Foraging distance of *Pogonomyrmex occidentalis* (Hymenoptera: Formicidae) on grazed and ungrazed shortgrass prairies in Colorado Shaharra J. Usnick 201
- An annotated list of Trichoptera along several streams in the Bankhead National Forest in northwest Alabama M. B. Hicks, C. G. Haynes 206
- An annotated list of Trichoptera in the Black Belt Prairie region of west central Alabama M. B. Hicks, C. G. Haynes 215
- Found: Holotype of the lace bug *Elasmognathus helferi* (Heteroptera: Tingidae) Richard C. Froeschner 223
- Re-establishing the validity of *Cicindela scutellaris* (Coleoptera: Cicindelidae) Howard P. Boyd 224
- New descriptions and distributional records for eastern North American caddisflies David E. Ruitter 227

ENTOMOLOGICAL NEWS is published bi-monthly except July-August by The American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pa. The October and March meetings are held at the Department of Entomology, University of Delaware, Newark, Delaware.

Society Members who reside outside the local eastern Pennsylvania, southern New Jersey, and Delaware area are urged to attend society meetings whenever they may be in the vicinity. Guests always are cordially invited and welcomed.

Officers for 1997-1998: President: Jon K. Gelhaus; Vice-President: Susan P. Whitney; Recording Secretary: Charles R. Bartlett; Corresponding Secretary: William J. Cromartie; Treasurer: Howard P. Boyd.

Publications and Editorial Committee: Howard P. Boyd, Chr., D. Otte, and Norman E. Woodley.

Previous editors: 1890-1920 Henry Skinner (1861-1926); 1921-1944 Philip P. Calvert (1871-1961); 1945-1967 R.G. Schmieder (1898-1967); 1968-1972 R.H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

Subscriptions: *Private subscriptions for personal use of members of the Society, domestic and foreign: \$10.00 per year postpaid. Subscriptions for non-members \$25.00. Subscriptions for institutions such as libraries, laboratories, etc., domestic: \$20.00 per year postpaid; foreign: \$22.00 per year post-paid. Communications and remittances regarding subscriptions should be addressed to ENTOMOLOGICAL NEWS, The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa. 19103-1195, U.S.A.*

Back issues of most numbers may be obtained by writing to the office of The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

Membership dues: \$15.00 per year (regular); \$10.00 per year (student).

Manuscripts and all communications concerning same should be addressed to the editor: Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A. Manuscripts will be considered from any authors, but papers from members of the American Entomological Society are given priority. It is suggested that all prospective authors join the society. All manuscripts should follow the format recommended in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, Sixth Edition, and should follow the style used in recent issues of ENTOMOLOGICAL NEWS. Three double-spaced, typed copies of each manuscript are needed on 8¹/₂ x 11 paper. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible. Articles longer than eight printed pages may be published in two or more installments, unless the author is willing to pay the entire costs of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Editorial Policy: Manuscripts on taxonomy, systematics, morphology, physiology, ecology, behavior and similar aspects of insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Papers on applied, economic and regulatory entomology and on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields.

(Continued on inside of back cover)

Postmaster: *If undeliverable, please send form 3579 to Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A.*

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088, U.S.A.

LARVA, PUPA, AND ADULTS OF *GLOSSOSOMA NIGRIOR* (TRICHOPTERA: GLOSSOSOMATIDAE) WITH A REVIEW OF THE EASTERN NORTH AMERICAN SPECIES OF *GLOSSOSOMA*¹

Douglas A. Wymer², John C. Morse^{3,4}

ABSTRACT: The three eastern North American species of the genus *Glossosoma* are reviewed with a new description for the male, female, pupa, and larva of *Glossosoma nigrior*. New characters are presented to distinguish the larva of *G. nigrior* from that of *G. intermedium*, and illustrated keys are provided to distinguish males, females, and larvae of these two species and *G. lividum*.

The genus *Glossosoma* Curtis, 1834, is represented in eastern North America by three species, *G. intermedium* (Klapálek, 1892), *G. lividum* (Hagen, 1861), and *G. nigrior* Banks, 1911, all of which are in the subgenus *Eomystra* Martynov, 1934. These three species are widespread in eastern North America (Fig. 1). *Glossosoma intermedium* is restricted to more-northern locations (Fig. 1A). *Glossosoma lividum* has been reported only from Vermont, Massachusetts, New York, and Tennessee (Fig. 1B). A record of *G. lividum* from either North Carolina or South Carolina by Unzicker et al (1982) is unconfirmed. *Glossosoma nigrior* is distributed over both of these ranges as well as more-southern locations (Fig. 1C). Figure 1 was compiled from information published by Leonard and Leonard (1949), Ellis (1962), Hilsenhoff et al (1972), Longridge and Hilsenhoff (1973), Resh (1975), Etnier and Schuster (1979), Wimmer (1979), Masteller and Flint (1980), Anderson (1981), Parker and Voshell (1981), Penrose et al (1982), Hury and Foote (1983), Vinikour et al (1983), Harris et al (1984), Lake (1984), Steven and Hilsenhoff (1984), Glazier and Gooch (1987), Garono and MacLean (1988), Floyd and Schuster (1990), Harris and Lago (1990), and Tarter (1990). Despite their widespread occurrence there is no reliable key for separating the larvae or the adults of these species.

Kimmins (1943) produced descriptions and illustrations of the larva and case of *G. intermedium* (as *Mystophora intermedia*). Additional descriptions of the *G. intermedium* larva were provided by Ross (1944), Hickin (1967), Mackereth (1956), and Lepneva (1964, as *M. intermedia*). The adults of *G. intermedium* were redescribed by Ross (1944, 1956), Unzicker (1968), Nimmo (1974), and Schmid (1982).

¹ Received 5 May 1998, Accepted 2 August, 1998.

² Department of Biology, Tennessee Technological University, Cookeville, TN 38505.

³ Department of Entomology, 113 Long Hall, Box 340365, Clemson University, Clemson, SC 29634-0365.

⁴ Author to whom request for reprints should be sent.



Figure 1



Fig. 1, Collection locations for *Glossosoma* species in eastern North America: A, *G. intermedium*; B, *G. lividum*; C, *G. nigrior*.

Glossosoma americanum Banks, 1897, was synonymized with *G. lividum* by Ross (1965). Betten (1934) and Schmid (1980, 1982, 1998) redescribed and illustrated the male. Descriptions and illustrations of the larva and case of *G. lividum* were given by Lloyd (1921) and of its pupa by Sibley (1926) as *G. americanum* and *M. americanum*, respectively.

Eomystra unica Denning, 1942, was synonymized with *G. nigrior* by Ross (1944). Descriptions of the larva and pupa of *G. nigrior* were provided by Neubauer and Robertson (1985) along with a key for larvae which we have found to be unreliable.

Specimens examined for this study were borrowed from A.P. Nimmo, University of Alberta, Edmonton (APN); The Royal Ontario Museum, Toronto (ROM), The Frost Museum, Pennsylvania State University (FM); the Illinois Natural History Survey, Urbana (INHS), the University of Minnesota Insect Collection (UMN), and the Clemson University Arthropod Collection, Clemson, South Carolina (CUAC).

Glossosoma nigrior Banks

Glossosoma nigrior Banks, 1911 ("1910"), p. 355, pl. 13 fig. 23; lectotype male (Type 11745) and lectoallotype female at the Harvard Museum of Comparative Zoology, Cambridge, Massachusetts (Ross, 1938); type locality — "Black Mountain, North Carolina, north fork of the Swannanoa River, May."

Eomystra unica Denning, 1942, pp. 46-48, pl. 6 figs. 1-1B (synonymy by Ross, 1944, p. 292).

Male: Length from front of head to tip of folded wings 7.4-7.6 mm (n=9). Forewings 5.9-6.1 mm (n=9, Fig. 2A). Hindwings 3.9-4.1 mm (n=9, Fig. 2B). Specimens in alcohol with dorsum of head and thorax light to medium brown. Thoracic venter and appendages light brown to yellow. Abdomen light brown to yellow with slightly darker genitalia. Forewings and hindwings uniformly dark brown. Maxillary and labial palps much longer than head is wide. Antennae extending to apex of abdomen. Inner apical tibial spur on each hind tibia flattened and sharply hooked (Fig. 2C). Abdominal segment IX with tergum light brown, broad dorsally, tapering ventrally to short, transverse sternal band (Fig. 2F). Inferior appendages broad basally, divided apically into two long branches. Dorsal branch slender, setose, slightly sinuous; ventral branch bare in distal half with acute tip curved slightly dorsad and mesad (Fig. 2F).

Female: Length from front of head to tips of folded wings 8.5-8.7 mm (n=10). Forewings 7.7-7.0 mm (n=10). Hindwings 4.2-4.4 mm (n=10). Coloration and general structure resembling that of male. Tibia and basitarsus of each mesothoracic leg much broader than in males, and concave posteriorly. Tibial spurs unmodified. Abdominal segment VIII lobed posterolaterally (Fig. 3B), deeply and broadly incised ventrally and dorsally (Figs. 3C and 3D, respectively). Segment IX evidenced only by pair of internal apodemes articulating externally with anterolateral corners of tergum X (Schmid, 1982), long membranous region anterior of tergum X and segment XI (Fig. 3A); cerci 1-segmented, dark brown distally, spermathecal sclerite elongate, oval (Fig. 3E).

Pupa: Length 5-6 mm (n = 14). Pupal cocoon reddish-brown, cigar-shaped. Pupal and larval case dome-shaped dorsally (Fig. 4E). Larval case modified for pupation by removal of transverse ventral strap, with dome-shaped dorsal portion firmly attached to rock substrate. Head medium brown with dark brown mandibles. Light yellow stripe connecting antennal bases. Mandibles each serrate on inner surface, one prominent median tooth with inconspicuous tooth at its base (Fig. 2D). Antennae curving around head posterior to eyes and extending along ventrolateral margins of body to abdominal segment VII or VIII. Tibial spurs 2-4-4, mid-tibial

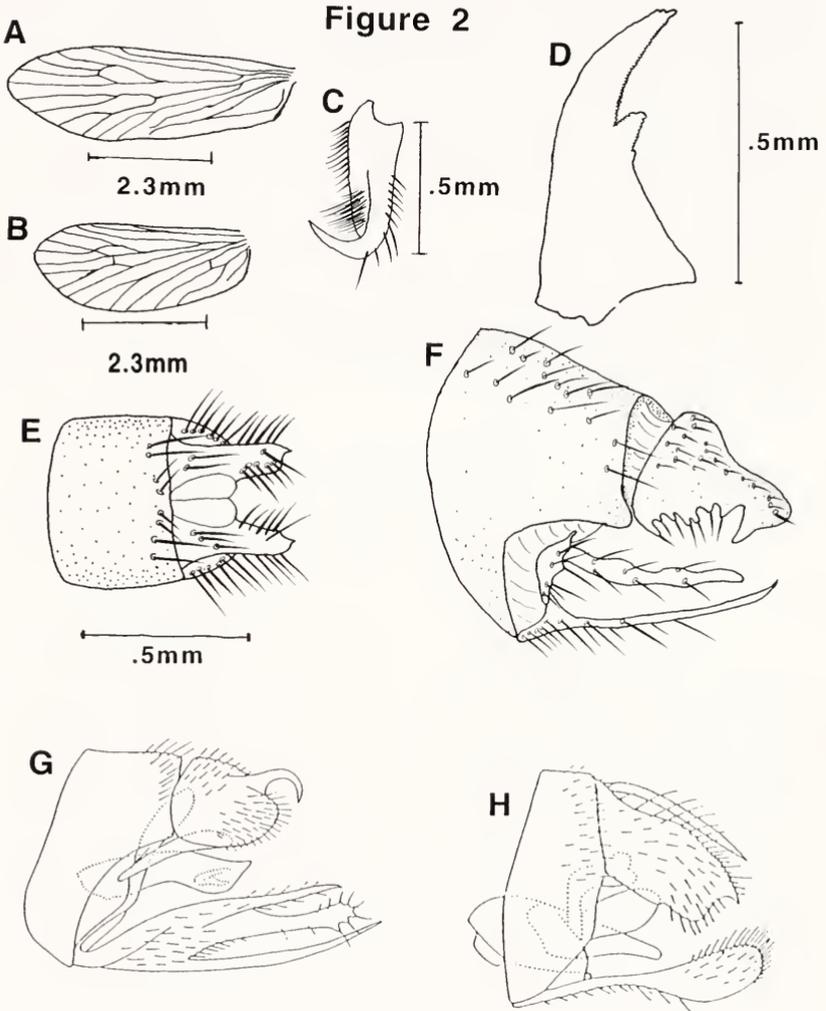


Fig. 2, Characters of *Glossosoma* species males and pupa: A-F, *G. nigrior*; G, *G. lividum*; H, *G. intermedium*. A, right forewing, dorsal view; B, right hindwing, dorsal view; C, right inner apical spur, lateral view; D, left pupal mandible, dorsal view; E, genitalia, dorsal view; F, genitalia, left lateral view; G, genitalia, left lateral view (From Schmid, 1982); H, genitalia, left lateral view (From Schmid, 1982).

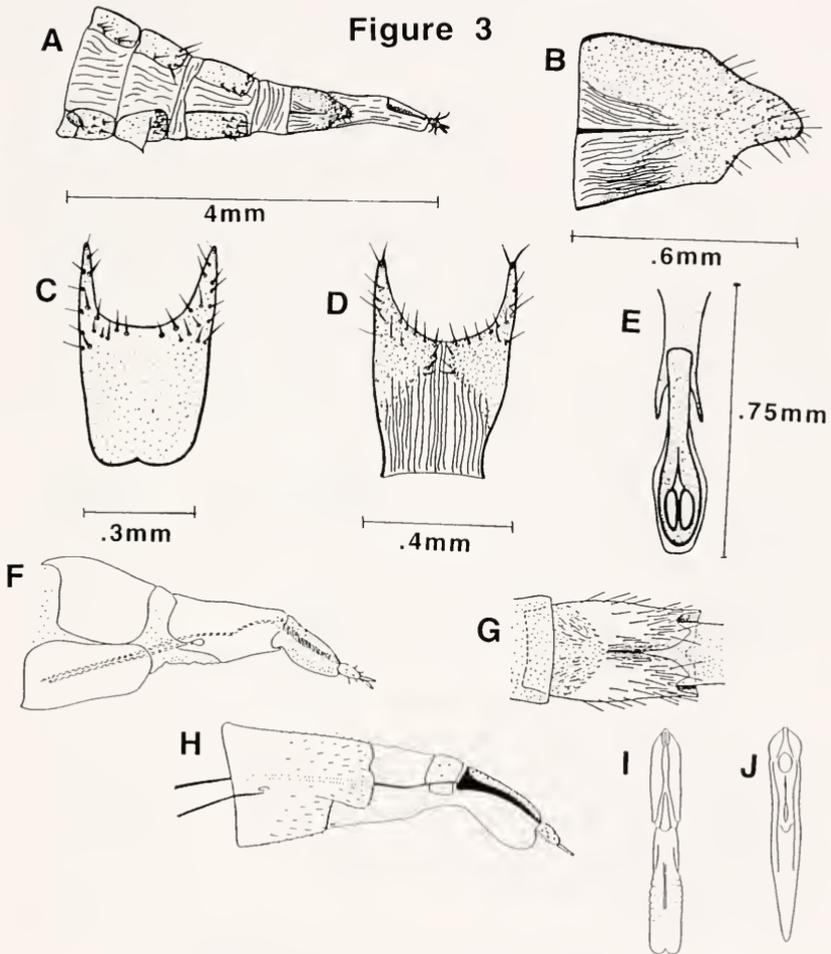


Fig. 3. Characters of *Glossosoma* species females: A-E, *G. nigrior*; F-G, J, *G. intermedium*; H-I, *G. lividum*. A, abdominal segments V-XI, left lateral view; B, abdominal segment VIII, dorsal view; C, abdominal segment VIII, dorsal view; D, abdominal segment VIII, ventral view; E, spermathecal sclerite, ventral view; F, abdominal segments VII-X, left lateral view (From Ross, 1944); G, abdominal segment VIII, ventral view (From Ross, 1944); H, abdominal segments VIII-X, left lateral view (From Schmid, 1982); I, spermathecal sclerite, ventral view (From Schmid, 1982); J, spermathecal sclerite, ventral view (From Schmid, 1982).

and hind-tibial spurs about one-quarter length of tibia, fore-tibial spur much shorter. Male pupa with inner apical spur of each hind tibia flattened and sharply hooked (Fig. 2C). Abdomen dorsally medium brown mottled with light tan ventrally. Anterior dorsal hook plates on segments III-IX and posterior dorsal hook plates on terga IV and V. Very lightly sclerotized terminal segment with two tufts of setae, each with three setae about as long as terminal segment.

Larva: Length 4-5 mm (n=20). Body cylindrical and somewhat C-shaped. Case made of small stones, top dome-shaped, ovoid; floor open ventrally near either end with flat mid-ventral strap transversely connecting long sides of oval (Fig. 4E). Head moderately dark brown with light brown mottling. Epicranial suture and frontal sutures light in color and highly visible. Light yellow patch around eye extending posteroventrad. Leading edge of frontoclypeus slightly to strongly notched (Fig. 4A). Pronotum heavily sclerotized with small black spot on each anterolateral margin just above forecoxa and with black mark on each posterolateral margin (Fig. 4C). Meso- and metanota entirely membranous. Thoracic legs medium brown with black margins. Small dark sclerite in intersegmental fold posterior of each meso- and metathoracic epimeron (Fig. 4H). Tarsal claws each with basal seta on short pedicel, seta extending nearly to tip of claw (Fig. 4F). Abdomen membranous and light-colored except for dark brown, sclerotized tergite IX and anal prolegs. Tergite IX with five pairs of setae posteriorly (Fig. 4G). Anal opening with long, dark, sclerotized, vertical bar on each side. Anal prolegs each with four long setae distally (Fig. 4G). Anal proleg claws each with accessory hook dorsally and small ventral process directed basad (Fig. 4D).

Key To Larvae Of Eastern *Glossosoma* spp.

- 1 Pronotum with small black spot above forecoxa (Fig. 4C) 2
- 1' Pronotum without small black spot above forecoxa
(Lloyd 1921, fig. 193) *G. lividum*
- 2 Intersegmental fold between thorax and abdomen posterior
of each metathoracic epimeron with small sclerite (Fig. 4H) *G. nigrior*
- 2' Intersegmental fold between thorax and abdomen posterior
of each metathoracic epimeron without small sclerite *G. intermedium*

Key To Adult Males Of Eastern *Glossosoma* spp.

- 1 Inferior appendages each single, clavate (Fig. 2H) *G. intermedium*
- 1' Inferior appendages each with two or more branches 2
- 2 Inferior appendages each with two branches; preanal
appendages each with irregular incision in posteroventral margin
and without dorsal hook (Fig. 2F) *G. nigrior*
- 2' Inferior appendages each with three branches; preanal
appendages not incised posteroventrally, but each with
hook dorsally (Fig. 2G) *G. lividum*

Key To Adult Females Of Eastern *Glossosoma* spp.

- 1 Abdominal segment VIII broadly and deeply incised
posterodorsally and posteroventrally, lobed posterolaterally
(Figs. 3C, 3D); spermathecal sclerite clavate (Fig. 3E) *G. nigrior*
- 1' Abdominal segment VIII not incised dorsally and with quadrate
or acute incision posteroventrally; spermathecal sclerite not
clavate (Figs. 3I, 3J) 2
- 2 Abdominal segment VIII with broad, nearly quadrate incision
posteroventrally (Fig. 3H); spermathecal sclerite rectangular (Fig. 3I) *G. lividum*
- 2' Abdominal segment VIII with deep narrow cleft posteroventrally
(Fig. 3G); spermathecal sclerite tapered (Fig. 3J) *G. intermedium*

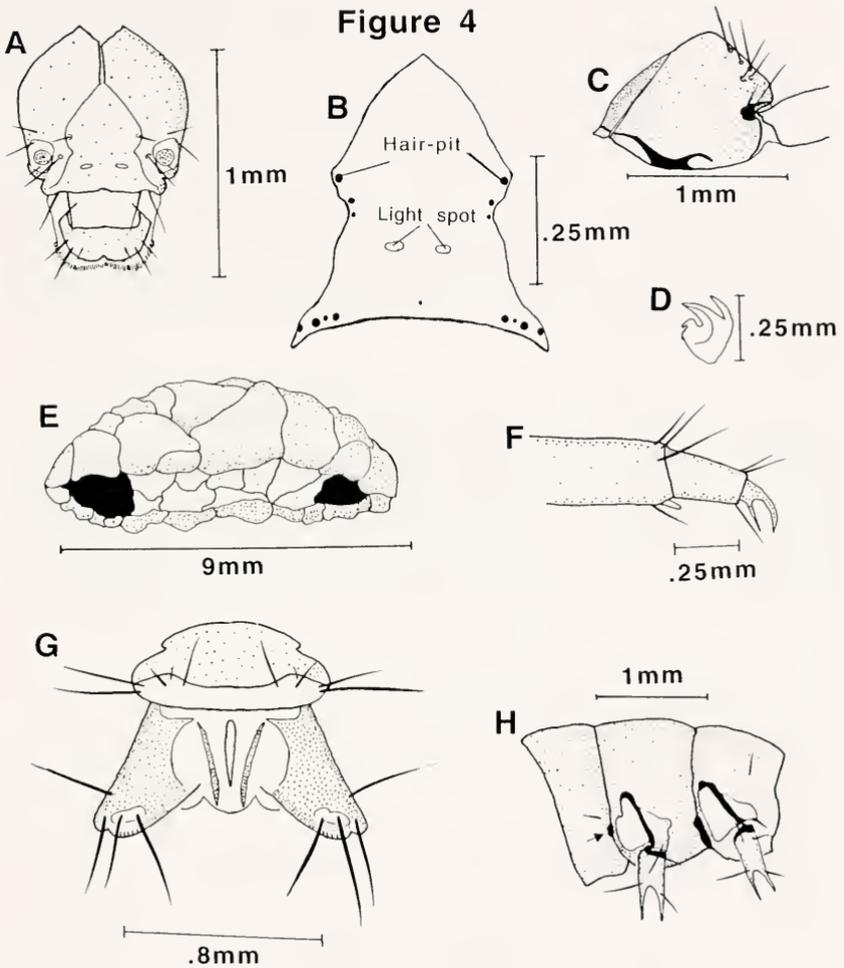


Fig. 4. Characters of *G. nigrior* larva; A, head capsule, dorsal view; B, frontoclypeus showing hair-pit arrangement and light spots, dorsal view; C, pronotum, right posterodorsolateral view; D, right anal proleg claw, lateral view; E, larval case, ventrolateral view; F, tarsus and claw of right foreleg, right lateral view; G, abdominal segments IX and X and anal prolegs, caudal view; H, meso- and metathorax and abdominal segment I, right lateral view.

MATERIAL EXAMINED

Glossosoma nigrrior: South Carolina, Pickens County — Clemson Experimental Forest, Wildcat Creek, 34.75° N, 82.83° W: 5M, 3F, 10P, 14L (CUAC); unnamed tributary to Seneca River, 2.4 km east of Old Central Road, 2L (CUAC). North Carolina, Haywood County — Creek at Big Creek Road, 35.67° N, 83.00° W: 4M, 8F, 6P (CUAC); Macon County — Shope Creek nr. Coweeta Hydrologic Lab: 1L, 4P (ROM). Kentucky, Lyon County — Cannon Spring, 3L (CUAC). Ontario, Algoma District — Chippewa River at Rt. 17E, Batchawana Provincial Park, 3P, 3L (ROM).

Glossosoma lividum: Ontario, Thunder Bay — Tributary of Coldwater Creek, nr. Dorion: 1P, 2L (ROM); Sturgeon River at Rt. 11, 17.6 km NE of Jellicoe: 8P (ROM).

Glossosoma intermedium: Pennsylvania, Centre County — Upper Spruce Creek: 4P, 6L (FM); Steel Hollow Run, 4.8 km NW of Julian: 3L (FM). Maryland, Garrett County — River beside road, ca. 2.4 km E of Friendsville: 6P, 9L (FM). Minnesota, Hennepin County — Bass Pond: 7P (UMN). Ontario, Algoma District — Small stream at Rt. 17, 25.4 km SE of Batchawana Provincial Park: 1P, 8L (ROM). Alberta — Creek 24 km south of Hanging Stone River at Hwy. 63: 8M, 10F (APN).

ACKNOWLEDGMENTS

We would like to thank our colleagues at Clemson University for their input during the development of this project. We would also like to thank the Entomological Society of Canada and the National Research Council of Canada for use of their illustrations of *Glossosoma intermedium* and *Glossosoma lividum* adults. Special thanks go to Aysa Prather who prepared the illustrations for the female of *Glossosoma nigrrior*. We are grateful to the following people and institutions for the loan of specimens: A.P. Nimmo; The Royal Ontario Museum; The Frost Museum; and the Illinois Natural History Survey. This is Technical Contribution No. 4382 of the South Carolina Agricultural and Forestry Research System, Clemson University.

LITERATURE CITED

- Banks, N.** 1897. New North American neuropteroid insects. *Trans. Am. Entomol. Soc.* 24: 21-31.
- Banks, N.** 1911. New species of North American neuropteroid insects. *Trans. Am. Entomol. Soc.* 34(4): 336-360.
- Betten, C.** 1934. The caddisflies or Trichoptera of New York State. *Bull. NY State Mus.* 292: 576 pp.
- Curtis, J.** 1834. Descriptions of some (hitherto) nondescript British species of may-flies of anglers. *Philos. Mag. J. Sci.*, third series 4(21): 120-125, 212-218.
- Denning, D.G.** 1942. Descriptions of new Trichoptera from the United States. *Can. Entomol.* 74: 46-51.
- Ellis, R.J.** 1962. Adult caddisflies (Trichoptera) from Houghton Creek, Ogemaw County, Michigan. *Occas. Pap. Mus. Zool. Univ. Mich.* No. 624. 16 pp.
- Etnier, D.A., and G.A. Schuster.** 1979. An annotated list of Trichoptera (Caddisflies) of Tennessee. *J. TN Acad. Sci.* 54(1):15-22.
- Floyd, M.A., and G.A. Schuster.** 1990. The caddisflies (Insecta Trichoptera) of the Buck Creek System, Pulaski County, Kentucky. *Trans. KY Acad. Sci.* 51(3-4): 127-134.
- Garono, R.J., and D.B. MacLean.** 1988. Caddisflies (Trichoptera) of Ohio wetlands as indicated by light-trapping. *Ohio J. Sci.* 88(4): 143-151.
- Glazier, D.S., and J.L. Gooch.** 1987. Macroinvertebrate assemblages in Pennsylvania (U.S.A.) springs. *Hydrobiologia* 150: 33-43.
- Hagen, H.** 1861. Synopsis of the Neuroptera of North America with a list of the South American species. *Smithson. Misc. Coll. Washington, D.C.* 347 pp.

- Harris, S.C., and P.K. Lago. 1990. Annotated checklist of the Rhyacophiloidea and Intregripalpia (Trichoptera) of Alabama. *Entomol. News* 101(1): 57-66.
- Harris S.C., P.K. Lago, and P.E. O'Neil. 1984. Trichoptera of the Cahaba River system in Alabama. *Entomol. News* 95(3): 103-112.
- Hickin, N. 1967. Larvae of British Trichoptera. Fairleigh Dickinson University Press, Rutherford, United Kingdom. 480 pp.
- Hilsenhoff, W.L., J.L. Longridge, R.P. Narf, K.J. Tennessen, and C.P. Walton. 1972. Aquatic insects of the Pine-Popple River, Wisconsin. *Tech. Bull. Dep. Nat. Res., Madison, Wisconsin*, 54. 44 pp.
- Huryn, A.D., and B.J. Foote. 1983. An annotated list of the caddisflies (Trichoptera) of Ohio. *Proc. Entomol. Soc. of Wash.* 85(4): 783-796.
- Kimmins, D.E. 1943. A note on the caddisfly, *Mystrophora intermedia* Klapálek (Trichoptera). *Proc. R. Entomol. Soc. Lon. Ser. A Gen. Entomol.* 18: 96-98.
- Klapálek, F. 1892. Trichopterologický Výzkum Cech vr. 1891. *Rozpravy České Akad. Císare Frantiska Josefa prov vedy, Slovenost a Umení v Praxe* 1, 2(23): 443-462.
- Lake, R.W. 1984. Distribution of caddisflies (Trichoptera) in Delaware. *Entomol. News* 95(5): 215-224.
- Leonard, J.W., and F.A. Leonard. 1949. An annotated list of Michigan Trichoptera. *Occas. Pap. Mus. Zool. Univ. Mich.* 522: 1-35.
- Lepneva, S.G. 1964. Fauna of the USSR, Trichoptera, Larvae of Annulipalpia. Zoological institute of the Academy of Sciences of the USSR, new series 88. 2(1). 638 pp. [Translated from Russian by Israel program for scientific translations, 1970].
- Lloyd, J.T. 1921. The biology of North American caddis fly larvae. In: J.U. and C.G. Lloyd (eds.), *Bull. Lloyd Libr. Bot. Pharm. Mater. Med. Entomol. Ser.* 21(1): 173-183.
- Longridge, J.L., and W.L. Hilsenhoff. 1973. Annotated list of Trichoptera (caddisflies) in Wisconsin. *Wis. Acad. Sci. Arts Lett.* 61: 173-183.
- Mackereth, J.C. 1965. Taxonomy of the larvae of the British species of the sub-family Glossosomatinae (Trichoptera). *Proc. Entomol. Soc. Lond.* 31: 167-172.
- Martynov, A.V. 1934. Tableaux analytiques de la Faune de l'USSR, 13: caddisflies, Trichoptera, Annulipalpia, 1. Institut zoologique de l'Académie des Sciences, pp. 1-321. Trichoptera Annulipalpia of the USSR, with descriptions of new or little known species and genera. Institut zoologiques de l'Académie des Sciences, pp. 322-343 [English translation of selected descriptions in the preceding work].
- Masteller, E.C., and O.S. Flint, Jr. 1980. Caddisfly (Trichoptera) emergence patterns from two streams of the Allegheny National Forest area of Pennsylvania. *Melsheimer Entomol. Ser.* 29: 12-22.
- Neubauer, C., and E. Robertson. 1985. A description of the larva and pupa of *Glossosoma nigrior* Banks (Trichoptera Glossosomatidae). *J. Entomol. Sci.* 20(3): 300-304.
- Nimmo, A.P. 1974. The adult Trichoptera (Insecta) of Alberta and eastern British Columbia, and their post-glacial origins II. The families of Glossosomatidae and Philopotamidae. *Questiones Entomologicae* 10: 315-349.
- Parker, C.R., and J.R. Voshell, Jr. 1981. A preliminary checklist of the caddisflies (Trichoptera) of Virginia. *J. GA Entomol. Soc.* 16(1): 1-7.
- Penrose, D.L., D.R. Lenat, and K.W. Eagleson. 1982. Aquatic macroinvertebrates of the Upper French Broad River Basin. *Brimleyana* 8: 27-50.
- Resh, V.H. 1975. A distributional study of the caddisflies of Kentucky. *Trans. KY Acad. Sci.* 36(1-2): 6-16.
- Ross, H.H. 1938. Lectotypes of North American caddis flies in the Museum of Comparative Zoology. *Psyche* 45(1): 1-61.
- Ross, H.H. 1944. The caddisflies, or Trichoptera, of Illinois. *Bull. Ill. Nat. His. Surv.* 23: 1-326.
- Ross, H.H. 1956. Evolution and classification of the mountain caddisflies. *Univ. Ill. Press, Urbana.* 231 pp.

- Schmid, F.** 1980. Les Insectes et Arachnides du Canada, Partie 7: Genera des Trichoptères du Canada et des États adjacents, Agriculture Canada, Publication 1692. 296pp.
- Schmid, F.** 1982. Révision des Trichoptères Canadiens. II. Les Glossosomatidae et Philopotamidae (Annulipalpia). *Mém. Soc. Entomol. Can.* 122: 1-76.
- Schmid, F.** 1998. The Insects and Arachnids of Canada, Part 7: Genera of the Trichoptera of Canada and Adjoining or Adjacent United States. NRC Research Press, Ottawa, Ontario, Canada. 319 pp.
- Sibley, C.K.** 1926. A preliminary biological survey of the Lloyd-Cornell Reservation: Studies on Trichoptera. *Bull. Lloyd Libr. Bot. Pharm. Mat. Med. Entomol. Ser.* 27(5): 185-221, 236-247.
- Steven, J.C., and W.L. Hilsenhoff.** 1984. The caddisflies (Trichoptera) of Otter Creek, Wisconsin. *Wis. Acad. Sci. Arts Lett.* 72: 157-172.
- Tarter, D.C.** 1990. A checklist of the caddisflies (Trichoptera) from West Virginia. *Entomol. News* 101(4): 236-245.
- Unzicker, J.D.** 1968. The comparative morphology and evolution of the internal female reproductive system of Trichoptera. Illinois Biological Monographs, Univ. Ill. Press, Urbana. 72 pp.
- Unzicker, J.D., V.H. Resh, and J.C. Morse.** 1982. Trichoptera. Chapter 9. Pages 9.1-9.127 in A.R. Brigham, W.U. Brigham, and A. Gnilka (editors), Aquatic insects and oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois. iv-837 pp.
- Vinikour, W.S., and R.V. Anderson.** 1981. Diptera larvae (Empididae and Chironomidae) in Trichoptera pupal cases (Glossosomatidae and Limnephilidae). *Entomol. News* 92(2): 69-74.
- Waltz, R.D., and W.P. McCafferty.** 1983. The caddisflies of Indiana (Insecta: Trichoptera). *Res. Bull. Agric. Exp. Stn., Purdue Univ.* 978 pp.
- Wimmer, H.P.** 1979. An anatomical and phylogenetic study of Trichoptera, including a partial check-list of Vermont species. Ph.D. dissertation, Univ. VT. 300 pp.

**DESCRIPTION OF THE MALE OF *BELOSTOMA*
FOVEOLATUM AND NEW RECORDS OF
B. COSTALIMAI AND *B. STOLLII*
(HETEROPTERA: BELOSTOMATIDAE)¹**

José Ricardo Inacio Ribeiro²

ABSTRACT: The male of *Belostoma foveolatum* is described for the first time. This species can be distinguished from other species of the *B. dentatum* group by the length of the first rostral segment and features of the male genitalia, especially the dorsal arms of phallus. The relatively short anteoculus confirms a close similarity between *B. foveolatum* and *B. porteri*. *B. foveolatum* is newly recorded from the Brazilian states of Ceará and Mato Grosso do Sul, *B. costalimai* from the Brazilian states of Roraima and Pará, and *B. stollii* from the Brazilian states of Pará and Rio de Janeiro and the Bolivian Department of Santa Cruz.

The subfamily Belostomatinae can be distinguished from other subfamilies of Belostomatidae mainly by the sternites not being subdivided by a suture (Mahner 1993), and the peculiar egg-laying habit of females (Lauck and Menke 1961). According to Nieser (1975) and Lanzer-de-Souza (1980), *Belostoma* Latreille, 1807 has 70 described species, being most richly represented in tropical South America. Forty-two species are currently reported from Brazil (Lanzer-de-Souza 1980, 1992, 1996, Ribeiro 1999). *Belostoma* can be distinguished from other genera of Belostomatinae by the large membrane of hemelytra, the phallobase bifurcate dorsally, and dorsal arms of phallus extending nearly to apex of ventral diverticulum (De Carlo 1968, Nieser 1975).

Lauck (1962) started using the male genital structures for distinguishing species within *Belostoma*. In his study he proposed 16 groups of species based on features of the male genitalia. The species of the *Belostoma dentatum* group (*sensu* Lauck 1962) are large, varying in length from 38 to 52 mm, and present a distinct, very large ventroapical protuberance in the ventral diverticulum of the male genitalia (Lauck 1962, Estévez 1996). Nieser (1975) included in this group some species treated by Lauck (1962) in the *B. subspinosum* group. The *B. dentatum* group as defined by Nieser (1975) can be recognized by the length of the scutellum, reaching the nodal line, and by the ventral diverticulum of the genitalia, which presents ventral and dorsal protuberances apically. The following very closely related species are currently known in the group: *B. dentatum* (Mayr, 1863), *B. malkini* Lauck, 1962, *B. foveolatum* (Mayr, 1863), *B. harrisi* Lauck, 1962, and *B. porteri* De Carlo, 1942. This group is

¹ Received August 2, 1999. Accepted October 20, 1999.

² Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Caixa Postal 68044, 21944-970, Rio de Janeiro, RJ, Brasil. E-mail: belostom@acd.ufrj.br

widely distributed in South America, being also found in Panama.

B. foveolatum was described from a single female specimen of unknown origin. De Carlo (1938), Lauck (1962), Schnack (1973) and Nieser (1975) redescribed this species based only on females. Although some authors referred to males of *B. foveolatum* in their studies, up to the present there is no description of the male for this species. During a revisional study of *Belostoma* from southeastern Brazil it was possible to describe male specimens of *B. foveolatum* and some genitalia variations which I have observed, as well as new South American records for this species, *B. costalimai* De Carlo, 1938, and *B. stollii* (Amyot and Serville, 1843).

MATERIAL AND METHODS

The description and new records are based on specimens deposited in the following institutions: American Museum of Natural History, New York (AMNH), Departamento de Parasitologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Belo Horizonte (DPIC), Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (UFRJ), Museo Argentino de Ciencias Naturales, Buenos Aires (MACN), Museu de Zoologia da Universidade de São Paulo, São Paulo (MZSP), Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (MNRJ), Naturhistorisches Museum Wien, Vienna (NHMW), and Snow Entomological Museum, University of Kansas, Lawrence (SEMC). In quotations of label data, a comma separates different information and a point separates information on different specimens. Collectors and insect collection institutions are cited in parentheses.

Morphological terminology for head, thorax, abdomen, and male genitalia follows Dupuis (1955), Lauck and Menke (1961), Lauck (1962), Estévez (1996), and Ribeiro (1999). Techniques for removing the male genital structures follow those of Lauck (1962) and Estévez (1996). The dissected parts are stored in microvials with glycerin. Structures and methods of measurement are given in figures 1 - 6.

Belostoma foveolatum (Mayr)

(Figs. 7 - 10)

Zaitia foveolata Mayr, 1863: 355.

Zaitia foveolata: Berg, 1879: 192.

Belostoma foveolata: Kirkaldy and Torre-Bueno, 1909: 191.

Description of male. — Total length (from apex of head to apex of hemelytra at rest) 40.25 - 44.90 mm; largest width of body 15.00 - 19.50 mm; length of anteoculus 2.24 - 3.36 mm; length of anterior frontogenal suture (= anteclypeus - maxillary plate suture) 1.12 - 1.84 mm; length of posterior frontogenal suture (= anteclypeus - loral suture) 1.12 - 1.60 mm; length of interoculus 1.96 - 3.04 mm; posterior interocular width 2.52 - 3.68 mm; length of

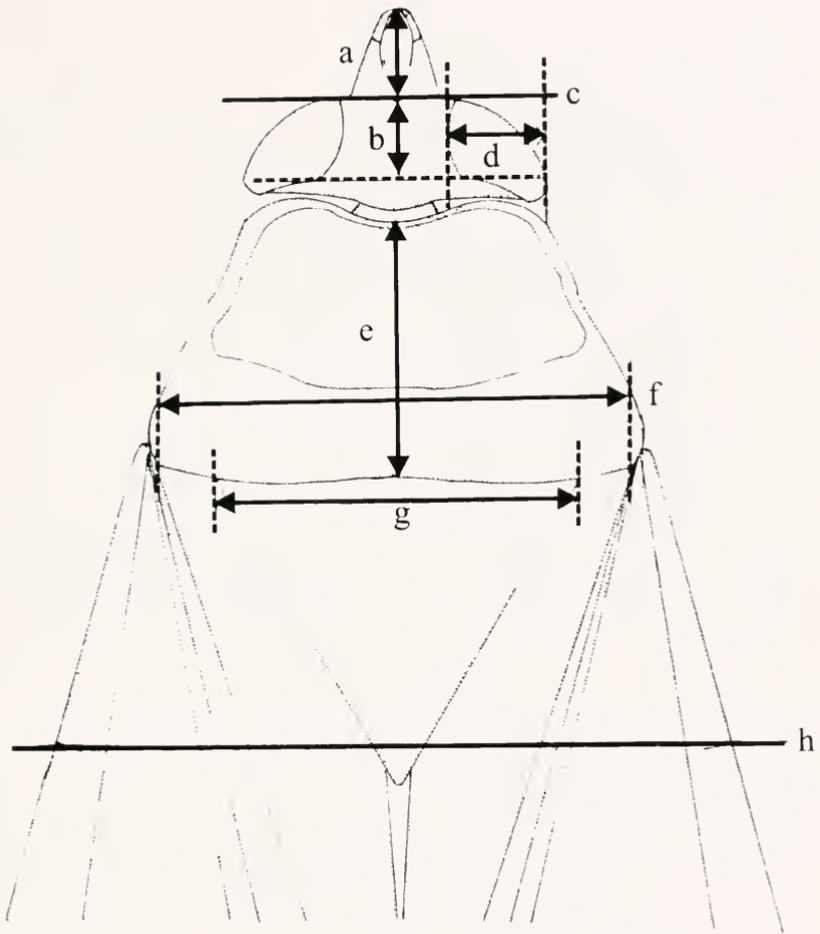
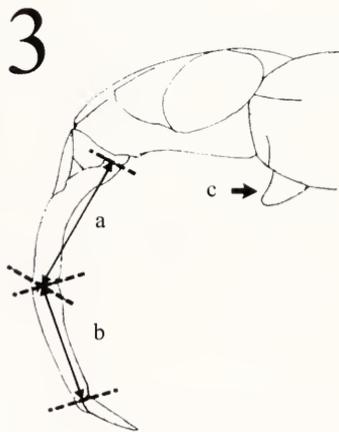
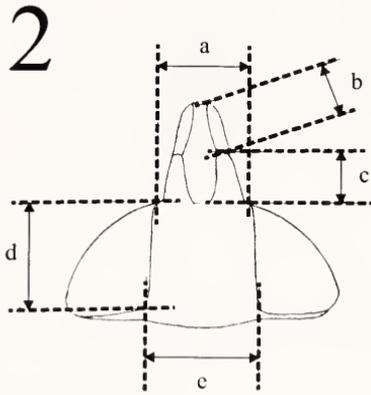
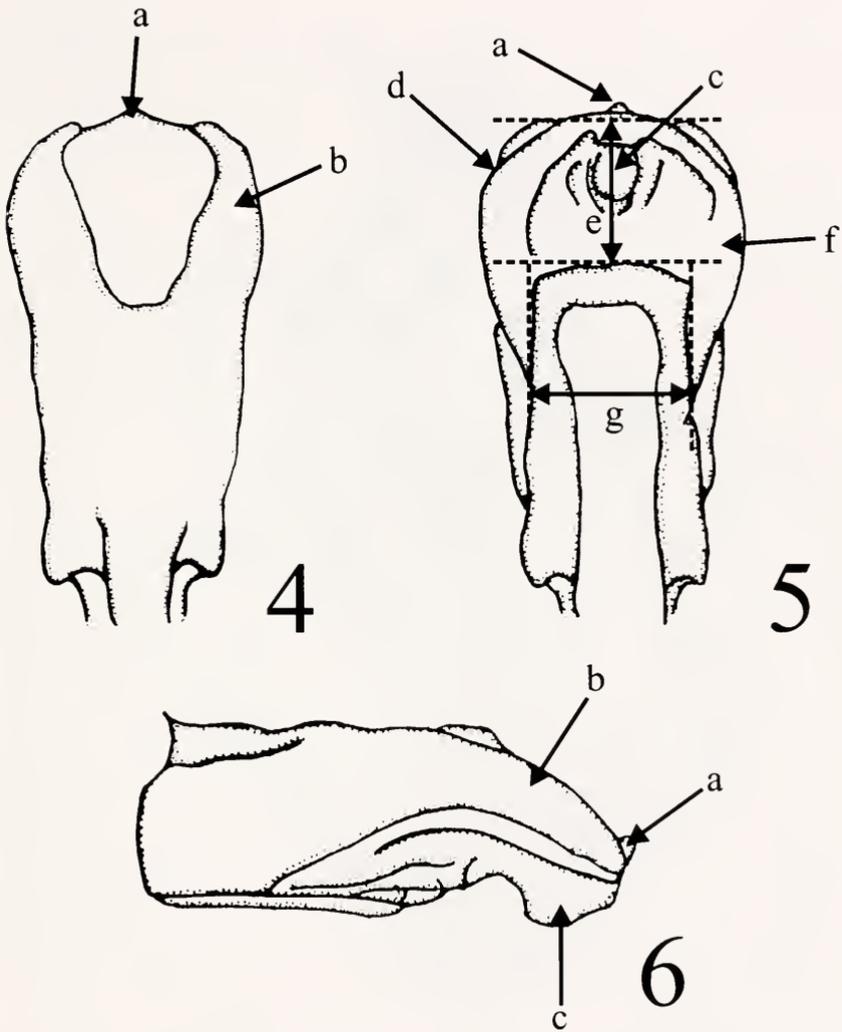


Fig. 1. External morphology of *Belostoma* Latreille, 1807 showing the major morphological features referred to in the taxonomic description. Dorsal aspect of head, pronotum and part of abdomen of *Belostoma*. a) length of anteoculus; b) length of interoculus; c) ocular line; d) width of an eye; e) length of pronotum; f) largest width of pronotum; g) width of scutellum; h) nodal line.



Figs. 2 and 3. External morphology of *Belostoma* Latreille, 1807 showing the major morphological features referred to in the taxonomic description. Fig. 2. Dorsal aspect of head of *Belostoma*. a) anterior interocular width; b) length of anterior frontogenal suture (= anteclypeus - maxilar plate suture); c) length of posterior frontogenal suture (= anteclypeus - loral suture); d); length of an eye; e) posterior interocular width. Fig. 3. Lateral aspect of head of *Belostoma*. a) length of segment I of rostrum; b) length of segment II of rostrum; c) prosternal keel.



Figs. 4 - 6. External morphology of *Belostoma* Latreille, 1807 showing the major morphological features referred to in the taxonomic description. Aspect of the phallus of *Belostoma* sp. Fig. 4. Dorsal view. Fig. 5. Ventral view. Fig. 6. Lateral view. a) dorsal apical protuberance; b) dorsal arms; c) ventroapical protuberance; d) caudal lateral margin of ventral diverticulum; e) length of ventral diverticulum; f) ventral diverticulum; g) width of ventral diverticulum.

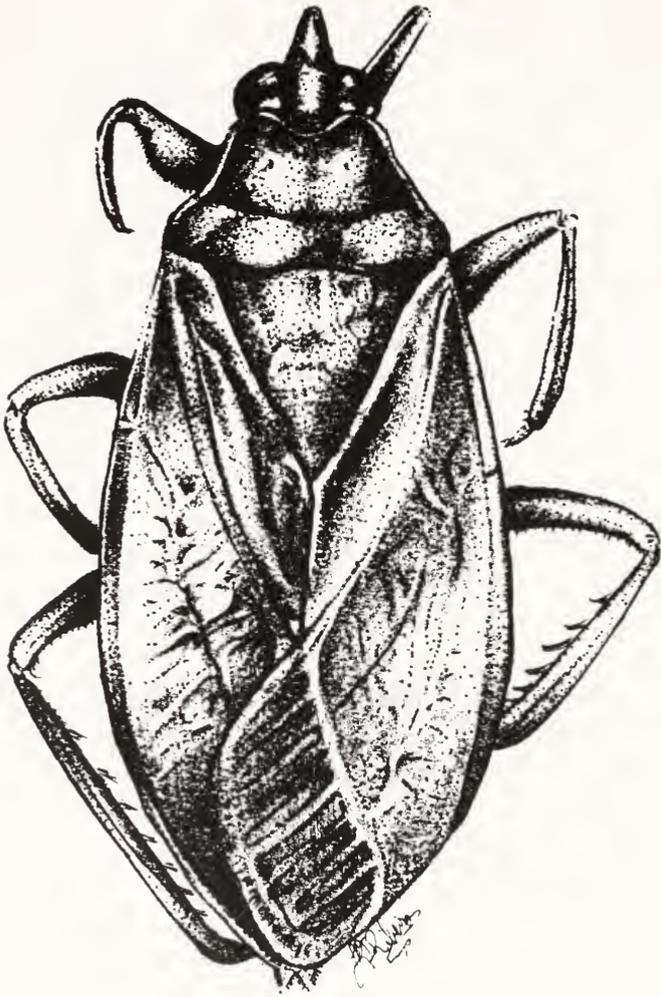


Fig. 7. Dorsal aspect of the male of *Belostoma foveolatum* (Mayr, 1863). Scale: 20.00 mm.

segment I of rostrum 3.04 - 4.80 mm; length of segment II of rostrum 2.38 - 4.24 mm; length of pronotum 6.16 - 8.08 mm; largest width of pronotum 11.06 - 14.48 mm.

General coloration nearly uniformly brown, occasionally suffused with yellowish brown. Pronotum with two yellowish longitudinal stripes, each parallel to lateral borders, pair of dark brown triangular marks adjacent to inner margins of longitudinal stripes. Abdominal venter yellowish brown. Legs with patches varying from darkish brown to reddish brown.

Body elongate and ellipsoid. Length of anteoeculus 0.94 - 1.14 times the length of interoculus. Clypeus reaching or nearly reaching the ocular line (0 - 0.24 mm). Anterior frontogenal suture equal to or longer than posterior frontogenal suture (1.00 - 1.25 times). Length of segment I of rostrum 1.13 - 1.29 times the length of segment II. Interoculus wider than long. Posterior interocular width 1.06 - 1.35 times the width of an eye, distinctly wider than the length of anteoeculus (1.05 - 1.24 times). Vertex without a longitudinal median carina. Eyes rounded, internal margins with a sulcus that does not extend to vertex. Pronotum and scutellum without a distinct median carina. Largest pronotum width 1.73 - 1.89 times its length. Scutellum reaching nodal line. Prosternal keel somewhat rounded (Fig. 8). Pilosity extending only slightly beyond eighth abdominal sternum, covering from about one to two-thirds of margin of connexivum.

Male genitalia (Fig. 9). — Dorsal arms are slightly broader at middle, not narrowing gradually toward apex in dorsal view. Phallus moderately symmetrical in dorsal view. Ventral diverticulum with a dorsal caudal protuberance in lateral view. Ventral diverticulum with a very large, distinct ventroapical protuberance in lateral and ventral views. Caudal lateral margins of ventral diverticulum are sinuses instead of convex in ventral view. Length of ventral diverticulum 1.0 time width in ventral view.

Variations (Fig. 10). — I have seen two specimens from the state of São Paulo, Brazil which have the total length and genitalia relatively bigger than other specimens examined, but which still possess distinct protuberances. However, dorsal arms are slightly broad at base, narrowing gradually toward apex in dorsal view. Caudal lateral margins of ventral diverticulum are not sinuses but convex.

Material examined. — One female [holotype] (NHMW): [without locality], [without date], [without collector], A. L. Montandon det. 1909, G. Mayr det. 1863. BRAZIL. State of Pará — One female (INPA 0020872): Curuauna [near Santarém], X-XI.1980, (R. C. Best), J. R. I. Ribeiro det. 1999. One female (SEMC): Lago Grande, II.1939, (A. M. Olalla), D. R. Lauck det. 1959. One male and two females (AMNH): Jacareacanga, VI.1970, (M. Alvarenga), J. R. I. Ribeiro det. 1999. State of Ceará — One female (AMNH): [without date], (Manin), J. R. I. Ribeiro det. 1999. One female (UFRJ 24): Pacatuba, Caracanga [Sítio Cajazeiras], 11.V.1986, (P. M. B. Carvalho), J. R. I. Ribeiro det. 1999. State of Mato Grosso do Sul — One male and two females (DPIC 567): Corumbá, 17.XI.1992, (Fabiana & T. P. S. Sereno), J. R. I. Ribeiro det. 1999. State of Minas Gerais — One male (DPIC 461): Belo Horizonte [reared in laboratory], [without date], (A. L. Melo), A. L. Melo det. One male (DPIC 1331): Calceolândia, II.1990, (A. L. Melo), A. L. Melo det. One male (DPIC 209): Lagoa Santa, [without date], (A. L. Melo), A. L. Melo det. One male (DPIC 409): Lagoa Santa, [without date], (A. L. Melo), A. L. Melo det. One male (DPIC 1618): Lagoa Santa [Lagoa Olhos d'Água], XII.1990, (M. H. Pereira), J. R. I. Ribeiro det. 1999. One male (DPIC 1620): Lagoa Santa [Lagoa Olhos d'Água], [without date], (M. H. Pereira), J. R. I. Ribeiro det. 1999. One male (DPIC 1606): Lagoa Santa [Lagoa Olhos d'Água], XII.1990, (M. H. Pereira), J. R. I. Ribeiro det. 1999. One male (DPIC 1607): Lagoa Santa [Lagoa Olhos d'Água], 22.IX.1988, (M. H. Pereira), J. R. I. Ribeiro det. 1999. One female (DPIC 210): Lagoa Santa [reared in laboratory], [without date], (A. L. Melo), A. L. Melo det. One male (DPIC 1249): Januária, 23.XI.1997, (A. L. Melo), J. R. I. Ribeiro det. 1999. State of São Paulo — One female (MZSP 70.032): rio Tietê, VIII.1996, (Bicego), J. A. De Carlo det. One male and one female (MZSP): Ribeirão Preto [Fac. Medicina], XI.1954, (Barretto) [coleção M. P. Barretto, 1969], J. R. I. Ribeiro det. 1999. One male (SEMC): [with

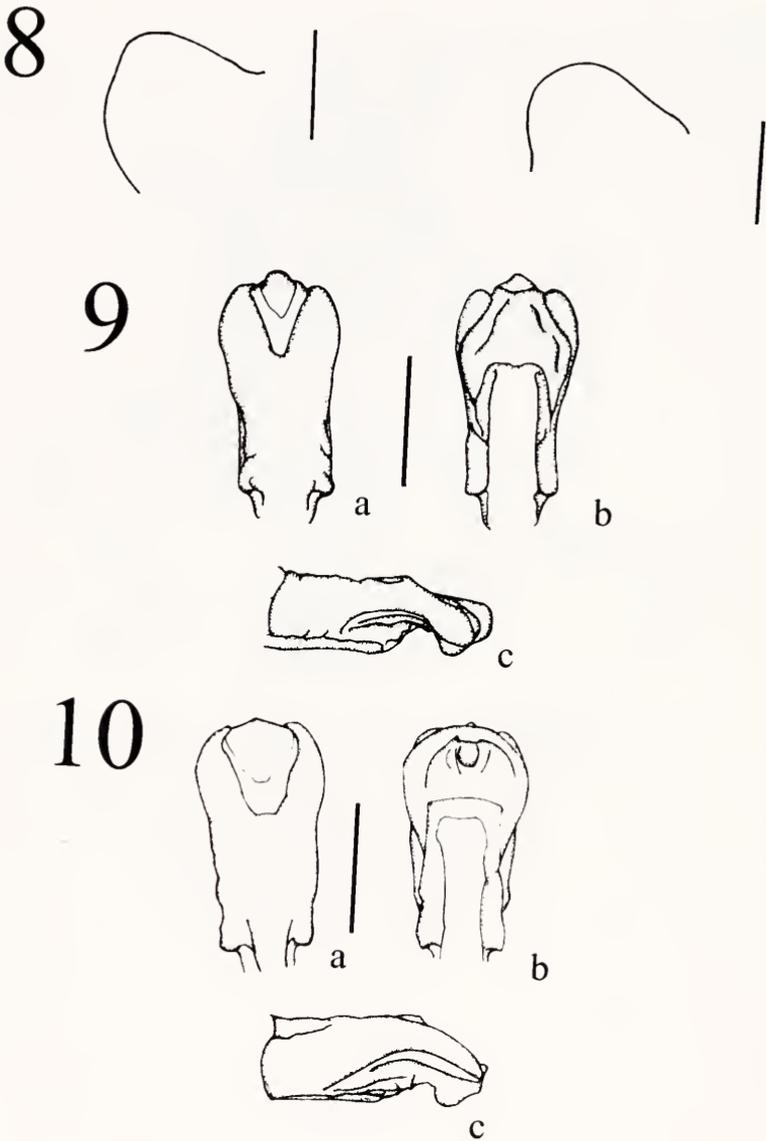


Fig. 8. Prosternal keel of *Belostoma foveolatum* (Mayr, 1863) (lateral view). Specimens from state of São Paulo, Brazil. Figs. 9 - 10. Phallus of *Belostoma foveolatum* (Mayr, 1863). Fig. 9. Specimen of Minas Gerais, Brazil. Fig. 10. Specimen from São Paulo, Brazil. a) dorsal view; b) ventral view; c) lateral view. Scales: 1.00 mm.

out date], (E. D. Tacwmsend), J. R. I. Ribeiro det. 1999. One female (SEMC 326): [without date], [without collector], A. L. Montandon det. 1914, D. R. Lauck det. 1959. Two males (MNRJ 85): São José dos Campos; XII.1934, (H. S. Lopes), J. A. De Carlo det. One female (MACN 39316): [without date], [illegible collector], J. A. De Carlo det. One male (MACN 39316): VIII.1960, [illegible collector], J. A. De Carlo det. One female (MACN 39316): I.1907, [illegible collector], J. A. De Carlo det.

Known distribution (Fig. 11). —The known distribution of the species now includes French Guyana (Cayenne) and Brazil (states of Pará — N., Ceará - Pacatuba [03° 58' S, 38° 37' W - new record] — NE., Mato Grosso do Sul - Corumbá [19° 01' S, 57° 39' W - new record] — central W., Minas Gerais, Rio de Janeiro, and São Paulo — SE.). Borneo (Lanzer-de-Souza 1980: 56) is clearly a erroneous record.

Notes. — The relatively short antecolus confirms a close relationship between *B. foveolatum* and *B. porteri*, as suggested by Nieser (1975). *B. foveolatum* can be distinguished from *B. elongatum* Montandon, 1908 by the relation of the length: width of the diverticulum in ventral view, which is about 1.3 times in *B. elongatum*. Finally *B. foveolatum* can be distinguished from the remaining species of the *B. dentatum* group (*sensu* Nieser 1975) by the length of segment I of the rostrum (including variations) and features of the male genitalia. In *B. foveolatum* the length of rostral segment I never exceeds 1.3 times the length of segment II, while segment I in the remaining species is at least 1.3 times longer than segment II. Moreover, the dorsal arms of the phallus in *B. foveolatum* are slightly broader at the middle, a characteristic that is not present in the other members of the *B. dentatum* group even though the dorsal arms of variants gradually narrow toward the apex in dorsal view.

New records of *Belostoma costalimai* De Carlo from Brazil

Belostoma costalimai De Carlo, 1938: 234.

B. costalimai has been reported from the Brazilian states of Goiás, Mato Grosso, Minas Gerais, Rio de Janeiro, and São Paulo (De Carlo 1938, Lauck 1964, Menke and Lauck 1962, Nieser and Melo 1997). Herein I report the following new records of *B. costalimai* in N. Brazil: state of Roraima, Boa Vista [2° 49' S, 60° 40' W] — one male (AMNH), 18.IX.1966, (M. Alvarenga), J. R. I. Ribeiro det., and state of Pará, Jacareacanga [6° 16' S, 57° 39' W] — one male and two females (AMNH), VI.1970, (M. Alvarenga), J. R. I. Ribeiro det. 1999 (Fig. 11).

New records of *Belostoma stollii* (Amyot and Serville, 1843) from South America

Zaitha stollii Amyot and Serville, 1843: 430 [type for *Zaitha*].

Belostoma stollii: Montandon, 1903: 240.

Belostoma stollii: Kirkaldy and Torre-Bueno, 1909: 192.

Belostoma stollii: Nieser and Melo, 1997: 61.

B. stollii has been reported from Guyana, Surinam, French Guyana, Venezuela, and the Brazilian states of Amazonas, Mato Grosso, and Minas Gerais (Amyot and Serville 1843, Kirkaldy and Torre-Bueno 1909, Lauck 1963, Nieser 1975, Lanzer-de-Souza 1980, Nieser and



Fig. 11. Geographic distribution map for *Belostoma foveolatum* (Mayr, 1863), *B. costalimai* De Carlo, 1938 and *B. stollii* (Amyot and Serville, 1843) in South America. (● = *B. foveolatum*; ■ = *B. costalimai*; ★ = *B. stollii*). (Map radically compressed to show "true proportion" per Peter's projection.)

Melo 1997). Records from Guatemala, Chile, and southern Brazil were considered erroneous and based on misidentifications (Lauck 1963). Herein I report the following new records of *B. stollii* in South America: BRAZIL State of Pará, Cachimbo [8° 57' S, 54° 54' W] — one female (MNRJ 107), VI.1955, (J. A. Araújo), J. A. De Carlo det. [as *B. brasiliensis*], J. R. I. Ribeiro det. 1999. State of Rio de Janeiro, Magé, Citrolândia [22° 35' S, 43° 00' W] — one male (UFRJ 465), [without date], (H. W. Tavares), J. R. I. Ribeiro det. 1999. One male [with eggs on dorsum] (UFRJ 466), 14.II.1988, [without collector], J. R. I. Ribeiro det. 1999, and BOLÍVIA. Dpto. Santa Cruz, Nueva Moka (untraced) — one female (MACN 53946), III.1955, (A. Martínez), J. A. De Carlo det. [as *B. brasiliensis*], J. R. I. Ribeiro det. 1999 (Fig. 11).

ACKNOWLEDGMENTS

The manuscript benefited from the useful comments of G. Mejdalani, A. L. Carvalho and A. L. Melo. Fellowships from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ), and Fundação Universitária José Bonifácio (FUJB) are gratefully acknowledged.

LITERATURE CITED

- Amyot, C. J. B. & J. G. A. Serville 1843. Histoire naturelle des insectes Hémiptères. Librairie Encyclopédique de Roret, Paris.
- Berg, C. 1879. Hemiptera Argentina enumeravit speciesque novas. Pauli E. Coni, Bonariae.
- De Carlo, J. A. 1938. Los Belostómidos Americanos. An. Mus. argent. Cienc. nat. 39(155): 189-260 + 7 pls.
- De Carlo, J. A. 1968. Aparato genital de macho y hembra de *Belostoma* sp. (Hemiptera-Belostatidae). Revta Soc. ent. argent. 30(1-4): 45-49.
- Dupuis, C. 1955. Les génitalia des Hémiptères Hétéroptères. Mém. Mus. natn. Hist. nat. (sér. A) 6(4): 183-278.
- Estévez, A. L. 1996. Revision sistemática del género *Belostoma* Latreille (Hemiptera – Heteroptera). Grupos de *Belostoma* (*Belostoma* *triangulum*, *B. (B.) minor*, *B. (B.) oxyurum*, *B. (B.) plebejum* y *B. (B.) denticolle*. D. Sc. thesis, unpublished, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata.
- Kirkaldy, G. W. & J. R. de la Torre-Bueno 1909. A catalogue of American aquatic and semi-aquatic Hemiptera. Proc. ent. Soc. Wash. 10: 190-191.
- Lanzer-de-Souza, M. E. 1980. Inventário da distribuição geográfica da família Belostatidae Leach, 1815 (Hemiptera-Heteroptera) na região Neotropical. Iheringia 55: 43-86.
- Lanzer-de-Souza, M. E. 1992. Nova espécie do género *Belostoma* Latreille, 1807. Iheringia 72: 147-150.
- Lanzer-de-Souza, M. E. 1996. Nova espécie brasileira do género *Belostoma* (Heteroptera, Belostatidae). Iheringia 81: 3-6.
- Lauck, D. R. 1962. A monograph of the genus *Belostoma* (Hemiptera) Part I. Introduction to *B. dentatum* and *subspinosum* groups. Bull. Chicago Acad. Sci. 11(3): 34-81.
- Lauck, D. R. 1963. A monograph of the genus *Belostoma* (Hemiptera), Part. II. *B. aurivillianum*, *stolli*, *testaceopallidum*, *dilatatum*, and *discretum* groups. Bull. Chicago Acad. Sci. 11(4): 82-101.
- Lauck, D. R. 1964. A monograph of the genus *Belostoma* (Hemiptera) Part. III. *B. triangulum*, *bergi*, *minor*, *bifoveolatum* and *flumineum* groups. Bull. Chicago Acad. Sci. 11(5): 102-154.
- Lauck, D. R. & A. S. Menke 1961. The higher classification of the Belostatidae (Hemiptera). Ann. ent. Soc. Amer. 54(5): 644-657.

- Mahner, M.** 1993. Systema Cryptoceratorum Phylogenicum (Insecta, Heteroptera). Zoologica 48(143): 1-302.
- Mayr, G.** 1863. Hemipterogische Studien. Die Belostomiden. Verh. zool.- bot. Ges. Wien 13: 339-364.
- Menke, A. S. & D. R. Lauck** 1962. The Machris Brazilian Expedition - Entomology: Belostomatidae (Hemiptera). Contr. Sci. 55: 3-8.
- Montandon, A. L.** 1903. Hémiptères aquatiques, notes synonymiques et géographiques, descriptions d'espèces nouvelles. Bul. Soc. rom. Sci. Sti. 12: 97-121.
- Nieser, N.** 1975. The water bugs (Heteroptera: Nepomorpha) of the Guyana Region. Uitg. natuurw. Studkring Suriname 16(81): 1-308.
- Nieser, N. & A. L. Melo** 1997. Os heterópteros aquáticos de Minas Gerais. Guia introdutório com chave de identificação para as espécies de Nepomorpha e Gerromorpha. Ed. UFMG, Belo Horizonte.
- Ribeiro, J. R. I.** 1999. Revisão das espécies de *Belostoma* Latreille, 1807 (Insecta: Heteroptera: Belostomatidae) ocorrentes no sudeste do Brasil. M. Sc. thesis, unpublished, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro.
- Schnack, J. A.** 1973. Clave para determinación de especies argentinas del género *Belostoma* Latreille (Hemiptera: Belostomatidae). Revta Mus. La Plata (secc. zoología) 12(3): 1-10.

A NEW SPECIES OF *COTINIS* (*COTINIS*) (COLEOPTERA: MELOLONTHIDAE) AND A KEY FOR THE IDENTIFICATION OF MEXICAN SPECIES¹

Cuauhtémoc Deloya², Sergio Ibáñez-Bernal², Guillermo Nogueira³

ABSTRACT: *Cotinis* (*Cotinis*) *sinitoc*, new species, from northwestern Mexico, is described and illustrated. Some comments about its relation with *C. pokornyi*, as well as an identification key for the 16 species of the subgenus *Cotinis* known to date in Mexico are presented.

The subgenus *Cotinis* is the most speciously diverse group in the genus *Cotinis* Burmeister with 21 species, of which 15 occur in Mexico (Goodrich, 1966; Deloya & Ratcliffe, 1988; Deloya, 1995; Delgado, 1988). Of the 15 species, *C. pueblensis* Bates, *C. pauperula* Burmeister, *C. pokornyi* Deloya, *C. rufipennis* Bates, *C. laticornis* Bates, *C. sphyracera* Deloya & Ratcliffe, *C. antonii* Duges, *C. orientalis* Deloya & Ratcliffe, *C. subviolacea* Gory & Percheron, and *C. beraudi* Delgado, and the new species, are endemic of Mexico.

Cotinis sinitoc Deloya, Ibáñez-Bernal & Nogueira, NEW SPECIES

(Fig. 1-6)

Holotype. Male. Length from apex of pronotum to apex of elytra: 16.4 mm; humeral width: 9.6 mm. Dorsum velvety, venter shiny. Dorsal coloration: head bright green, pronotum ashy-brown with some green reflections, elytra ashy-brown, each with two longitudinal green vittae.

Head (Fig. 1, 2). Frontal projection fused, occupying 72% of length from vertex to clypeus, tapered apically; surface with subrugate punctures and long, thin, yellowish setae. Clypeus with trapezoidal laminar projection, anterior margin bisinuate in dorsal view and straight-angulate from disc level in lateral view.

Thorax: Pronotum with a shallow median longitudinal impression; punctures of median size, distinctly separate and irregularly spaced; with coarse punctures moderately separated and with short yellowish setae at each side of pronotum; anterior and lateral surfaces shiny, basal part of disc opaque; lateral margins shiny and strongly marked; base without marginal line; mesoepimera with ventral region substrigulose, with long and thin setae, dorsal region smooth and punctate. Elytra with two slightly marked longitudinal costae converging at apical callus; with very small punctures well separated and with short setae; large, coarse C-shaped punctures irregularly disposed over apical third between elytral suture and inner costae; lateral margins shiny. Ventral region: Mesosternal projection with semi-rounded apex, parallel to body plane (Fig. 3). Metasternum with longitudinal line and small punctures at each side; central surface with punctures of moderate size, with yellow setae, punctures distinctly separate, lateral region substrigose, with large yellowish setae. Protibia tridentate, basal tooth short (Fig. 4). Abdominal sternites with long setae laterally.

Pigidium: Surface strigose with moderately separated short, yellow setae on disc; apex margined with short yellowish setae.

¹ Received October 27, 1999. Accepted November 18, 1999.

² Instituto de Ecología, A.C., Departamento de Entomología. Apartado Postal 63, 91000 Xalapa, Veracruz, México. E-mail: entomol@ecologia.edu.mx

³ Present address: Av. Central 14-A, Ciudad Granja, Guadalajara, Jalisco 45010, México.

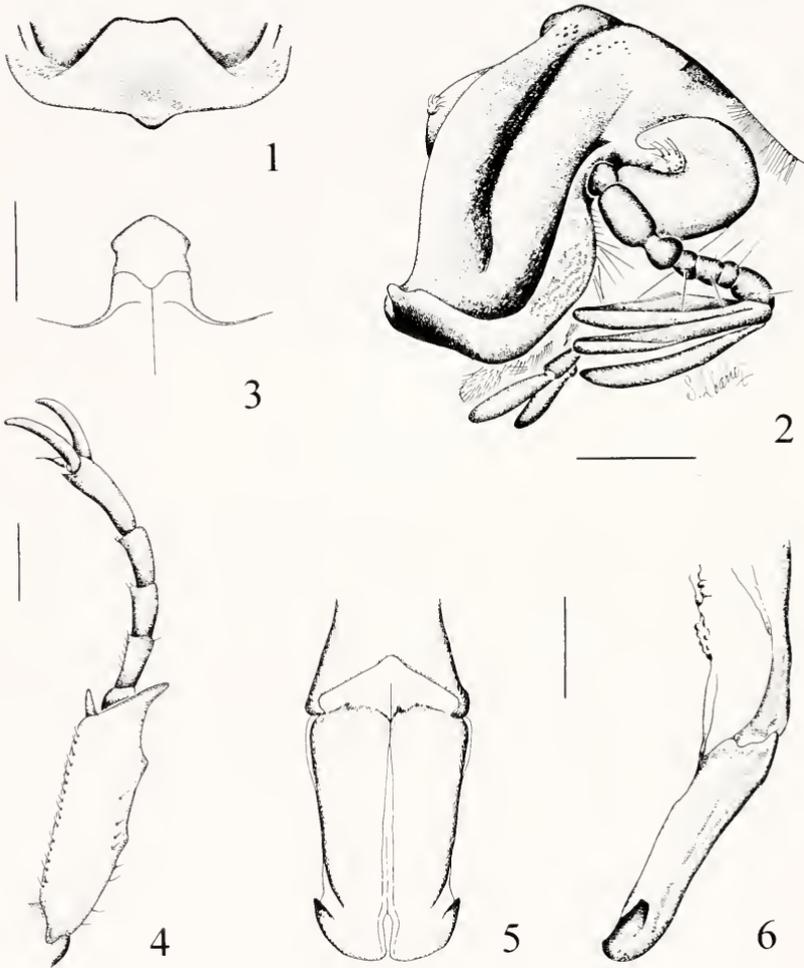


Fig. 1-6. *Cotinis sinitoc* new species (Holotype ♂). 1) Clypeus, frontal view; 2) Head, fronto-lateral view; 3) Mesosternum; 4) Protibia and tarsi, dorsal view; 5) Genitalia, dorsal view; 6) Genitalia, lateral view. Scale = 1 mm.

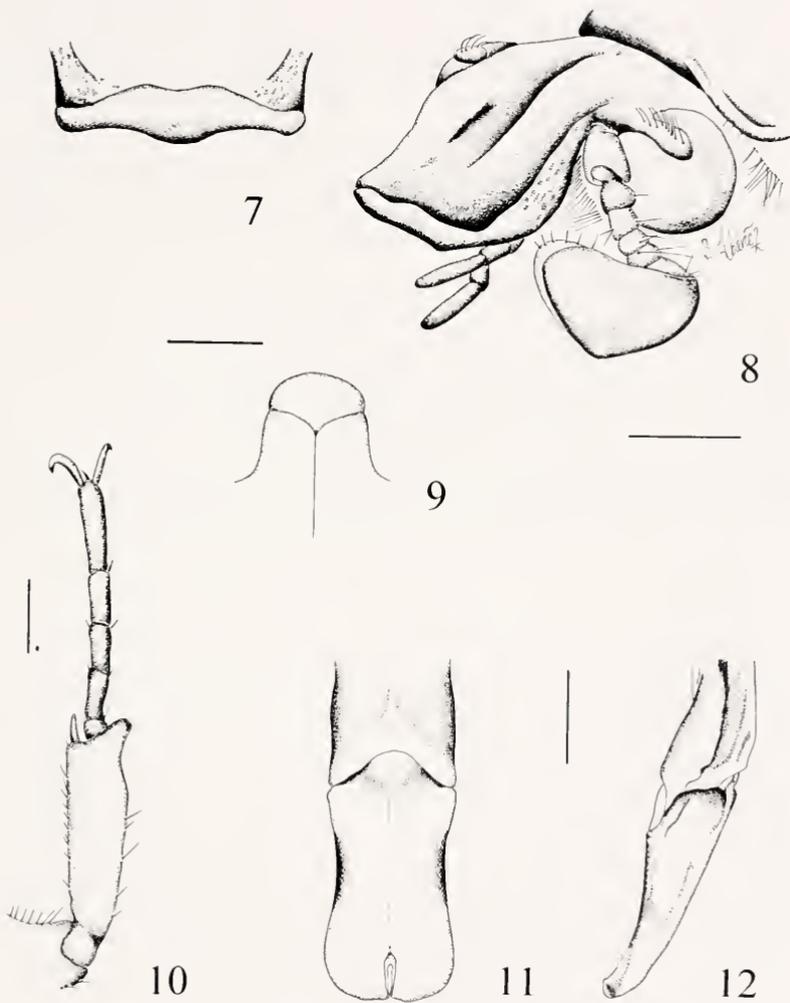


Fig. 7-12. *Cotinis pokornyi* Deloya (Paratype ♂). 7) Clypeus, frontal view; 8) Head, fronto-lateral view; 9) Mesosternum; 10) Protibia and tarsi, dorsal view; 11) Genitalia, dorsal view; 12) Genitalia, lateral view. Scale = 1 mm.

Genitalia (Fig. 5, 6). Parameres elongate, rectangular, 82% of length fused, convex, expanded latero-apically; antero-central margins not curved ventrally, with antero-lateral projections.

Allotype. Female. Similar to male, except for the following characteristics: length from apex of pronotum to apex of elytra: 17.9 mm; humeral width: 11.1 mm. Clypeus with a trapezoidal laminar projection with anterior margin straight. Elytra without large, coarse, C-shaped punctures over apical third between elytral suture and internal costae; mesosternal projection with rounded apex.

Variation in paratypes. The five paratypes (one male, three females, one not sexed) are similar to the holotype and allotype, differing only as follows: length from apex of pronotum to apex of elytra varies from 14.7 and 18.4 mm; humeral width varies from 8.8 to 11.2 mm; and the clypeal laminar projection may be small and short.

Type locality. Rosario de Tezopaco, state of Sonora, Mexico (approx. 27° 48' N; 109° 26' W).

Type material. Holotype ♂, allotype ♀, and 5 paratypes. Holotype ♂, allotype ♀, paratypes (1♂, 1♀) labeled: "MEXICO, Sonora, Rosario de Tezopaco, 30-VII-98, 470 m, G. Nogueira, col"; 2♀ paratypes with same data, except date "30-VIII.98". One paratype (not sexed) labeled "Mexico, Sonora, Cocorit, 22-VII.1966, T. De la Rosa, col". The holotype, allotype, and one female paratype deposited in Entomological Collection of Instituto de Ecología, A.C. (IEXA), one male and one female paratypes will be deposited in "Instituto de Biología, Universidad Nacional Autónoma de México (IBUNAM)", one paratype in H. & A. Howden collection (HAHC), and the other female paratypes in the particular collections of Guillermo Nogueira (GN), Miguel Angel Morón (MXAL) and Cuauhtémoc Deloya (CD).

Etymology. The specific name *C. sinitoc* is the anagram of the generic name *Cotinis*.

Remarks. *Cotinis sinitoc* is related to *C. pokornyi*, both having the same form of frontal and clypeal projections, having the frontal projection a little elevated and not visible in lateral view (cf. figs 1-2 vs. 7-8), pronotum with the lateral margins arcuate, and by the general form of the parameres. Differ by the ashy-brown with green reflections coloration of pronotum and elytra, and the presence of two green vittae in each elytron in *C. sinitoc*, whereas the coloration is blackish-green in the same structures of *C. pokornyi*. The clypeal projection is trapezoidal in *Cotinis sinitoc* and semitrapezoidal in *C. pokornyi* (Fig. 7). *C. sinitoc* has the pronotum with smaller punctuation and the basal lobe rounded, whereas in *C. pokornyi* the punctuation is larger and the lateral lobe sinuate. *C. sinitoc* has the dorsal surface of mesepimeron with separate punctures and long setae, whereas *C. pokornyi* has the dorsal surface of mesepimeron with tight punctures and long setae. The elytra are smooth with fine punctuation only visible at great magnification in *C. sinitoc* and punctate-striate in *C. pokornyi*. The mesosternal projection is semi-rounded with angulate apex in *C. sinitoc* (Fig. 3) and slightly rounded in *C. pokornyi* (Fig. 9). The parameres have antero-lateral projections in *C. sinitoc* (figs 5-6), absent in *C. pokornyi* (figs. 11-12). Finally, the protibia is tridentate with short basal tooth in *C. sinitoc* (Fig. 4), whereas it is bidentate with the basal tooth difficult to see in *C. pokornyi* (fig. 10).

Cotinis sinitoc lives in a thorn forest with xerophitic brush-wood species: *Prosopis*, *Parkinsonia*, *Cercidium*, *Acacia*, *Larrea*, *Celtis*, *Ferocactus* and numerous perennial herbaceous plants. The soil has a high clay content.

One male and two females were attracted to light traps (ultraviolet light with and without filters, mercury vapor lamps, and lamps of mercury vapor with metallic additives) between 20:00-22:00 hours (summer Pacific time). Additionally, one male and one female were obtained with traps baited with fermented banana and pineapple, placed at 1 m above ground. Another female specimen was collected in flight around thorny plants at 18:00 hours.

In life, the specimens show an iridescent green coloration with bright yellowish-orange stripes over the pronotum and elytra, which are lost when killed with ethyl acetate.

C. sinitoc apparently has crepuscular or nocturnal habits, as does *C. orientalis* Deloya & Ratcliffe, 1988; both have been captured at light traps.

Key to the known Mexican species of *Cotinis* (*Cotinis*).

(Modified from Deloya & Ratcliffe, 1988)

1. Dorsum opaque, velvety or pruinose-like; venter shiny 2
- 1'. Dorsum and venter shiny, smooth (in *C. antonii* dorsal surface is not smooth) 12
2. Frontal projection partially free, never fused. Clypeal projection large 8
- 2'. Frontal projection fused. Clypeal projection large or reduced. 3
3. Clypeal projection pronounced. Elytra punctate 4
- 3'. Clypeal projection reduced. Elytra smooth. 7
4. Frontal projection short, no more than 50% of length from vertex to apex of clypeus *C. pueblensis* Bates
- 4'. Frontal projection long, at least 55% of length from vertex to clypeal apex 5
5. Clypeal projection triangular. *C. pauperula* Burmeister
- 5'. Clypeal projection semitrapezoidal or trapezoidal 6
6. Clypeal projection semitrapezoidal. Pronotum and elytra blackish-green, elytra punctate-striate *C. pokorny* Deloya
- 6'. Clypeal projection trapezoidal. Pronotum ashy-brown with green reflections; each elytron with two green vittae *C. sinitoc*, n. sp. Deloya, Ibáñez-Bernal & Nogueira
7. Frontal projection long, at least 60% of length from vertex to clypeal apex, extending beneath antennal insertion. *C. impia* (Fall)
- 7'. Frontal projection short, no more than 50% of length from vertex to clypeal apex *C. rufipennis* Bates
8. Clypeal projection narrow, less than 0.5 mm thick in lateral view 9
- 8'. Clypeal projection distinctly thickened, greater than 0.5 mm in lateral view 11
9. Elytra punctate-striate, punctures C-shaped *C. punctatostriata* Bates
- 9'. Elytra not punctate-striate 10
10. Clypeal projection in form of inverted triangle, apically expanded. Dorsal coloration opaque dark green with blue luster reflections, rest of body bright blue-green *C. beraudi* Delgado
- 10'. Clypeal projection variable, i.e., quadrate, rectangular, triangular or only a little expanded apically. Dorsal coloration variable, green, black or red *C. mutabilis* (Gory & Percheron)

11. Frontal projection with apex pointed in dorsal view. Clypeal projection expanded apically *C. laticornis* Bates
- 11'. Frontal projection with apex abruptly expanded and rounded. Clypeal projection semicircular. Surface of clypeus with longitudinal ridge between two depressions. Frons with depression either side of frontal projection *C. sphyracera* Deloya & Ratcliffe
12. Frontal projection completely fused, short, not reaching antennal insertion. Clypeal projection reduced to two lobes. Elytra punctate-striate *C. antonii* Duges
- 12'. Frontal projection partially free, extending beyond insertion of antenna. Clypeal projection variable. 13
13. Metasternum with long setae, greater than 0.5 mm in length. Clypeal projection obtusely angled from plane of clypeal disc in lateral view *C. orientalis* Deloya & Ratcliffe
- 13'. Metasternum with short setae, less than 0.5 mm long. Clypeal projection obtusely or right angled from plane of clypeal disc in lateral view 14
14. Clypeal projection right-angled from plane of disc in lateral view. Elytra with two well-developed costae *C. viridiacyanea* (Perbosc)
- 14'. Clypeal projection obtusely angled from plane of disc in lateral view. Elytra lacking costae 15
15. Color brownish black or deep plum. Internal sac of male genitalia with large teeth, greater than 0.5 mm in length *C. fuscopicea* Goodrich
- 15'. Color variable, blue to bluish green to purplish. Internal sac of male genitalia with small teeth, less than 0.5 mm. ... *C. subviolacea* Gory & Percheron

ACKNOWLEDGMENTS

We are grateful to Miguel Angel Morón-Ríos and Pedro Reyes-Castillo for their critical review of the manuscript, and to two anonymous revisors for their comments.

LITERATURE CITED

- Delgado, L.** 1998. A new Mexican species of *Cotinis* (Coleoptera, Melolonthidae) Revista Brasileira de Entomologia, 41(2-4):451-452.
- Deloya, C.** 1995. A new species of *Cotinis* (*Cotinis*) Burmeister from Mexico (Coleoptera: Melolonthidae, Cetoniinae). Coleop. Bull., 49(2):149-152.
- Deloya, C. & B.C. Ratcliffe.** 1988. Las especies de *Cotinis* Burmeister en México (Coleoptera: Melolonthidae: Cetoniinae). Acta Zoológica Mexicana (n.s.), 28:1-52.
- Goodrich, M.A.** 1966. A revision of the genus *Cotinis* (Col. Scarabaeidae). Ann. Entomol. Soc. Amer., 59(3):550-568.

A NEW SPECIES OF *LEPTONEMA* OF THE *OCCIDENTALE* GROUP (TRICHOPTERA: HYDROPSYCHIDAE) FROM MADAGASCAR¹

Oliver S. Flint, Jr.²

ABSTRACT: *Leptonema ranomafana* new species, a member of the *occidentale* group, is described from the Ranomafana National Park in Madagascar. Eight species were previously recognized from the island, all belonging to the endemic *affine* group. The *occidentale* group had been known from 5 species recorded from Ghana south and east through central Africa to Natal. The Madagascan species agrees closely with its group, but is easily recognized by the structure of the tenth tergum and phallus.

The hydropsychid genus *Leptonema* is known from the Greater Antilles, South and Central America (97 species), Africa (12 species) and Madagascar (8 species). It was first monographed by Mosely (1933; 37 species) and then again by Flint, McAlpine and Ross (1987; 105 species), subsequently Flint (1991) and Muñoz-Quesada (1997) have added another 6 species from the New World. Very recently Chvojka and Sykora (1998) reviewed the Madagascan species recognizing two more species, but all in the endemic *affine* species group. No species other than those in this species group have been reported from the island.

In 1988 and 1990 Mr. Warren E. Steiner, Jr. of the Entomology Department, Smithsonian Institution, collected insects as part of the Duke-Malagasy biotic survey of the Ranomafana National Park. On both of these years he collected a comparatively small, dark macronematine hydropsychid that on study turned out to be an undescribed species belonging, not to the *Leptonema affine* group, but to the *occidentale* group. This latter group contained 5 previously described species, distributed from Ghana on the west, south and east through the Cameroons and Zaire to Natal in the southeast. The discovery of a sixth species on the island of Madagascar was wholly unexpected.

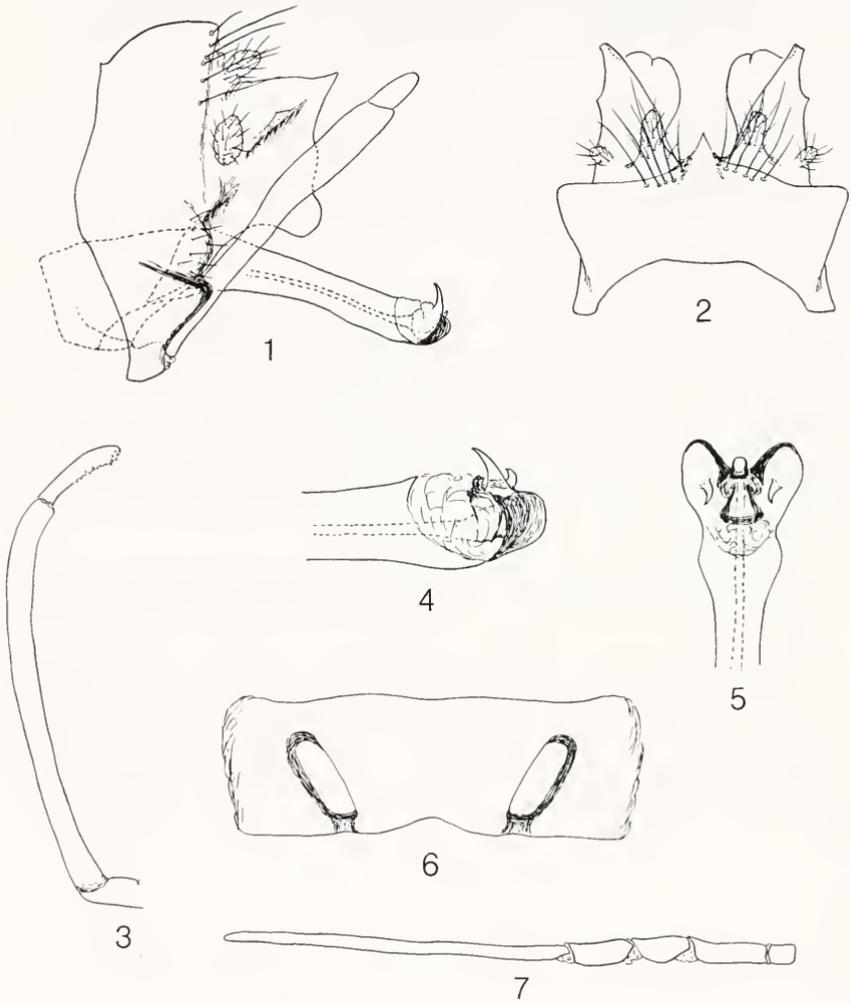
Leptonema ranomafana Flint, NEW SPECIES

Figures 1-7

This new species is a typical member of the *occidentale* group, conforming well to the group characteristics (Flint et al. 1987). It is, perhaps, most closely related to *L. marlieri* Flint, McAlpine and Ross based on the presence of an apicodorsal process from the tip of the phallus. It is easily distinguished from this species, and all others in the group, by the presence of an elongate

¹ Received November 22, 1999. Accepted December 27, 1999.

² Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-0105 USA.



Figures 1-7. *Leptonema ranomafana* n. sp., male structures. 1, genitalia, lateral; 2, ninth and tenth terga dorsal; 3, inferior appendage, posteroventral; 4, apex of phallus, lateral; 5, apex of phallus, dorsal; 6, fifth sternum, ventral; 7, maxillary palpus, lateral.

wart *a* and development of a large apicoventral lobe on the tenth tergum, the very long, slender basal segment of the inferior appendage, and the details of the structures at the apex of the phallus.

Male: Length of forewing 10-11 mm. Color fuscous, venter and legs stramineous. Fourth segment of maxillary palpus longer than third, fifth segment 1.6 times longer than basal 4 segments combined (Fig. 7). Foretibia with a single apical spur. Fifth sternal lobes elongate-ovoid, set obliquely, about 2/3 width of sternum (Fig. 6). Male genitalia: Tenth tergum with wart *a* well developed, elongate, terete, wart *c* ovoid, protuberant; lateral lobe broad, with a small, obliquely set point laterally, apicodorsal tip slightly upturned, posterior margin strongly produced ventrad into a large, rounded lobe (Figs. 1, 2). Inferior appendage with basal segment very long, slender, lacking processes; apical segment less than 1/4 length of basal segment with spinose setae on inner margin (Fig. 3). Phallus with basal section enlarged, set at a slight angle to stem; apex separated from stem by a membranous region; with rounded apicolateral lobe and reflexed dorsolateral point, apicodorsal opening small, dorsal rim produced into a small point in lateral aspect, phallosomal complex situated centrally (Figs. 4, 5).

Female: Length of forewing 8-10 mm. Color fuscous, as in male.

Material Examined: Madagascar, Prov. Fianarantsoa, 7 km W Ranomafana, 1100m, 1-7 Nov 1988, W.E. Steiner, Holotype, male, NMNH. Paratypes: Same data, 16♂; same, but 8-21 October 1988, 17♂, 1♀; same, but 17-22 February 1990, 13♂; same, but 22-31 October 1988, 12♂; same, but Malaise trap in small clearing, montane rain forest, 1♀; same, but flight intercept-yellow pan trap in Malaise trap in small clearing, montane rainforest, 1♂, 1♀; same, but 1-7 Nov 1988, 2♀; same, but 1000m, 26-29 January 1990, Malaise trap across stream, montane rain forest, 1♂, 1♀; same, but 900m, 1-7 March 1990, Malaise trap in small clearing, montane rain forest, 1♀; same, but 8-13 March 1990, Malaise trap across stream, montane rain forest, 3♂, 4♀; same, but 20-24 March 1990, Malaise trap across stream, montane rain forest, 5♂, 6♀. 7km W Ranomafana, 1100m, 7-14 Sept 1988, C. Kremen, 4♂; Holotype and many paratypes in the NMNH; paratypes will be deposited in the British Museum, London, England; Muséum National d'Histoire Naturelle, Paris, France; Albany Museum, Grahamstown, South Africa; Musée Royal de l'Afrique Central, Belgium.

Biology: The immature stages of this species have not been associated. Adults were taken both by net and in Malaise traps. Those without an accessory label were mostly taken by net as they swarmed over the stream in the evening (Steiner, pers. com.).

Etymology: The name *ranomafana* is taken from the name of the national park and treated as a noun in apposition. Its meaning is "hot water", an allusion to the hot springs in the town of Ranomafana.

ACKNOWLEDGMENTS

I am indebted to Mr. Steiner for collecting these and many other most interesting caddisflies on the island of Madagascar. The contribution of two anonymous reviewers is gratefully acknowledged.

LITERATURE CITED

- Chvojka, Pavel and Jan L. Sykora.** 1998. Revision of the *Leptonema affine* group (Insecta: Trichoptera: Hydropsychidae) from Madagascar with the description of a new species. Cas. Nár. Muz. Rada Přírodoved. 167:25-33.
- Flint, Oliver S., Jr.** 1991. Studies of Neotropical Caddisflies, XLV: The Taxonomy, Phenology, and Faunistics of the Trichoptera of Antioquia, Colombia. Smithson. Contrib. Zool. 520:1-113.
- Flint, Oliver S., Jr., J. Frank McAlpine and Herbert H. Ross.** 1987. A Revision of the Genus *Leptonema* Guérin (Trichoptera: Hydropsychidae: Macronematinae). Smithson. Contrib. Zool. 450: 1-193.
- Mosely, Martin E.** 1933. *A Revision of the Genus Leptonema*. 69 pages. London: Br. Mus. (Nat. Hist.).
- Muñoz-Quesada, Fernando.** 1997. Five new species and a new record of Costa Rican *Leptonema* Guérin (Trichoptera: Hydropsychidae). Proc. Entomol. Soc. Wash. 99:115-132.

A NEW ORIENTAL *BLERA* (DIPTERA: SYRPHIDAE)¹

F. Christian Thompson²

ABSTRACT: The only known *Blera* from the Oriental Region is described and named *himalaya* (HTO♂ The Natural History Museum, London)

INTERPRETATIVE SUMMARY: A new pollinator is described and illustrated. The information will enable conservationists, ecologists and systematists to identify the species and will contribute to the inventory of the biological diversity of the Oriental Region.

The flower fly genus *Blera* Billberg is characteristic of the North Temperate forest, the maggots live in tree holes and rotten stumps and the flies are common at flowers in the spring (Barkalov & Mutin 1991, 1992; Rotheray & Stuke 1998). Previously, the genus has only been known from the Holarctic Region. The first Oriental species is here described from the southern slopes of the Himalaya Mountains in northern India.

Blera himalaya Thompson, NEW SPECIES

Male.—Face yellow and white pollinose except broad brown shiny medial vitta; gena shiny and brown on anterior 1/2, yellow, white pilose and pollinose elsewhere; frontal lunule orange; frontal triangle bare, brown and shiny on anterior 1/2, white and white pollinose posteriorly; eyes holoptic, with contiguity as long as ocellar triangle; ventral triangle black and gray pollinose except brown and yellow pollinose anterior to ocellar triangle, brownish-yellow pilose; antenna light brown, more orange ventrally, black pilose; basoflagellomere with elongate medial sensory pit; arista long, longer than face; occiput black to dark brown on dorsal 1/3, yellow ventrally, white pollinose, yellow pilose.

Thorax. Postpronotum yellow, yellowish-gray pollinose, yellow pilose; mesonotum black except broadly orange laterally, sparsely gray pollinose except with irregular shiny areas mesad to wing, yellow pilose; postalar callus orange, sparsely gray pollinose, yellow pilose; scutellum yellow, yellow pilose, with distinct yellow subscutellar fringe; calypter and plumula yellow; halter orange except base of capitulum brown; katepimeron bare; metasternum bare; pleuron gray pollinose, yellow pilose, black except with orange areas on posterior antepisternum, dorsal katepisternum and anterior edge of meron. Legs: coxae yellow, white pollinose, yellow pilose; trochanters yellow, yellow pilose; profemur yellow on basoventral 1/3 and apex, brownish black elsewhere, yellow pilose; mesofemur yellow on basoventral 1/2 and apex, brownish black elsewhere, yellow pilose; metafemur yellow on base and apex, black elsewhere, yellow pilose except for short black pile ventrally; pro & mesotibiae yellow, yellow pilose; metatibia yellow on basal 2/3, brownish black apically, yellow pilose; pro & mesotarsi yellow except apical 2 tarsomeres brown, yellow pilose; metatarsus brownish black, black pilose. Wing: hyaline, bare on basoanterior 1/2, microtrichose posteriorly; microtrichose on apical 1/3 cell Sc, apical 1/3 cell R1, apical 2/3 cell R2+3, apical 1/2 cell R4+5, apicomedial 1/2 cell DM, apicomedial 1/3

¹ Received October 19, 1999. Accepted November 30, 1999.

² Systematic Entomology Laboratory, ARS, USDA, NHB-168, Smithsonian Institution, Washington, D. C. 20560.

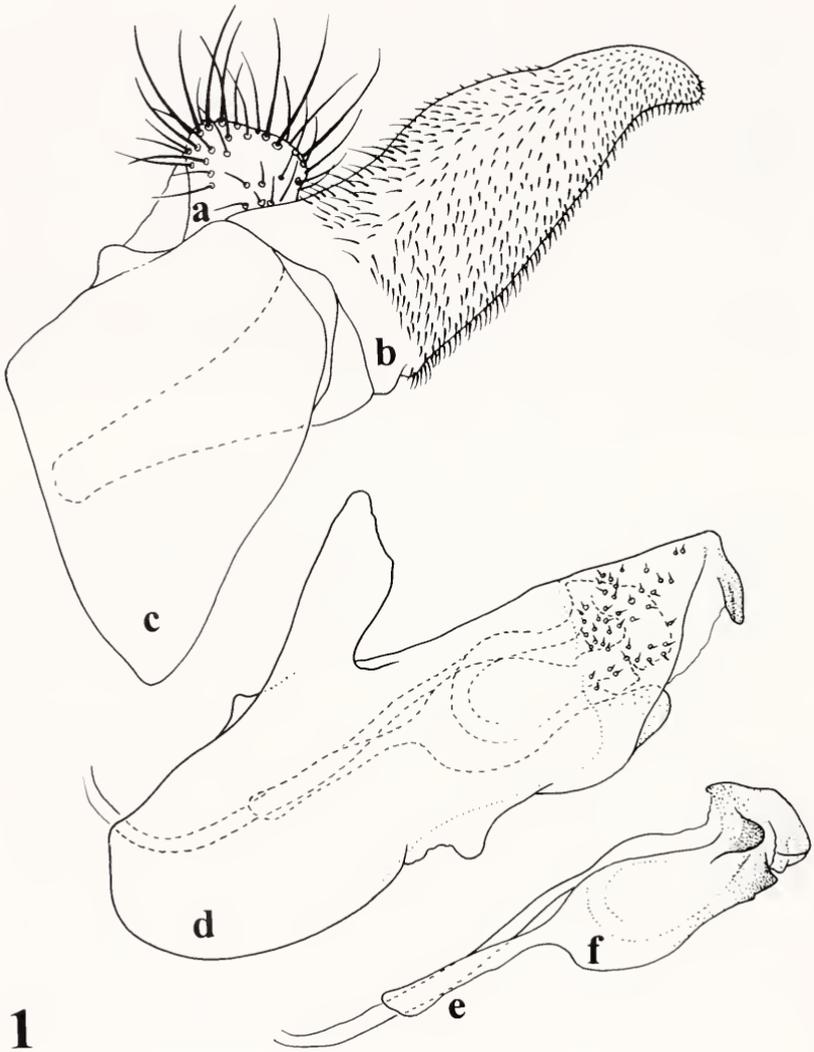


Fig. 1. *Blera himalaya*. Male genitalia, lateral view: a, cercus; b, surstyle; c, epandrium; d, hypandrium; e, aedeagal apodeme; f, aedeagus.

cell CuA1, apicomedial 1/4 cell CuP and all of alula and posterior margin beyond the cells.

Abdomen: 1st tergum yellow, sparsely white pollinose laterally, yellow pilose; 2nd tergum black with two complete yellow fasciae, yellow pilose except for a few black pili along apicomedial margin, with 1st fascia on middle of tergum but reaching along lateral margin to base of tergum, with other fascia along apical margin; 3rd & 4th terga similar to 2nd, except basal black areas narrower and apical yellow fascia correspondingly broader, with more black pile apically; male genitalia (Fig. 1) brownish orange, black pilose.

Female.—Similar to male except for normal sexual dimorphism; frons brownish black, shiny except yellowish-gray pollinose laterally, yellow pilose; vertex brown, shiny except ocellar triangle gray pollinose; 5th tergum brownish black except basal 1/4 yellow, black pilose.

Holotype. Male: INDIA: Himachal Pradesh, Simla, the Glen, 6,000 ft. [=1,828 m], October 1945, T. Jermyn, deposited in the Natural History Museum, London. Paratypes: 1♂ 1♀ with the same data (1♂ USNM, 1♀ BMNH); "N. E. India," Partabnagar, 7,000 ft. [2,133 m], 31 October 1944, T. Jermyn (1♂ USNM).

The specific epithet, *himalaya*, is a noun in apposition, alluding to the home of the species.

Blera himalaya is easily recognized as the only *Blera* species which mimics *Apis* bees. Superficially, the species may be confused with two Indian *Criorhina* Meigen species described by Brunetti (1923). *Blera himalaya* differs from one, *interrupta*, by having a broad brown facial vitta, and from the other, *dentata*, by lacking the large ventral spur on the hind femur.

The genus *Blera* was revised recently by Barkalov and Mutin (1991, 1992). *Himalaya* is placed in the genus *Blera* as it displays all the essential characters of the genus: bare and undeveloped metasternum, distinctive facial shape with produced frontoantennal region, bare and usually holoptic eyes, short apical section of vein R4+5, et cetera. In their key to the species of *Blera*, *himalaya* runs to *notata* Wiedemann (couplet 17) as the postpronotum and scutellum are pale yellow, the metafemur has no apical process, the pro and mesofemora are narrowly pale basally, and 2nd tergum has narrow pale fasciae. *Blera himalaya* is different from *notata* in overall appearance. *Blera notata* (southeastern USA) is a black species with reduced basolateral yellow triangular maculae on 2nd and 3rd terga and has a completely yellow face, whereas *himalaya* is a brown and yellow to orange species with broad brown facial vitta and double continuous pale fasciae on 2nd through 4th terga. In the structure of the male genitalia, *himalaya* appears most similar to *flukei* Curran and *robusta* Curran, two Nearctic species. Unfortunately, Barkalov and Mutin (1991, 1992) do not illustrate the aedeagus, nor are the details of the apical half of the hypandrium clear. So, all that can be stated is that the shape of the surstyle of *himalaya* is similar, but differs in the shape of the apex.

ACKNOWLEDGMENTS

I thank Nigel Wyatt and Richard Vane-Wright, Natural History Museum, London (BMNH) for permission to study material in their care. The art work was done by Taina Litwak, for

which I am grateful. The acronym USNM is here used for the National Entomological Collections of the Smithsonian Institution, Washington. I also thank Stephen Gaimari, Department of Entomology, Smithsonian Institution, Washington; Douglass R. Miller, Allen Norrbom, and Manya B. Stoezel of the Systematic Entomology Laboratory, USDA, Washington; for their critical review of the manuscript.

LITERATURE CITED

- Barkalov, A. V. and Mutin, V. A.** 1991. Revision of hover-flies of the genus *Blera* Billberg 1820 (Diptera, Syrphidae). *Entomologicheskoye Obozreniye* 70: 204-213, 737-749. [In Russian, translation in 1992, *Entomol. Rev.* 70(9): 53-63, 71(4): 115-131.]
- Brunetti, E.** 1923. Pipunculidae, Syrphidae, Conopidae, Oestridae. Diptera. In: [Shipley, A. E., ed.] *The fauna of British India including Ceylong and Burma*. Vol. 3, xii + 424 pp. Taylor & Francis, London.
- Rotheray, G. E. and Stuke, J.-H.** 1998. Third stage larvae of four species of saproxylic Syrphidae (Diptera), with a key to the larvae of British *Criorhina* species. *Entomol. Gazette* 49: 209-217.

A NEW SPECIES OF *BABYCURUS* (SCORPIONES: BUTHIDAE) FROM NORTHERN OMAN¹

Graeme Lowe²

ABSTRACT. A new species of *Babycurus* is described from Jabal Akhdar, in the Al Hajar Mountains of Northern Oman. The discovery extends the range of this Afrotropical genus to southeastern Arabia. It represents a significant disjunction with the only other known record of *Babycurus* on the Arabian peninsula, that of *B. zambonellii* from southwestern Yemen and Eritrea.

Babycurus Karsch, 1886, currently includes fourteen named species and two named subspecies, mostly distributed over tropical and subtropical Africa (Lamoral & Reynders 1975; Sissom, 1990). The genus has not been reviewed since Vachon (1940) provided a key to the known species. Recently, Sissom (1994) reported *Babycurus zambonellii* Borelli, 1902, from San'a, Yemen, providing the first record of this genus in the Arabian peninsula. The present paper describes a new *Babycurus* recently discovered in the course of a detailed survey of the scorpion fauna of the Sultanate of Oman. The new find is regarded as the sister species of *B. zambonellii*, and extends the range of the genus to the Oriental region.

Babycurus exquisitus, NEW SPECIES

(Figs. 1-9)

Diagnosis. *Babycurus exquisitus* from Oman is closely related to *Babycurus zambonellii* Borelli, 1902, from Eritrea. Both are differentiated from other *Babycurus* by the following characters: relatively small species (adults < 50 mm); pale straw-colored body; metasoma uniformly wide, segment V smooth to weakly granular with all keels obsolete; vesicle of telson smooth, covered with a dense brush of long setae on its ventral and lateral surfaces (mostly broken off in the holotype of *B. zambonellii*); ventral surface of pedipalp femur with scattered coarse granules at base, otherwise smooth; external keel of pedipalp femur strong, denticulate to granulate; dorsointernal, dorsomedian and dorsoexternal keels of pedipalp patella well developed, smooth to granulose; manus of pedipalp chela smooth, keels reduced or obsolete; dentate margin of fixed finger with 7-8 linear, non-imbricated subrows of primary denticles; subrows of pedipalp fingers flanked by a single external accessory denticle; pedipalps and legs without dense pubescence.

Babycurus exquisitus is further differentiated as follows: small size, body length less than 40 mm; longer pectines: pectine length/carapace length 0.78-

¹ Received October 14, 1999, Accepted November 26, 1999.

² 75-16 Drexelbrook Dr, Drexel Hill, Pennsylvania 19026, USA. e-mail: lowe@monell.org

1.0; keels of metasoma I-IV finely denticulate or crenulate; telson elongate, streamlined, vesicle length/depth 1.8-2.0, pectine length/vesicle depth 2.6-3.1; pedipalp chela of male with long thin fingers and a swollen manus, that of female very slender with a narrow manus; chela length/width 4.2-4.7 (males), 6.12 (female), manus length/width 1.57-1.76 (males), 1.86 (female), movable finger length/underhand length 1.45-1.74 (males), 2.35 (female).

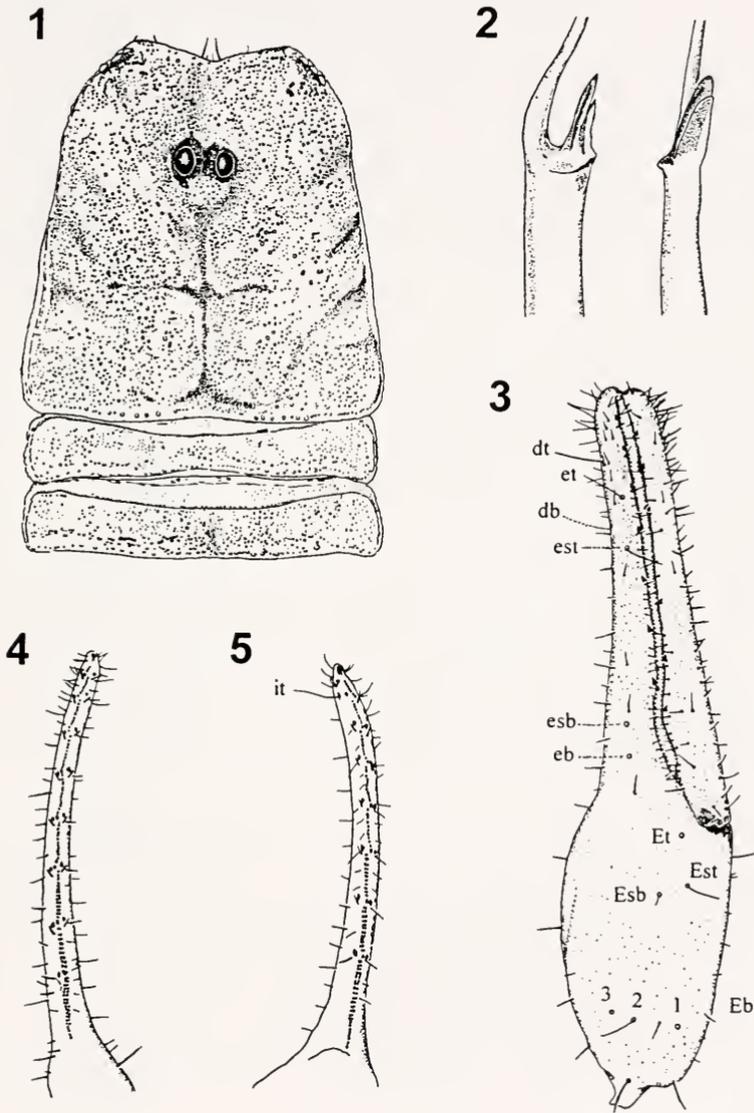
Babycurus zambonellii differs as follows: larger size, up 50 mm in length; pectine length/carapace length 0.69-0.70; keels of metasoma ranging from denticulate or crenulate to heavily granulose; telson more bulbous, vesicle length/depth 1.6-1.8, pectine length/vesicle depth 2.0-2.1; subaculear spine more stout; chela of female less slender, chela length/width 5.14, manus length/width 1.77, movable finger length/underhand length 1.87.

Description of holotype male (adult): Coloration: Base color uniform pale yellow; chela fingers, metasoma V and telson light orange; cheliceral teeth, denticles of chela fingers, articular condyles of chela movable finger and leg segments, aculeus and subaculear spine dark reddish brown; black pigmentation around median and lateral eyes.

Prosoma: Carapace subrectangular, nearly parallel-sided (Fig. 1); anterior margin concave, bearing a single median pair of setae; entire surface coarsely granular except for posterior and lateral furrows, and small smooth patches behind the lateral eyes; superciliary crests granulose, all other keels reduced or absent; posterior median furrow deep, posterior lateral furrows moderate; ocular tubercle not elevated; three lateral eyes present; distance of center of ocular tubercle from anterior margin 0.28 times length of carapace. Chelicerae with typical buthid dentition; two denticles on ventral surface of fixed finger, as in other *Babycurus* (Sissom, 1990).

Mesosoma: Tergite I without keels, tergites II-VI with a single granulate median keel; median keel weak on tergite II, moderate on III, strong on IV-VI; tergite VII pentacarinat, with a broad, convex granular median keel and two pairs of well developed crenulate lateral keels; all tergites with dense granulation on intercarinal surfaces and a row of separated granules along posterior margin; sternite III with convex medial area slightly wrinkled, bearing 11 reddish setae; sternites IV-VI smooth, with lateral margins lightly shagreened; sternite VII shagreened, with a pair of smooth, nearly obsolete median keels, and obsolete lateral keels indicated by fine granules; tips of pectines extending to proximal third of trochanter IV; pectinal tooth count, left 22, right 21; combs with nine smooth middle lamellae bearing few setae; basal middle lamella with rounded corners, proximal corner not produced into a lobe or projection; basal piece with transverse suture, anterior area convex on sides with a deep anterior median furrow lined with short macrosetae, posterior area flat, steeply sloped, border convex with a median lobe.

Metasoma (Fig. 9) (nomenclature of Levy & Amitai, 1980): Segment I with 10 keels, intermediary keels complete; segments II-IV with 8 keels, intermediary keels absent; all keels obsolete on segment V; dorsal and dorsolateral keels moderately developed and finely crenulate to serrate on segments I-III, weak and feebly granulate on IV; intermediary keels on I moderate, crenulate; ventrolateral keels weak and finely granulate on I-III, nearly obsolete on IV; ventral keels weak and nearly smooth on I-III, essentially obsolete on IV; dorsal and lateral intercarinal surfaces on segments I-III finely shagreened, more densely so on anterior seg-

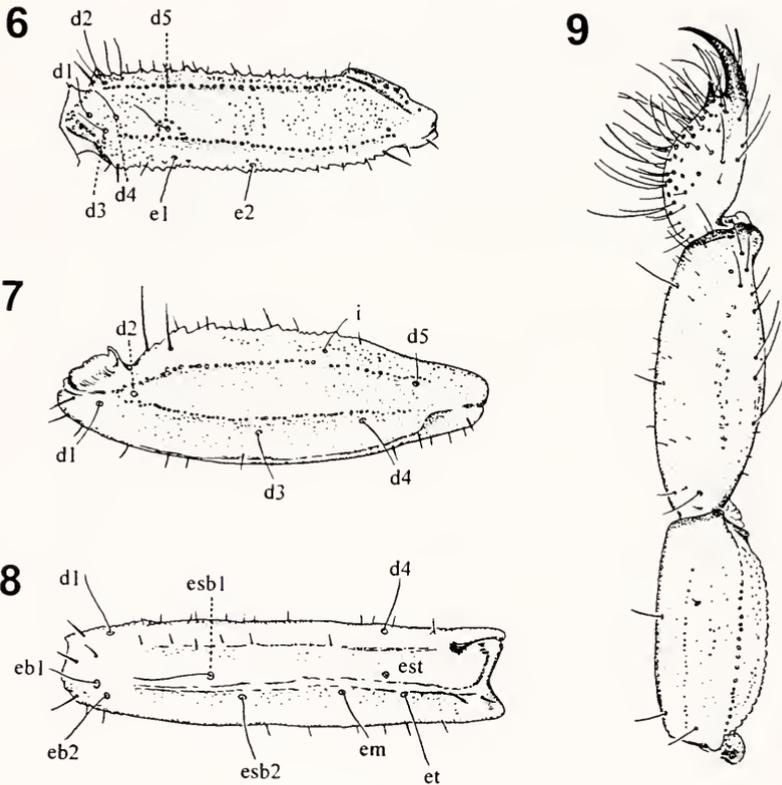


Figures 1-5. *Babycurus exquisitus* n.sp., male. 1, Carapace and tergites I-III. 2, Right hemispermatophore, lobes at base of flagellum, dorsal (left) and ental (right) aspects. 3, Right pedipalp chela, external aspect. 4, Left chela, movable finger dentition. 5, Left chela, fixed finger dentition. Figs. 1, 3-5: holotype male. Fig. 2: paratype male.

ments; other intercarinal surfaces smooth; dorsal surface with shallow median furrow on I-IV, convex on V; chaetotaxy: segments I-IV with 3 pairs of macrosetae (including posterior marginal setae) on ventral keels, 2 pairs of macrosetae on ventrolateral keels; metasoma V with 5-7 long, backwardly curved macrosetae along dorsolateral margins, and 2-3 curved macrosetae on posterior lateral flank; anal margin smooth, bearing over a dozen large and small setae.

Telson: (Fig. 9) Telson smooth, slender, teardrop-shaped, with a prominent subaculear spine; ventral, lateral and posterior dorsal surfaces of vesicle clothed in a brush of numerous (approximately 140) long, curved macrosetae; dorsal surface also bearing scattered short, fine microsetae; aculeus shorter than vesicle, rather stout and strongly curved.

Pedipalp: Femur (Fig. 6) 3.86 times longer than wide, tetracarinate, with external, dorsoexternal, dorsointernal, and ventrointernal keels distinct, crenulate to serrate (Fig. 6); intercarinal surfaces smooth to shagreened; dorsal surface shagreened, dorsoexternal surface



Figures 6-9. *Babycurus exquisitus* n.sp., holotype male. 6. Right pedipalp femur, dorsal aspect. 7. Right pedipalp patella, dorsal aspect. 8. Right pedipalp patella, external aspect. 9. Metasoma IV, V and telson, lateral aspect.

nearly smooth except for scattered proximal granules, ventral surface nearly smooth on distal half, with scattered granulation on proximal half; internal surface coarsely shagreened, divided by a broad ridge with coarse polished granules; patella (Figs. 7, 8) 3.18 times longer than wide, with five weak keels; dorsointernal and dorsomedian keels finely granular, dorsoexternal keel nearly smooth, external keel smooth, ventroexternal keel polished and weakly granulose; internal surface divided by a granulate ridge; dorsointernal surface sparsely granular, other surfaces smooth; pedipalp chela (Fig. 3) smooth with digital and dorsal marginal keels weak, smooth, confined to distal manus and fixed finger; other keels obsolete; manus swollen, manus width/underhand length 0.58; chela fingers slender, proximally scalloped; movable finger length/underhand length 1.45; dentition (Figs. 4, 5): fixed finger with 8 subrows of primary denticles; movable finger with 8 subrows of primary denticles, including long compound proximal subrow on basal lobe; proximal three subrows of fixed finger and proximal two on movable finger composed of bicuspid denticles; enlarged primary denticle on subrows 1-6 of both fingers flanked by enlarged internal and external accessory denticles; proximal subrow of movable finger compound, with single enlarged internal accessory denticle near midpoint; tip of movable finger with two enlarged internal subdistal denticles flanked by an external row of four small denticles; tip of fixed finger with one enlarged internal subdistal denticle; trichobothrial pattern orthobothriotaxic, type A- β (Vachon, 1974, 1975) (Figs. 3, 6-8); femur with trichobothrium *d*₁ displaced internally; chela with *et* located near distal end of denticle subrow 4 of fixed finger, *est* at middle of subrow 5.

Legs: Basitarsi with two ventral rows of long macrosetae and numerous smaller setae on prolateral and retrolateral surfaces; telotarsi with two ventral rows of short macrosetae, and sparse setation on prolateral and retrolateral surfaces; prolateral tarsal spurs with a small basal bifurcation bearing a single stout seta, retrolateral tarsal spurs simple; unguis stout.

Measurements of holotype male (mm) (L, length; W, width; D, depth): total length 33.50; carapace, L 3.75, ocular tubercle to anterior margin 1.08; metasoma I, L 2.50, W 2.00; metasoma II, L 3.00, W, 1.83; metasoma III, L 3.17, W 1.75; metasoma IV, L 3.67, W 1.75; metasoma V, L 4.17, W, 1.69; telson vesicle, W 1.08, D 1.17; pedipalp chela, L 6.54; underhand, L 2.67; manus, W 1.54, D 1.67; fixed finger, L 3.75, movable finger L 3.88; pedipalp femur, L 3.71, W 0.96; pedipalp patella L 4.29, W 1.35; pectine, L 3.63.

Hemispermatothore from paratype male (Fig. 2): two long, laminiform, apically blunt lobes at base of flagellum; inner lobe separate from flagellum, slightly widened at base; outer lobe opposing inner lobe; basal lobe rudimentary, forming a lamina on a low, transverse ridge.

Paratype female (adult): differs from holotype male as follows: body larger, carapace and tergites proportionately wider; tergites flatter, less convex laterally; pedipalp patella more slender, 3.42 times longer than wide; pedipalp chela more slender, manus width/underhand length 0.53; fingers much longer, movable finger length/underhand length 2.35; proximal scalloping absent; denticles in proximal subrows not bicuspid; fixed finger with 7 subrows of primary denticles, with compound proximal subrow formed by fusion of two subrows (fusion point marked by internal and external accessory denticles); movable finger with 8 subrows of primary denticles, including long, proximal subrow flanked by a single external accessory denticle; pectines shorter, only attaining distal tip of coxa IV; basal piece of pectines wider; metasoma IV with ventral and ventrolateral keels weak but distinct, smooth to weakly crenulated; metasoma V with ventrolateral keels weak, marked by fine granules; ventromedian keel indicated by weak, polished granulations; pectinal tooth counts and metasomal morphometrics similar in the two sexes.

Measurements of paratype female (mm): total length 39.00; carapace, L 4.42, ocular tubercle to anterior margin 1.25; metasoma I, L 2.67, W 2.21; metasoma II, L 3.25, W 1.96; metasoma III, L 3.42, W 1.83; metasoma IV, L 3.92, W 1.79; metasoma V, L 4.58, W 1.75; telson vesicle, W 1.29, D 1.33; pedipalp chela, L 7.40; underhand, L 2.25; manus, W 1.21, D 1.25, fixed finger, L 4.92, movable finger, L 5.29; pedipalp femur, L 4.17, W 1.17; pedipalp patella, L 4.92, W 1.44; pectine, L 3.46; pectinal tooth counts, left 22, right 22.

Variation. Adult males exhibit little variation in color, size or form: body length 33-34 mm, carapace length 3.65-3.75 mm; morphometric ratios: carapace width/length 0.91-0.94, pedipalp femur length/carapace length 0.98-1.01, pedipalp femur length/width 3.67-3.86, pedipalp patella length/width 3.02-3.18, pedipalp movable finger length/underhand length 1.45-1.74; pedipalp chela length/width 4.25-4.66, metasomal segment length/width: I 1.16-1.25, II 1.55-1.64, III 1.64-1.82, IV 1.99-2.10, V 2.47-2.49. Male pectinal tooth counts: 21-22 (2 combs with 21 teeth, 4 with 22); pedipalp denticle subrows (including proximal): movable finger 8-9 (3 fingers with 8 subrows; 3 with 9), fixed finger 8.

A single immature male differs from adults as follows: pedipalp: patella slightly more slender, chela more elongate, manus not swollen, fingers lacking proximal scalloping and bicuspid dentition; metasoma IV and V with fully developed carination, not convex and smooth; metasoma IV with ventral and ventrolateral keels moderate, smooth to weakly crenulate; metasoma V with ventromedian, ventrolateral and dorsolateral keels weak to moderate, smooth to weakly crenulate.

Holotype. Adult male, Oman, Jabal Shams, Jabal Akhdar, Al Hajar Al Gharbi, 23°14.29'N 57°11.62'E, 1855 m, ultraviolet detection on ground surface in gravelly wadi with trees and rocks, surrounded by boulder strewn slopes, 2 October 1994, G.Lowe, M.D.Gallagher; depository: Naturhistorisches Museum, Basel, Switzerland.

Paratypes: 1 adult female, 1 immature, same locality as holotype (NMB); 1 adult male, Oman, Jabal Shams, Jabal Akhdar, Al Hajar Al Gharbi, ultraviolet detection, in narrow rocky wadi, walking slowly on rock, 23°14.27'N 57°11.68'E, 1870 m, 2 October 1994, G.Lowe, M.D.Gallagher (GL); 1 adult male, Oman, Jabal Shams, in spider web in tree, 23°14.31'N 57°11.64'E, 1900 m, 14 October 1993, 21:12 hrs, G.Lowe, M.D.Gallagher (NMB).

Comparative material: *Babycurus zambonellii*: holotype (male?), Ethiopia (Eritrea), Chenafena, Magretti (MRSN); 1 female, Yemen, Sana'a, June-July 1981, Lanza, Borri & Poggesi, (MZUF).

Depositories: GL, collection of G.Lowe; NMB, Naturhistorisches Museum, Basel, Switzerland; MZUF, Museo Zoologico "La Specola" dell'Università de Firenze, Florence, Italy; MRSN, Museo Regionale di Scienze Naturali, Turin, Italy.

Etymology. The specific epithet derives from the Latin adjective, *exquisitus*, meaning careful or delicate, in reference to the behavior and morphology of the animal.

Remarks: The holotype of *Babycurus zambonellii* from Eritrea was assumed to be a male (Borelli, 1902; Sissom, 1994). If so, it would be atypical in that it lacks certain male traits observed in some other members of genus: scalloping and bicuspid dentition at the base of the pedipalp fingers, and a

heavy, swollen manus. The manus resembles that of females of other African members of the genus. It is as robust as the manus of male *B. exquisitus*, but the latter species has more slender chelae than other *Babycurus*. Sissom (1994) referred a female from Sana'a, Yemen, to *B. zambonellii*. The form of the pedipalp and telson of this specimen are intermediate between the holotype of *B. zambonellii* and the paratype female *B. exquisitus*, but the metasoma is more elongate than either. Immature buthids can have a more slender pedipalp and metasoma; however, the size of the Sana'a female indicates it to be a subadult or adult. Study of additional material is needed to clarify variation and sexual dimorphism in *B. zambonellii*.

The *Babycurus* in Eritrea, Sana'a and northern Oman comprise a series of allopatric populations likely to be related by common descent. All possess a dense brush of long setae on the telson, a unique synapomorphy within the genus. The decision to place the Jabal Akhdar population in a separate species is based on clear differences in the shape of the telson and pedipalp chelae, smaller body size, more delicate form, and the distance and isolation from its nearest relatives in southwest Arabia and Ethiopia.

Babycurus is primarily an Afrotropical taxon adapted to mesic and humid environments. One may speculate that it invaded Arabia during the Miocene or earlier, crossing a land bridge at the south end of the Red Sea (Coleman, 1993), and spreading to northern Oman under mesic conditions. Subsequent development of hot, arid conditions in Arabia and north Africa during the Quaternary period restricted its distribution to higher elevations. Post-Miocene uplift of the Al Hajar ranges (Lippard et al, 1986) provided a refuge for the northern populations. I propose that *B. exquisitus* represents a Pleistocene relict confined to the highest parts of the Al Hajar mountains. It has not been found in extensive collections made at lower elevations in the Al Hajar mountains and Batinah coastal region of northern Oman, and it is unknown from the hot, arid steppes and dune systems of central Oman.

ACKNOWLEDGMENTS

The author is grateful to: HH The Minister of National Heritage and Culture, Sultanate of Oman, for sponsoring the scorpion study; Michael D. Gallagher for his strong support and guidance, including participation in trips to Jabal Akhdar to collect the types of this new species; the staff of the Ministry of National Heritage and Culture who provided support for my 1993-94 visits to Jabal Akhdar, including Said Ali Said Al-Farsi, and Saddiqa Rhamdan; Andrew S. Gardner, Jim Dundon, Ian Harrison, J.Neil Barnes and many other collectors in Oman; the curators who loaned *Babycurus* material: L.Bartolozzi and Sarah Whitman (MZUF), N. Franzese and Lisa Levi (MRSN), H.W. Levi and Laura Leibensperger (Museum of Comparative Zoology, Harvard University) and Scott F.Larcher (National Museum of Natural History, Washington DC); and František Kovařík and Michael E. Sologlad for critical review of the manuscript, helpful comments and discussion.

LITERATURE CITED

- Borelli, A.** 1902. Di una nuova specie di scorpione della Colonia Eritrea. *Boll. Mus. Zool. Anat. comp. R. Univ. Torino*. 17 (422): 1-3.
- Coleman, R.G.** 1993. Geologic evolution of the Red Sea. *Oxford Monogr. Geol. Geophys.* No. 24, New York, Oxford Univ. Press.
- Lamoral, B.H. & Reynders, S.C.** 1975. A catalogue of the scorpions described from the Ethiopian faunal region up to December 1973. *Ann. Natal Mus.* 22 (2): 489-576.
- Levy, G. & Amitai, P.** 1980. Fauna Palaestina. Arachnida I. Scorpiones. Jerusalem: The Israel Acad. Sciences and Humanities.
- Lippard, S.J., Shelton, A.W. & Gass, I.G.** 1986. The ophiolite of northern Oman. *Mem. Geol. Soc. London*. No. 11. Oxford, Blackwell.
- Sissom, W. D.** 1990. Systematics, biogeography and paleontology. In: G. A. Polis (ed.), *Biology of Scorpions*, pp. 64-160. Stanford Univ. Press, Stanford, CA.
- Sissom, W.D.** 1994. Descriptions of new and poorly known scorpions of Yemen (Scorpiones: Buthidae, Diplocentridae, Scorpionidae). *Fauna Saudi Arabia*. 14: 3-39.
- Vachon, M.** 1940. Voyage en A.O.F. de L. Berland et J. Millot - Scorpions. V. *Bull. Soc. Zool. Fr.* 65: 170-184, figs. 1-25.
- Vachon, M.** 1974. Étude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). *Bull. Mus. Nat. d'Hist. Nat. Paris*, (3), 140 (Zool. 104), 1973: 857-958.
- Vachon, M.** 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de famille des Buthidae Simon. *C.R. Hebd. Séances Acad. Sci.*, D. 281 (21): 1597-1599.

**FIRST REPORT OF *CALLEIDA (CALLEIDA)*
PURPUREA (COLEOPTERA: CARABIDAE)
IN MINNESOTA AND A NOTE ON ITS OCCURRENCE
ON PASQUE FLOWER^{1,2}**

Paul P. Tinerella³

ABSTRACT: The carabid beetle species, *Calleida purpurea* is reported here for the first time from Minnesota. At present, no published records exist for the adjacent states of North Dakota and Iowa. This species has been reported (cited as rare) from South Dakota (Kirk and Balsbaugh 1975), Wisconsin, and Manitoba (Bousquet and Laroche 1993).

A total of 38 specimens of the carabid beetle, *Calleida purpurea* (Say) was collected from pitfall traps on the Felton Prairie Complex, Clay County, northwestern Minnesota, at 47°03'20"N, 96°25'45"W. Specimens were collected from May-September, during 1995 through 1999. On 14 May 1998, a single specimen was collected from Pasque flower, *Anemone patens* Linnaeus, during routine early season set-up of field transects. Before its collection, this specimen was observed moving about on the flower.

All specimens were collected from 3 adjacent transects within the Felton Prairie Complex. The transect sites are located on dry tall-grass prairie. Pitfall traps were placed on gravelly ridges which grade from east to west, onto slightly mesic prairie. Vegetation on these sites consists of dry ground, tall-grass prairie indicator species such as Pasque flower, *A. patens*, Purple Coneflower, *Echinacea angustifolia* DC., Pussytoes, *Antennaria* spp., and at least two species of Blazing Star, *Liatris* spp.

Taxonomic notes on *Calleida* Latreille & Dejean- Adults of the genus *Calleida* are slender, metallic, medium sized beetles (6.0- 10.0 mm). The genus, in habitus, appears similar to the platynine genus *Agonum* Bonelli, but is distinguished immediately by the presence of one pair of supraorbital punctures (2 pairs of supraorbital punctures are present in the Platynini), and the deeply bilobed or emarginate fourth tarsal segment. *Calleida purpurea* is an uncommon carabid species; adults are readily recognized by the metallic blue-green color of the integument, bilobed fourth tarsal segment, the yellowish-red third and fourth antennomeres, and the rounded hind angles of the pronotum. The species is keyed in Lindroth (1969:1060).

Natural History of *Calleida* Latreille & Dejean- The genus *Calleida* belongs to the large, polygeneric tribe Lebiini. The tribe is most speciose in the tropics, where its members exhibit an arboreal habit. In temperate regions,

¹ Received November 3, 1999; Accepted December 27, 1999.

² Approved as North Dakota Insects Publication No. 17 Schafer-Post Series.

³ Department of Entomology, North Dakota State University, Fargo, ND 58105.

most members of the tribe are ground dwelling or "planticolous"- dwelling on bushes and herbs (Lindroth 1969, Larson 1969). Members of the subgenus *Calleida* Dejean are cited by Lindroth (1969) as arboreal – usually dwelling on bushes and herbs, however, specific ecological details were not recorded for *C. purpurea*. Larson (1969) discussed the arboreal nature of the subtribe Calleidina, noting that many species of the subgenus *Philophuga* Motschulsky [treated by Larson as a genus, see Lindroth, 1969], had been collected from vegetation. In his review, Larson included label data confirming the presence of *Calleida* (*Philophuga*) spp. on specific plant species. The larvae of *C. decora* (F.) and *C. purpurea* were examined by van Emden (1942); however, no ecological information was recorded. Adults of the genus are thought to be predaceous (Lindroth 1969), with *C. (Calleida) punctata* LeConte and *C. (Calleida) decora* being specialized feeders on noctuid and pyralid caterpillars (Watson 1916; Dozier 1917).

The presence of specific plant species on the Felton Prairie Complex, in association with soil type and soil moisture, may be indicative of suitable habitat for *C. purpurea*. All specimens of *C. purpurea* reported from the Felton Prairie Complex occur on sites with similar vegetation, soil type, and similar moisture gradients. On adjacent transects, where soil moisture and floral composition differ, no *C. purpurea* have been collected. The highly fragmented state of such habitat, both locally and regionally, coupled with a previous lack of collecting on such habitats, may perhaps explain the lack of records of this species in Minnesota. All specimens of *C. purpurea* reported here were deposited in the North Dakota State Insect Reference Collection.

ACKNOWLEDGMENTS

I thank David A. Rider, Dept. of Entomology, North Dakota State University, Allan C. Ashworth, & Donald P. Schwert, Dept. of Geosciences, North Dakota State University, for review and comments pertaining to the manuscript. Appreciation is also extended to Gerald M. Fauske, Dept. of Entomology, North Dakota State University for discussion and comments pertaining to the Felton Prairie Complex. The helpful comments and suggestions of two anonymous reviewers is also acknowledged, their comments serving to improve the manuscript. I also wish to thank Brian Winter, The Nature Conservancy – Minnesota Chapter, for coordination and access to the Felton Prairie Complex. Financial support for this research was provided by the Minnesota Chapter of the Nature Conservancy, the Wisconsin Department of Natural Resources, and the Minnesota Department of Natural Resources, Nongame Wildlife Fund.

LITERATURE CITED

- Bousquet, Y. A. Larochele. 1993. Catalogue of the Geadephaga (Coleoptera: Trachypachidae, Rhyssodidae, Carabidae, including Cicindelini) of America North of Mexico. Mem. Entomol. Soc. Can. (167) 1-397.
- Dozier, H.L. 1917. The life history of the Okra or Mallow caterpillar (*Cosmophila erosa* Hübner). J. Econ. Entomol. 10: 536-542.
- Emden, F. I. van. 1942. A key to the genera of larval Carabidae. Trans. Royal Entomol. Soc. London. 92: 1-99.

-
- Kirk, V.M. and E.U. Balsbaugh Jr.** 1975. A list of the beetles of South Dakota. Agric. Exp. Sta. So. Dak. State Univ. 139 pp.
- Larson, D.J.** 1969. A revision of the genera *Philophuga* Motschoulsky and *Technophilus* Chaudoir with notes on the North American Callidina (Coleoptera: Carabidae) Quaest. Entomol. 5:15-84.
- Lindroth C.H.** 1969. The ground beetles (Carabidae excl. of Cicindelinae) of Canada and Alaska. Part 6. Opus. Entomol., Suppl. 34(1969): 945-1192.
- Watson, J.R.** 1916. Life history of the velvet-bean caterpillar (*Anticarsia gemmatilis* Hübner). J. Econ. Entomol. 9: 521-528.

FIRST RECORD OF THE GENUS *PSEPHENOPS* (COLEOPTERA: PSEPHENIDAE) FROM MEXICO, WITH A DESCRIPTION OF A NEW SPECIES¹

Roberto Arce-Pérez, Rodolfo Novelo-Gutiérrez²

ABSTRACT.- *Psephenops mexicanus*, new species, is described based on specimens collected in a stream running through a cloud forest at Xico Viejo (1800 m asl), Veracruz State, Mexico, bringing the total number of described species assigned to the genus to seven. Complete illustrations are provided, for the first time, for the genus *Psephenops*.

The genus *Psephenops* (= *Xexanchorinus*) is comprised of six known species, with an apparent fragmentary distribution: *P. smithi* Grouvelle, 1898 (Antillean); *P. grouvellei* Champion, 1913 (Guatemala); *P. haitianus* Darlington, 1936 (Haiti); *P. maculicollis* Darlington, 1936 (Colombia and Costa Rica), *P. argentinensis* Delève, 1967 (Argentina) and *P. prestonae* Spangler, 1990 (Costa Rica). In this paper, we provide the first record of the genus for Mexico along with the description of a new species.

METHODS

Fifteen specimens were collected in a stream located at Xico Viejo village (1800 m altitude), Municipality of Xico, Veracruz State, Mexico. Individuals were initially preserved in ethanol 80% and some were later pinned; all collected material was examined. Male genitalia were extracted in ethanol, and potassium hydroxide (KOH 5%) was used to clear genitalia, which were used to make illustrations. Microphotographs were taken with a scanning electron microscope JEOL, model JSM T20 with magnification of 200x.

Psephenops mexicanus, NEW SPECIES

(Figs. 1-4)

DESCRIPTION: Holotype Male: Body oval, depressed; integument black, with reddish-yellow reflections, completely covered with iridescent, reddish-yellow, short setae; head, antennae, pronotum and scutellum black; elytra dark reddish brown, slightly elevated at humeral region; legs dark reddish brown, darker than elytra; ventrally reddish black, vestiture short, fine and dense, grayish, with iridescent, yellow reflections; total length 3.3 mm, maximum humeral width 1.5 mm.

Head (Fig. 1): Black and short, transverse; clypeus subrectangular, declivous at an angle of less than 90 degrees from the plane of the frons, distal margin widely emarginate; frontoclypeal surface with long, robust and stiff setae; vertex minutely punctate, with minute setae and a very shallow longitudinal furrow at middle. Antennae moniliform, 11 segmented, scape

¹ Received April 19, 1999. Accepted November 8, 1999.

² Instituto de Ecología, A.C. Departamento de Entomología. Apartado Postal 63, 91000 Xalapa, Veracruz, Mexico. E-mail: entomol@ecologia.edu.mx

larger than other segments, pedicel 0.60 length of scape and subglobose; 8 flagellar segments small, apical segment acuminate. Eyes lateral, rounded, very prominent, dark reddish brown; with post-ocular area amber yellow. Labrum similar to clypeus but shorter; maxillary palpi 4 segmented (Fig. 2), covered with long setae; segment 1 smallest; the apical segment largest; relative proportion of segments: 0.40, 0.80, 0.60, 1.0, basal segments 1-3 subconical; segment 4 oval, slightly depressed and ending in an inner subapical ridge. Labial palpi very short (Fig. 2), 3 segmented; segments 1-2 rounded and wide, segment 3 subconical and slightly longer than preceding ones.

Thorax: Pronotum black and subtrapezoidal (posterior margin 1.4 mm, lateral margin 0.78 mm); anterior margin arcuate; posterior margin bisinuate and almost as wide as elytral base (Fig. 1); lateral margins straight along anterior half and expanded laterally on posterior half; posterolateral angles subacute; all margins narrowly rimmed; pronotal disc with middorsal longitudinal carina (Fig. 1), carina well developed at distal half, and a wide, shallow, circular depression at each side of carina; in profile view, pronotal disc (except for posterolateral expansions) convex; pronotal surface with a punctation coarser than that of the head, and covered with short, cineraceous-yellow setae, and long dark reddish setae, setae shorter than those of head. Scutellum short and black, bluntly-pointed at apex.

Elytra: dark reddish brown, with short yellow setae and long reddish-yellow setae; sides parallel on basal 0.75, then gradually converging rearwardly; base depressed on each side within humeri; surface without striae; length (from base to apex of suture) 2.45 mm; width (across humerus), 1.55 mm. Prosternum black, short and slightly carinate; with long, concave, lanceolate and slightly carinate postcoxal process (Fig. 2), which reaches anterior half of mesosternum. Mesosternum black, short; with wide groove for reception of prosternal process. Metasternum black, large and bulky.

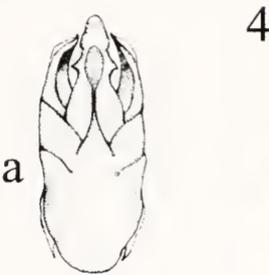
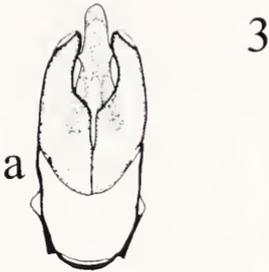
Legs: procoxae globose, mesocoxae conical, and metacoxae transverse; femora robust with yellowish-gray setae; tibiae slender; metatibiae as long as femora; protibiae with distinct apical posterolateral denticle; tarsi, 5 segmented, tarsomeres 1 and 2 bilobed, with ventral, moderately rolled-up, spongy-like pad covered with dense short pubescence ventrally; spongy-like pad of tarsomere 1 extending distally to level where tarsomere 2 divides; spongy-like pad of tarsomere 2 largest, extending distally and covering area beneath tarsomeres 3,4 and most of 5; proportional length of tarsomeres: 0.30, 1.0, 0.25, 0.20, 0.65; a pair of long, curved, and slender apical claws present; with small basal tooth.

Abdomen: Vestiture short, fine, dense and grayish; with distinct, yellow, iridescent reflections on segments 1-3; setae long, black and stout on segments 4-7. Seven visible sterna in relaxed specimens; usually the segment 6 hidden under segment 5. Sternum 2 the largest. Posterior margin of sternum 1 deeply concave at middle, sinuate at sides. Posterior margin of sternum 2 as in sternum 1 but concavity shallow medially. Posterior margin of sterna 3 and 4 straight, that of sternum 5 with a wide and shallow concavity at each side of midline. Sternum 6 very short, posterior margin widely concave. Pygidial plate narrow, oval, as long as sternum 5, and densely covered with long and stiff black setae.

Genitalia (Figs. 3-4): Trilobate, total length 0.57 mm. Paramere, in dorsal view, as in Fig. 3a; length 0.27 mm. Penis longer than paramere; in ventral view (Fig. 4a), apical half subtriangular, lanceolate; with a small tooth-like lateral projection at each side of basal 0.50, bearing a longitudinal lance-shaped sclerite along base; penis length, 0.22 mm. Phallobase, in lateral view, concave dorsally; in ventral view, bulky, hemicylindrical; length 0.24 mm, width 0.22 mm.

Female: Unknown.

Variation in paratype series.- Some specimens have the elytra and legs black or reddish-brown; posterior margin of abdominal sternum 5 not clearly convex at middle. One specimen has antennal segments 5 and 6 almost merged.



Figs. 1-4, *Psephenops mexicanus* sp. nov. 1) Details of head and pronotum showing middorsal carina, dorsal view; 2) detail of venter showing prosteral process; 3) and 4) male genitalia: 3a) diagram, dorsal view, showing bulky phallobase and paramere, 3b) microphotograph, dorsoapical view; 4a) diagram, ventral view, showing long penis and lanceolate apical half, 4b) microphotograph, ventrobasal view.

Measurements (in mm): total length of body, 3.15-3.55; maximum width 1.45-1.7; length of pronotum 0.75-0.8, basal width 1.35-1.45; elytral length 2.25-2.60.

DISCUSSION

Psephenops mexicanus, n. sp., may be separated from the other species of the genus by the following combination of characters: sides of pronotum straight on anterior half, suddenly and distinctly convex at posterior half; segment 4 of maxillary palpus almost twice as long as segment 3 and only slightly longer than segment 2; elytra without conspicuous striae; seven abdominal sterna visible; male paramere with the lateral sides almost straight, apex subtruncate; penis lanceolate and conspicuously longer than paramere. *Psephenops mexicanus*, n. sp., resembles other species in the following features: total length (*grouvellei*) (Champion, 1913); antennal scape almost two times longer than pedicel (*haitianus* [Darlington, 1936] and *prestonae* [Spangler, 1990]); number of sterna visible (*haitianus*, *maculicollis*, *smithi* [Darlington, 1936]; *prestonae* [Spangler, 1990]). Apparently, *P. mexicanus* is most similar to *P. maculicollis*.

Finally, it is important to note that this species represents the seventh described species of the genus, and is the northernmost record of the genus *Psephenops*.

Type material. Holotype labeled: "MEXICO, Veracruz, Xico, Xico Viejo; 1800 m, bosque mesófilo de montaña, 3-VIII-98, R. Arce col." Nine male paratypes, same data as holotype, except: 25-VII-97, 1♂; 26-VII-98, 4 ♂♂. Holotype and paratypes deposited at Colección Entomológica, Instituto de Ecología, A.C., Xalapa, Veracruz, México (IEXA).

Etymology. Because it is the first record of the genus for the country, it is named *mexicanus*.

Type locality. Xico Viejo, Xico, Veracruz, México.

Habitat. Adult males of *Psephenops mexicanus* were captured in a stream with rapid water flow, on emergent and overhanging riparian vegetation, as well as on big rocks not exposed directly to the water current but in the spray zone.

ACKNOWLEDGMENTS

We thank Alonso Ramirez (Georgia) for his invaluable help with the English syntax for the final manuscript and also providing part of the literature. Tiburcio Láziz Aponte took the microphotographs and Cesar Rojas composed the illustrations. Finally, special thanks are due to Harley P. Brown (Oklahoma), and an anonymous reviewer for their comments and suggestions for the final manuscript.

LITERATURE CITED

- Champion, G.C.** 1913. III. Notes on various Central American Coleoptera, with descriptions of new genera and species. Trans. Entomol. Soc. London. 1913:62-169.
- Grouvelle, A.H.** 1898. Clavicornes de Grenada et de St. Vincent (Antilles) recoltés par M.H.H. Smith, et appartenant au Musée de Cambridge. Notes from the Leyden Museum 20:35-48.
- Darlington, P.J.** 1936. A list of the West Indian Dryopidae (Coleoptera) with a new genus and eight species, including one from Colombia. Psyche 43:65-83.
- Delève, J.** 1967. Contribution à l' étude des Dryopoidea (Coleoptera). XIX. Notes diverse et descriptions d' espèces nouvelles. Bull. Ann. Soc. Entomol. Belgique 103:414-445.
- Spangler, P.J.** 1990. A new species and new record of the water-penny genus *Psephenops* (Coleoptera: Psephenidae) from Costa Rica. Entomol. News 101(3):137-139.

FORAGING DISTANCE OF *POGONOMYRMEX OCCIDENTALIS* (HYMENOPTERA: FORMICIDAE) ON GRAZED AND UNGRAZED SHORTGRASS PRAIRIES IN COLORADO¹

Shaharra J. Usnick²

ABSTRACT: Western harvester ants (*Pogonomyrmex occidentalis*) are granivores that preferentially collect certain seeds. In the ants' search for these preferred seeds, their foraging distances can be lengthy. However, the effects of grazing on *P. occidentalis* foraging distances have not been sufficiently studied. To test whether the ants foraged farther in grazed than in ungrazed sites, I offered commercial seeds (wheat and millet) at varying distances from the nests (6, 10, 12, 15, and 18m). Western harvester ants foraged significantly greater distances in grazed sites than in ungrazed sites. I conclude that the ants forage farther to collect their preferred seeds in grazed ecosystems because there is more bare ground, a consequence of grazing.

Pogonomyrmex species foragers often travel long distances to collect preferred seeds (Rogers 1974, Whitford 1978, DeVita 1979, Anderson 1988, Holldobler & Wilson 1992). DeVita (1979) found that the foraging activity of *P. californicus* in the Mojave desert was highest near the nest, but that individual ants foraged up to 13 m away from their nests. Rogers (1974) studied foraging in northeastern Colorado in lightly grazed and heavily grazed grasslands; maximum foraging distances were 11.0 m and 14.3 m, respectively. Rogers' differences were not significant, but the data support DeVita's findings in terms of the maximum foraging distance for the ants. Other studies have verified these foraging distances for *Pogonomyrmex* species and other granivorous ants (Whitford 1976, Anderson 1988). Fewell (1988) showed that on sparsely vegetated sites, such as grazed sites, western harvester ants walked significantly faster and traveled significantly farther. In this study I tested the hypothesis that western harvester ants forage farther in grazed sites than in the ungrazed sites.

MATERIALS AND METHODS

In order to determine the maximum foraging distance of the ants and to establish whether this distance varied between the grazed and ungrazed sites, I offered millet and crushed wheat seeds to the ants in petri dishes. These seeds were offered at varying distances away from the nests on two study sites, one grazed and one ungrazed. Millet and crushed wheat seeds were of-

¹ Manuscript received November 23, 1998. Accepted January 19, 2000.

² Previous Address: High Plains Grassland Research Station, USDA Agricultural Research Service, 84008 Hildreth Road, Cheyenne, WY 82009.

Current Address: USDA-ARS, Southern Weed Science Research Unit, 141 Experiment Station Road, Stoneville, MS 38776.

ferred because preliminary experiments showed that the ants readily collected these seeds. However, the use of crop seeds did not lead to an overestimation of foraging distances because I followed the ants' trunk trails as they foraged up to and beyond the tested distances prior to the availability of crop seeds.

Both grazed and ungrazed sites were located in Boulder County, CO. One site was located in Louisville on Rock Creek, which is owned by Boulder County Open Space. The second site was located on Horse Creek Ranch, just north of the City of Boulder.

At each site, a minimum of three nests were tested but whenever possible more nests were used. Therefore, a minimum of 15 nests were tested during these times. These nests were well established and were approximately the same size and age.

I placed the seeds in petri dishes and set them in or near an active trunk trail. The active trunk trails were randomly chosen. The seeds were placed near the trunk trails to ensure that the ants would find the dishes and forage from them. Only one trial per day was run to avoid "forager memory" of the dish placement. In addition, trials were done on alternating days.

Beginning 23 June, 1994, crop seeds in shallow petri dishes were placed at 6, 10, 12, 15, and 18m from the nest entrance. The test ended at 18m because previous studies showed that the ants foraged primarily up to 14m. In addition, I found low numbers of ants at the ungrazed sites at the farther distances away from the nests.

Ants were observed for 2 minutes every 15 minutes for a minimum of 8 observation periods per distance per nest. A total of 266 observation periods were done over the field season.

Ants that were within one meter on either side of the dish or were actually in the dish were counted as foraging at the dishes. In addition, dishes were placed at only one distance at a time to avoid distracting the ants to closer dishes and to allow the establishment and maintenance of a trunk trail to the dish.

The data were analyzed by using a two-way ANOVA for unequal sample numbers, with sampling periods within nests as the samples. This test was done to test the interaction between grazing treatment and foraging distance.

RESULTS AND DISCUSSION

A significantly ($P \leq 0.0001$) larger concentration of ants foraged at the longer distances for seeds on the grazed sites than on the ungrazed ones (Fig. 1). On both grazed and ungrazed sites, there was a high concentration of ant foragers at 6m. However, the number of foragers decreased sharply after 6m in the ungrazed sites while ants on the grazed sites regularly foraged at 18m and at all intermediate distances (Fig. 1). A significantly larger concentration of ants foraged at longer distances in the grazed sites than in the ungrazed sites ($P \leq 0.001$). The largest number of foraging ants in the grazed site was observed at

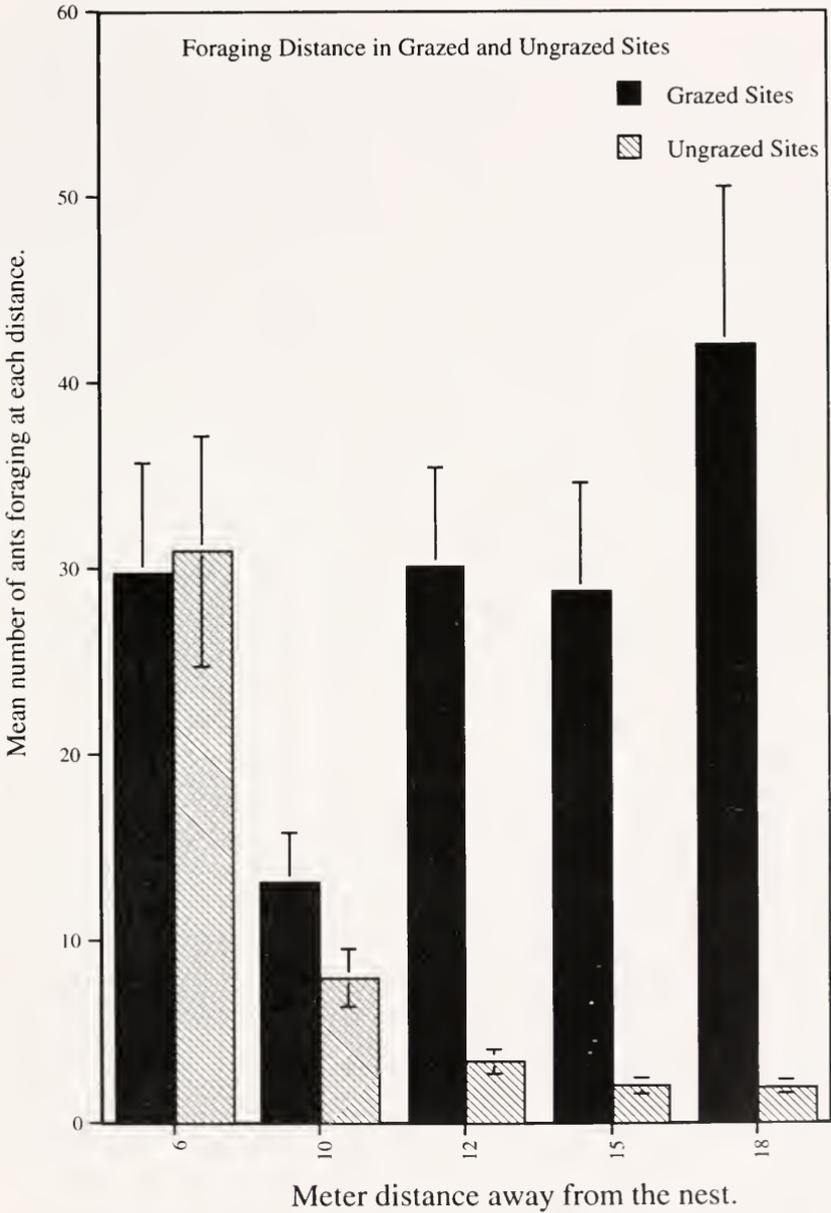


Fig. 1. Foraging distances of western harvester ants (*Pogonomyrmex occidentalis* Cresson) on grazed and ungrazed shortgrass rangeland (lines at the top of each bar indicate standard error of means).

18m (Fig. 1). In addition, when a two-way ANOVA was done on the interaction of ant numbers for each distance at grazed and ungrazed sites, the difference was highly significant ($P \leq 0.0001$).

The greater distances traveled on the grazed sites were likely caused by the increase in bare ground produced by livestock grazing (Milchunas et al. 1989, 1992; Gillen et al. 1991; Bock and Bock 1993), although the amount of bare ground and availability of the ants' preferred seeds were not examined in this study, I believe that this hypothesis is correct because Fewell (1988) showed that on sparsely vegetated sites, such as grazed sites, *P. occidentalis* walked significantly faster and farther without an increase in foraging time. In this study, the ants in the grazed sites foraged farther than those in the ungrazed sites to collect seeds, perhaps because there was more bare ground on the grazed sites, which lowered the likelihood that the ants would encounter a preferred seed in the shorter foraging ranges. However, in order to accurately determine if grazing treatments did affect the ants and their foraging distances, an accurate estimate of the number of ants or nests per hectare needs to be done.

Several other studies examined the foraging distance of *P. occidentalis* but those distances were not as long as those in this study. Crist and MacMahon (1992) found that foraging activity was concentrated 2-7m from the nest but could progress up to 7-12m. Rogers (1974) found that the maximum foraging distances of *P. occidentalis* were 14.3m in lightly grazed grasslands and 11.0m in heavily grazed grasslands. Rogers' findings are similar to mine because I found that the ants on the grazed sites commonly foraged farther, up to and beyond 18m away from the nest, whereas, in the ungrazed sites the ants foraged primarily at 6m.

Crist and MacMahon (1991) found that individual ants exhibited fidelity in their search sites, as well as a fidelity to certain seeds of certain select species. Their findings suggested that individual ants may forage in the same direction each day. In my study, individual ants could be actively foraging in the direction of previous dishes. However, the ants' fidelity is unlikely to artificially increase the foraging distance encountered in my study because my tests were not done on consecutive days.

The exact reason for the ants' extended foraging distances in the grazed sites remains unclear because there was a greater concentration of the ants' preferred seed species within 10m of the ant nests in the grazed sites. The first two preferred seed species of these ants were *Heterotheca villosa* (Asteraceae) and *Stipa comata* (Gramineae) (Usnick, 1996). Although the ants' preferred seed species are more abundant in the grazed than in the ungrazed sites, there was also a higher abundance of exotic, annual plants, which the ants do not prefer (Usnick, 1996).

Harvester ants do appear to have a preferred foraging habitat, which in this study is grazed grasslands. However, how these preferences are affected by habitat characteristics, such as increased bare ground and increased amounts

of exotic plants caused by grazing, remains unknown due to the difficulty in eliminating abiotic and biotic factors from the environment.

In addition, due to these environmental factors, colony growth over the year may be fairly flexible. The amount of seeds that the ants are capable of collecting would be less than the colony needs. This is especially apparent during the summer months when colony growth is at its highest point. Therefore, the ants may travel farther during the summer months than they would during other times of the year when they do not have the additional colony growth. These extended foraging distances would be especially apparent on grazed grasslands. Although grazed grasslands have higher numbers of the ants' preferred plant species (Usnick, 1996), they also have increased amounts of bare ground and more exotic plant species. Therefore the ants may have to forage farther and spend larger amounts of time to collect preferred seeds.

In conclusion, western harvester ants forage up to and beyond 18m in grazed shortgrass prairies, while most ants on ungrazed prairies foraged primarily at 6m. I suggest that grazed grasslands have larger amounts of bare ground and therefore, the ants must travel farther in grazed sites to find their preferred seeds.

ACKNOWLEDGMENTS

Thanks to Boulder County Open Space for generous use of the sites. Also I thank Richard Hart, Brian Kreiser, Rob Kaczanowski, and Susan and Chenoa Usnick for their help on various aspects of this project.

LITERATURE CITED

- Anderson, A. N. 1988. Dispersal Distance as a Benefit of Myrmecochory, *Oecologia* 75:507-511.
- Bock, C. E. & J.H. Bock 1993. Cover of Perennial Grasses in Southeastern Arizona in Relation to Livestock Grazing, *Conserv. Bio.* 7(3): 371-377.
- Crist, T. O. & J. A. MacMahon 1991. Individual Foraging Components of Harvester Ants: Movement Patterns and Seed Patch Fidelity, *Insect Societies* 38: 379-396.
- DeVita, J. 1979. Mechanisms of Interference and Foraging among Colonies of the Harvester ant *Pogonomyrmex californicus* in the Mojave Desert, *Ecology* 60(4): 729-737.
- Fewell, J. H. 1988. *Behav Ecol Sociobiol* 88(22): 401-408.
- Gillen, R.L., F. T. McCollum, M. E. Hodges, J. E. Brummer, & Tate, K.W. 1991. Plant Community Responses to Short Duration Grazing in Tallgrass Prairie. *Jrn. of Range Mgmt.* 44(2): 124-128.
- Holldobler, B. & E. O. Wilson 1992. *The Ants*, Harvard University Press, Boston, MA.
- Milchunas, D.G., W. K. Lauenroth, P. L. Chapman, & M. K. Kazempour 1989. Effects of Grazing, Topography, and Precipitation on the Structure of a Semiarid grassland, *Vegetatio* 80: 11-23.
- Rogers, L.E. 1974. Foraging Activity of the Western Harvester Ant in the Shortgrass Plains Ecosystem, *Environ. Entomol.* 3(3): 420-424.
- Usnick, S.J. 1996. Seasonal Seed Preference & Foraging Distance of *Pogonomyrmex occidentalis* (Hymenoptera: Formicidae), Western Harvester Ants, in the Grasslands surrounding Boulder Co., CO. Univ. Colorado, Boulder. M.A. Thesis (unpubl.).
- Whitford, W.G. 1978. Foraging in Seed-Harvesting Ants *Pogonomyrmex* spp. *Ecology* 59(1): 185-189

AN ANNOTATED LIST OF TRICHOPTERA ALONG SEVERAL STREAMS IN THE BANKHEAD NATIONAL FOREST IN NORTHWEST ALABAMA¹

M. B. Hicks², C. G. Haynes³

ABSTRACT: The distribution and seasonal occurrence of adult Trichoptera at fifteen stream sites within the Bankhead National Forest is presented. Annotations include information on species habitat and relative abundance. The trichopteran fauna was represented by 135 species. Forty-four species previously unknown from this area and two species that appear to be endemic were collected. One species collected is a new state record for Alabama (*Pycnopsyche guttifer*), and one species is new to science (*Setodes* n. sp.)

The Bankhead National Forest (BNF) is the largest of Alabama's National forests. It is distinctive among other national forests in the state because it contains the Sipsey Wilderness Area. The relative absence of certain anthropogenic activities, for example, silviculture, poultry operations and industrial facilities in the National Forest, especially within the Sipsey Wilderness Area, has enhanced its ability to sustain populations of flora and fauna that might not exist in other more impacted streams in Alabama. Previous surveys have detected several rare or restricted plants and animals (Harris 1990; McDearman 1976; McGregor 1992), but studies of caddisflies in the area have been few. Several caddisflies found in the BNF are thought to be rare or restricted in distribution (Harris 1990).

The BNF is situated in Franklin, Lawrence, and Winston Counties in Northwest Alabama, and lies almost entirely within the Cumberland Plateau in the Appalachian Plateau physiographic province, with a small northern portion located in the Highland Rim. Although the Bankhead has remained somewhat protected for a large part of this century, increases in silviculture, poultry industries, and strip mining over the past several decades have increased the chances for degradation to occur in streams draining this region. Because of this possible risk coupled with the relatively unknown insect fauna of this region, a survey and analysis of the caddisfly fauna of several streams in the forest was initiated.

Fifteen sites on fourteen streams located throughout the BNF were sampled monthly for one year, during the months between January and December 1993. The majority of the BNF lies within the Mobile Bay Drainage and contains tributaries of the Sipsey Fork of the Black Warrior River. However, Tennessee River tributaries drain a small portion of it, one of which, Lee Creek was

¹ Received December 20, 1998. Accepted December 27, 1999.

² Mississippi Department of Environmental Quality, 2142 Jackson Ave. West, Oxford, MS 38655.

³ Department of Biology, Shelton State Community College, Cottondale, AL 35405.

sampled. The remaining streams are all part of the Mobile Bay Drainage. The majority of the forest is underlain by sandstone and shale of the Pottsville Formation of the Pennsylvanian age, with limestone and dolomite crops occurring in the upper area ranging in age from Early Mississippian to Early Pennsylvanian (Adams et al. 1926). Streams that lie in the Cumberland Plateau portion of the forest all flow to the south and are tributaries to the Black Warrior River. The larger streams occupy deeply entrenched valleys, with overhanging bedrock cliffs occurring throughout the drainage basin. Streams located in the northern boundaries of the forest lie within the Highland Rim Province and drain to the Tennessee River. This area is characterized by gently rolling hills, and the majority of the streams are slow and meandering. The benthic substrates of streams occurring in the Bankhead, although variable, consist primarily of flat bedrock with large, flat slabs of sandstone. A few of the smaller streams have sandy substrates, and streams draining the Bangor Limestone have limestone substrates of cobbles and boulders. Thompson Creek in western Lawrence County is unique in having large cobble for substrate, intermixed with sand and gravel. Lee Creek, in the northern-most boundary of the forest, displays slow moving waters, with sand and gravel substrate. It also contained a large amount of organic debris in its channel during the colder months.

METHODS

During the survey, water and air temperature (bulb thermometer), specific conductance (Cole-Parmer Model 1481-40), and pH (Cole-Parmer Model 612 pH meter) were measured monthly in the field at all sites. Water samples were taken seasonally and returned to the lab where alkalinity was determined (Wetzel and Likens 1991). All water quality parameters were expressed as the mean of the 12 monthly samples (Table 1). The majority of the biological collections were obtained by ultraviolet light trapping methods (Harris et al. 1991) from February to November 1993. Light traps were situated on the stream banks and operated for approximately one hour after dusk. Additional adult specimens were occasionally collected by sweeping along stream margins. Specimens were preserved in 80% ethanol. In all, 102 collections were made from which 9,329 caddisfly individuals were identified.

RESULTS

One hundred thirty-five (135) species representing 19 families and 46 genera were recorded. An annotated list of species documented is presented below (Table 2). Information for each species includes collection sites and number of individuals collected. A more detailed discussion of distributions is contained in Hicks (1995). An asterisk indicates species previously not reported from the BNF. In most cases only males of the species were identified. Voucher specimens are housed in the Aquatic Insect Museum of the University of Alabama.

COLLECTION SITES

1. Lawrence Co.; Borden Creek; Forest Rd 208, 12.5 mi N Double Springs, T8S, R8W, Sec. 28/21.
2. Lawrence Co.; Brushy Creek; Forest Rd 254, 9.1 mi S Moulton, T8S, R7W, Sec. 21.
3. Lawrence Co.; Hubbard Creek; Forest Rd 210, 8.5 mi NE Haleyville, T8S, R9W, Sec. 23.
4. Lawrence Co.; Lee Creek; Alexander Motorway, 8.5 mi S/SW Moulton, T8S, R7W, Sec. 1.
5. Lawrence Co.; Thompson Creek; Forest Rd 208, 9.5 mi NE Haleyville, T8S, R9W, Sec. 22.
6. Lawrence Co.; West Fork Creek; Forest Rd 244, 10.6 mi S Moulton, T8S, R8W, Sec. 36.
7. Winston Co.; Brushy Creek; Forest Rd 255, 5.2 mi NW Addison, T9S, R7W, Sec. 23.
8. Winston Co.; Clear Creek; Co. Rd 25, 1.3 mi SW Double Springs, T11S, R9W, Sec. 1.
9. Winston Co.; Coon Creek; Co. Rd 8, 6.5 mi SE Double Springs, T11S, R7W, Sec. 30.
10. Winston Co.; Inman Creek; Forest Rd 124, 1.6 mi W Addison, T9S, R7W, Sec. 26.
11. Winston Co.; Long Branch; Co. Rd 80, 2 mi NE Addison, T9S, R6W, Sec. 23.
12. Winston Co.; Mile Creek; Co. Rd 13, 2.8 mi SW Addison, T10S, R7W, Sec. 15.
13. Winston Co.; Sandy Creek; Co. Rd 2, 3 mi NE Double Springs, T10S, R8W, Sec. 11.
14. Winston Co.; West Sipsy Fork; Recreational site, Sipsy Wilderness Area, 9.5 mi N Double Springs, T9S, R8W, Sec. 8.
15. Winston Co.; Wildcat Branch; unnamed Co. Rd, 6 mi S/SW Double Springs, T11S, R9W, Sec. 25.

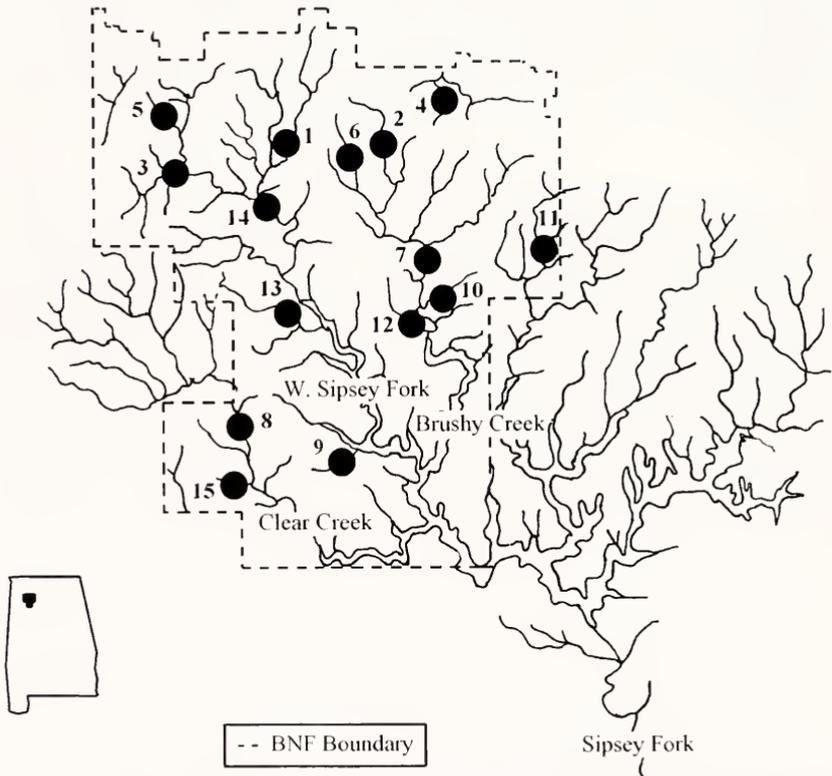


Figure 1. Collecting sites in the Bankhead National Forest. Numbers correspond to those listed in text.

Table 1. Annual mean values for selected water quality parameters of streams sampled in the Bankhead National Forest (Winston Co., Lawrence Co.) (1993)

Stream	Air Temp. (°C)	Water Temp. (°C)	pH (units)	Conductivity (umhos/cm)	Alkalinity (mg/l as CaCO ₃)
Clear Cr.	18.1	15.4	7.1	25.1	1.2
Coon Cr.	19.2	15.4	6.9	23.4	1.0
Inman Cr.	16.8	15.2	7.3	22.4	1.1
Long Br.	15.7	14.3	7.2	41.2	1.6
Mile Cr.	18.9	15.8	6.9	25.1	0.9
Sandy Cr.	18.6	15.9	6.9	26.7	0.6
W. Sipsey Fork	18.3	16.7	7.2	65.2	2.8
Wildcat Br.	18.7	16.2	6.8	18.0	0.5
Borden Cr.	18.6	16.9	7.2	135.6	6.7
Brushy Cr. I	15.7	15.4	6.9	19.0	1.0
Brushy Cr. II	16.2	14.5	7.2	16.5	1.1
Hubbard Cr.	18.0	15.0	6.7	20.9	1.3
Lee Cr.	16.0	15.7	7.1	84.5	6.0
Thompson Cr.	18.5	16.6	6.9	51.2	3.8
West Fork Cr.	18.6	15.9	7.2	26.3	1.0

Table 2. Annotated list of species collected in the Bankhead National Forest

Family	Species	Collection Site Number	# of Individuals
Dipseudopsidae	<i>Phylocentropus carolinus</i>	7,9,12	
	Carpenter*		15
	<i>P. lucidus</i> (Hagen)	3,9	4
Hydropsychidae	<i>P. placidus</i> (Banks)	1,3,5,6,7,10,11,12,13,14,15	92
	<i>Ceratopsyche sparna</i> Ross	1,3,7,8,9,10,11,12,13,14,15	88
	<i>Cheumatopsyche burksi</i> Ross*	8,10	2
	<i>C. campyla</i> Ross*	6,8,9,10,13	243
	<i>C. editsa</i> Gordon*	2	2
	<i>C. goera</i> Denning	1,4,6,7,8,10,11,12,13,14,15	147
	<i>C. kinlockensis</i> Gordon, Harris, Lago	3	1
	<i>C. oxa</i> Ross	1,2,3,4,5,6,7,10,12	34
	<i>C. pasella</i> Ross	1,2,3,5,6,7,8,9, 10,11,12,13, 14,15	130
	<i>C. pettiti</i> (Banks)	2,5,6,7,8,10,11,12,13,14,15	53
	<i>C. pinaca</i> Ross	3,12,15	6
	<i>Hydropsyche betteni</i> Ross	2,3,5,6,9,12,15	51
	<i>H. dicantha</i> Ross*	1,2,3,7,8,9,15	54
	<i>H. sp. nr. frisoni</i> Ross*	14	1
	<i>H. mississippiensis</i> Flint*	1,2,8,11,12,13,14,15	143
	<i>H. orris</i> Ross	1,3,4,5,6,7,8,9,10,11,12,13	73
	<i>H. rossi</i> Flint, Voshell, Parker*	8,13	3
<i>H. venularis</i> Banks*	8,10,12	10	
<i>Macrostemum carolina</i> (Banks)*	4,5,8,15	10	
<i>M. zebratum</i> (Hagen)*	8	4	

Family	Species	Collection Site Number	# of Individuals	
Polycentropodidae	<i>Cernotina calcea</i> Ross	7,9,11,13	6	
	<i>Cynnellus fraternus</i> (Banks)*	5,6,7,12,14	12	
	<i>Neureclipsis melco</i> Ross	13	1	
	<i>Paranycitophylax affinis</i> (Banks)	1,2,7,12,13,14	23	
	<i>P. denningi</i> (Morse)	3,4,5,6,9,10,11,12,14,15	151	
	<i>P. moesta</i> (Banks)	5,6,7,12,14,15	26	
	<i>P. serratus</i> (Lago and Harris)	2	3	
	<i>Polycentropus alabamensis</i> Hamilton, Harris, and Lago	3,9	5	
	<i>P. blicklei</i> Ross and Yamamoto	5,8,9,14	14	
	<i>P. cinereus</i> Hagen	1,5,12	6	
	<i>P. confusus</i> Hagen	1,3,5,6,8,9,10,11,12,13,14,15	257	
	<i>P. crassicornis</i> Walker*	4	4	
	Psychomyiidae	<i>Lype diversa</i> (Banks)	1,2,3,4,5,6,7,8,9,10,11,12, 13,14	167
		<i>Psychomyia flavida</i> Hagen*	1,7,8,12,14	86
	Philopotamidae	<i>Chimarra aterrima</i> Hagen	1,3,5,6,7,14	51
<i>C. feria</i> Ross*		14	2	
<i>C. obscura</i> (Walker)		1,3,4,5,8,11,12,13,14,15	401	
<i>Dolophilodes distinctus</i> (Walker)		4,5,9	4	
Glossosomatidae	<i>Agapetus alabamensis</i> Harris*	4	1	
	<i>A. hessi</i> Leonard and Leonard	1,2	42	
	<i>A. rossi</i> Denning	5,7,10,11	34	
Hydroptilidae	<i>Glossosoma nigrior</i> Banks	1,3,14	4	
	<i>Dibusa angata</i> Ross*	1,5,7,8,12,13,14	48	
	<i>Hydroptila alabama</i> Harris and Kelley	1,2,3,5,7,8,10,11,12,13,14,15	182	
	<i>H. armata</i> Ross	1,3,11,13,14	5	
	<i>H. disgalera</i> Holzenthal and Kelley	9	4	
	<i>H. gunda</i> Milne	3,5,8,11,12,13,14	59	
	<i>H. hamata</i> Morton	1,3,5,6,7,8,10,11,12,13,14	667	
	<i>H. novicola</i> Blicke and Morse	8,15	14	
	<i>H. oakmulgeensis</i> Harris	3,5,8,14,15	169	
	<i>H. oneili</i> Harris	3,10,11,13,14,15	38	
	<i>H. parlatosa</i> Harris	5,9	2	
	<i>H. paramoena</i> Harris*	12	1	
	<i>H. quinola</i> Ross	3,8,12	9	
	<i>H. remita</i> Blicke and Morse*	9	1	
	<i>H. vala</i> Ross	2,3,4,5,6,10,11,12,14	80	
	<i>H. virgata</i> Ross*	4,5	2	
	<i>H. waubesia</i> Betten	11,14	7	
	<i>Mayatrichia ayama</i> Mosely*	8,15	56	
	<i>Neotrichia vibrans</i> Ross	4,5,8,9,12,14,15	59	
	<i>Ochrotrichia shawnee</i> Ross	5,8,10,14,15	245	
<i>O. elongiralla</i> Harris*	4	1		
<i>Orthotrichia aegerfasciella</i> (Chambers)	1,2,3,4,5,6,7,8,11,12,13,14	62		

Family	Species	Collection Site Number	# of Individuals
	<i>O. cristata</i> Morton*	1,5,8,13,14	28
	<i>Oxyethira janella</i> Denning*	7	1
	<i>O. novasota</i> Ross	1,2,3,5,6,8,9,12,13,14,15	7
	<i>O. pallida</i> (Banks)	9,13	3
	<i>O. rivicola</i> Blickle and Morse	5,7,14	10
	<i>O. zeronia</i> Ross*	13	2
	<i>Stactobiella delira</i> Ross*	2,7,8,14	27
	<i>S. palmata</i> Ross	1,7,10	7
Rhyacophilidae	<i>Rhyacophila carolina</i> Banks	2,3,4,5,6,8,9,10,12,13	47
	<i>R. fenestra</i> Ross*	1,4,5	4
	<i>R. glaberrima</i> Ulmer	9,13	2
	<i>R. ledra</i> Ross*	8	1
	<i>R. lobifera</i> Betten*	7,11,14	5
	<i>R. torva</i> Hagen*	9	1
Brachycentridae	<i>Brachycentrus numerosus</i> (Say)*	8	1
	<i>Micrasema rusticum</i> (Hagen)	2,3,5,7,8,10,11,12,13,14	144
	<i>M. wataga</i> Ross	7	1
Goeridae	<i>Goera townesi</i> Morse	1,2,5,7,8,10,12,13,14	69
Lepidostomatidae	<i>Lepidostoma latipenne</i> (Banks)	3,5,6,8,9,13,14	32
	<i>L. weaveri</i> Harris*	5	1
Limnephilidae	<i>Ironoquia punctatissima</i> (Walker)*	4	1
	<i>Pycnopsyche gentilis</i> (Mclachlan)*	15	3
	<i>P. guttifer</i> (Walker)	1	1
	<i>P. indiana</i> (Ross)	8,10,14	9
	<i>P. lepida</i> (Hagen)	1,10,14	10
	<i>P. luculenta</i> (Betten)	9,13	3
	<i>P. scabripennis</i> (Rambur)	5,6,7,10,14	12
Uenoidae	<i>Neophylax oligius</i> Ross	10	1
	<i>N. concinnus</i> Mclachlan	1	3
Phryganeidae	<i>Agrypnia vestita</i> (Walker)	8,9,15	26
	<i>Ptilostomis ocellifera</i> (Walker)*	4,9,10,15	7
	<i>P. postica</i> (Walker)*	4	1
Calamoceratidae	<i>Anisocentropus pyraloides</i> (Walker)	5,9,14	34
	<i>Heteroplectron americanum</i> (Walker)	9	4
Leptoceridae	<i>Ceraclaea ancylus</i> (Vorhies)*	1,7,8,11,12	37
	<i>C. cancellata</i> (Betten)	1,3,5,6,7,8,14,15	1,010
	<i>C. flava</i> (Banks)	1,8	328
	<i>C. macualta</i> (Banks)	2,7,8,11,14	83
	<i>C. nepha</i> (Ross)	8,11,12,14	16
	<i>C. protonepha</i> Morse and Ross	2,7,9,10	6
	<i>C. tarsipunctata</i> (Vorhies)	2,5,7,8,10,12,13,14,15	938
	<i>C. transversa</i> (Hagen)*	1,2,3,5,7,8,10,12,13,14	72
	<i>Leptocerus americanus</i> (Banks)	13	1
	<i>Mystacides sepulchralis</i> (Walker)	1,2,3,4,6,7,8,9,10,11,12,13,14	201
	<i>Nectopsyche candida</i> (Hagen)	8	18
	<i>N. exquisita</i> (Walker)*	2,8,14	13
	<i>N. pavida</i> (Hagen)	1,3,8,10,12,13,14	125

Family	Species	Collection Site Number	# of Individuals
	<i>Oecetis avara</i> (Banks)	2,3,14	18
	<i>O. cinerascens</i> (Hagen)*	5	1
	<i>O. ditissa</i> Ross	1,3,4,5,6,11,13,14,15	37
	<i>O. georgia</i> Ross	9	7
	<i>O. inconspicua</i> (Walker)	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	365
	<i>O. nocturna</i> Ross	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	228
	<i>O. persimilis</i> (Banks)	1,2,3,5,7,8,10,11,12,13,14	123
	<i>O. sphyra</i> Ross	6,8,9,15	471
	<i>Setodes</i> n. sp.	14	2
	<i>Triaenodes cumberlandensis</i> Etnier and Way	13	1
	<i>T. ignitus</i> (Walker)	8,9,10,15	9
	<i>T. injustus</i> (Hagen)	15	2
	<i>T. marginatus</i> Sibley*	3	1
	<i>T. ochraceus</i> (Betten and Mosely)	3,4,6	3
Molannidae	<i>Molanna blenda</i> Sibley*	12	1
	<i>M. tryphena</i> Betten	1,2,3,6,7,8,9,10,12,13	41
	<i>M. ulmerina</i> Navas	6,9,10,12,13	19
Odontoceridae	<i>Psilotreta frontalis</i> Banks	2,9	6
Helicopsychidae	<i>Helicopsyche borealis</i> (Hagen)	3,5,7,8,14,15	48
Sericostomatidae	<i>Agarodes crassicornis</i> (Walker)*	8,9,15	19
	<i>A. griseus</i> Banks	8,9,15	12
	<i>A. libalis</i> Ross and Scott*	8	6
	<i>A. stannardi</i> (Ross)	8,9,13,15	19

DISCUSSION

One hundred two collections from 15 sites along 14 streams in the Bankhead National Forest yielded 135 species of caddisflies, from 46 genera and 19 families. Two species collected are apparently endemic to the BNF (*Cheumatopsyche kinlockensis* and *Setodes* n. sp.). One species was a new state record for Alabama (*Pycnopsyche guttifer*). One species was collected that is new to science (*Setodes* n. sp.).

Adults were collected from March to October, 1993. The number of species and individuals collected were greatest from May to August, with greatest monthly diversity occurring from May to July. Numbers of species, genera and families collected were high in comparison to other trichopteran surveys of drainages or regions of Alabama and other states (Frazer et al. 1991, Holzenthal et al. 1982, Harris et al. 1984, Haynes 1995), which suggests that the BFN supports a particularly rich fauna. The wide diversity of habitats and cool, swift, oxygen richwaters probably accounts for the rich fauna. Emergence patterns of specific taxa were not different based on size or location of stream.

Hydropsychidae, Hydroptilidae, Leptoceridae and Polycentropodidae were represented by a total of 91 species, accounting for 66.9 percent of the species collected, whereas Calamoceratidae, Lepidostomatidae, Psychomyiidae, Uenoidae, Odontoceridae, Helicopsychidae and Goeridae were represented by 11 species, accounting for eight percent of the species collected. These percentages are similar to other southeastern systems and are explained by the adaptation of the larger families to warmer waters and the smaller families containing fewer species per family (Wiggins 1977).

Clear Creek exhibited the largest number of species (62) and individuals (4588) collected, whereas Lee Creek contained the smallest (26 species and 67 individuals). Streams draining the Wilderness Area yielded 2101 individuals (23 % of total) and 85 species (63 % of total). All other streams yielded 7228 individuals (77 % of total) and 123 species (91 % of total). The difference in percentages of these two areas likely is due to the difference in number of streams and area sampled.

Some taxa had widespread distributions and others appear to be limited in their distribution within the study area. A number of taxa were restricted to more than one stream located in the southern portion of the study area. Two species were restricted to more than one stream in the Wilderness Area. No taxa were restricted to more than one stream located in the western portion of the study area. These distributional patterns may arise from a variety of factors including habitat, characteristics of the stream, or water chemistry. A more detailed discussion of distribution patterns can be found in Hicks (1995).

Based on the results presented in this survey, the BNF contains a rich fauna of Trichoptera compared to other areas in Alabama, and contains several rare or endemic species. Because of this and other similar faunistic and floristic surveys of the area, the BNF deserves protection from harmful impacts in order to protect its natural history.

ACKNOWLEDGMENTS

The Department of Biology at the University of Alabama provided support and facilities during the course of this study and is gratefully acknowledged. We would like to thank S.C. Harris, Clarion University for verifying several identifications. We would also like to thank S. Harris, R. Holzenthal, B. Stark, and P. Lago for reviewing the manuscript.

LITERATURE CITED

- Adams, G.I., Butts, Charles, L.W. Stephenson, and C.W. Cooke. 1926. Geology of Alabama: Geol. Surv. Ala. Spec. Rept. 14. 312 p.
- Frazer, K.S., S.C. Harris, G.M. Ward. 1991. Survey of the Trichopteran in the Little River drainage of northeastern Alabama. Bull. Ala. Mus. Nat. Hist. 11:17-22.
- Harris, S.C. 1990. Preliminary considerations on rare and endangered invertebrates in Alabama: Geol. Surv. Ala. reprint Series 78. 92 p.
- Harris, S.C., P.K. Lago, and P.E. O'Neil. 1984. Trichoptera of the Cahaba River system in Alabama. Entomol. News 95:103-112.

- Harris, S.C., P.E. O'Neil, and P.K. Lago.** 1991. Caddisflies of Alabama: Geol. Surv. Ala. Bull. 142. 442 p.
- Haynes, C.G.** 1995. Caddisflies of the Black Belt Prairie Region in West Central Alabama. M.S. Thesis. Univ. Ala. 164 p.
- Hicks, M.B.** 1995. Survey of Caddisflies (Trichoptera) of the Bankhead National Forest in Northwest Alabama. M.S. Thesis. Univ. Ala. 285 p.
- Holzenthal, R.W., S.C. Harris, and P.K. Lago.** 1982. An annotated checklist of the caddisflies (Trichoptera) of Mississippi and southeastern Louisiana. Part III: Limnephiloidea and conclusions. Proc. Entomol. Soc. Wash. 84:513-520.
- McDearman, W.W.** 1976. A floristic survey of Thompson Creek Watershed in the Sipsey River Wilderness Area of Lawrence County, Alabama. M.S. Thesis. Miss. State Univ. 93 p.
- McGregor, S.W.** 1992. A mussel survey of streams draining Bankhead National Forest and the Oakmulgee Division of Talladega National Forest, Alabama: Unpublished report for Ala. Geol. Surv. 27 p.
- Weber, C.I.** 1973. Biological field and laboratory methods for measuring the quality of surface water and effluents. Report No. EPA-670/4-73-001, Off. Res. Develop. U.S. EPA Cincinnati, Ohio. 149 p.
- Wetzel, R.G., and G.E. Likens.** 1991. Limnological Analysis. Springer-Verlag. 391 p.
- Wiggins, G.B.** 1977. Larvae of North American Caddisfly Genera (Trichoptera). Univ. Toronto Press. 401 p.

AN ANNOTATED LIST OF TRICHOPTERA IN THE BLACK BELT PRAIRIE REGION OF WEST CENTRAL ALABAMA¹

M. B. Hicks², C. G. Haynes³

ABSTRACT: Distributional records for 72 species of caddisflies from 15 sites located in the Black Prairie Region of West-Central Alabama are presented, along with information on seasonal occurrence, habitat and relative abundance. Leptoceridae is best represented (22 species), followed by Hydropsychidae (17 species), Hydroptilidae (17 species), Polycentropodidae (6 species), Philopotamidae (5 species), Limnephilidae (2 species), Phryganeidae (2 species), and Molannidae (1 species). Of the species reported, 12 are new records for this area.

The Black Belt Prairie Region or Black Belt is a Physiographic Subdistrict of the East Gulf Coastal Plain that is geologically and biologically distinctive among physiographic regions of the Coastal Plain. The Black Belt is a crescent shaped region of approximately 8,000 square miles that extends southward from West Tennessee into Northeastern Mississippi and eastward into West-Central Alabama. This region is characterized by deeply weathered undulating plains of relatively low relief, that are developed on chalk and marl of the Selma Group (Copeland 1968). The Selma Chalk is composed of concentrations of fossiliferous, soft, white-gray limestone (chalk) that weathers into a fertile black soil. The soil of this region is particularly noted for baking hard and dry in the summer and becoming highly adhesive when wet (Doster and Weaver 1987). Many of the chalk beds of this region contain more than 75 percent calcium carbonate (Szabo and Beg 1977).

Because of the thin soils and the impermeable nature of the chalk bedrock, the Black Belt represents a unique and clearly defined hydrologic region in the Coastal Plain. The streams of this region are noted for high turbidity, high rates of runoff, and great variability in flow (Harper 1943, Harris et al. 1991). During the dry seasons the smaller streams go dry and the larger streams are significantly reduced in flow. Harper (1943) noted that this was the driest region of the state, and that prairie grasslands once covered up to 10% of the area. Because of its harsh hydrologic characteristics, this region has a negative impact on the distributions of many aquatic organisms. Many species of fish, mollusks, and aquatic insects that are common throughout the Coastal Plain are rare or absent within the Black Belt. An extensive survey of the fishes of Alabama (Mettee et al. 1989) has shown that 16 species of fishes common to the Coastal Plain are absent or rarely encountered in the Black Belt. Prelimi-

¹ Received December 20, 1998. Accepted December 27, 1999.

² Mississippi Department of Environmental Quality, 2142 Jackson Ave. West, Oxford, MS 38655.

³ Department of Biology, Shelton State Community College, Cottondale, AL 35405.

nary work on caddisflies in Alabama indicates that many common Coastal Plain caddisflies are absent from the Black Belt, but that at least one species is endemic to this region (Harris et al. 1991).

In view of the natural history and unique hydrology of this region, along with the lack of aquatic entomological surveys for the area, a thorough survey of the caddisflies of the Black Belt was conducted during 1993 and 1994. The objective of this survey was to gather information on species composition, abundance, and distribution of the caddisflies of this physiographic region. This information should be useful to both industries and agencies trying to regulate and maintain water quality, as well as to systematists, biogeographers, and ecologists conducting research on the Black Belt and the aquatic systems of other regions.

METHODS AND RESULTS

In order to determine the caddisfly fauna of the Black Belt, light-trap collections were made for adult specimens. Ultraviolet lights were connected to rechargeable 12-volt gel batteries and placed over white enamel pans filled with 80% ethanol. The batteries have a 3-hour life span. The traps were placed at the sites about 1 to 1.5 hours before dusk and operated until 1.5 to 2 hours following dusk. Collections were made monthly from February 1993 to January 1994. During the warmer months (March-October) aerial nets were used to sweep the riparian vegetation for any adults not attracted to lights. Benthic "kick" samples were taken with aquatic D-frame nets at all sites where possible in order to obtain larval and pupal specimens. "Kick" samples were taken during the wettest months (November-April) when sufficient flow was available for collecting. Collected specimens were taken to the lab where they were identified to the lowest taxon level possible.

In order to characterize further the aquatic environment of the study area, several water quality parameters were measured monthly at all collection sites. Water temperature (bulb thermometer), pH (Cole-Parmer Model 612 pH meter), and conductivity (Cole-Parmer Model 1481-40) were determined in the field. Water samples were collected quarterly and returned to the laboratory to determine alkalinity (Wetzel and Likens 1979). A list of water quality parameters by site is given in Table 1. All parameters are expressed as the mean of the monthly and quarterly samples.

From this survey a total of 182 collections were made from which 21,877 caddisflies were identified. Seventy-two (72) species representing eight families and 24 genera were recorded. An annotated list of species documented is presented below (Table 2). Information for each species includes collection sites and number of specimens collected. A more detailed discussion of distributions is contained in Haynes (1995). An asterisk indicates species previously not reported from the Black Belt (*). In most cases only males of the species were identified. Voucher specimens are housed in the Aquatic Insect Museum of the University of Alabama.

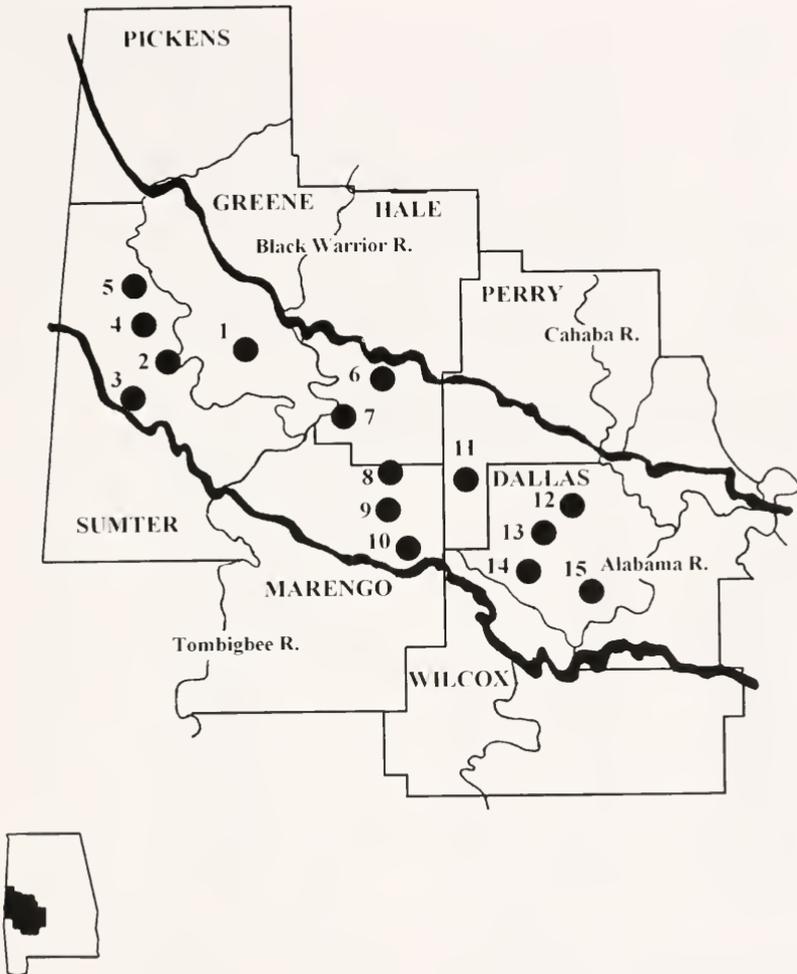


Figure 1. Collecting sites in the West Central Alabama Black Belt Prairie Region of West-Central Alabama. Numbers correspond to those listed in text.

COLLECTION SITES

1. Greene Co.; Taylor Creek; County Road 72, 5 mi S Boligee, T20N, R1E, Sec. 21.
2. Sumter Co.; Wiggins Creek; U.S. Highway 11, ¼ mi S Epes, T20N, R2W, Sec. 25.
3. Sumter Co.; Brown Brick Creek; unnamed dirt road ¼ mi off State Highway 28, 2 mi NW Livingston, T19N, R2W, Sec.7&8.
4. Sumter Co.; Turkey Creek; State Highway 39, 6.5 mi S Gainesville, T20N, R2W, Sec. 11.

5. Sumter Co.; Noxubee River; County Road 85, 1 mi N Gainesville, T21N, R2W, Sec. 3.
6. Hale Co.; Jacks Branch; County Road 16, 6 mi S Greensboro, T19N, R4E, Sec.13.
7. Hale Co.; Yellow Creek; County Road 2, 3 mi S Arcola, T18N, R3E, Sec.15.
8. Marengo Co.; Powell Creek; unnamed dirt road 3 mi off U.S. Highway 80E, 4 mi W Faunsdale, T17N, R4E, Sec. 10.
9. Marengo Co.; Little Dry Creek; County Road 44, ½ mi W Dayton, T16N, R4E, Sec.14.
10. Marengo Co.; Whites Branch; County Road 80, 2 mi N Thomaston, T15N, R5E, Sec. 5.
11. Perry Co.; Tayloe Creek; unnamed dirt road 1 mi off U.S. Highway 80E, 3.5 mi E of Uniontown, T17N, R6E, Sec. 24.
12. Dallas Co.; Tatum Creek; County Road 11, ½ mi NW Orrville, T16N, R8E, Sec. 28.
13. Dallas Co.; Bogue Chitto Creek; State Highway 22, 2 mi W Orrville, T15N, R8E, Sec. 7.
14. Dallas Co.; Bear Creek; County Road 21, 3.5 mi W Orrville, T15N, R8E, Sec. 7.
15. Dallas Co.; Big Swamp Creek; County Road 33, 1 mi NE Five-Points off County Road 33, T15N, R8E, Sec. 25.

Table 1. Annual mean values for selected water quality parameters of streams sampled in the Black Belt Prairie Region of Alabama (1993)

Stream	Air Temp. (°C)	Water Temp. (°C)	pH (SU)	Conductivity (umhos/cm)	Alkalinity (mg/l as CaCO ₃)
Taylor Cr.	21.5	19.7	6.9	456.7	13.6
Wiggins Cr.	21.3	18.5	7.6	460.4	16.0
Brown Brick Cr.	20.5	19.5	7.3	453.4	15.7
Turkey Cr.	21.8	22.1	7.5	375.5	19.2
Noxubee River	21.1	19.5	7.6	220.3	5.8
Jacks Branch	23.0	19.4	7.3	444.5	10.8
Yellow Cr.	21.0	19.3	7.1	447.0	17.1
Powell Cr.	21.6	19.4	7.2	470.7	13.3
Little Dry Cr.	21.0	19.3	7.2	510.5	21.0
Whites Branch	20.7	18.5	7.4	111.8	10.8
Tayloe Cr.	19.3	17.8	7.0	495.6	15.7
Tatum Cr.	20.7	18.8	7.0	112.0	3.3
Bogue Chitto Cr.	20.8	19.0	7.1	162.0	6.7
Bear Cr.	21.0	19.7	7.3	348.0	9.2
Big Swamp Cr.	22.3	17.6	7.0	88.3	1.7

Table 2. Annotated list of species collected in the Black Belt Prairie Region

Family	Species	Collection Site Number	# of Individuals
Hydropsychidae	<i>Cheumatopsyche burksi</i> Ross	1,2,6,7,8,9,10,12,13	17
	<i>C. campyla</i> Ross	1,2,3,5,6,11,12,13,14,15	323
	<i>C. edista</i> Gordon	1,4,8,12,14	17
	<i>C. ela</i> Denning	5,12,13,15	73
	<i>C. geora</i> Denning*	11,12	4
	<i>C. pasella</i> Ross	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	2,444

Family	Species	Collection Site Number	# of Individuals
	<i>C. pettiti</i> (Banks)	1,2,3,5,6,8,9,11,12,13,14	518
	<i>C. sordida</i> (Hagen)	1,3,5,12,14	13
	<i>Hydropsyche alvata</i> Denning	4,5,11,13,14	123
	<i>H. betteni</i> Ross	12,13,14	11
	<i>H. sp. nr. frisoni</i> Ross	4	12
	<i>H. mississippiensis</i> Flint	9,14	6
	<i>H. orris</i> Ross	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	3,010
	<i>H. rossi</i> Flint, Voshell, and Parker	2,6,9,12,13,14	201
	<i>Macrostemum carolina</i> (Banks)	1,2,4,5,6,8,9	95
	<i>M. transversum</i> (Walker)	3,4,5	119
	<i>Potamyia flava</i> (Hagen)	6,7,8,11,13,14,15	233
Polycentropodidae	<i>Cernotina calcea</i> Ross	1,2,3,4,5,6,7,8,9,11,12,13,14	3,032
	<i>Cyrnellus fraternus</i> (Banks)	1,2,4,5,6,7,8,11,12,13,14,15	406
	<i>Neureclipsis crepuscularis</i> (Banks)	2,5,11,12,13,14,15	40
	<i>Paranyctiophylax affinis</i> (Banks)	3	19
	<i>P. serratus</i> (Lago and Harris)	3,10,12,14,15	11
	<i>Polycentropus crassicornis</i> Walker*	1,2,6,7,8,9,10	73
Philopotamidae	<i>Chimarra aterrima</i> Hagen*	15	6
	<i>C. florida</i> Ross	12,15	9
	<i>C. moselyi</i> Denning	11	8
	<i>C. obscura</i> (Walker)	1,2,5,6,7,8,10,11,12,13,14,15	952
	<i>C. parasocia</i> Lago and Harris	5	6
Hydroptilidae	<i>Hydroptila alabama</i> Harris and Kelley	1,12,13,14,15	150
	<i>H. angusta</i> Ross	1,3,4,6,12,13	57
	<i>H. armata</i> Ross	1,8,12,13,15	42
	<i>H. cretosa</i> Harris*	1	11
	<i>H. gunda</i> Milne	1,7,12,13,14,15	73
	<i>H. hamata</i> Morton	1,3,5,7,12,13,14,15	116
	<i>H. novicola</i> Blickle and Morse	1,11,12,13,15	232
	<i>H. quinola</i> Ross	1,7,12,13,15	20
	<i>H. waubesia</i> Betten	1,3,5,7,8,9,11,12,13,14,15	450
	<i>Neotrichia vibrans</i> Ross	5,12,13,15	48
	<i>Ochrotrichia confusa</i> (Morton)*	5,13,15	48
	<i>O. dardeni</i> Harris	2,3,4,6,13,14	71
	<i>Orthotrichia aegerfasciella</i> (Chambers)	1,2,3,4,5,6,7,8,11,12,13,14,15	262
	<i>O. cristata</i> Morton	2,3,4,6,8,10,11,12,13,15	75
	<i>Oxyethira janella</i> Denning	12,13,14,15	245
	<i>O. novasota</i> Ross	1,4,5,10,12,13,15	41
	<i>O. pallida</i> (Banks)	1,4,5,10,12,13,15	586
Limnephilidae	<i>Ironoquia punctatissima</i> (Walker)*	9	9
	<i>Pycnopsyche scabripennis</i> (Rambur)*	15	9
Phryganeidae	<i>Agrypnia vestita</i> (Walker)*	8,11,14	6
	<i>Ptilostomis postica</i> (Walker)*	1,5,6,7,10	27
Leptoceridae	<i>Ceraclea flava</i> (Banks)	2,3,5,11,12,13,14,15	625

Family	Species	Collection Site Number	# of Individuals
Leptoceridae	<i>C. maculata</i> (Banks)	1,2,3,5,6,7,8,9,10,11,12,13, 14,15	1,271
	<i>C. nepha</i> (Ross)	1,2,4,10,12,13,14	33
	<i>C. ophioderus</i> (Ross)	2,3,6,13,14,15	51
	<i>C. protonepha</i> Morse and Ross	1,2,5,7,8,9,11,12,13,14	60
	<i>C. tarsipunctata</i> (Vorhies)	1,2,4,5,6,7,8,9,10,11,13,14,15	162
	<i>C. transversa</i> (Hagen)	1,7,8,9,12,13,15	19
	<i>Nectopsyche candida</i> (Hagen)	1,4,5,7,13,14,15	177
	<i>N. exquisita</i> (Walker)	12,13	316
	<i>N. pavida</i> (Hagen)	5,6,12,13,14,15	249
	<i>Oecetis avara</i> (Banks)	5,9,13,14	370
	<i>O. cinerascens</i> (Hagen)	1,2,3,4,5,7,8,9,10,11,12,13, 14,15	516
	<i>O. ditissa</i> Ross	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	375
	<i>O. inconspicua</i> (Walker)	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15	677
	<i>O. nocturna</i> Ross	1,2,3,4,5,6,7,8,9,11,12,13, 14,15	2,205
	<i>O. osteni</i> Milne	10,13,14	62
	<i>O. persimilis</i> (Banks)	1,2,3,4,5,11,12,13,14,15	227
	<i>O. sphyra</i> Ross	2	32
	Molannidae	<i>Triaenodes ignitus</i> (Walker)	2,12,13,14,15
<i>T. melaca</i> Ross*		2,10,11	45
<i>T. ochraceus</i> (Betten and Mosely)*		13	6
<i>T. tardus</i> Milne		1,2,4,5,7,8,12,13	46
<i>Molanna tryphena</i> Betten*		13	8

DISCUSSION

One hundred eighty two collections from 15 streams in the Black Belt yielded 72 species of caddisflies, from 24 genera and eight families. Three families, five genera and 12 species were found that were previously not reported as occurring in the Black Belt. No species new to science, or new state records were discovered. Adults were collected from February to November. The number of species collected was greatest from May to July, with the greatest number (56) being collected in May. The number of individuals collected was greatest from April to June, with June yielding the greatest numbers (9,035). The total number of adult specimens collected and identified was 21,877. The number of species of caddisflies in the Black Belt Prairie is slightly lower than other regions and drainages of Alabama. Surveys of other aquatic organisms in this region have also produced low species numbers and is probably due to the region's harsh prairie-like characteristics, in particular the intermittent nature of most of this region's streams. However, the familial composition of caddisflies in the Black Belt Prairie is similar to other regions throughout Alabama. The Hydropsychidae (17 species), Hydroptilidae (17 species), Lepto-

ceridae (22 species), and Polycentropodidae (6 species) were represented by a total of 62 species, which accounts for 86 percent of the species collected. The Philopotamidae (5 species), Limnephilidae (2 species), Phryganeidae (2 species), and Molannidae (1 species) were represented by a total of 10 species which accounted for a total of 14 percent of the species collected.

By site, taxa richness ranged from 49 species at Bogue Chitto Creek (Site 13), which represented 68 percent of all species collected, to 19 species at Whites Branch (Site 10), which represented 26 percent of all species collected. The average number of species collected at a site was 30, with 7 of the sites having 30 or more species. Monthly, taxa richness ranged from 56 species collected in May (77 percent of all species collected) to 1 species collected in February. No specimens of Trichoptera were collected in December or January. In terms of biomass, Bogue Chitto Creek yielded the largest number of individuals (5,569), representing 25.5 percent of the total number of individuals collected (21,877), while Little Dry Creek (Site 9) yielded the smallest number (406 individuals), which represented only 1.9 percent of the total number of individuals collected. In general, most sites yielded over 700 individuals, with 5 sites yielding over 1,000 individuals. Throughout the year, the number of individuals collected ranged from 9,035 (41.3 percent of the total) in June, to only 2 individuals in February. Most individuals emerged during the warmer, summer months.

In general, Trichoptera were common throughout the entire study area. However, certain regions yielded a larger number of species and individuals than others. The eastern region of the study area (sites 11-15), located in Dallas and Perry Counties, produced both the greatest number of species and individuals, followed closely by the western region (sites 1-5), located in parts of Sumter and Greene Counties. The central region of the study area (sites 6-10), located in Hale and Marengo Counties yielded the lowest number of species and individuals. Many species such as *Cheumatopsyche sordida*, *Ceraclea flava*, and *Neureclipsis crepuscularis* that were commonly collected in the western and eastern regions were completely absent in the central region of the study area. A survey of the region's agricultural activity reveals that the central part of the study area is the most heavily farmed region. In the western and eastern regions, farming activities comprise much fewer acres (Kleweno 1994). Streams of the central region are more heavily silted than in other regions, and overall water quality appears to be lower in streams of the central region. Other species were restricted to only a single region, such as *Hydropsyche betteni*, which was found only in the eastern region. Several species were restricted to a single stream such as *Paranyctiophylax affinis*, which was found only in Brown Brick Creek. However, most species were found in several streams located throughout the entire study area.

Previous surveys of this region (Harris et al. 1991) indicated that as many as 67 species were likely to occur in the Black Belt. This survey recorded 60 of

those species plus an additional 12 species that were previously unknown from the Black Belt. Out of the previously unknown species, three families (Limnephilidae, Molannidae, and Phryganeidae) representing five genera (*Agrypnia*, *Ironoquia*, *Molanna*, *Ptilostomis*, and *Pycnopsyche*), are new records for the Black Belt. Although seven species previously found in the Black Belt were not identified in this survey, all previously known families and genera, except the genus *Leptocerus* were recorded in this study. No species new to science were discovered, and no new state records were established. However, four species (*Ochrotrichia confusa*: Hydroptilidae, *Ironoquia punctatissima* and *Pycnopsyche scabripennis*: Limnephilidae, *Agrypnia vestita*: Phryganeidae), previously known only from regions of the state located on or above the Fall Line, were collected in this survey.

ACKNOWLEDGMENTS

The Department of Biology at the University of Alabama provided support and facilities during the course of this study and is gratefully acknowledged. We would like to thank S.C. Harris, Clarion University for verifying several identifications. We would also like to thank S. Harris, R. Holzenthal, B. Stark, and P. Lago for reviewing the manuscript.

LITERATURE CITED

- Copeland, C.W.** 1968. Geology of the Alabama coastal plain: a guidebook. Geol. Surv. Ala. Circ. 47. 97 p.
- Doster, J.F. and D.C. Weaver.** 1987. Tenn-Tom country: the upper Tombigbee valley. Univ. Ala. Press. 238 p.
- Harper, R.M.** 1943. Forests of Alabama: Geol. Surv. Ala. Mon. 10. 230 p.
- Harris, S.C., P.E. O'Neil, P.K. Lago.** 1991. Caddisflies of Alabama: Geol. Surv. Ala. Bull. 142. 442 p.
- Haynes, C.G.** 1995. Caddisflies of the Black Belt Prairie Region in West Central Alabama. M.S. Thesis. Univ. Ala. 164 p.
- Kleweno, D. D.** 1994. Alabama farm facts. Ala. Dept. Agric. Indus.
- Mettee, M.F., P.E. O'Neil, J.M. Pierson, and R.D. Suttkus.** 1989. Fishes of the Western Mobile River Basin in Alabama and Mississippi: Geol. Surv. Ala. Atlas 24. p. 18.
- Szabo, M.W., and M.A. Beg.** 1977. Chalk resources of West Central Alabama: Geol. Surv. Ala. Circ. 102. 15 p.
- Wetzel, R.G., and G.E. Likens** 1991. Limnological Analysis. Springer-Verlag. 391 p.

**FOUND: HOLOTYPE OF THE LACE BUG
ELASMOGNATHUS HELFERI
(HETEROPTERA: TINGIDAE)¹**

Richard C. Froeschner²

ABSTRACT: The missing holotype of *Elasmognathus helferi* was found, labeled as such, and returned to the Naturhistorisches Museum, Vienna, Austria.

Drake and Ruhoff's (1965, United States Natl. Mus. Bull., 243:202) catalog of the "Lacebugs of the World" reported the status of the type material of *Elasmognathus helferi* Fieber (1844 Entomon. Monographien, page 91, pl. 7, figs. 33-41) as "sex and deposition of type unknown."

Examination of Tingidae in the Drake Collection (now part of the collections in the Smithsonian Institution, Washington D.C.) found a point-mounted female of that species with a time-faded paper label reading "Elasmognathus Fieber Helferi Fieber, Indes Or. +" in what appears to be Fieber's handwriting.

Because the original description dealt with only one specimen, and the present specimen and its labelling agree with that description and original figures, this specimen is here considered the holotype. A red label "HOLOTYPE *Elasmognathus helferi* Fieber, labeled by Froeschner 2000" was put on its pin and the specimen was returned to the Naturhistorisches Museum, Vienna, Austria, for incorporation with the other Fieber material there.

ACKNOWLEDGMENTS

My sincere thanks go to Thomas J. Henry, U.S.D.A. Systematic Entomology Laboratory, and Paul J. Spangler, Smithsonian Institution, for helpful reviews of this manuscript.

¹ Received March 24, 2000. Accepted March 24, 2000.

² Department of Entomology, MRC-0105, United States National Museum of Natural History, Washington, D.C., 20560-0105.

ESTABLISHING THE VALIDITY OF *CICINDELA SCUTELLARIS* (COLEOPTERA: CICINDELIDAE)¹

Howard P. Boyd²

ABSTRACT: *Cicindela scutellaris* (Coleoptera: Cicindelidae) is sustained. *C. varians* is designated a nomen oblitum.

Ever since its description in 1823, *Cicindela scutellaris* Say has been the established name for a polymorphic species of tiger beetle (Coleoptera: Cicindelidae) widespread in North America. As a consequence, *Cicindela scutellaris* has appeared often in the literature in ecological studies, subspecies descriptions, and faunal treatises (Shelford 1917, Vaurie 1950, Boyd 1978). So it was remarkable that the valid name of this taxon should be challenged recently (Cassola 1999).

Apparently, the sole female syntype of the taxon *Cicindela varians* Ljungh 1799 was rediscovered recently among some old tiger beetle material from the Zoological Museum of the Lund University, Lund, Sweden, by Fabio Cassola, Rome, Italy, who identified it as conspecific with *C. scutellaris*, possibly *C. s. rugata* Vaurie. Formerly, *Cicindela varians* has been regarded in all catalogs and checklists (Boyd 1982, Freitag 1999) as one of several junior synonyms of *Cicindela sexguttata* Fabricius 1775, another widespread North American species.

Cassola (1999) published his rediscovery, designated the specimen as the lectotype of *Cicindela varians* Ljungh, and provided full label data in narrative and photographic form for the unambiguous recognition of this specimen. In the same paper, Cassola (1999) proposed to redesignate the name of the taxon from *Cicindela scutellaris* to *C. varians* based on his identification and the earlier publication date of *C. varians* 1799 compared to *C. scutellaris* 1823. This proposal was made despite the fact that *C. varians* has never been applied in the literature to any *C. scutellaris* taxon for 200 years, and in contradiction of articles 23b and 79c of the 1985 International Code of Zoological Nomenclature (ICZN) still in force at the time Cassola published.

In summary, Cassola (1999) proposed *C. varians* as the senior synonymic name for the species, tenuously assigned it to the taxon formerly known as *C. scutellaris rugata* which would fall as a junior synonym to *C. varians varians*, and reassigned *C. scutellaris* as a subspecific entity under *C. varians scutellaris*. In all, nine new taxonomic combinations were proposed by Cassola (1999).

¹ Received March 15, 2000. Accepted April 8, 2000.

² Honorary Associate, Academy of Natural Sciences, Philadelphia, PA. Home address: 232 Oak Shade Road, Tabernacle, NJ 08088.

Following is a brief history of Cassola's efforts to publish his rediscovery and proposed nomenclatural changes. Earlier, attempts to publish his findings in the United States were met with mixed success. Cassola first submitted his paper to the Coleopterists Bulletin but when it was not accepted, he next submitted it to Entomological News under date of 17 October 1998. Following peer reviews, consultations with other cicindelid authorities, and additional correspondence with Cassola, Entomological News, on 15 April, 1999, accepted that part of his paper which recounted his rediscovery but did not accept publication of his proposed redesignations, indicating, instead, that he should submit all his proposed redesignations to the ICZN for approval before their publication. Cassola was unwilling to accept this compromise and so withdrew his paper. Subsequently, he had it published in the journal *Fragmenta entomologica*, Roma (Cassola 1999).

Following that publication, in my dual role as Editor of Entomological News and as a worker in the Cicindelidae (Boyd 1973, 1978, 1982), I brought this matter to the attention of the ICZN and am now in receipt of a letter dated 4 February 2000 from Philip K. Tubbs of the ICZN (pers. comm.), pertinent excerpts from which are quoted below, as follows:

"Your letter of 15 April 1999 to Dr. Cassola was entirely right: under the 1985 Code he should have maintained the usage of *C. scutellaris* Say, 1823, and not reintroduced *C. varians* Ljungh, 1799 as a valid name. He himself explicitly admits (pp. 76-77) that his action contravenes Article 23b of the 1985 Code, and under Article 79c his usage would not be recognized by the Commission. It follows that the valid name of the species remains *C. scutellaris*.

"As you probably know, a new and very considerably revised edition of the Code was published last year and came into force on 1 January. Under this (Article 23.9) a name in wide usage (like *C. scutellaris*) must automatically be given precedence over a name which has not been used as a valid (name) for the taxon since 1799 (a nomen oblitum such as *C. varians*); reference to the Commission is no longer necessary. Of course Cassola's paper was published before Article 23.9 came into force, but it is the case that his action does not count as a usage under the new edition and *scutellaris* is correct.

"It is possible that *varians* might displace the subspecific name *rugata* Vaurie, but that depends on the usage of the latter name; in any case Dr. Cassola is not entirely confident of the synonymy.

"One can sympathize emotionally with Dr. Cassola's desire for 'cultural justice' for long-dead workers, but ALL changes of names (which are really just labels for taxa) cause confusion, and the displaced names always have to be cited – otherwise all existing information on the species would be lost. It is for this reason that the Code (and especially the new one) lays emphasis on the need to maintain the prevailing usage of names unless a case is necessary for real taxonomic reasons."

It follows, therefore, that the name *Cicindela scutellaris* continues to be the valid name for this taxon and *C. varians* must be treated as a nomen oblitum under this species rather than a junior synonym of *C. sexguttata* Fabricius 1775 as in all catalogs. Consequently, the nine new combinations proposed by Cassola (1999) for the subspecific taxa currently recognized under *Cicindela scutellaris* are invalid.

ACKNOWLEDGMENTS

I thank Robert E. Acciavatti, Carnegie Museum of Natural History, Pittsburgh, PA., Richard Freitag, Lakehead University, Thunder Bay, Ontario, and Ronald L. Huber, Editor of the Journal *Cicindela* for their reviews and correspondence regarding this matter. I especially thank Robert Acciavatti for his suggestions for improvements in this paper.

LITERATURE CITED

- Boyd, H.P. 1973. Collecting tiger beetles in the Pine Barrens of New Jersey. *Cicindela* 5(1): 1-12.
- Boyd, H.P. 1978. Tiger Beetles (Coleoptera: Cicindelidae) of New Jersey, with special reference to their Ecological Relationships. *Trans. Amer. Entomol. Soc.* 104 (2): 191-242.
- Boyd, H.P. and Assoc's. 1982. Checklist of Cicindelidae. Plexus Publishing Co., Marlton, NJ.
- Cassola, F. 1999. Studies on Tiger Beetles. CI. Rediscovery and re-establishment of *Cicindela varians* Ljungh, 1799 (Coleoptera: Cicindelidae). *Fragmenta entomologica*, Roma, 31 (1): 71-80.
- Freitag, R. 1999. Catalogue of the Tiger Beetles of Canada and the United States. Nat'l. Research Council, Canada.
- Shelford, V.E. 1917. Color and color-pattern mechanism of Tiger Beetles. III. *Biol. Mono.* 3(4): 395-532.
- Vaurie, P. 1950. Four new subspecies of the genus *Cicindela* (Coleoptera: Cicindelidae). *Amer. Mus. Novitates*, 1458: 1-6.

NEW DESCRIPTIONS AND DISTRIBUTIONAL RECORDS FOR EASTERN NORTH AMERICAN CADDISFLIES (TRICHOPTERA)¹

David E. Ruiters²

ABSTRACT: A new caddisfly species *Glossosoma spinatum* (Glossosomatidae) is described from Newfoundland and Quebec. The female of *Rhyacophila acutiloba* (Rhyacophilidae) is described for the first time. New distributional records and notes for 19 caddisfly species are presented.

Twenty-two species of *Glossosoma* were listed from North America by Morse (1993). The following new species of *Glossosoma* is the first member of the subgenus *Diploglossa* Martynov in the *Eomystra* line of Ross (1956) reported from North America.

Glossosoma spinatum NEW SPECIES

Description: Structure typical for genus. Color dark brown (all specimens in alcohol). Length from front of head to apices of folded forewings 6-7 mm. Male (Figs. 1-2): Abdominal sternite VI with short, broadly rounded ventromesal process. Sternite VII with small, acute ventromesal process. Tergum X divided mesally into two lateral lobes with dorsolateral margins composed of numerous spines directed caudad and ventrolateral portion lobate, cupped mesally. Inferior appendages each divided into two long, slender lobes, with mesal lobe directed dorsolaterally; lateral lobe directed caudomesally. Phallus large, vasiform, with the dorsal branch having dorsal spinous lobe; phallicata membranous.

Female (Figs. 3-6): Abdominal sternite VI with short, acute ventromesal process. Sclerotized portion of segment VIII with dorsal margin about twice length of ventral margin in lateral view; anteroventral surface divided mesally by membranous area. Vaginal apparatus very long, narrow; essentially membranous, with a single long, faint sclerite anteriorly and three faint sclerites posteriorly.

Immature stages unknown.

Diagnosis: The male is distinguished from all North American *Glossosoma* species by the numerous lateral spines of the mesally split tergum X; the female by the short, ventrally divided, eighth segment. The male can be distinguished from the closely related Eurasian *Glossosoma nylanderi* McLachlan, by the numerous, relatively short and nearly subequal spines of tergum X; the relatively short, broadly rounded ventral lobe of the tergum X; and the subequal lobes of each inferior appendage (see Martynov 1934, Ross 1956, Malicky 1983, and Vshivkova 1986 for figures of *G. nylanderi*). The female can be separated from *G. nylanderi* by the essentially membranous vaginal apparatus, and fewer setae along the distal margin of segment VIII.

¹ Received May 4, 1999. Accepted March 23, 2000.

² 6260 South Grant Street, Littleton, Colorado 80121.

Holotype male - Newfoundland: South Branch Grand Codroy River, Highway 1, NW South Branch, 5 June 1998, R.W. Baumann and B.C. Kondratieff. Allotype female: same data. Holotype and allotype deposited at the National Museum of Natural History. Seven paratype males and females, same data, deposited as follows: 1M 1F: Royal Ontario Museum; 1M 1F: Illinois Natural History Survey; 1M: BYU; 1M: CSU; 1M: DER.

Additional material examined: Quebec: Riviere St. Anne, Beupre, 15 June 1997, B.C. Kondratieff and R.W. Baumann. 1M (CSU). Newfoundland: Humber River, NE Cormack, 8 June 1998, B.C. Kondratieff & R.W. Baumann. 1M 1F (DER). Newfoundland: Rocky Brook, Reidville Road, N Deer Lake, 8 June 1998, R.W. Baumann & B.C. Kondratieff. 1M (BYU).

Rhyacophila acutiloba Morse & Ross, 1971

Rhyacophila acutiloba was described from males collected in New Hampshire (Morse & Ross 1971). Prather et al. (1997) reported additional collections from MA, ME, NC, NY, SC, VA, VT, WV, and indicated the female was still unknown. The following description is based on females from New York (Hamilton County, West Stony Creek, Highway 30, north of Great Sacandaga Lake, B.C. Kondratieff and R.W. Baumann, 5 June 1997, 3M 5F (CSU), 2M 5F (DER).

Female genitalia (Figs. 7-11): In lateral view, posterior margin of segment VIII strongly concave and dorsal margin with distinct bump; in dorsal view, dorsoposterior margin indented and ventroposterior margin broadly convex, extending caudad beyond dorsal margin. Posterior process of vaginal apparatus cleft mesally.

Additional records and notes on Eastern North American Caddisflies

The following appear to be new province/state records for eastern North American caddisflies. Material is deposited in the following collections: C.P. Gillette Museum of Arthropod Diversity, Colorado State University (CSU); Monte L. Bean Museum, Brigham Young University (BYU); Stephen R. Moulton (SRM); author's collection (DER).

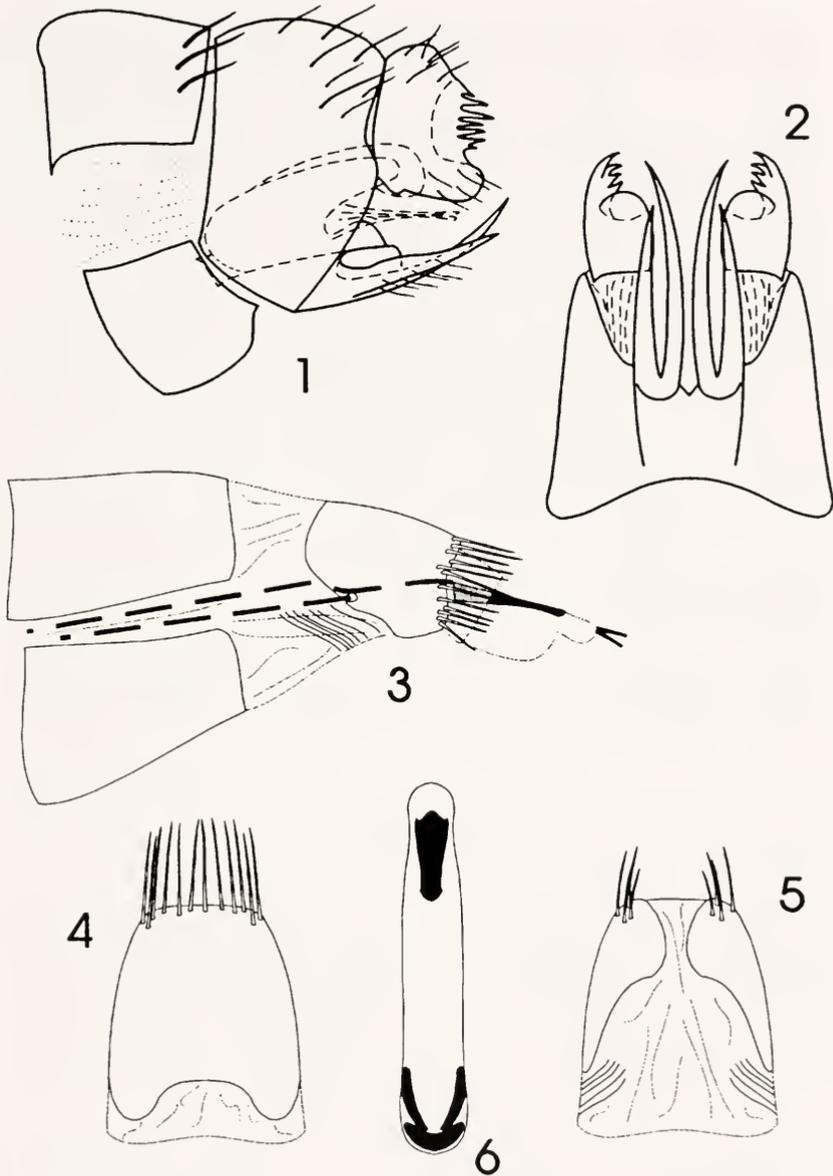
Micrasema bennetti Ross 1947 - TENNESSEE: Sumner County, Bledsoe Creek, junction of 31E and Route 231, R.F. Kirchner and B.C. Kondratieff, 9 April 1994, 1M (CSU).

Micrasema rickeri Ross and Unzicker 1965 - TENNESSEE: Blount County, Middle Prong of the Little River, Little Creek Road, D.E. Ruiter, 15 May 1988, 2M1F (DER).

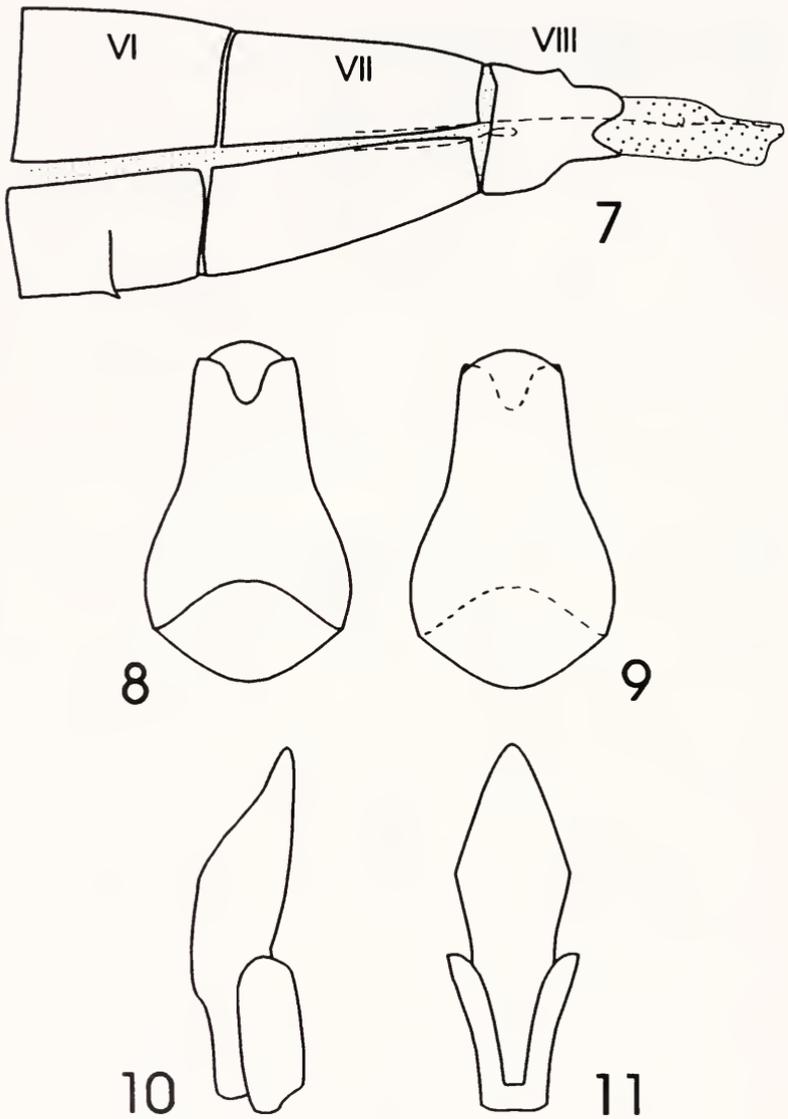
Micrasema sprulesi Ross 1941: MAINE: Penobscot County, stream between Garland and Exeter, on Route 143, D.E. Ruiter, 2 June 1987, 1M1F; Piscataquis County, West Gate of Baxter State Park, D.E. Ruiter, 1 June 1987, 5M (DER).

Cheumatopsyche helma Ross 1939 - ARKANSAS: Stone County, UV Light, North Sylamore Creek, Blanchard Spring Campground, B.J. Armitage, 3 June 1985, 2M (DER).

Cheumatopsyche pettiti (Banks) 1908 - NEW BRUNSWICK: York County, Pokiok Stream, Highway 635, below Lake George, B.C. Kondratieff and R.W. Baumann, 15 June 1993, 1M (CSU).



Figs. 1-6. *Glossosoma spinatum* - male terminalia: 1, lateral view; 2, ventral view; female terminalia: 3, lateral view; 4, dorsal view; 5, ventral view; 6, vaginal apparatus, ventral view.



Figs. 7-11. *Rhacophila acutiloba*, female terminalia: 7, lateral view; VIII segment, 8, dorsal view; 9, ventral view; vaginal apparatus: 10, lateral view, 11, ventral view.

Homoplectra doringa (Milne) 1936 - WEST VIRGINIA: Kanawka County, Buzzard Branch, 4 miles south of Prath, CR-83, B.C. Kondratieff and R.F. Kirchner, 28 May 1992, 1M (CSU); Mingo County, Laurel Creek, 2 miles east of Dingess, B.C. Kondratieff and R.F. Kirchner, 27 May 1993, 1M (CSU).

Hydropsyche frisoni Ross 1938 - WEST VIRGINIA: Mercer County, Bluestone River at Eads Mill, CR-3, B.C. Kondratieff and R.F. Kirchner, 27 May 1992, 1M (DER).

Oxyethira grisea Betten 1934 - NOVA SCOTIA: Yarmouth County, Clyde River, Highway 203, B.C. Kondratieff and R.W. Baumann, 24 June 1993, 7M6F (CSU).

Stactobiella palmata (Ross) 1938 - NOVA SCOTIA: Halifax County, Guys River, Highway 224 and 227, Carrol Corner, B.C. Kondratieff and R.W. Baumann, 23 June 1993, 1M (CSU).

Lepidostoma lydia Ross 1939 - OHIO: Scioto County, small tributary of Mackletree Creek, B.C. Kondratieff, 10 May 1988, 4M2F (CSU, DER).

Lepidostoma prominens (Banks) 1930 - WISCONSIN: Douglas County, Bois Brule River, Brule River State Forest, Route FF, B.C. Kondratieff, 20 August 1992, 2M1F (CSU, DER).

Lepidostoma reosum Denning 1954 - WEST VIRGINIA: Pendleton County, Seneca Creek, Judy Spring Trail, B.C. Kondratieff, R.F. Kirchner and J. Welch, 15 May 1990, 11M (CSU, DER). This appears to be a significant southwestern distribution extension.

Ironoquia kaskaskia Ross 1944 - ARKANSAS: Montgomery County, Rattlesnake Creek, 4 miles northeast of Caddo Gap, north of Road C52, T3S, R24W, sec. 33, H.W. Robison, 17 October 1996, 1M3F (SRM).

Molanna ulmerina Navas 1834 - NOVA SCOTIA: Hants County, Nine Mile River, Highway 14, Hardwood Lands, R.W. Baumann and B.C. Kondratieff, 23 June 1993, 1M1F (BYU).

Marilia flexuosa Ulmer 1905 - INDIANA: Kosciusko County, Lake Wawasee, B.C. Kondratieff, 2 July 1992, 1M (DER).

Banksiola dossuaria (Say) 1828 - WISCONSIN: Forest County, blacklight at dusk, Gliske Creek, 3/4 mile above Rice Lake, Mole Lake Reservation, Arin Davis, 12 August 1996, 1F (CSU).

Rhyacophila parantra Ross 1948 - MISSOURI: Franklin County, small stream, Meremac State Park, B.C. Kondratieff, 1 June 1990, 1M1F (CSU); WEST VIRGINIA: Mingo County, Laurel Creek, 2 miles east of Dingess, B.C. Kondratieff and R.F. Kirchner, 27 May 1993, 1M1F (DER).

Agarodes griseus Banks 1899 - NOVA SCOTIA: Hants County, Nine Mile River, Highway 14, Hardwood Lands, R.W. Baumann and B.C. Kondratieff, 23 June 1993, 1M (BYU).

ACKNOWLEDGMENTS

I thank Boris Kondratieff and Dick Baumann for providing most of these specimens. Steve Moulton provided the record for *Ironoquia kaskaskia*. I also thank Trond Anderson for providing specimens of *G. nylanderi* from Norway for comparison. Boris and Steve provided necessary comments on an early draft of this paper. Two anonymous reviewers provided necessary comments with one providing very useful additional information concerning *G. nylanderi*.

LITERATURE CITED

- Malicky, H.** 1983. Atlas of European Trichoptera. Dr. W. Junk Publishers, The Hague. Series Entomologica 24. 298 pp.
- Martynov, A.B.** 1934. Caddisflies. Trichoptera Annulipalpia. Acad. Sci. USSR Publ., Leningrad. 343 pp.
- Morse, J.C.** 1993. A checklist of the Trichoptera of North America, including Greenland and Mexico. Trans. Am. Entomol. Soc. 119:47-93.
- Morse, J.C. and H.H. Ross.** 1971. Two new species of *Rhyacophila* from Eastern North America. J. Kans. Entomol. Soc. 44:403-405
- Prather, A.L., A.L. Syrett and J.C. Morse.** 1997. Females of *Rhyacophila* (Trichoptera: Rhyacophilidae) from the southeastern United States. In: Holzenthal R.W. and O.S. Flint, jr. (editors). Proc. 8th Inter. Symp. Trichop. 1995. Ohio Biol. Surv., Columbus, Ohio pp. 387-399.
- Ross, H.H.** 1956. Evolution and classification of the mountain caddisflies. Urbana: Univ. Ill. Press. 213 pp.
- Vshivkova, T.S.** 1986. Caddisflies of the family Glossosomatidae Wall. (Insecta, Trichoptera) in Far Eastern U.S.S.R.: I. Subfamily Glossosomatinae Wall. In coll.: Bottom organisms of Far East freshwaters, Vladivostok: BPI DVNC SSSR. pp. 58-75.
- Wiggins, G. B.** 1996. Larvae of the North American caddisfly genera (Trichoptera). 2nd Ed. Univ. Toronto Press, Toronto, Canada. 457 pp.

When submitting papers, all authors are requested to (1) provide the names of two qualified individuals who have critically reviewed the manuscript *before* it is submitted and (2) suggest the names and addresses of two qualified authorities in the subject field to whom the manuscript may be referred by the editor for final review. All papers are submitted to recognized authorities for final review before acceptance.

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.

Illustrations: For maximum size and definition, full page figures, including legends, should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4 1/2 x 6 1/2 inches. Authors will be charged for all text figures and half-tones at the rate of \$20.00 each, regardless of size.

Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in The Entomologist's Library on books dealing with taxonomy, systematics, morphology, physiology ecology, behavior and similar aspects of insect life and related arthropods. Books on applied, economic and regulatory entomology, on toxicology and related subjects will not be considered.

Study notices, want items and for sale notices are published in The Entomologist's Market Place .

Page charges: For society members, a charge of \$20.00 is made for each published page of an article, plus costs of all illustrations. For non-society members, the page charge is \$25.00 per page. If any charges are not paid within 120 days of billing, authors will be charged an additional \$5.00 per page. Papers may be published ahead of their regularly scheduled time at a cost of \$35.00 per page.

Unemployed and retired amateur and scientist members of the American Entomological Society who are without institutional support or are not subsidized by grants and who are without funds for publishing may apply for financial assistance at the time their manuscript is submitted. Such application must include an explanation of the author's status (unemployed or retired). Page charges for these individuals are negotiable, with a minimum of \$10.00 per page.

Reprints: (without covers) may be ordered when corrected page proofs are returned to the editor. Schedule of reprint costs will appear on order form.

This publication is available
in microform from University
Microforms International.

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.



The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at \$1.00 per line, payable in advance to the editor. Notice of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

FOR SALE: Quality insect pins, black enamelled, stainless steel. Best prices guaranteed. Call for free samples. Phone: 1(800) 484-7347 Ext. 1324. Fax: (352) 371-6918. E-mail: morpho@afn.org or write to **Morpho Ventures**, P.O. BOX 12454, Gainesville, Florida 32604.

FOR SALE: Baltic amber pieces with insects, spiders, plants. Material for scientific work, as well as better pieces for display and teaching. O. Holden, Junkerg. 37, S-126 53 Hegersten, Sweden, fax: 01146-8-7268522.

FOR SALE: Light traps, 12 volt DC or 110 volt AC with 15 watt or 20 watt black lights. Traps are portable and easy to use. Rain drains and beetle screens protect specimens from damage. For a free brochure and price list, contact Leroy C. Koehn, 207 Quail Trail, Greenwood, MS 38930-7315, Telephone 601-455-5498.

FOR SALE: Tropical butterflies and beetles, A1 quality with data, including ORNITHOPTERA WITH PERMITS. Also entomology pins. Ianni Butterfly Enterprises - P.O. Box 81171, Cleveland, OH 44181. (440) 888-2310. Fax (440) 888-8129. Email: butrfly@en.com

Ground beetles identified: Carabidae of eastern United States, especially from agricultural, forest, and wetland sites in the Midwest, determined for a reasonable fee. Foster Forbes Purrington, purrington.l@osu.edu, (614) 292-5965, 1735 Neil Avenue, Columbus, OH 43210.

ENTOMOLOGICAL NEWS

Q L
461
E831
ENT

type series of <i>Altica chalybaea</i> (Coleoptera: Curculionidae)	Laurent LeSage	233
<i>Monosoma pulverata</i> (Hymenoptera: Tenthredinidae), an alder-feeding sawfly new to North America	D.R. Smith, H. Goulet	238
Further contributions to the study of <i>Dalquestia</i> (Opiliones: Sclerosomatidae)	J.C. Cokendolpher, W.D. Sissom	243
Maternal care in Neotropical centipede <i>Otostigmus scabricauda</i> (Chilopoda: Scolopendromorpha)	G. Machado	250
The genus <i>Kunzella</i> and a closely related new genus <i>Youngszella</i> (Homoptera: Cicadellidae)	Paul H. Freytag	255
Further contributions to the spatulate clawed Baetidae (Ephemeroptera)	W.P. McCafferty, R.P. Randolph	259
A new Nearctic <i>Apobaetis</i> (Ephemeroptera: Baetidae)	W.P. McCafferty	265
Length-weight relationships of Jamaican arthropods	M.D. Johnson, A.M. Strong	270
<i>Allocapnia polemistis</i> (Plecoptera: Capniidae), new for Mississippi	B.P. Stark, M.H. Alford, S.G. Tucker	283
Alkaloid content of parasitoids reared from pupae of an alkaloid-sequestering arctiid moth (<i>Utetheisa ornatix</i>)	C. Rossini, E.R. Hoebeke, V.K. Iyengar, W.E. Conner, M. Eisner, T. Eisner	287
First record of Nycteribiidae (Diptera) in Virginia, and a discussion of host specificity and distribution of <i>Basilia boardmani</i>	Christopher S. Hobson	291
Life history and behavior of African bush grasshopper, <i>Phymateus viridipes</i> (Orthoptera: Pyrgomorphidae) in captivity	Tohko Kaufmann	294
Genus <i>Festella</i> (Orthoptera: Tettigoniidae) with description of <i>F. rammei</i> sp. n.	Battal Çıplak	299
<i>Allotrochosiphum</i> (Homoptera: Greenideidae), a newly reported genus from China, and description of a new species	G.X. Qiao	307
SCIENTIFIC NOTES:		
Mississippi record for <i>Curicta scorpio</i> (Hemiptera: Nepidae)	Paul K. Lago	282
Reporting species record data	W.P. McCafferty	312
BOOK REVIEW		313
BOOKS RECEIVED AND BRIEFLY NOTED		237, 242
SOCIETY MEETING REPORTS		290, 314, 315, 316
NOTICE: Defective March/April 2000 Issue		254

ENTOMOLOGICAL NEWS is published bi-monthly except July-August by The American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A. AES office phone: 215-561-3978; e-mail: aes@ansp.org; website: <http://www.ansp.org/aes>.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pa. The October and March meetings are held at the Department of Entomology, University of Delaware, Newark, Delaware.

Society Members who reside outside the local eastern Pennsylvania, southern New Jersey, and Delaware area are urged to attend society meetings whenever they may be in the vicinity. Guests always are cordially invited and welcomed.

Officers for 1999-2000: President: Jon K. Gelhaus; Vice-President: Susan B. Whitney; Recording Secretary: Charles R. Bartlett; Corresponding Secretary: William J. Cromartie; Treasurer: Howard P. Boyd.

Publications and Editorial Committee: Howard P. Boyd, Chr., D. Otte, and Norman E. Woodley.

Previous editors: 1890-1920 Henry Skinner (1861-1926); 1921-1944 Philip P. Calvert (1871-1961); 1945-1967 R.G. Schmiedler (1898-1967); 1968-1972 R.H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

Subscriptions: *Private subscriptions for personal use of members of the Society, domestic and foreign: \$10.00 per year postpaid. Subscriptions for non-members \$25.00. Subscriptions for institutions such as libraries, laboratories, etc., domestic: \$20.00 per year postpaid; foreign: \$22.00 per year post-paid. Communications and remittances regarding subscriptions should be addressed to ENTOMOLOGICAL NEWS, The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa. 19103-1195, U.S.A.*

Back issues of most numbers may be obtained by writing to the office of The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

Membership dues: \$15.00 per year (regular); \$10.00 per year (student).

Manuscripts and all communications concerning same should be addressed to the editor: Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A. Manuscripts will be considered from any authors, but papers from members of the American Entomological Society are given priority. It is suggested that all prospective authors join the society. All manuscripts should follow the format recommended in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, Sixth Edition, and should follow the style used in recent issues of ENTOMOLOGICAL NEWS. Three double-spaced, typed copies of each manuscript are needed on 8 1/2 x 11 paper. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible. Articles longer than eight printed pages may be published in two or more installments, unless the author is willing to pay the entire costs of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Editorial Policy: Manuscripts on taxonomy, systematics, morphology, physiology, ecology, behavior and similar aspects of insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Papers on applied, economic and regulatory entomology and on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields.

(Continued on inside of back cover)

Postmaster: *If undeliverable, please send form 3579 to Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A.*

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088, U.S.A.

ON THE TYPE SERIES OF *ALTICA CHALYBAEA* (COLEOPTERA: CHRYSOMELIDAE)¹

Laurent LeSage²

ABSTRACT: Types are designated for *Altica chalybaea*. In addition, the median lobe of the male aedeagus, the spermatheca and styles of the female are described and illustrated for the first time.

RÉSUMÉ: L'auteur désigne les types d'*Altica chalybaea*. Il décrit et illustre aussi pour la première fois le lobe médian de l'édéage mâle de même que la spermatheque et les styles de la femelle.

Illiger (1807) described several new European, Brazilian and North-American species in his paper entitled *List of Haltica species in the Collection Hellwig-Hoffmansegg*. It is worth mentioning here that the *Haltica* of Illiger corresponded more, at that time, to the present whole subfamily Alticinae than to the genus *Altica* as it is defined today (LeSage 1995).

The purpose of the present paper is to designate a lectotype for *Altica chalybaea*, and to describe and illustrate the male and female genitalia which are not treated in the original description.

Type designation

The original series, consisting of six specimens, comes from the A.S. Knoch Collection which is currently preserved in the Museum für Naturkunde der Humbolt-Universität zu Berlin in Germany. The collection label for the whole syntype series reads: "*Chalybaea* N/ A.S. Knoch/ Georg. Am. Francil. (= *Georgia Americana*, Francillon).

LECTOTYPE. The presently selected male bears the following labels: a hand written label "*oleracea* F./ *Am. bor.* Leg." (= *America borealis* Leg.), a grey label with the number "55818" typed on it, a green label "*America bor./* Knoch/ Nr. 55818", and a beige label: "Zool. Mus. Berlin." I have added the following red label: **LECTOTYPE:** *Altica chalybaea* Illiger/ Des. LeSage 1999."

This specimen had been originally misidentified, probably by Knoch, as indicated on the first label. Fortunately, this misidentification does not affect the nomenclature of the species because Knoch never published it.

PARALECTOTYPES. The selected and dissected female bears a green and a beige label similar to the lectotype labels, and a small square piece of paper with the number "126" typed on it.

¹ Received November 1, 1999. Accepted November 26, 1999.

² Agriculture Canada, ECORC, Neatby Bldg 3032, 960 Carling Ave. Ottawa, Ontario. Canada K1A 0C6.



The remaining syntypes comprise four specimens. A male and a female, both remounted on small cards, had been dissected in the past but their genitalia not preserved. The other two specimens are pinned males. They all bear a green and a beige label similar to those of the lectotype except for the last male which bears only a beige label. I have added the following yellow label to these: **PARALECTOTYPE:** "*Altica chalybaea* Illiger/ Des. LeSage 1999".

Description: The original Latin description is very scanty: *Sulcicollis, ovalis, cyanea, thorace transverso, elytris punctatis.*" (Thorax grooved, oval, blue, pronotum transverse, elytra punctate).

Illiger added the following information to the description (translation): "Originating from Georgia, North America, Francillon. According to Professor Knoch, it is also found in Pennsylvania. Length, two and two thirds lines, fairly similar to *oleracea* in shape, but much broader. The width of the pronotum exceeds its length by one-half. The posterior transverse groove is located in front of the posterior third, and is transformed into lateral grooves on the sides toward the head. The posterior margin of the pronotum is projecting in the middle, forming a flattened bow. This beetle is slightly metallic dark blue with a tendency to green. Due to fine grey setae, the antennae are brownish black, except for the basal segments which are clearly blue. The underside of the body and the legs are covered with fine, grey, inconspicuous setae. The elytra bear punctures which form anteriorly fairly close elongate series. The first segments of the anterior legs are bigger, thicker and broader than the other segments."

Other external characters such as the number of labral setae (6), the frontal tubercles (smooth), the vertex (smooth), the pronotal groove (deep), the antennae, etc. are also found in several other species of the genus (LeSage, in preparation).

MALE GENITALIA (lectotype). The terminology follows that used previously in my revision of the North American costate species (LeSage 1995).

Median lobe of the aedeagus (fig. 1), 1.9 mm long, 500 μ m wide; tip nipple-shaped. On the dorsal side, ostium of moderate length, about 1/4 length of median lobe; ostium lamellae markedly asymmetrical, the median lamella being 3 times as broad as the lateral ones; first 4-5 dorsal undulations interrupted in middle at base by median depression, approximately 20 in number. On ventral side, median carina not high, barely indicated, shorter than ventral ridges; ventral longitudinal ridges short, almost parallel, about 1/7 length of aedeagus; lateral folds much reduced, little raised, less than 1/10 length of aedeagus; ventral wrinkles markedly developed, oblique, and about 20-25 in number.

FEMALE GENITALIA (paralectotype). Styles ("vaginal palpi") (fig. 2): length, 505 μ m, width, 93 μ m; fused for basal 1/6; tips slightly divergent; sensilla, 15 (left) to 16 (right) in number; apical setae, 13 on left, 16 on right. Spermatheca: 293 μ m long; receptacle cylindrical; pump extending beyond base of receptacle; small triangular appendix present at tip; basal portion of spermathecal duct straight and relatively long; spermathecal duct apparently with 3 complete loops; valve of spermathecal gland of medium size.

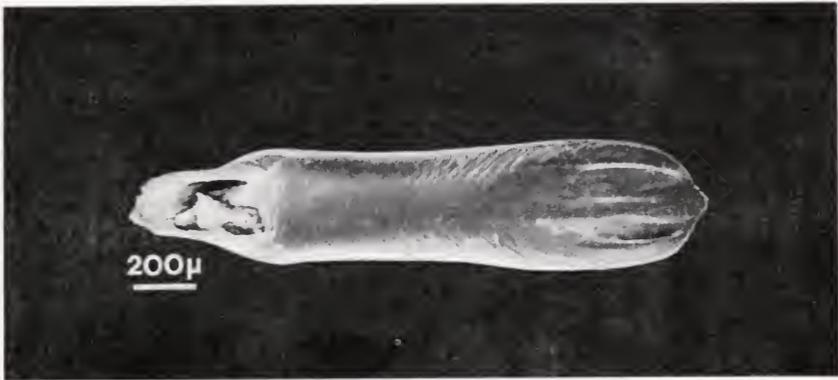


Figure 1. Median lobe of the aedeagus of the lectotype *Altica chalybaea* Illiger, ventral side.

DISCUSSION

Unfortunately, the original description is not very useful for the recognition of *Altica chalybaea* although the blue color and the ovoid shape of the body are the two most noticeable external features in this species. The statement about the broader shape of the body is true but must be interpreted carefully since it applies to most females of *Altica* which are proportionally broader than males. In addition, there are several species with an ovoid body (e.g. *A. ovulata* Fall, *A. ulmi* Woods, etc.) consequently, it is not possible to recognize this species only on the basis of the body shape (LeSage, in preparation).

The character state given for the pronotum can be applied to all *Altica* species, and it is also much more variable than reported by various authors (LeSage 1995). The same observation applies to the setae on the underside of the body and legs. The broader shape of the first tarsome of the front legs is a sexual character, not a specific one as reported by Illiger. Actually, this segment, with few exceptions, is distinctly broader in males than in females in the genus *Altica*.

As regards the external features of *Altica chalybaea*, the medium size, the ovoid shape, and the blue color of the body appear to be the most distinctive ones, but these characters are useful only in combination with those of the genitalia since there are quite a few North American species with a similar size, shape and/or color (e.g. *A. ovulata* Fall, *A. ulmi* Woods, etc.).

As regards the male genitalia, the numerous oblique wrinkles on the ventral side of the median lobe of the aedeagus are very distinctive. In other species, these wrinkles are either not so numerous or not so oblique.

In the female, the diagnostic features of the genitalia of *Altica chalybaea* are more difficult to recognize because the female genitalia of most North

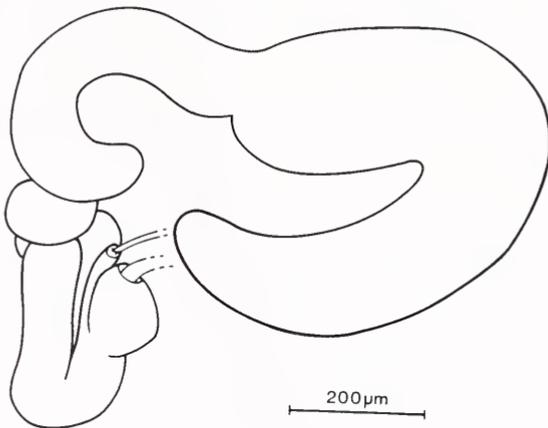
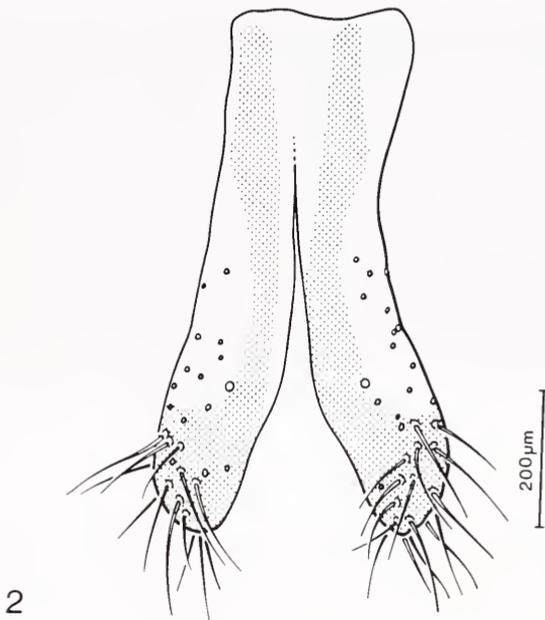


Figure 2. Styles of a paralectotype female of *Altica chalybaea* Illiger.

Figure 3. Spermatheca of a paralectotype female of *Altica chalybaea* Illiger.

American *Altica* species are still unknown except for the costate species which have been revised recently (LeSage 1995). In *A. chalybaea*, the basal portion of the spermathecal duct appears fairly long whereas it is proportionally shorter in other species, the receptacle of the spermatheca is not inflated whereas it is distinctly so in most species, and the inner margins of the styles diverge less at the tip than those of the known species.

ACKNOWLEDGMENTS

The assistance of Manfred Uhlig of the Museum für Naturkunde der Humbolt-Universität of Berlin in obtaining types has been greatly appreciated as well as the comments on the manuscript by my colleagues John Huber and Lubomir Masner.

Thanks are extended to Go Sato for inking the figures and to Eric Rickey for the SEM picture.

LITERATURE CITED

- Illiger, K. 1807. Verzeichniss der Arten der Flokäfer, *Halticae*, in der Hellwig-Hoffmanns'schen Sammlung, mit Beschreibung der neuen, und Bezeichnung der übrigen Arten. *Magazin für Insektenkunde* 6: 81-188.
- LeSage, L. 1995. Revision of the costate species of *Altica* Müller of North America north of Mexico (Coleoptera: Chrysomelidae). *Can. Entomol.* 127: 295-411.
-
-

BOOKS RECEIVED AND BRIEFLY NOTED

CATALOG OF THE NEOTROPICAL CADDISFLIES (INSECTA: TRICHOPTERA). O.S. Flint, Jr., R.W. Holzenthal, S.C. Harris. 1999. 239 pp. 8-1/2 x 11 format. ppbk. \$30 plus shipping & handling.

As the title states, this is a systematic catalog of the Trichoptera fauna of all American (New World) countries south of the United States.

GENERIC KEY TO THE ADULT OCELLATE LIMNephILOIDEA OF THE WESTERN HEMISPHERE (INSECTA: TRICHOPTERA). D.E. Ruiter. 2000. 22pp. 8-1/2 x 11 format. ppbk. \$10 plus shipping & handling.

REVISION OF THE NEARCTIC SPECIES OF THE GENUS *POLYPEDILUM* Kieffer (DIPTERA: CHIRONOMIDAE) IN THE SUBGENERA *P. (Polypedilum)* Kieffer and *P. (Uresipedilum)* Oyewo and Saether. D. Maschwitz and E.F. Cook. 2000. 135 pp. 8-1/2 x 11 format. ppbk. \$25 plus shipping & handling.

The above three titles are recent publications of the Ohio Biological Survey, The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212-1192.

MONOSOMA PULVERATA (HYMENOPTERA: TENTHREDINIDAE), AN ALDER-FEEDING SAWFLY NEW TO NORTH AMERICA¹

David R. Smith,² Henri Goulet³

ABSTRACT: *Monosoma pulverata*, a European alder-feeding sawfly, is reported as new to North America from specimens taken in Newfoundland. It is separated from the only native North American species of *Monosoma*, *M. inferentia*.

Monosoma pulverata (Retzius), an alder sawfly native to Europe, northern Africa, and the Near East, was collected on three different occasions in Newfoundland in 1991 and 1998. The species is undoubtedly a relatively recent introduction, and, because of the prevalence of its host plant in North America, it is likely to spread on the continent. It is an addition to several species of sawflies on alder that have previously been accidentally introduced into North America: *Fenusa dohrnii* (Tischbein), a leafminer, and *Eriocampa ovata* (L.) and *Croesus varus* (Villaret), both external leaf feeders (all Tenthredinidae) (Smith, 1979b).

Monosoma MacGillivray was treated by Smith (1979a) in a revision of North American Allantinae and includes only one native species, *Monosoma inferentia* (Norton), which also feeds on *Alnus* spp. *Monosoma inferentia* occurs from Newfoundland (insular and Labrador) west to British Columbia in Canada, and from Maine to North Carolina west to Minnesota and Illinois in the United States. The sheath, lancet, and male genitalia were illustrated by Smith (1979, figs. 186, 187, 189, 190).

Monosoma pulverata occurs throughout Europe and in northern Africa (Lacourt, 1975) and Turkey to the Caucasus (Benson, 1968). Notes on its larva and biology were given by Pieronek (1976, 1980, 1983, 1985). The male genitalia were illustrated by Taeger (1987, fig. 13) and Lacourt (1975, fig. 1). Taeger (1987, fig. 14) illustrated a central depression on the 8th tergite; we did not see this in males of *M. inferentia*. We have not seen males from North America. Males are rare in Europe, and Benson (1952) believed it to be parthenogenetic since males had not been found in Britain.

The females of the two species are distinguished by coloration. Both sexes also can be distinguished by clypeus shape, size of the postocellar area, and dull or shining surface sculpture.

¹ Received September 10, 1999. Accepted October 20, 1999.

² Systematic Entomology Laboratory, PSI, Agricultural Research Service, U. S. Department of Agriculture, c/o National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-0168, U.S.A.

³ Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Research Branch, K.W. Neatby Building, CEF, Ottawa, Ontario K1A 0C6, Canada.

Key to Species

1. Postocellar area longer than broad (Fig. 3); head and thorax dull, with fine microsculpture; in female, anterior half or more of clypeus whitish and thorax and abdomen largely yellow to orange, variable; clypeus shorter and broader (Fig. 1) *M. inferentia*
- Postocellar area about as long as broad (Fig. 4); head and thorax shining, without microsculpture; in female, less than half of anterior of clypeus reddish brown and thorax and abdomen mostly black; clypeus longer and less broad (Fig. 2) *M. pulverata*

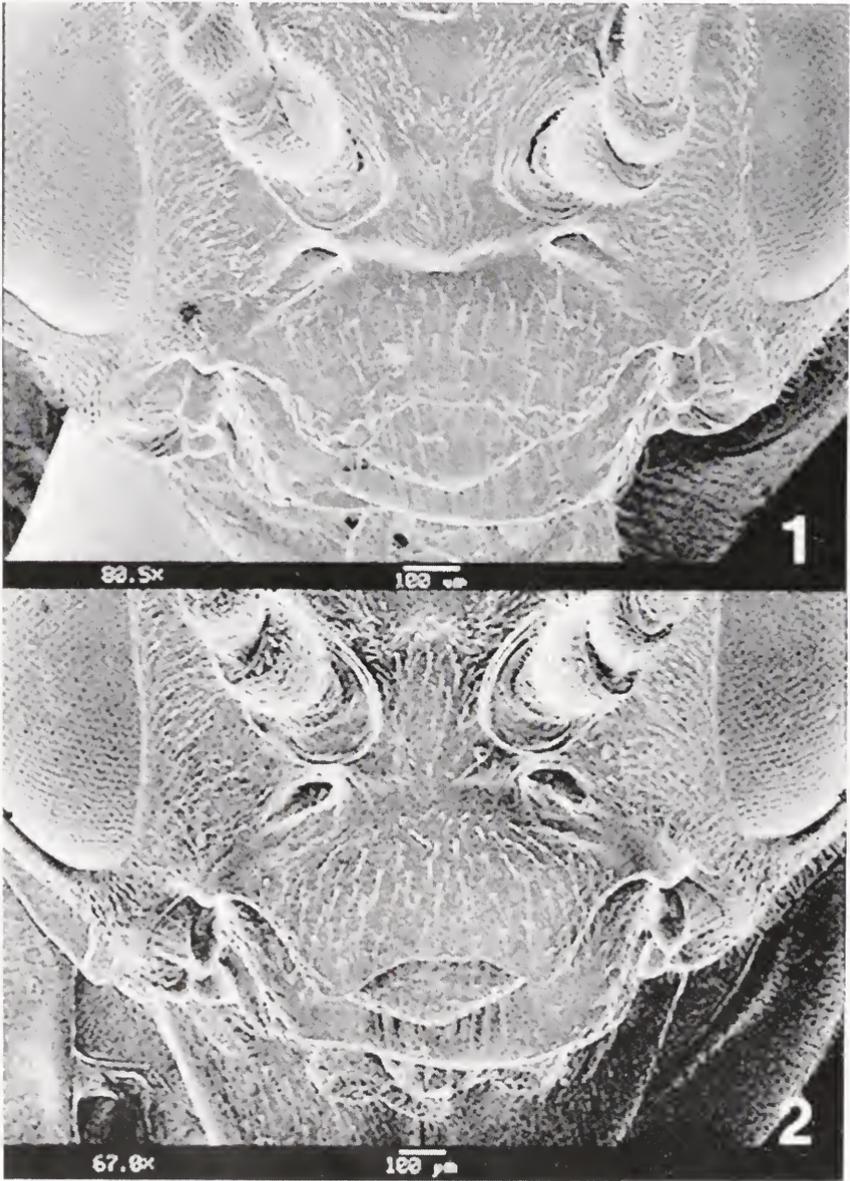
Females of *Monosoma pulverata* have the antenna and head black with the labrum white and front margin of the clypeus reddish brown; thorax black with posterior corners of the pronotum and tegula yellow and sometimes a brownish stripe on the posterior margin of the mesepisternum; legs reddish brown with the base and inner surface of the coxae black and the hindtibia and all tarsi blackish; abdomen black with the apical margins of the segments beyond the first, apical segment, and lateral spots on the terga whitish to yellowish. The wings are hyaline with the subcosta and stigma of the forewing amber and remaining veins brownish to black.

North American records for *Monosoma pulverata* are: NEWFOUNDLAND: South Branch Grand Codroy R., Hwy 1, 5 June 1998, B. Kondratieff, R. Baumann (2 ♀); Gander R., Hwy 1, Appleton, 9 June 1998, B. Kondratieff, R. Baumann (1 ♀); Codroy pond, 10 June 1991, H. Goulet (1 ♀). Deposited in the Colorado State University collection and the Canadian National Collection.

Females of *Monosoma inferentia* are mostly orange to reddish brown with the clypeus white, antenna black and usually some marks on the mesosternum, lobes of mesonotum, posterior portion of mesoscutellum, and metanotum black. The coloration is variable and the head may be mostly black and the black marks on the thorax faint or extensive. The wings are hyaline with the stigma and veins of the forewing brownish to black with the basal half of the stigma amber.

ACKNOWLEDGMENTS

We appreciate the help of B. Kondratieff, Colorado State University, Fort Collins, for allowing study of specimens in their collection. Cathy Anderson, Systematic Entomology Laboratory, USDA, took the SEM photographs and prepared the plates. Thanks also to the following for reviewing the manuscript: N. M. Schiff, U.S. Forest Service, Stoneville, MS and N. E. Woodley, Systematic Entomology Laboratory, USDA, Washington, DC.



Figs. 1-2. Front of head. 1, *Monosoma inferentia*. 2, *M. pulverata*.



Figs. 3-4. Dorsal view of head. 3, *Monosoma inferentia*. 4, *M. pulverata*.

LITERATURE CITED

- Benson, R.B.** 1952. Hymenoptera, Symphyta. Handbooks for the Identification of British Insects, Royal Entomol. Soc. London, Vol. 6, part 2(b), pp. 51-137.
- Benson, R.B.** 1968. Hymenoptera from Turkey, Symphyta. Bull. British Mus. (Nat. Hist.) Entomol. 22: 110-207.
- Lacourt, J.** 1975. Note sur les Tenthredes de l'Aulne au Maroc. L'Entomologiste 31: 173-176.
- Pieronek, B.** 1976. The instars and last moult of sawfly larvae (Hymenoptera, Symphyta). Polskie Pismo Entomol. 46: 767-769.
- Pieronek, B.** 1980. On the larval *Monosoma pulverata* (Retzius) feeding on alder (Hymenoptera: Tenthredinidae-Blennocampinae). Mitt. Zool. Mus. Berlin 56: 195-199.
- Pieronek, B.** 1983. The larvae of Symphyta (Hymenoptera) feeding on *Alnus* (Mill.). Verhandl. Symp. Internat. Entomofaunisticae Europe Centralis, pp. 119-122.
- Pieronek, B.** 1985. Food dependences and productivity of the larvae of *Cimbex connata* (Schr.) and *Monosoma pulverata* (Retz.) (Hymenoptera, Symphyta). Mitt. Deut. Gesell. Allgemeine und Angewandte Entomol. 4: 236-239.
- Smith, D.R.** 1979a. Nearctic sawflies IV. Allantinae: Adults and larvae (Hymenoptera: Tenthredinidae). U. S. Dept. Agr., Tech Bull. 1595, 172 pp., 24 pls.
- Smith, D.R.** 1979b. Symphyta, pp. 3-137. IN: Krombein, K.V., P.D. Hurd, Jr., D.R. Smith, and B.D. Burks, eds. Catalog of Hymenoptera in America North of Mexico, Vol. 1, Smithsonian Inst. Press, Washington, D.C. 1198 pp.
- Taeger, A.** 1987. Ergänzungen zur Blattwespenfauna Bulgariens und Bearbeitung der Gattung *Monostegia* O. Costa (Insecta, Hymenoptera, Symphyta, Tenthredinidae). Faun. Abhandl. Staat. Mus. Tierkunde Dresden 15: 1-10.

BOOKS RECEIVED AND BRIEFLY NOTED

MEDICAL ENTOMOLOGY FOR STUDENTS, 2nd ed. M.W. Service. 2000. Cambridge University Press. 283 pp. ppbk. \$37.95.

Basic information on the recognition, biology, and medical importance of arthropod vectors of disease and their control. All major groups of medically important arthropods are included in this updated edition.

A FLY FOR THE PROSECUTION. HOW INSECT EVIDENCE HELPS SOLVE CRIMES. M.L. Goff. 2000. Harvard University Press, 225 pp. Hard Cover. \$22.95.

From twelfth century China to twenty-first century America, the author, a noted professional forensic entomologist, chronicles the evolution of this science, and in a narrative punctuated by his own personal experiences, explains how, exactly, insects can provide clues about a crime.

FURTHER CONTRIBUTIONS TO THE STUDY OF *DALQUESTIA* (OPILIONES: SCLEROSOMATIDAE)¹

James C. Cokendolpher², W. David Sissom³

ABSTRACT: *Dalquestia leucopyga* n. sp. is described from northeastern Tamaulipas, Mexico. New localities are provided for *Dalquestia concho* in Chihuahua, Mexico, *Dalquestia formosa* in Texas, USA, and *Dalquestia grasshoffi* in Durango, Mexico. The first record of *D. formosa* in Mexico is also provided from Nuevo León. Additional biological notes are provided for *D. formosa* in Texas.

RESUMEN: *Dalquestia leucopyga*, sp. n., es descrita de Tamaulipas del noreste, México. Los nuevos lugares se proporcionan para el *Dalquestia concho* Cokendolpher en Chihuahua, México, *Dalquestia formosa* (Banks) en Tejas, los EEUU, y el *Dalquestia grasshoffi* Cokendolpher en Durango, México. El primer expediente de *D. formosa* en México también se proporciona de Nuevo León. Las notas biológicas adicionales se proporcionan para *D. formosa* en Tejas.

Since the original description of *Dalquestia* (Cokendolpher, 1984), two papers have been published relative to this genus. Cokendolpher & Stockwell (1986) described a new species from Arizona, USA, and provided a revised key to the species of the genus. Tsurusaki & Cokendolpher (1990) reported the first karyotype of any member of *Dalquestia* (*D. formosa*).

The higher classification of the Phalangioidea Opiliones remains unsettled. Although it is clear that *Dalquestia* belongs to an unnamed assemblage (family or subfamily?) with *Metopilio* Roewer, *Diguetinus* Roewer, *Eurybunus* Banks, and *Globipes* Banks, their relationship to other Phalangioidea is unclear. In the latest catalogue to the genera of Phalangioidea, Crawford (1992) listed the *Metopilio* assemblage (equivalent to subfamily) within the Sclerosomatidae. For lack of better evidence, Cokendolpher & Lee (1993) and Kury & Cokendolpher (in press) followed this assignment in catalogues to the Opiliones of North America.

Almost a decade ago, Marie Goodnight gave the senior author a large collection of harvestmen which she and Clarence Goodnight had accumulated over the years as the reigning authorities on North American Opiliones. Among this material is a new species of *Dalquestia* as well as several new records of the genus. Herein we describe that species and provide records and biological data obtained since the original publication of the genus.

¹ Received October 4, 1999. Accepted November 8, 1999.

² 2007 29th Street, Lubbock, Texas 79411 USA.

³ Department of Life, Earth, & Environmental Sciences, West Texas A&M University, Box 60808, Canyon, Texas 79016 USA.

METHODS

The description format and terms essentially follow those of Cokendolpher (1984). The penis was examined and illustrated while it was immersed in K-Y® Brand Jelly (Ortho Pharmaceutical Corp., Raritan, New Jersey, USA) on a depression slide. To our knowledge this is the first time this material has been used with Opiliones. This clear jelly is water/alcohol soluble and thick enough to hold the object under study in any position. Museum collections reported here are: American Museum of Natural History, New York (AMNH); Texas Memorial Museum, Austin (TMM); personal collection of J. C. Cokendolpher (JCC).

Dalquestia leucopyga, NEW SPECIES

(Figs. 1-7).

Dalquestia n. sp. 1 Tamaulipas (endemic): Kury & Cokendolpher, in press.

Diagnosis.— Each abdominal tergite with two rows of tubercles, tubercles of anterior row smaller than in posterior row; white spot at tip of abdomen dorsally; tibia II without pseudosegments, sharply bicolored; basal cheliceral segment with laterally compressed subconical spur below, a few small tubercles above.

Identification.— All species of *Dalquestia* thus far known are found in widely separated and geographically isolated areas. Identifications can usually be made by referring to the map in Cokendolpher (1984), with the addition of *D. rothorum* Cokendolpher & Stockwell, 1986, from Arizona, USA. Possibly because of these isolated distributions, the genitalia of *Dalquestia* members are very conservative and appear similar. This is the opposite of *Metopilio* spp. which are often sympatric. A key to the species of *Dalquestia* (based entirely on external features of adults) is provided by Cokendolpher & Stockwell (1986). In that key, *D. leucopyga* will be identified as *D. rothorum*. *Dalquestia leucopyga* is easily distinguished from *D. rothorum* on the basis of the chelicerae. *D. leucopyga* has a spur on the basal segment of the chelicera and lacks tubercles on the distal article of the chelicera. These two are also widely separated in their distributions. *Dalquestia rothorum* is known only from a live oak riparian zone on a mountain surrounded by desert in Arizona. *Dalquestia leucopyga* is thus far known only from the coastal plain in north-eastern Tamaulipas.

Etymology.— The specific name is Greek (*leuc* = white and *pyg* = rump) and refers to the white spot found on the posterior end of the abdomen.

Type data.— Male holotype from Km 158 on Highway 110, about 7 km SW of San Fernando, Tamaulipas, Mexico, 60-90 m elev., 22 Feb. 1973, T. R. Mollhagen (AMNH).

Description.—Based on the male holotype. With the characters of the genus (Cokendolpher, 1984). Total length 4.95 mm, greatest width 3.00 mm, maximum height 2.35 mm. Dorsum brown, lighter on borders of cephalothorax and anterior portion of abdomen, with two small whitish median spots on segments I, II, and larger creamy white spot distally on abdomen (tergites VI distally, VII). Cephalothorax densely covered with low rounded granules and with a transverse row of larger tubercles along posterior margin; preocular area on anterior margin with pointed denticles medially; pair of pointed tubercles between pores and preocular tubercles. Ocular tubercle dark brown, contrasting somewhat with surrounding portion of cephalothorax; length 0.40 mm, width 0.40 mm, height 0.20 mm; eyes flanked medially by two rows of 7 tubercles. Each tergite with double rows of tubercles, tubercles of anterior rows smaller than those of posterior rows (Fig. 1). Genital operculum length 1.70 mm, width at neck 0.70 mm, width at base 1.55 mm. Genital operculum creamy yellow; leg coxae and trochanters creamy yellow with pointed tubercles. Sternites brownish-yellow with small brownish granules on extreme lateral edges; posterior half of sternite VIII, all of sternite IX, and anal operculum darker brown with dense, rounded brown granules. Pedipalp with coxa and trochanter yellow; femur, patella, and tibia yellow brown; tarsus yellowish; all segments except tarsus with numerous tubercles; tarsus with ventral rows of denticles; tips of claws black. Palpal segment lengths: femur 1.10 mm, patella 0.80 mm, tibia 1.10 mm, tarsus 1.30 mm. Chelicera creamy yellow with short blackish setae on anterior and medial faces (Figs. 2, 3); basal segment with laterally compressed subconical tubercle ventrally (Fig. 2). Leg segments yellowish-brown except as follows: femur, patella, and tibia of leg I light orange brown; tibia I shaded to narrow whitish distal band; femur of leg II with narrow brown band distally, patella II light brown, tibia II brown on basal two thirds and whitish on distal third; tibiae III-IV light brownish with narrow whitish band distally. All legs with longitudinal rows of tubercles; tibiae and metatarsi lacking pseudosegments; femora and tibiae strongly angular in cross-section. Femora I-IV lengths (respectively, in mm): 2.00, 5.90, 2.10, 3.20; tibiae I-IV lengths: 2.10, 4.60, 1.90, 2.40. Penis as in Figs. 4-7; length 3.85 mm.

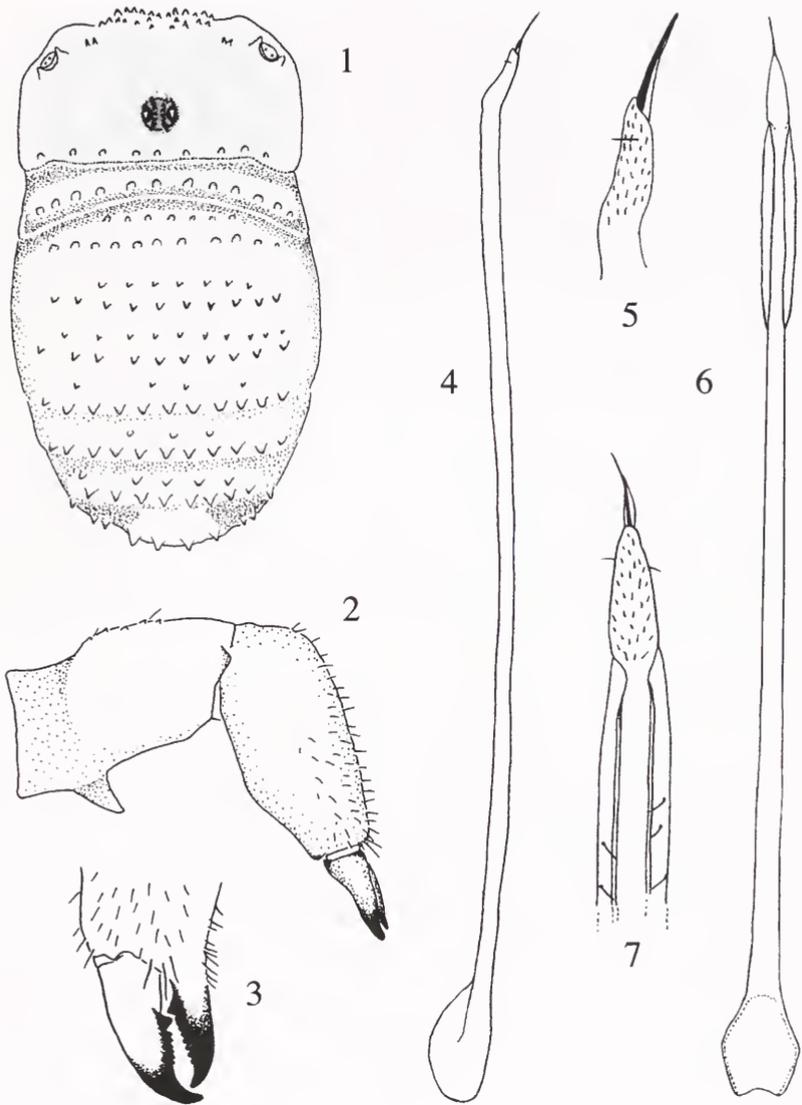
Female: Unknown.

Specimens examined.— Only the holotype.

Dalquestia formosa (Banks)

Kury & Cokendolpher (in press) listed this species from Nuevo León but did not provide any details. The only known record for the state as well as many new records from Texas are listed below.

New Records.— MEXICO: NUEVO LEÓN: Cuevas Buenavistas, Sierra de Lampasos, E. of Bustamante, 15 Sept. 1985 (T. Raines), 1 female (TMM). USA: TEXAS: Bexar Co., Friedrich Wilderness Area, north of San Antonio, 366-381 m elev., 6 Feb. 1983 (F. E. Walker) 1 male, 4 females, eggs, 1st instars reared from eggs (TMM). Blanco Co., Rough Hollow Creek and Hwy. 2766, 6 km E. Johnson City, 3 Oct. 1994 (A. G. Grubbs), 1 male (TMM); Flat Creek Ranch, 19.3 km E. Johnson City, 28 May 1995 (A. G. Grubbs), 1 male (TMM). Brewster Co., Chisos Mountains, Big Bend National Park, 1,676 m elev., 28 June 1947 (C. L. Remington), 1 male, 3 juv. (AMNH); 1,829 m elev., 29 June 1947 (C. L. Remington), 1 male, 5 juv. (AMNH); The Basin, 2 July 1947 (C. L. & J. E. Remington), 1 male, 1 female (JCC); 16 June 1948 (M. Cazier), 1 male (AMNH); Lost Mine Trail, 19 March 1991 (K. McWest & T. J. Fuller) 1 female, 1st instars from eggs (TMM). Burnett Co., Simons Squirm-Around Cave, 20 Nov. 1990 (J. Reddell, M. Reyes), 1 female (TMM); Simons Water Cave, 12 Nov. 1990 (J. Reddell, M. Reyes, M. Warton), 1 male (TMM); Snake Pit Cave, 20 Nov. 1990 (J. Reddell, M. Reyes), 1 female (TMM); FM 2341, 19.3 km NW Burnet, 13 Oct. 1994 (A. G. Grubbs), 1 male (TMM); Gridiron Creek, 7.2 km NW Spicewood, 27 Sept. 1994 (A. G. Grubbs), 1 male (TMM); Co. Rd.



Figs. 1-7. *Dalquestia leucopyga* n. sp. male. 1, dorsum of body; 2, mesal view of left chelicera; 3, anterior view of left cheliceral jaws; 4, lateral view of penis; 5, enlargement, lateral view of distal end of penis; 6, ventral view of penis; 7, enlargement, ventral view of distal end of penis.

404, 2.4 km W. Spicewood, 9 Nov. 1994 (A. G. Grubbs), 1 female (TMM); 2.6 km SW Smithwick, 13 Oct. 1994 (A. G. Grubbs), 1 male (TMM); 2.6 km S. Marble Falls, 20 Sept. 1994 (A. G. Grubbs), 1 juv. (TMM). Gillespie Co., 12.9 km NW Fredericksburg, 24 Oct. 1985 (J. C. and J. E. Cokendolpher), 1 juv. (TMM). Hays Co., Recharge Farms, 8 km NNW San Marcos, 2 Feb. 1983 (A. G. Grubbs), 2 males (TMM). Kerr Co., 1.6 km NE Mountain Home, 7 June 1988 (B. J. Nichols), 1 male (TMM), 21-24 July 1988 (B. J. Nichols), 1 male (JCC); 3.2 km SSE Center Point (W. Rogers, et al.), 7 May 1983, 1 juv. (TMM); 25 June-2 July 1983, 1 juv. (TMM); 16-23 Sept. 1983, 1 juv. (TMM); 16 Oct. 1983, 2 males (JCC), 7 males, 1 female (TMM); 4-11 Feb. 1984, 1 juv. (TMM); 27 May-4 June 1984, 2 juv. (TMM); 6.4 km E. Kerrville, 16 Oct. 1983 (W. Rogers), 1 juv. (TMM); 6.4 km E. Kerrville (W. Rogers, et al.), 7 May 1983, 1 juv. (TMM); 27 May-4 June 1983, 7 juv. (TMM); 25 June 1985, 2 females (TMM); 20-26 Aug. 1983, 2 juv. (TMM); 23 Sept. 1983, 1 juv. (TMM). Travis Co., Bee Creek Nature Preserve, Austin, 21 June 1988 (S. W. Taber), 1 female (JCC); Adobe Springs Cave, 29 May 1989 (W. Elliott, J. Reddell, M. Reyes), 1 juv. (TMM); Sunset Canyon, W Austin, 6.4 km E. Dripping Springs, 17 Oct. 1985 (W. R. Elliott), 1 male, 2 females (TMM). Uvalde Co., Jester's Gold Cave, 4 April 1993 (J. Loftin), 1 female (TMM). Val Verde Co., 8 km S. Loma Alta on Rt. 277, 9 June 1984 (S.A. Stockwell), 1 juv (JCC); 33.8 km N. Langtry, 15 April 1973 (C. McConnell), 2 females (JCC); 16 April 1973 (T. R. Mollhagen), 2 females (JCC).

Natural history.— A female from near San Antonio, Texas, laid 34 eggs on either 21 or 22 Feb. 1983. Twenty-seven eggs hatched on 28-29 April 1983. This developmental time was at about 22° C. A female collected in Big Bend National Park on 19 March 1991 laid eggs the following weekend. The number of eggs is not available for this female because the egg mass began to decay before a count could be made.

Almost all of the specimen vials which are labeled with habitat data mention some sort of juniper habitat. Piñon-juniper habitats are recorded in the Chisos Mountains. Juniper (primarily *Juniperus ashei* Buchh.) habitats (often semi-arid) are recorded from central and north-central areas of this species range. According to Walker (pers. comm., 6 Feb. 1983), *D. formosa* occurs north of San Antonio in an area of *J. ashei* and rocks. On the lower slopes, where the area is not as arid, the junipers grow thickly and litter the ground with their needles. No *D. formosa* were encountered in this region. Higher up on the slopes where it is more arid and the vegetation is more sparse, *D. formosa* was encountered under rocks.

During an extensive pitfall trapping study in central Texas (13,440 trap nights spread over a year in eight localities, Phillips, et al., 1986), only 57 *D. formosa* were collected. Four habitat types were sampled during the trapping: juniper-grassland, live oak-grassland, grazed pasture-grassland, and southern cypress-grassland communities. *Dalquestia formosa* was only collected in *J. ashei*-grasslands. Those collections are plotted in Fig. 8. Pitfall trapping does not appear to be a good method to obtain life history data on *D. formosa*. Apparently, the younger instars either spend their time in habitats not sampled by the traps (cracks and holes in the earth), or they are relatively immobile and do not wander far from the site from where they were born. Limited laboratory observations indicate that at least the first two instars of *D. formosa* are very

easily desiccated. They could not survive on the surface except on very moist occasions. We suggest the pitfall trap data are relatively accurate for describing adult activity because those individuals appear to be less sensitive to moisture. Adults are active in October and November, following the decline in the number of juveniles. It appears mating occurs in October and November. Egg laying presumably occurs during the same period. Although a female was collected in June, it is uncertain if it was a newly maturing individual or one that had already over-wintered as an adult. As already noted, females from slightly more southern localities have been observed to lay eggs in February and March. Cokendolpher (1984) reported that adults were known from all months with the majority from July to November. He also stated that two females collected during October were filled with large eggs. His data may be somewhat misleading though, as it includes records from throughout the range of this species.

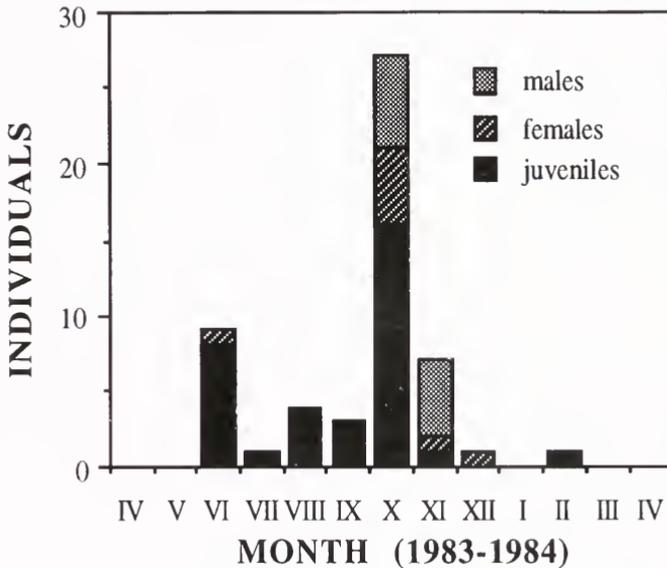


Fig. 8. Monthly collections by pitfall trapping of *Dalquestia formosa* in juniper-grasslands of central Texas.

Dalquestia concho Cokendolpher

New Record.— MEXICO: CHIHUAHUA: Torrecillas, 2,103 m elev., 17 August 1947 (G. M. Bradt), 1 juv. (JCC).

Comment.— This juvenile does not differ from the original description of that stage. The new record is the southernmost record for the species, but only extending the range south about 60 km from Encino, Durango.

Dalquestia grasshoffi Cokendolpher

Record.— MEXICO: Hidalgo: Jacala, 20 July 1956 (V. Roth, W. Gertsch), 1 male (JCC).

Comment.— The above listed record (from the type locality) is only the second collection of this species. This male does not differ significantly from the original description of the male.

ACKNOWLEDGMENTS

We thank Marie Goodnight for the gift of the specimens, some of which are reported upon herein. James R. Reddell, Texas Memorial Museum, kindly loaned specimens of *Dalquestia*. Kari M. McWest, Tony Mollhagen, and Fred E. Walker are thanked for their conversations/ correspondences about *Dalquestia* natural history and collection localities. We are grateful to Joe Bigelow for informing us about the use of K-Y® Brand Jelly in the observation of minute objects. Darrell Ubick (California Academy of Sciences) and Allen Dean (Texas A&M University) kindly reviewed the final draft of the manuscript; their efforts are sincerely appreciated. We also thank Douglas P. Bingham and the Department of Life, Earth, and Environmental Sciences at West Texas A&M University for providing financial support to cover publication costs.

LITERATURE CITED

- Cokendolpher, J. C.** 1984. A new genus of North American harvestmen (Arachnida: Opiliones: Palpatores). Pp. 27-43 IN: N. V. Horner (ed.). Festschrift for Walter W. Dalquest in honor of his sixty-sixth birthday. Midwest. State Univ., Wichita Falls, Texas.
- Cokendolpher, J. C. & S. A. Stockwell.** 1986. A new species of harvestmen from Arizona (Arachnida: Opiliones: Palpatores: *Dalquestia*). Southwest. Nat., 31:49-53.
- Cokendolpher, J. C. & V. F. Lee.** 1993. Catalogue of the Cyphopalpatores and bibliography of the harvestmen (Arachnida, Opiliones) of Greenland, Canada, USA, and Mexico. Private Publ., Lubbock, Texas, 82 pp.
- Crawford, R. L.** 1992. Catalogue of the genera and type species of the harvestman superfamily Phalangioida (Arachnida). Burke Mus. Contr. Anthropol. Nat. Hist., no. 8, 60 pp.
- Kury, A. B. & J. C. Cokendolpher.** In press. Opiliones. IN: Biodiversidad, Taxonomía y Biogeografía de Artrópodos de México: Hacia una síntesis de su conocimiento (Vol. II).
- Phillips, S. A., Jr., S. R. Jones, D. M. Claborn & J. C. Cokendolpher.** 1986. Effect of Pro-Drone, an insect growth regulator, on *Solenopsis invicta* Buren and nontarget ants. Southwest. Entomol., 11:287-293.
- Tsurusaki, N. & J. C. Cokendolpher.** 1990. Chromosomes of sixteen species of harvestmen (Arachnida, Opiliones, Caddidae and Phalangiidae). J. Arachnol., 18:151-166.

MATERNAL CARE IN THE NEOTROPICAL CENTIPEDE *OTOSTIGMUS SCABRICAUDA* (CHILOPODA: SCOLOPENDROMORPHA)¹

G. Machado²

ABSTRACT: This paper provides the first field report of maternal care in a Neotropical centipede. Nine females of *Otostigmus scabricauda* were found taking care of eggs or first instar nymphs at São Sebastião Island, southeastern Brazil. Brood-guarding females were found in the leaf litter or under fallen trunks. The mean clutch size was 29.1 ± 15.7 and no egg was observed to be infected with fungi. The nymphs are non-pigmented and hatch with 21 segments. Egg-laying in *O. scabricauda* probably takes place in the beginning of the wet-warm season (October), and the reproductive season lasts until February. Predation pressure in the leaf litter and the high risk of infection due to fungi may have favored the evolution of maternal care in many arthropods living on the soil, such as centipedes.

Parental investment is defined as any behavior exhibited by a parent towards the progeny which increases its survival rate at the cost of the aptitude of the parent to invest in another progeny (Trivers, 1972). Among arthropods this may include investment by females in the choice of an appropriate site for oviposition, incubation, and egg-guarding, as well as the feeding of young by one or both parents (Clutton-Brock, 1991).

There are about 2500 described species of centipedes (order Chilopoda) in both temperate and tropical regions (Cloudsley-Thompson, 1958; Lewis, 1981). Centipedes usually live in damp and dark places such as under stones, fallen leaves, logs, under barks, or in crevices. The reproductive biology of centipedes is poorly known, but at least some species present some degree of parental care. Females in the suborders Scolopendromorpha and Geophilomorpha lay their eggs in clusters and guard the eggs from oviposition to hatching, then caring for the young until they disperse (Brunhuber, 1970).

While the female guards her offspring she is very sensitive to disturbance and commonly abandons the egg-batch which may be attacked by fungi or predators. Thus, females and their brood cannot be transported to the laboratory in order to observe their behavior and development (Brunhuber, 1970). Among the Scolopendromorpha, maternal care has been reported only for *Scolopendra cingulata* (Heymonds, 1901; Klingel, 1960), *S. dalmatica* (Heymonds, 1901), *S. amazonica* (Lewis, 1966), and *Cormocephalus anceps anceps* (Brunhuber, 1970), all from Asian and African regions. There is no record of maternal care in Neotropical centipedes.

¹ Received June 4, 1999, Accepted October 23, 1999.

² Museu de História Natural, Instituto de Biologia, CP 6109, Universidade Estadual de Campinas, 13083-970 Campinas SP, Brazil. fax 55 19 2893124 e-mail glaucom@unicamp.br

The genus *Otostigmus* (Scolopendridae: Otostigminae) has a global distribution, including the Americas, Africa, Oceania, India and Japan. Its representatives range from 4-12 cm in length and their tegument is colorful (Bücherl, 1939a). *Otostigmus scabricauda* H. & Saus., 1870 is common in Brazil, especially in the coastal forests. Observations on reproductive behavior from laboratory indicate that in this species females take care of their eggs and nymphs (Martins & Knysak, 1996). However this behavior has never been recorded in nature and this paper provides the first field account of maternal care for a Neotropical centipede.

MATERIAL AND METHODS

This study was conducted on São Sebastião Island (23°47' S; 45°24' W), southeastern coast of São Paulo State, Southeast Brazil. Approximately 80% of the island is area covered by Atlantic Forest (IBGE, 1983). The climate is warm and wet with maximum rainfall in December (2000 mm) and minimum in August (80 mm). Collections of centipedes were made between 100 and 900 m altitude during March and February 1997, and from December 1997 to January 1998 (wet and warm season). Individuals of *Otostigmus scabricauda* were found during a study of litter invertebrate diversity. A leaf litter area of about 5800 m² corresponding to 92 plots of 64m² was sampled. All centipedes found were collected and later preserved in 70% ethanol. During the collection I recorded the behavioral responses of the individuals to disturbance, such as attempts to escape, and the egg or nymph cannibalism. Voucher specimens are in the Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo, Brazil.

RESULTS AND DISCUSSION

I found nine females of *Otostigmus scabricauda* with offspring: three of them cared for eggs and six cared for first instar nymphs. Female length ranged from 36.4 to 53.5 mm. Brood-guarding females were found in the leaf litter (n = 5) or under fallen trunks (n = 4). The female curls herself around the eggs or the young, laying on her side and enclosing the brood between her legs and the ventral surface of her body (Fig. 1). As recorded for other centipede species, the eggs and the young are thus safeguarded from contact with the soil (see Cornwell, 1934; Lawrence, 1947; Brunhuber, 1970). When disturbed during brooding, the females abandon their eggs or young (7 observations), or eat them (2 observations). Apparently, females caring for first instar nymphs abandon their offspring more frequently than females caring for eggs ($\chi^2 = 5.5$; d.f. = 1; $p > 0.05$). After the mother deserts, the nymphs generally flee, or burrow themselves in the soil.

The mean clutch size was 29.1 (S.D. = 15.7; range = 16 - 58; n = 9). The



Figure 1: Female of *Otostigmus scabricauda* curled around her early-hatched nymphs as found under a fallen trunk in nature.

eggs are oval, yellowish, and have a mean individual volume of 48.5 mm^3 (SD = 5.9 mm^3 ; range = $40.6 - 56.8 \text{ mm}^3$; $n = 10$) (Fig. 1). No egg was observed to be infected with fungi. The nymphs are non-pigmented and have a mean length of 11.6 mm (S.D. = 1.1 mm ; range = $8.4 - 13.5 \text{ mm}$; $n = 65$) (Fig. 1a). The nymphs hatch with 21 segments, and as in other scolo-pendromorphs (see Cloudsley-Thompson, 1958) the development is epimorphic (the young display the complete number of segments upon hatching). The embryonic phase of *Otostigmus scabricauda* under laboratory conditions ranged from 45 to 60 days and the nymphs remain with the mother for 15 -20 days before dispersal (Martins & Knysak, 1996). If the incubation time in the field is similar to that described in the laboratory, egg-laying in *O. scabricauda* probably takes place in the beginning of the wet-warm season (October), and the reproductive sea-

son lasts until February. The same pattern seems to occur in other scolopendrid species that reproduce during the rainy season (see Lewis, 1966).

Despite the large number of species of centipedes in the Neotropical region (see Bücherl, 1939b) the behavior and ecology of the group is still poorly known. The developmental stages of the Geophilomorpha (Palmén & Rantal, 1954) and Scolopendromorpha (Lawrence, 1947; Brunhuber, 1970) have already been described and in these groups maternal care is crucial for the survival of the eggs and young. The female grooms the eggs and juveniles; this apparently increases offspring survival, because without the mother the eggs and nymphs always die from fungal attack or unknown reasons (Brunhuber, 1970). In some cases a female can also move her egg batch to other microsites with better temperature and humidity conditions (see Brunhuber, 1970). Among arthropods, parental care is commonly associated with physically harsh or biologically dangerous habitats (Clutton-Brock, 1991; Zeh & Smith, 1985). Predation pressure in the leaf litter and the high risk of infection due to fungi may have favored the evolution of maternal care in many arthropods living on the soil, such as some beetles (Scott, 1990), earwigs (Wilson, 1971), crickets (West & Alexander, 1963), harvestmen (Goodnight & Goodnight, 1976; Mora, 1990), spiders (Horel & Gundermann, 1992), and probably centipedes.

ACKNOWLEDGMENTS

I am most grateful to C. H. F. Vasconcelos, R. J. Sawaya, R. Nunes, L. A. Anjos and A. M. F. Pacheco for help in field work; to I. Knysak for identification of the centipede species; to R. J. Sawaya for photographs; to P. S. Oliveira, K. S. Brown Jr., A. V. L. Freitas, I. Sazima, and an anonymous reviewer for comments on the manuscript.

LITERATURE CITED

- Brunhuber, B. S.** 1970. Egg laying, maternal care and development of young in the scolopendromorph centipede, *Cormocephalus anceps anceps* Porat. Zool. J. Linn. Soc. 49: 225-234.
- Bücherl, W.** 1939a. Os Quilópodos do Brasil. Mem. Inst. Butantan 13: 49-320.
- Bücherl, W.** 1939b. Catálogo dos Quilópodos de zona neotropical. Mem. Inst. Butantan 15: 251-372.
- Clutton-Brock, T. H.** 1991. The evolution of parental care. Princeton Univ. Press, Princeton, NJ.
- Cornwell, W. S.** 1934. Notes on the egg-laying and nesting habits of certain species of North Carolina myriapods and various phases of their life history. J. Elisha Mitchell Sci. Soc. 149: 289-291.
- Cloudsley-Thompson, J. L.** 1958. Spiders, Scorpions, Centipedes and Mites, Pergamon Press, Oxford, London.
- Goodnight, M. R. and C. J. Goodnight.** 1976. Observations on the systematics, development and habits of *Erginulus clavotibialis* (Opiliones, Cosmetidae). Trans. Amer. Microsc. Soc. 95: 654-664.
- Heymonds, R.** 1901. Entwicklungsgeschichte der Skolopender. Zoologica Stuttg. 13: heft 33.

- Horel, A. and J. L. Gundermann. 1992. Egg sac guarding by the funnel-web spider *Coelotes terrestris*: function and development. *Behav. Proc.* 27: 85-94.
- IBGE 1983. Levantamento de Recursos Naturais, Folhas SF 23/24 Rio de Janeiro/Vitória. Ministério das Minas e Energia, Projeto Radambrasil. Secretaria Geral, Rio de Janeiro.
- Klingel, H. 1960. Vergleichende Verhaltensbiologie der Chilopoden *Scutigera coleoptrata* L. ('Spinnenassel') und *Scolopendra cinculata* L. (Skolopender). *Z. Tietpsychol.* 17: 11-30.
- Lawrence, R. F. 1947. Some observations on the post-embryonic development of the Natal forest centipede *Cormocephalus multispinus* (Kraep.). *Ann. Natal. Mus.* 11: 139-156.
- Lewis, J. G. E. 1966. The taxonomy and biology of the centipede *Scolopendra amazonica* in the Sudan. *J. Zool.* 149: 188-203.
- Lewis, J. G. E. 1981. The biology of centipedes, Cambridge Univ. Press, Cambridge.
- Mora, G. 1990. Parental care in a neotropical harvestman, *Zygopachylus albomarginis* (Arachnida: Gonyleptidae). *Anim. Behav.* 39: 582-593.
- Martins, R. and I. Knysak. 1996. Observações sobre cuidados com a prole em *Otostigmus scabricauda* (Scolopendridae) nascidos em cativeiro. *Anais de Etologia, Uberlândia, MG,* 14: 288.
- Palmén, E. and M. Rantala. 1954. On the life history and ecology of *Pachymerium ferruginum* Koch (Chilopoda: Geophilidae). *Ann. Zool. Soc. 'Vanamo'* 16: 1-44.
- Scott, M. P. 1990. Brood guarding and the evolution of male parental care in burying beetles. *Behav. Ecol. Sociobiol.* 26: 31-39.
- Trivers, R. L. 1972. Parental investment and sexual selection. pp. 136-179. In *Sexual selection and the descent of man*, (Campbell, B. ed.), Chicago, Aldine.
- West, K. J. and R. D. Alexander. 1963. Sub-social behavior in a burrowing cricket *Anurogryllus muticus* (De Geer). *Orthoptera: Gryllidae.* *Ohio J. Sci.* 63: 19-24.
- Wilson, E. O. 1971. *Insect societies.* Harvard Univ. Press, Cambridge.
- Zeh, D. W. and R. L. Smith. 1985. Paternal investment by terrestrial arthropods. *Am. Zool.* 25: 785-805.
-
-

NOTICE

DEFECTIVE MARCH/APRIL, 2000, VOL. 111 (2) ISSUE

When one Society member & subscriber wrote to me that he had received a defective March/April, 2000 issue, I checked and discovered that of the 128 copies I had on hand, 22, or 17%, were defective. In the majority of cases the problem was one of four pairs of blank pages opposite each other for a total of eight blank pages. In one case, four pages were in double.

Each and every subscriber, both individual and institutional, should check his or her copy for any possible defect and, if one is found, please advise our business office in Philadelphia and request a replacement copy.

Entomological News regrets any inconvenience this printing error may have caused.

H. P. B.

THE GENUS *KUNZELLA* AND A CLOSELY RELATED NEW GENUS *YOUNGSZELLA* (HOMOPTERA: CICADELLIDAE)^{1,2}

Paul H. Freytag³

ABSTRACT: The genus *Kunzella* is revised to include only the type-species *marginella*. A new genus *Youngszella* is described for the species *Dikraneura pseudomarginella* (designated type-species), which has been confused with *Kunzella marginella*. One other species (transferred to the genus *Youngszella*) is *russea* (new combination).

The genus *Kunzella* was described by Young (1952) with the type-species as *Dikraneura marginella*. The species was confused with another species *D. pseudomarginella* Caldwell almost from the time *D. marginella* was first described. This paper is an attempt to properly place these two species and the one closely related species. Since this involved a misidentified type species of a genus it was submitted to the Commission on Zoological Nomenclature, but since no action was taken I am now designating the type species for *Kunzella* under the new (1-1-2000) rules of nomenclature.

D. marginella was first described as *D. marginatus* by DeLong (1924). This species was renamed the next year as *D. marginella* by Baker (1925), because *marginatus* was a homonym of *marginata* Sahlberg (1871). DeLong originally described the species on the basis of three specimens from Florida. These specimens were examined in the DeLong Collection, Ohio State University, and are without type labels. I designate one of the males as the lectotype of this species, and the other male and the female as paralectotypes. All three specimens fit the description as given by DeLong and were collected in Miami, Florida, April 2 and 3, 1921.

D. marginella was adequately described by DeLong (1924) in the original description, and DeLong and Caldwell (1937a) added the description of the male genitalia. The type series constitutes all the specimens of this species I have seen. The distribution of this species is questionable as presently it is only known from the Miami area.

All specimens attributed to *D. marginella*, except the types, are the species *D. pseudomarginella* Caldwell described in 1952. Caldwell noted this confusion at that time, however Young (1952) did not, so his description of *D. marginella* is really that of *D. pseudomarginella*. Young apparently assumed there was but one species and set up the genus *Kunzella* on that assumption.

¹ Received April 30, 1998. Accepted March 15, 2000.

² The investigation reported in this paper (No. 98-08-62) is in connection with a project of the Kentucky Agricultural Experiment Station and is published with the approval of the Director.

³ Department of Entomology, University of Kentucky, Lexington, KY 40546-0091.

These two species have quite different male genitalia and belong in separate genera. Therefore I modify couplet 17 (on page 43) in the key to the Dikrineurini in Young's 1952 paper as follows:

17. Style with conspicuous preapical lobe, not abruptly hooked at apex
 (Plate 21, fig. 57g); pygofer hooks posterodorsal in origin or absent 18
 Style without conspicuous preapical lobe, slender throughout, sharply hooked
 at apex (Plate 23, fig. 62d); pygofer hooks apical in origin . *Kunzella* Young 1952
 Style without conspicuous preapical lobe, slender throughout, sharply hooked
 at apex (Plate 23, fig. 62d); pygofer hooks ventral in origin . *Youngszella* Freytag,
 new genus

These two genera and the species included in each are as follows:

Kunzella Young

Kunzella Young 1952, p. 65.

Type-species *Dikraneura marginella* Baker.

This genus includes only the type-species.

Kunzella marginella Baker)

Dikraneura marginatus DeLong 1924, p. 68.

Dikraneura marginata Ball and DeLong 1925, p. 311 (in part)

Dikraneura marginella Baker 1925, p. 160. New name for *D. marginata* DeLong [not *D. marginata* Sahlberg 1871)

Dikraneura marginella McAtee 1926, p.164. (in part)

Dikraneura marginella Osborn 1928, p. 267. (in part)

Dikraneura marginella Lawson 1930, p. 41. (in part)

Dikraneura marginella Osborn 1935, p. 189. (in part)

Dikraneura marginella Wolcott 1936, p. 91. (in part)

Dikraneura marginella DeLong and Caldwell 1937a, p. 22. (in part)

Dikraneura marginella DeLong and Caldwell 1937b, p. 60. (in part)

Dikraneura marginella DeLong and Knull 1946, p. 68 (in part)

Kunzeana marginella Oman 1949, p. 83. (in part)

Dikraneura marginella Wolcott 1950, p. 130. (in part)

Dikraneura marginella Caldwell, in Caldwell and Martorell 1952, p. 107.

Kunzella marginella Young 1952, p. 65. (in part)

This species is only known from the type series from Florida. It was described and illustrated (Plate VII, fig. 6) by DeLong (1924), and the male genitalia were described and illustrated (Plate I) by DeLong and Caldwell (1937a). The face of both sexes is quite distinct in that it is light brown with a darker brown transverse band just below the antennal bases. Otherwise the color pattern is very similar to that of most species of *Kunzeana*. The male genitalia are quite unique and are illustrated by DeLong and Caldwell (1937a). The pygofer is quite stout, heavily pigmented, with the dorsal apex curved dorsad. The aedeagus is a backward c-shaped structure, in lateral view, with the apex directed anteriorly.

Youngszella Freytag, NEW GENUS

Type-species *Dikraneura pseudomarginella* Caldwell.

This genus is closely related to *Kunzella* and *Kunzeana*, and differs only in the facial color pattern and the type of male genitalia. Characters shared by these genera are the following: hind wing with complete marginal vein, vannal veins fused, and first cubital vein branched. *Kunzella* and *Youngszella* have a y-shaped connective, and *Kunzeana* differs by having a u-shaped connective. *Kunzella* and *Youngszella* can be separated by the characters given in the above key. Young (1952) really adequately describes this genus under the name *Kunzella* as he did not describe *D. marginella* but really described *D. pseudomarginella*. The genus is characterized by having the characters of *Kunzeana*, except the color of the face is lighter just below the margin with a very dark transverse line through the middle of this lighter area (illustrated in Caldwell (1952) plate 47). Also the male genitalia are quite different from *Kunzeana*, in that the process of the pygofer is ventral, coming from the base, and quite long, extending along the line of the plate. There are two species in this genus.

Youngszella pseudomarginella (Caldwell) NEW COMBINATION

Dikraneura pseudomarginella Caldwell 1952, p. 106.

Kunzeila marginella Young 1952, p. 65. (in part)

All references under *Kunzella marginella* above, from Ball and DeLong (1925) to Walcott (1950), also refer to this species in part as all Neotropical specimens belong to this species. The species also occurs in Florida as Caldwell (1952) mentions.

This species is similar to *marginella*, except for the face which is described under the generic discussion. The male genitalia are quite different and are illustrated by both Caldwell (1952) Plate 45 and Young (1952) Plate 23.

I have seen specimens from the United States (Florida), Cuba, Dominican Republic, Puerto Rico; Costa Rica, Nicaragua, Honduras, Panama, and Venezuela.

Youngszella russea (McAtee) NEW COMBINATION

Dikraneura russea McAtee 1926, p. 160.

Dikraneura russea Oman 1949, p. 83.

Kunzella russea Young 1952, p.65.

I have not seen this species, but I place it in the same genus as *pseudomarginata* following Young's indication that they are congeneric. It was described from two specimens (one male and one female) from Honduras. Until

the types can be seen I feel it is best to retain the name as a separate species. Since I have only seen one species of *Youngszella* from Central America it is possible that this species and *pseudomarginata* are synonyms.

ACKNOWLEDGMENTS

I thank Charles A. Triplehorn for the permission to examine the type material in the Ohio State University Collection.

LITERATURE CITED

- Baker C. F.** 1925. Nomenclatorial notes on the Jassoidea, III. Phillipine J. Sci. 27:159-160.
- Ball, E. D. & D. M. DeLong.** 1925. The genus *Dikraneura* and its allies in North America. Ann. Entomol. Soc. Amer. 18:324-340, pls. 21-23.
- Caldwell, J. S. & L. P. Martorell.** 1952. Review of the Auchenorynchous Homoptera of Puerto Rico. Part I: Cicadellidae. Puerto Rico Univ. J. Agr. 34:1-132, i-vii illus.
- DeLong, D. M.** 1924. Some new Cicadellidae (Homoptera) from the southern United States. New York Entomol. Soc. J. 32:63-69, pl. 7.
- DeLong, D. M. & J. S. Caldwell.** 1937a. The genus *Dikraneura* - A study of male genitalia - with descriptions of new species. Entomol. Soc. Wash. Proc. 39:17-34, pls 1-3.
- DeLong, D. M. & J. S. Caldwell.** 1937b. Check list of the Cicadellidae (Homoptera) of America, north of Mexico. 1-93. p.
- DeLong, D. M. & D. J. Knull.** 1946. Check list of the Cicadellidae (Homoptera) of America, north of Mexico. Ohio State Univ. Press, Grad. School Stud., Biol. Sci. Ser. I. 1-102 p.
- McAtee, W. L.** 1926. Notes on Neotropical Eupteryginae, with a key to the varieties of *Alebra albostriella* (Homoptera: Jassidae). New York Entomol. Soc. J. 34:141-174, pls. 19-20.
- Oman, P. W.** 1949. The Nearctic leafhoppers (Homoptera:Cicadellidae). A generic classification and check list. Wash. Entomol. Soc. Mem. 3:1-253, pls. 1-44.
- Young, D. A.** 1952. A reclassification of western Hemisphere Typhlocybinae (Homoptera, Cicadellidae). Kansas Univ. Sci. Bul. 35:1-217, 38 pls.

(All literature can also be found in General Catalogue of the Homoptera Fascicle VI Cicadelloidea Bibliography of the Cicadelloidea (Homoptera: Auchenorhyncha). Agr. Res. Ser. USDA by Z. P. Metcalf 1964.

FURTHER CONTRIBUTIONS TO THE SPATULATE CLAWED BAETIDAE (EPHEMEROPTERA)¹

W. P. McCafferty, R. P. Randolph²

ABSTRACT: The formal new name, *Camelobaetidius kickapoo*, n. sp., is given for *Camelobaetidius* sp. 1 of McCafferty and Davis. The species is described from the lower Rio Grande between Texas and the Mexican states of Chihuahua and Coahuila, but it has also been taken in northwestern Colorado and the Gila River in Arizona. It is unique in North and Central America in having an intermediate number of denticles on the spatulate claws in both early and late instar larvae. *Camelobaetidius warreni* is shown to possess larval forecoxal osmobranchiae, and *C. sinaloa* is shown to be a new junior synonym of *C. musseri*. A revised key to the known larvae of the species of *Camelobaetidius* in North and Central America is given to express new and recent findings.

Recent important work dealing with the Western Hemisphere mayfly genus *Camelobaetidius* Demoulin that has appeared since the original work of Traver and Edmunds (1968) has included foremost the synoptic treatment of the North and Central American fauna by Lugo-Ortiz and McCafferty (1995). Our continuing research on the genus in North America and the recent examination of larval material upon which original descriptions were based has led to the discovery of certain discrepancies in the literature regarding the most ubiquitous species north of Mexico, *C. warreni* (Traver and Edmunds). In addition, our survey of a multitude of collections of *Camelobaetidius* from North America has also confirmed the uniqueness on the continent of a species previously referred to as *Camelobaetidius* sp. 1 by McCafferty and Davis (1992), McCafferty et al. (1993), and Lugo-Ortiz and McCafferty (1995). This species was not named previously because mature larvae were not known. One newly studied population, however, contains early to middle-instar larvae associated with ultimate instar larvae. This population thus confirms that larval characters previously thought to be diagnostic are consistent through the development of the larvae and allows the formal naming of the species previously known as *C. sp. 1* sensu McCafferty and Davis herein. Finally, our study has also revealed an additional species synonym involving what has been known as *C. sinaloa* (Allen and Murvosh). We provide evidence for that herein, and we also provide corrected and updated character information for the identification of North American species, including a revised larval key to species.

¹ Received September 25, 1999. Accepted March 16, 2000.

² Department of Entomology, Purdue University, West Lafayette, IN 47907.

Camelobaetidius kickapoo McCafferty, NEW SPECIES

Camelobaetidius sp. 1 McCafferty and Davis, 1992:207.

Material examined. HOLOTYPE: Larva: Texas, Presidio Co., Rio Grande, 13 miles downstream from Presidio, VI-28-1977, J. R. Davis, deposited in the Purdue Entomological Research Collection (PERC). PARATYPE: larva, Texas, Brewster Co., Rio Grande at Santa Elena Canyon, IX-28-1977, J. R. Davis (PERC), some mouthparts slide-mounted in Euparal. Additional larval material has been examined from Colorado, Moffat Co., Yampa R, Echo Park, Dinosaur National Monument, VII-16-1991 (in the C. P. Gillette Museum of Arthropod Diversity, Fort Collins, Colorado), from Texas, Val Verde Co., Rio Grande at Foster Ranch near Langtry, V-2-1977 (in the private collection of J. R. Davis, Austin, Texas), and from Arizona, Greenlee Co, Gila R just upstream from San Francisco R confluence, IX-17-1997, K. Palmer and R. Williams (in the EcoAnalysts collection, Moscow, Idaho).

Etymology. The species is named for the Native American Kickapoo tribe and is a noun in apposition.

Diagnosis. *Camelobaetidius kickapoo* is unique in North and Central America in that it possesses an intermediate number of claw denticles (13-18, often with 16). Other species have denticles in the range of 5-10 or 30-45. Segment 2 of the labial palps has a small medial point, approaching that of *C. waltzi* McCafferty in North America, and also *C. penai* (Traver and Edmunds) from Argentina and *C. anubis* (Traver and Edmunds) from Brazil. The dorsal submarginal row of labral setae is variable, sometimes with a large gap between the medial seta and the three or four lateral setae, similar to *C. mexicanus* (Traver and Edmunds) and *C. variabilis* Wiersema in North America, and sometimes with a narrower gap between the medial and lateral setae, similar to *C. waltzi* in North America. Such variability has also been observed between the left and right side of the labrum on the paratype larva. No coxal osmobranchiae are present in the new species.

Distribution. The species is currently known from northwest Colorado; far west Texas; eastern Arizona; far northeastern Mexico.

Remarks. Only the Peruvian species *C. cayumba* (Traver and Edmunds) has claw denticles similar in number to those of *C. kickapoo*. We have not studied the type material of *C. cayumba*, but have seen additional material from South America that agrees with the description of the larvae by Traver and Edmunds (1968). We do not presume, however, a close relationship from this similarity in denticle number, which could easily have resulted from homoplasy. Based on the shape of the labial palps, one might deduce that *C. kickapoo* and *C. waltzi* are closely related North American species, perhaps additionally related to certain South American species that also express a medially pointed labial palp segment 2 (see diagnosis above). The probable sister species *C. kickapoo* and *C. waltzi* currently appear to be separated geographically, with *C. kickapoo* being a mainly southwestern species, and *C. waltzi* being a plains species ranging from eastern Nebraska (Kubertanz and Jones 1999) to southwestern Indiana (McCafferty and Klubertanz 1994) to south-

eastern Texas (Wiersema and McCafferty 1999).

Although larvae of *C. kickapoo* were secured from the Rio Grande from the Texas side, the localities cited above along the Rio Grande are shared by the Mexican states of Chihuahua and Coahuila. *Camelobaetidius kickapoo* and *C. warreni* have both been taken from the upper Green River. We have seen larvae of *C. warreni* from the Green River, Daggett County, Utah, not far from the vicinity of the Colorado record for *C. kickapoo* (see McCafferty et al. 1993), and we expect that *C. kickapoo* will be found in this part of Utah. We have seen both *C. kickapoo* and *C. musseri* (Traver and Edmunds) from the Gila River in Arizona. Although *C. kickapoo* has been taken from the lower Rio Grande, it has not been found in the Rio Grande drainage in New Mexico nor have any other *Camelobaetidius* (McCafferty et al. 1997).

LARVAL DIAGNOSIS

Certain species of *Camelobaetidius* are known to possess coxal osmobranchiae. These are short, single, fingerlike filaments that have been referred to as gills by some authors. The term osmobranchia appears more appropriate than gill to us, because we have noted relative hypertrophy in these structures that suggests some osmoregulatory role and which may explain the sometimes difficult task in detecting these structures in some specimens.

In couplet 2 of the key to larvae of North and Central American species of *Camelobaetidius* given by Lugo-Ortiz and McCafferty (1995), the presence or absence of forecoxal osmobranchiae were used to separate *C. similis* Lugo-Ortiz and McCafferty (osmobranchiae present) from *C. waltzi*, *C. mexicanus*, and *C. warreni* (Traver and Edmunds) (osmobranchiae absent). In the larval key given by Traver and Edmunds (1968), the forecoxal osmobranchiae were not used; however, Traver and Edmunds (1968) indicated in their monograph that these structures had been encountered in larvae from Brazil, Uruguay, and Panama, but were absent in other material they had examined (which could be taken to include those larvae studied from North America).

Camelobaetidius warreni was described from California, but is now known from Costa Rica (Lugo-Ortiz and McCafferty 1995) to Saskatchewan (McCafferty and Randolph 1998), and is the most widely distributed species of *Camelobaetidius* in North America, having been taken from most western USA states (e.g., McCafferty et al. 1997). We have recently encountered considerable material from the West that agree with the previous published concepts of *C. warreni*, except for the presence of forecoxal osmobranchiae. We examined the paratype larval material from California (deposited at PERC) upon which the original description of the species was based and found that forecoxal osmobranchiae were indeed present, although they had neither been mentioned in the original description nor had they been depicted with the foreleg (figure 25 of Traver and Edmunds [1968]). We also re-examined all of the

larval material of *C. warreni* that had been reported by Lugo-Ortiz and McCafferty (1995) and consistently found forecoxal osmobranchiae present.

Traver and Edmunds (1968) did not mention coxal osmobranchiae, or coxal gills, in their description of *C. zenobia* (Traver and Edmunds), which is now known as a junior synonym of *C. warreni*, but our examination of paratype larvae of *C. zenobia* held at PERC revealed the presence of the forecoxal osmobranchiae. Traver and Edmunds (1968) gave a tentative designation of *C. cepheus* (Traver and Edmunds) to larvae from Idaho. The latter name has also proven to be a synonym of *C. warreni* (Lugo-Ortiz and McCafferty 1995). The larval material identified as *C. cepheus* by Traver and Edmunds is also held at PERC, and our examination of it confirmed that it too has forecoxal osmobranchiae. In larvae associated with other known synonyms of *C. warreni*, i.e., *C. navis* Allen and Chao from New Mexico and *C. trivialis* Allen and Chao from Arizona and New Mexico, Allen and Chao (1978) did not mention coxal osmobranchiae, or gills. Although we have not been able to examine original larval material associated with these latter two names, we assume the forecoxal osmobranchiae are present, based on all of our other observations.

This confirmation of the presence of forecoxal osmobranchiae in *C. warreni* is of considerable importance in the determination of North and Central American species of *Camelobaetidius*, because there has been, until now, a strong possibility of misidentifying the common species *C. warreni* as either *C. similis*, *C. variabilis*, or an unnamed species if a user is relying entirely on statements and figures by Traver and Edmunds (1968) or the key by Lugo-Ortiz and McCafferty (1995). These corrections and new observations regarding these species are reflected in the new key provided herein (see below).

We have made one other discovery that has direct bearing on larval diagnosis in North and Central America. Recently, we have had access to considerable new material of *Camelobaetidius* from Mexico. Mexican specimens would key to either *C. musseri* (Traver and Edmunds) or *C. sinaloa* (both with larval spatulate claws having 30-40 denticles and thus distinct from other North and Central American species known as larvae). However, it was particularly difficult to consistently distinguish between the two using the color pattern characterization given in the Lugo-Ortiz and McCafferty (1995) key. Populations often appeared to be mixed. Allen and Murvosh (1987) had based their *C. sinaloa* on two larvae taken at Sinaloa, Mexico, and indicated that they were similar to *C. musseri* and *C. salinas* Allen and Chao, and could be distinguished from *C. salinas* by lacking submedian markings on the abdominal terga; they did not state any characterization for differentiating their larvae from those of *C. musseri*. *Camelobaetidius salinas* was placed as junior subjective synonym of *C. musseri* by Lugo-Ortiz and McCafferty (1995) because the larval differences cited by Allen and Chao (1978) for *C. salinas* reflected intraspecific variability. Nonetheless, Lugo-Ortiz and McCafferty (1995) retained *C. sinaloa* and believed that the two could be distinguished by the pres-

ence of dark posterior borders on abdominal terga 1-9 in *C. sinaloa*, as per the figure given by Allen and Murvosh (1987), and as was reflected by couplet 7 in the Lugo-Ortiz and McCafferty key.

We have examined series of paratype larvae of *C. musseri* from the type locality population as well as other populations in Mexico (deposited at PERC), and found that the dark posterior borders indicated by Allen and Murvosh (1987) for *C. sinaloa* are present in most larvae of *C. musseri*. Paratype larvae of *C. musseri* show considerable variability both with respect to marginal shading on the abdominal terga and submedian maculation, which is present in some individuals and absent in others. On this basis, it is obvious that the two names refer to the same species, and we therefore place *C. sinaloa* as a junior subjective synonym of *C. musseri*, new synonym.

We offer the following updated key to the North and Central American species of *Camelobaetidius* species in the larval stage that takes into account all of the above observations as well as new species descriptions herein and elsewhere (Wiersema 1997) since Lugo-Ortiz and McCafferty (1995). Careful inspection is necessary for accurate claw denticle counts and the observation of coxal osmobranchiae. Furthermore, it should be kept in mind that precise inspection of the chetotaxy of the labrum and form of the labium require slide mounting and high magnification.

Revised key to the known North and Central American middle to late instar larvae of *Camelobaetidius*

1	Claws with 5-20 denticles	2
1'	Claws with 30-45 denticles	7
2	Claws with 5-10 denticles	3
2'	Claws with 13-20 denticles	<i>C. kickapoo</i>
3	Forecoxal osmobranchiae present	4
3'	Forecoxal osmobranchiae absent	6
4	Midcoxal osmobranchiae present	<i>C. variabilis</i>
4'	Midcoxal osmobranchiae absent	5
5	Labrum with second seta from center in dorsal submarginal line smaller and offset basally compared to adjacent setae (see Fig. 6, Lugo-Ortiz and McCafferty [1995])	<i>C. warreni</i>
5'	Labrum with second seta from center in dorsal submarginal line similar in size and level of origin with adjacent submarginal setae	<i>C. similis</i>
6	Labium with second segment of palps pointed (Fig. 5, McCafferty and Klubertanz [1994])	<i>C. waltzi</i>
6'	Labium with second segment of palps rounded	<i>C. mexicanus</i>
7	Claws with 40-45 denticles	<i>C. kondratieffi</i>
7'	Claws with 30-39 (usually 30-35) denticles	<i>C. musseri</i>

Although our revised key has utilitarian value, we strongly suggest that original descriptions and diagnoses of species also be consulted for confirmation of other characteristics not covered by the simplified couplets. The following published distributions of the species included (all citations above) may also be of some assistance in diagnosis but must remain ancillary to morphological characterization: *C. kickapoo* (Arizona, Colorado, Texas, northern Mexico, and ?Utah); *C. kondratieffi* Lugo-Ortiz and McCafferty (Central America); *C. mexicanus* (Kansas, northern and southern Mexico, and Texas); *C. musseri* (Arizona, Central America, southern and northern Mexico, Nevada, and New Mexico); *C. similis* (northern and southern Mexico); *C. variabilis* (northern Mexico, Oklahoma, and Texas); *C. waltzi* (Indiana, Iowa, Nebraska, and Texas); *C. warreni* (Arizona, California, Central America, Colorado, Idaho, southern and northern Mexico, New Mexico, Oregon, Saskatchewan, South Dakota, and Utah).

ACKNOWLEDGMENTS

We thank J. R. Davis, Austin, Texas, and G. Lester, Moscow, Idaho, for providing specimens for study. Funding for this research was provided in part by NSF grant DEB-9901577, and the paper has been assigned Purdue ARP Journal No. 16103.

LITERATURE CITED

- Allen, R. K. and E. S. M. Chao. 1978. Mayflies of the Southwest: new species and records of *Dactylobaetis* (Ephemeroptera: Baetidae). Pan-Pac. Entomol. 54: 300-304.
- Allen, R. K. and C. D. Murvosh. 1987. New Baetidae from the southwestern United States and northern Mexico (Ephemeroptera: Insecta), with notes. Can. Entomol. 11: 1095-1099.
- Klubertanz, T. H. and D. M. Jones. 1999. Adults of *Camelobaetidius waltzi* (Ephemeroptera: Baetidae), with field notes. Entomol. News 110: 173-176.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1995. Taxonomy of the North and Central American species of *Camelobaetidius* (Ephemeroptera: Baetidae). Entomol. News 106: 178-192.
- McCafferty, W. P. and J. R. Davis. 1992. New and additional records of small minnow mayflies (Ephemeroptera: Baetidae) from Texas. Entomol. News 103: 199-209.
- McCafferty, W. P. and T. H. Klubertanz. 1994. *Camelobaetidius* (Ephemeroptera: Baetidae) in Indiana and Iowa: new species and range extension. Proc. Entomol. Soc. Wash. 96: 37-43.
- McCafferty, W. P. and R. P. Randolph. 1998. Canada mayflies: a faunistic compendium. Proc. Entomol. Soc. Ontario 129: 47-97.
- McCafferty, W. P., R. S. Durfee, and B. C. Kondratieff. 1993. Colorado mayflies (Ephemeroptera): an annotated inventory. Southwest. Natural. 38: 252-274.
- McCafferty, W. P., C. R. Lugo-Ortiz, and G. Z. Jacobi. 1997. Mayfly fauna of New Mexico. Gr. Basin Natural. 57: 283-314.
- Traver, J. R. and G. F. Edmunds, Jr. 1968. A revision of the Baetidae with spatulate-clawed nymphs (Ephemeroptera). Pac. Insects 10: 629-677.
- Wiersema, N. A. 1998. *Camelobaetidius variabilis* (Ephemeroptera: Baetidae), a new species from Texas, Oklahoma and Mexico. Entomol. News 109: 21-26.
- Wiersema, N. A. and W. P. McCafferty. 1999. *Americabaetis* (Ephemeroptera: Baetidae) from Texas: first USA record and adult description of *A. pleurus*. Entomol. News 110: 36-38.

A NEW NEARCTIC *APOBAETIS* (EPHEMEROPTERA: BAETIDAE)¹

W. P. McCafferty²

ABSTRACT: *Apobaetis lakota*, new species, is described from larvae collected in southeastern Nebraska and northeastern North Dakota. *Apobaetis lakota* appears more derived than the plesiotypic South American *A. signifer*, as evidenced by certain apomorphies shared with the North American *A. indepressus*. The new species is somewhat larger than other known *Apobaetis*, and it is most easily distinguished by its unique labial and maxillary palps.

Apobaetis was established by Day (1955) for the North American species *A. indepressus* Day, which was known from both larvae and adults. That species is found through much of central and western North America, including California, Colorado, Kansas, Saskatchewan, and Texas (Day 1955, Liechti 1982, McCafferty and Davis 1992, McCafferty et al. 1993, Lugo-Ortiz and McCafferty 1995, McCafferty and Randolph 1998). Larvae of *Apobaetis* are very small, long-clawed, shifting-sand dwellers with distinctive mouthparts, and adults include species with double marginal intercalary veins in the forewings, no hindwings, and a prominent penes plate (see illustrations in Traver [1935] and Edmunds et al. [1976]). This unique combination of adult characteristics, along with eye and egg morphology allowed Waltz and McCafferty (1986) to recognize *A. etowah* (Traver) (originally described in *Pseudocloeon* Klapálek) as a second species of North American *Apobaetis*. This latter species is known only from Georgia (Traver 1935) and remains unknown in the larval stage. Lugo-Ortiz and McCafferty (1997) recently discovered a third species of the genus (*A. signifer* Lugo-Ortiz and McCafferty) based on larvae taken in Brazil and Paraguay.

A fourth species recently taken in southeastern Nebraska and northeastern North Dakota is described below. Although its known range is apparently encompassed by that of *A. indepressus*, the two species are morphologically very distinctive. Material examined of the new species is deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana.

Apobaetis lakota, NEW SPECIES

Larva. Body length 5.0 mm. Caudal filaments approximately 2.0 mm. Head yellowish, without markings except for brown ocelli. Labrum (Fig. 1) without medial notch but with medial area with approximately 12 short, stout setae on distal margin, and approximately 14 long, simple, hairlike setae laterally on either half of distal margin (laterad of short, stout, medial setae). Lobes of hypopharynx subequal in length. Left mandible (Fig. 2) with incisors deeply cleft, outer set with small medially basal denticle, inner set with denticles more poorly

¹ Received May 25, 1999; Accepted September 31, 1999.

² Department of Entomology, Purdue University, West Lafayette, IN 47907.

defined; prostheca stout and pointed, with row of short, fine, simple setae along part of medial margin, with apical seta prominent and more developed than others; large acute triangular process near medial base of mola surrounded by clusters of small, sharp denticulations at base (see Fig. 2); somewhat smaller, blunt triangular process between larger process and mola; several moderately long, sharp spines also emerging from surface of mola. Right mandible (Fig. 3) with incisors deeply cleft; prostheca thick hairlike and appearing bifid; mola with sharp, simple setae at medial and lateral margins, and with some short, dully pointed spines emerging over molar surface, and with enlarged stout process in midregion of mola. Galealacinae (Fig. 4) with two to three grouped, long, apical spines, linear row of three broad-based and spaced, long, subapical spines, and continuous linear row of five to seven slender, long, less sclerotized, subapical spines; maxillary palps three segmented, with segment 1 short, segment 2 extending slightly beyond tip of galealacinae, and segment 3 subequal in length to 1 and 2 combined, slightly narrower and coming to blunt medioapical point. Labium (Fig. 5) with glossae and paraglossae subequal in width and length, but with paraglossae more convex laterally; glossae with medial margin somewhat roughened in apical half, with lateral marginal rows of sparse, simple setae in apical half connecting by subapical transverse row; paraglossae with submarginal lateral row of sparse, simple setae and additional sparse oblique row from midbase to apex; distal segment of labial palps relatively large, highly setaceous with profuse, fine, long, silklike setae in outer aspect; distomedial projection (inner lobe) of apical palp segment highly developed and rounded (about as large as entire outer lobe of distal palp segment); distolateral region (outer lobe) of main body of distal palp segment strongly curved medially; inward oriented distal margin of outer lobe approaching truncate, laterally with slightly projecting point and medially slightly rounded; several long spines along truncated margin. Thorax cream-yellow with some light brown sclerite margination dorsally. Hindwingpads absent. Claw of hindleg (Fig. 6) long and slender, slightly longer than tarsus. Abdominal terga cream-yellow, with pairs of pale brown, short, longitudinal dashes submedially, and with some lateral, brown shading on terga 3, 5, and 9 (barely developed on 3 and 9). Sterna cream-yellow and unmarked. Gills unknown (missing on specimens). Paraproct as in Figure 7. Caudal filaments slightly darkening in midregion (broken apically or missing on specimens); medial caudal filament well developed.

Adult. Unknown.

Material examined. HOLOTYPE: Larva, North Dakota, Cavalier County, Little South Pembina River near Langdon, IX-24-1996, M. Elle [mouthparts and paraproct mounted on slide (medium Euparal)]. PARATYPE: Larva, Nebraska, Saline County, Big Blue River below Friskies Pet Food Plant, Sec. 26, T08N, R04E, X-1-1997, K. Bazata [mouthparts mounted on slide (medium Euparal)].

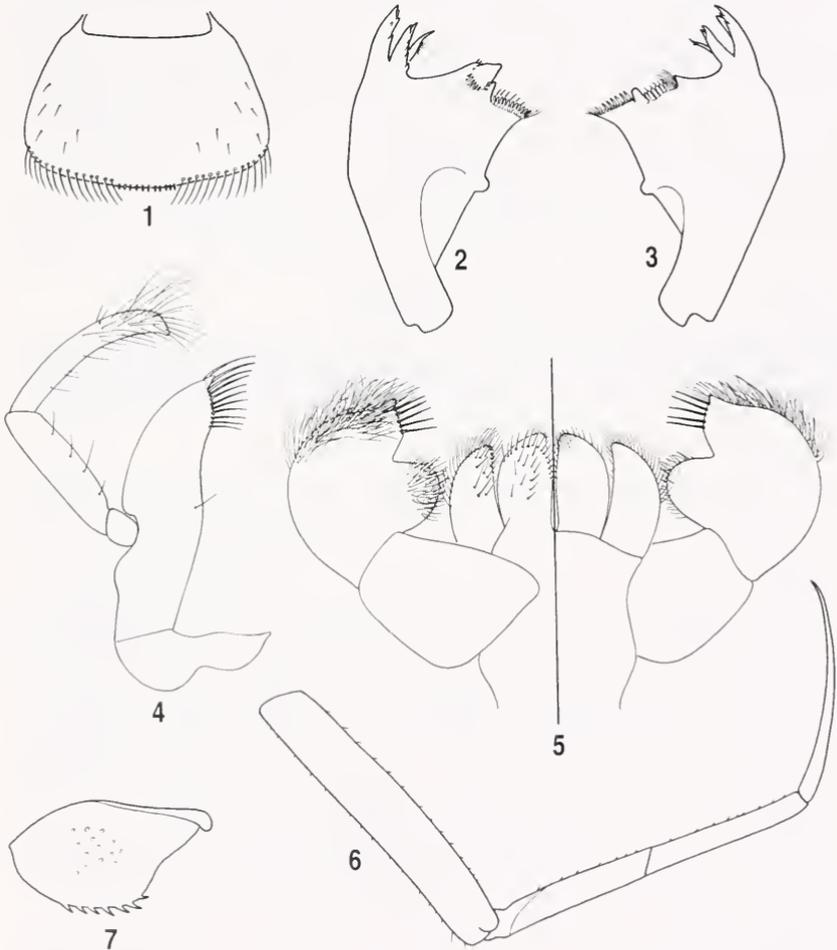
Etymology. The new species name is noun in apposition taken from the Lakota, Native Americans that inhabited much of the northern plains area prior to the twentieth century.

Discussion. This lotic, psammophilous species is generally similar to *A. indeprensus* and *A. signifer*, both of which are also known as larvae. The interspecific relationships of *A. lakota* can only be suggested at this time, and mouthpart morphology may be instructive in this respect.

The labrum of *A. lakota* (Fig. 1) is very similar to that of both *A. indeprensus* (Day 1955: Fig. 2) and *A. signifer* (Lugo-Ortiz and McCafferty 1997: Fig. 1); however, marginal lateral setation is most similar in *A. lakota* and *A. signifer*.

It cannot be determined from this character, when considered independently from other characters, if this similarity is plesiomorphic or apomorphic (however, see below).

Mandibles are very similar in the three species, but the left mandible of *A. lakota* (Fig. 2) is apparently unique in its possession of a clustered row of small denticulations near the base of the large triangular process medial of the mola.



Figs. 1- 6. *Apobaetis lakota* larva. 1. Labrum (dorsal). 2. Left mandible. 3. Right mandible. 4. Maxilla. 5. Labium (left-ventral, right-dorsal). 6. Hindleg. 7. Paraproct.

Shape and apical and subapical armature of the galealacinae are similar in the three species; however, the maxillary palps differ considerably among the species. *Apobaetis indepressus* is clearly the most apomorphic in this respect, with a narrow-elongate segment 3 and a unique small segment 4 (Day 1955: Fig. 5). The other species lack segment 4: *A. lakota* has a three-segmented palp (Fig. 4); *A. signifer* has a two-segmented palp (Lugo-Ortiz and McCafferty 1997: Fig. 5). Transition from a two- to three- to four-segmented maxillary palp is evident in the genus *Apobaetis*, with the palp of *A. lakota* representing an intermediate state between the most plesiomorphic palp of *A. signifer* and the most apomorphic palp of *A. indepressus*. Importantly in this respect, a closer cladistic relationship between *A. lakota* and *A. indepressus* than between *A. lakota* and *A. signifer* is suggested. This would appear logical from a biogeographic standpoint (see McCafferty 1998), and also, by deduction, would suggest that the similar labral setation in *A. lakota* and *A. signifer* is plesiomorphic. In *A. lakota*, the longer maxillary palp segment 2, relative to the length of the galealacinae, is apparently autapomorphic, particularly if segment 1 of *A. signifer* is assumed to be homologous with the combined segments 1 + 2 in *A. lakota* and *A. indepressus*.

The shape of the labial palps are very similar in *A. indepressus* (Day 1955: Fig. 6) and *A. signifer* (Lugo-Ortiz and McCafferty 1997: Fig. 6). In *A. lakota*, the extreme development of the inner lobe of the distal segment (Fig. 5) is highly specialized and unique among the known species of the genus *Apobaetis*. The apex of the palp (outer lobe) may not appear as truncate in *A. lakota* as it is in *A. signifer* and *A. indepressus*, due mainly to a slight rounding of its distomedial aspect. Whereas these shape modifications of the palp would not in themselves suggest any relationship because they are not shared by any other known species of *Apobaetis*, the development of long setae in the outer portion of the distal segment of the labial palps in *A. lakota* and *A. indepressus* does give additional credence to the hypothesis of a closer (possibly sister) relationship between these two species. Also, the presence of well-developed spines on the truncate apical margin of the outer lobe of the distal segment of the palp in *A. lakota* and *A. indepressus* is of similar cladistic significance. These apical spines, moreover, appear to be most developed in *A. indepressus*.

Based on the above, it appears that *A. lakota* and *A. indepressus* share a recent common ancestor, and they represent a more apotypic grade of evolution from that of the *A. signifer* lineage and possibly other Neotropical species that remain unknown. The various autapomorphies associated with either *A. lakota* or *A. indepressus* define these species and allow them to be easily distinguished from each other.

Apobaetis lakota is about 20% larger in body size than other known species, and its tarsal claws are exceedingly long (they are somewhat variable in *A. indepressus*). The most striking diagnostic feature of *A. lakota* is the highly

developed and rounded inner lobe on the distal segment of the labial palps (Fig. 5). The inner lobe is small and pointed in the other known species (Day 1955: Fig. 6; Lugo-Ortiz and McCafferty 1997: Fig. 6). The three-segmented maxillary palp of *A. lakota* (Fig. 4) is also diagnostic, keeping in mind that the short palp segment 1 in both *A. lakota* and *A. indeprensus* is sometimes apparent only with very close examination. Not only are the maxillary palps four segmented in *A. indeprensus* (Day 1955: Fig. 5), but the fact that palp segment 2 is shorter relative to the apex of the galealacina in *A. indeprensus* allows diagnostic use of the maxillary palps even if the more delicate palp segments 3 or 4 have been broken in larval specimens, which apparently often happens. The left mandible is also diagnostic (see above) but may require very close inspection.

The larva of *A. etowah* from Georgia remains unknown. Any possibility that the larva of *A. lakota* represents the unknown stage of *A. etowah* is extremely remote. Body sizes of the two species are disparate, and ranges would appear at this time to be considerably disjunct.

ACKNOWLEDGMENTS

I thank A. V. Provonsha for the figures used herein. I also thank G. T. Lester and M. McBride, who provided me with specimens of the genus *Apobaetis* for identification. Support for this research was provided in part by the National Science Foundation Grant DEB-9901577. This paper has been assigned Purdue Agricultural Research Program Journal No. 15998.

LITERATURE CITED

- Day, W. C. 1955. New genera of mayflies from California. *Pan-Pac. Entomol.* 31: 121-137.
- Edmunds, G. F., S. L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. Univ. Minn. Press, Minneapolis.
- Liechti, P. M. 1982. Five additional Ephemeroptera genera from Kansas. *Tech Publ. St. Biol. Surv. Kansas* 12: 13-16.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1995. The mayflies (Ephemeroptera) of Texas and their biogeographic affinities. Pp. 151-169. *In*: L. D. Corkum and J. H. Ciborowski (eds.), *Current directions in research on Ephemeroptera*. Can. Schol. Press, Toronto.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1997. First report of the genus *Apobaetis* (Ephemeroptera: Baetidae) from South America. *Aquat. Insects* 19: 243-246.
- McCafferty, W. P. 1998. Ephemeroptera and the great American interchange. *J. N. Am. Benthol. Soc.* 17: 1-20.
- McCafferty, W. P. and J. R. Davis. 1992. New and additional records of small minnow mayflies (Ephemeroptera: Baetidae). *Entomol. News* 103: 199-209.
- McCafferty, W. P. and R. P. Randolph. 1998. Canada mayflies: a faunistic compendium. *Proc. Entomol. Soc. Ontario* 129: 47-97.
- McCafferty, W. P., R. S. Durfee, and B. C. Kondratieff. 1993. Colorado mayflies (Ephemeroptera): an annotated inventory. *Southwest. Natural.* 38: 252-274.
- Traver, J. R. 1935. Part II Systematic. North American mayflies order Ephemeroptera. Pp. 237-739. *In*: J. G. Needham, J. R. Traver, and Y.-C. Hsu (eds.), *The biology of mayflies*. Comstock, Ithaca, New York.
- Waltz, R. D. and W. P. McCafferty. 1986. *Apobaetis etowah* (Traver), a new combination in Nearctic Baetidae (Ephemeroptera). *Proc. Entomol. Soc. Wash.* 88: 191.

LENGTH-WEIGHT RELATIONSHIPS OF JAMAICAN ARTHROPODS¹

Matthew D. Johnson^{2,3}, Allan M. Strong^{2,4}

ABSTRACT: We calculated length-weight regressions for above ground and leaf litter arthropods collected in Jamaica. Slope coefficients were generally lower (suggesting thinner, lighter bodies) than those reported from drier temperate regions, but were similar to those reported from moist Costa Rica for all taxa except Homoptera. This result is consistent with the hypothesis that selection has favored elongated body shapes in wet tropical regions where arthropods are little constrained by desiccation. The low slope for Jamaican Homoptera may be because small thin-bodied families (Cixiidae, Psyllidae, and Aphididae) are disproportionately more common in Caribbean than Central American insect faunas. Within Jamaica, slopes were lower for arthropods collected in wet habitats (wet limestone forest, mangrove swamp) than dry habitats (dry limestone forest, coastal thorn scrub), further suggesting the importance of microclimate as a factor influencing arthropod shape. However, leaf litter arthropods, which are relatively protected from desiccation, had higher slopes than those collected above ground, suggesting that other constraints, perhaps those imposed by means of locomotion, also affect arthropod shape.

Estimating the biomass of arthropods is important in biological studies due to the great abundance of arthropods in most ecological communities (Sample et al. 1993), their importance as a vertebrate food resource (Golley 1961), and their role as model organisms to study evolutionary processes affecting morphology (Schoener and Janzen 1968, Schoener 1980). In this regard, length-weight regressions have provided useful tools in estimating arthropod biomass in particular habitats (Rogers et al. 1977, Pearson and Derr 1986), examining the biomass of particular prey size classes in consumer diets (Harris 1986, Torok and Ludvig 1988, Omland and Sherry 1994), describing predator foraging behaviors (Sage 1982, Hill and Grossman 1993, Pulido and Diaz 1997), and comparing morphologies of insects in different regions (Schoener 1980). Comparative studies have found that due to differences in general arthropod shape, the coefficients of length-weight regressions can vary significantly between taxa (Rogers et al. 1977), and within taxa between regions (Schoener 1980). Thus, accurate regressions are best computed from locally collected specimens for as many different taxa as feasible (Rogers et al. 1976; Sample et al. 1993; Hodar 1996). To date, relatively few length-weight regressions are available for tropical arthropods (Schoener 1980), and no regressions have been reported for Caribbean islands.

The few data available suggest that tropical arthropods tend to be rela-

¹ Received May 17, 1999. Accepted March 31, 2000.

² Department of Ecology and Evolutionary Biology, Tulane University, New Orleans, Louisiana 70118.

³ Present address: Department of Wildlife, Humboldt State University, Arcata, California 95521.

⁴ Present address: School of Natural Resources, 364 Aiken Center, University of Vermont, Burlington, Vermont 05405-0088.

tively long and thin (lower regression slope coefficients) compared to their temperate counterparts (Schoener 1980). In offering an explanation for this pattern, Schoener (1980) suggested that climatic factors may be important. He reasoned that in arid regions, insects may be constrained to minimize surface area to volume ratios to counter desiccation. Therefore, selection pressure would favor (in addition to larger sizes) arthropods with more compact shapes (i.e., more spherical or cubic) with higher slope coefficients (i.e., closer to 3, *sensu* McMahon 1973). Conversely, in wet regions such as the tropics, arthropods would be relatively free from this constraint, and other selection pressures, such as risk of predation, may favor more elongated, cryptic body shapes. In support of this hypothesis, Schoener (1980) found that insects collected from wet forests in Costa Rica had lower slopes than those collected from drier sites, but other comparative data are lacking.

In this study, we present the first length-weight regressions of arthropods from Jamaica. In addition, we test the hypothesis that selection has favored elongated body shapes in wet areas where arthropods are little constrained by desiccation by testing predictions at three spatial scales. First, we predict regression slopes derived from our Jamaican collections to be lower than those obtained from insects in drier temperate regions, but similar to those from other tropical areas. Second, among our Jamaican samples, we predict the slopes of insects collected in relatively wet habitats (mangrove swamp and wet limestone forests) to be lower than those derived from insects collected in drier habitats (dry limestone forest and thorn scrub). Third, we predict that leaf litter arthropods are less constrained by desiccation than above ground arthropods, and consequently will yield lower length-weight regression slopes than arthropods collected above ground (i.e., foliage-dwelling and free-flying species).

METHODS

We collected arthropods using several techniques: branch clipping and Malaise trapping for above ground arthropods, and Berlese funnels and spot collecting for leaf litter arthropods. Branch clipping (Johnson 2000) consisted of positioning a collapsible bag in the understory or canopy (up to 9 m with the aid of extension poles), quickly enclosing the end of a branch, tightening the mouth of the bag around the branch with a drawstring, clipping the branch free with a telescoping tree pruner, then lowering the bag and visually inspecting the clipped branch for arthropods. Arthropod specimens were collected from the bag with an aspirator, and stored in 70% ethanol. Malaise trapping was conducted with standard Malaise traps (2 m high, pyramidal construction, Bioquip Inc., Cooper and Whitmore, 1990), which were erected and operated for approximately 24 hr. Lepidopteran adults were presorted from the collections in the field and stored in plasticine envelopes; other arthropods were stored in 70% ethanol.

To collect leaf litter arthropods, we pushed a 0.1 m² cylindrical core into the subsoil, collected all leaves and leaf fragments and briefly stored them in plastic bags. The leaves and leaf fragments were then placed in Berlese funnels for 14 h and the extracted arthropods were stored in 70% ethanol (see Levings and Windsor 1982 for additional details). A few additional specimens were collected with forceps directly from the leaf litter.

All sampling was conducted in the dry season (Nov. - Mar.) 1995-1997, except for above ground Aranae, which were collected in June 1998. We collected specimens from 26 sites representing six broad habitats along a wet-dry gradient (Fig. 1, Table 1). A habitat's moisture is a complex interaction of rainfall, temperature, evapotranspiration rates, and local shade conditions, and different sites within a habitat are not equivalent. Thus, rather than quantifying this wet-dry gradient, we instead ranked these six habitats based on patterns of rainfall and our own experience working in each of the sites (listed in order of increasing aridity): wet limestone forest, mangrove swamp, citrus orchard, shade-coffee plantation, dry limestone forest, and coastal thorn scrub. Habitat descriptions, including dominant plant species, are available in Asprey and Robbins (1953); more detailed site descriptions are available in Johnson (1999). For purposes of this report, arthropods from all habitats were pooled to provide adequate sample sizes to generate order-specific length-weight regressions which serve as general relationships for the island. To compare regression coefficients between habitats, we pooled all insect orders within a habitat to maintain adequate sample sizes. Regressions were run separately for above ground and leaf litter arthropods.

In the laboratory, all above ground adult arthropods were sorted into 12 taxonomic groups corresponding closely to order: Aranae, Orthoptera, Dictyoptera, Hemiptera, Homoptera, Coleoptera, Lepidoptera, Nematocera, other Diptera, Formicidae, and other Hymenoptera. Leaf litter arthropods were sorted into 10 groups: Aranae, Pseudoscorpiones, "Arthropods" (Diplopoda, Chilopoda, and Isopoda), Dictyoptera, Isoptera, Dermaptera, Hemiptera, Coleoptera, Formicidae, and various holometabolous larvae (Coleoptera, Lepidoptera, and Diptera). The lengths of all arthropods were measured (head to end of abdomen) to the nearest 0.1 mm using a 7.5-64x dissecting microscope equipped with an ocular micrometer, dried to constant mass (24 hr at 100° C), allowed to cool, and weighed to the nearest 0.1 mg using an electronic balance. To avoid pseudoreplication, we included multiple specimens of the same morphospecies only when they were of different lengths (with the exception of Isoptera, in which variation in length was slight). Small specimens (<1.5 mm), when weighed singly, resulted in only 1 significant digit for mass with a 0.1 mg precision balance. Therefore, wherever possible we weighed 2-10 small individuals of the same length and morphospecies together, then calculated a mean weight.

We used the power model described by Rogers et al. (1977) to calculate length-weight regressions of arthropod taxa with the formula:

$$\text{Weight} = b_0 (\text{length})^{b_1}$$

where b_0 and b_1 are constants. This equation was transformed with natural logarithms to

$$\ln(\text{weight}) = \ln(b_0) + b_1 \ln(\text{length})$$

and expressed in linear form for regression ($Y = B_0 + B_1X$) so that an arthropod's estimated weight may be calculated from its length and the regression coefficients using the formula:

$$\text{Weight in mg} = e^{B_0} (\text{length in mm})^{B_1}$$

where $B_0 = \ln(b_0)$ and $B_1 = b_1$, corresponding to the y-intercept and slope of the regression line respectively. Regression coefficients were calculated using SYSTAT 5.2.1 (Wilkinson 1989) and Excel 5.0 (Microsoft 1994). We compared slopes of Jamaican arthropods collected in different habitats with a test of homogeneity of slopes (THS, Sokal and Rohlf 1981). Strict statistical comparisons of slope (power) coefficients with previously published results are impossible without all the data used to generate the coefficients, thus, we compared slopes qualitatively and by examining confidence intervals (Sokal and Rohlf 1981).

RESULTS AND DISCUSSION

All length-weight regressions were statistically significant ($P < 0.01$) and correlation coefficients were generally high (r range 0.574-0.979, Tables 2 and 3). Low slope coefficients (B_1) indicate groups that are relatively light for their length, as is the case for thin, slight-bodied arthropods. Among Jamaican above ground arthropods (Table 2), slopes were lowest for Nematocera, other Diptera, and Homoptera (1.317-1.876) and highest for Hemiptera, Lepidoptera, and Dictyoptera (2.219-2.311). Slopes were lowest among leaf litter fauna for "arthropods" (Diplopoda, Chilopoda, and Isopoda, 2.014) and highest for Isoptera (3.177, Table 3). Regressions of morphologically diverse taxa for which we had many specimens, such as Coleoptera and Hemiptera (the latter included Emesinae [thread-legged bugs] and Pentatomidae [stink bugs]), yielded correlation coefficients that were as high as those found in morphologically stereotyped taxa for which specimens were uncommon (e.g., Nematocera, above ground Formicidae). This suggests that sample size, as much as morphological diversity, contributes to the variation in the precision of length-weight correlations.

To examine the effect of regional climate on arthropod shape, we compared regression slope coefficients derived from our Jamaican specimens with those previously published from temperate areas (Rogers et al. 1977, Sample et al. 1993) and from other tropical regions (Schoener 1980). Overall, the slopes calculated in this study were lower (all < 2.79 except for Isoptera) than those calculated from insects in temperate regions, which usually have values between 2.60 and 3.30, corroborating the pattern first documented by Schoener (1980). Comparing slopes within the tropics (only data from above ground insects were available), Jamaican slopes were, with one notable exception, similar to those for insects from Costa Rica (Schoener 1980). All 95% confidence intervals from Jamaican regressions, except those for Homoptera, contained the power coefficients of the corresponding taxa from either wet or dry habitats in Costa Rica (Table 4). These results support the hypothesis that selection has favored elongated body shapes in the wet tropics.

The particularly low slope of Jamaican Homoptera may be due to adaptations for camouflage. Within Homoptera, small phytophagous groups (such as Cixiidae, Psyllidae, and Aphididae) are disproportionately more abundant on Caribbean islands than on the Central American mainland (Janzen 1973). These groups, which can be important prey for Caribbean birds (Lack 1972), may be under especially intense selective pressure to blend in with their surroundings, and a thin shape has been suggested to be an advantage for camouflage (Schoener 1980). In support of this, Sample et al. (1993) found the slope of Cixiidae to be lower than that for other Homopterans. Thus, a high relative proportion of small, thin, camouflaged families within Homoptera on Caribbean islands may tend to keep the regression slope low relative to regions where Homopteran morphologies are more diverse.

To further evaluate the hypothesis that climate affects arthropod shape, we examined the slope coefficients derived from Jamaican above ground specimens collected in habitats across a wet-dry gradient. Leaf litter arthropods could not be analyzed separately by habitat because collections had been previously pooled across habitats for other analyses (Strong and Sherry in press). A test for the homogeneity of slopes demonstrated that arthropods collected in the six habitats resulted in significantly different slopes ($P < 0.01$, Fig. 2). As predicted, the wetter habitats (wet limestone forest and mangrove swamp) had the lowest slopes, whereas the more arid habitats (dry limestone forest and coastal thorn scrub) contained the highest slopes.

Lastly, we compared the slopes of leaf litter arthropods, which may be buffered somewhat from desiccation, to those from above ground specimens. In taxa for which we had adequate sample sizes (Araneae, Dictyoptera; Hemiptera, Coleoptera, and Formicidae), the slopes of Jamaican above ground arthropods were lower than those for leaf litter arthropods (Tables 2 and 3), indicating longer thinner arthropods above the ground, where desiccation risk is higher. This result is inconsistent with the hypothesis that microclimate is



Fig. 1. Collection sites and average annual rainfall in Jamaica (data from Lack 1976). See Table 1 for list of collection sites.

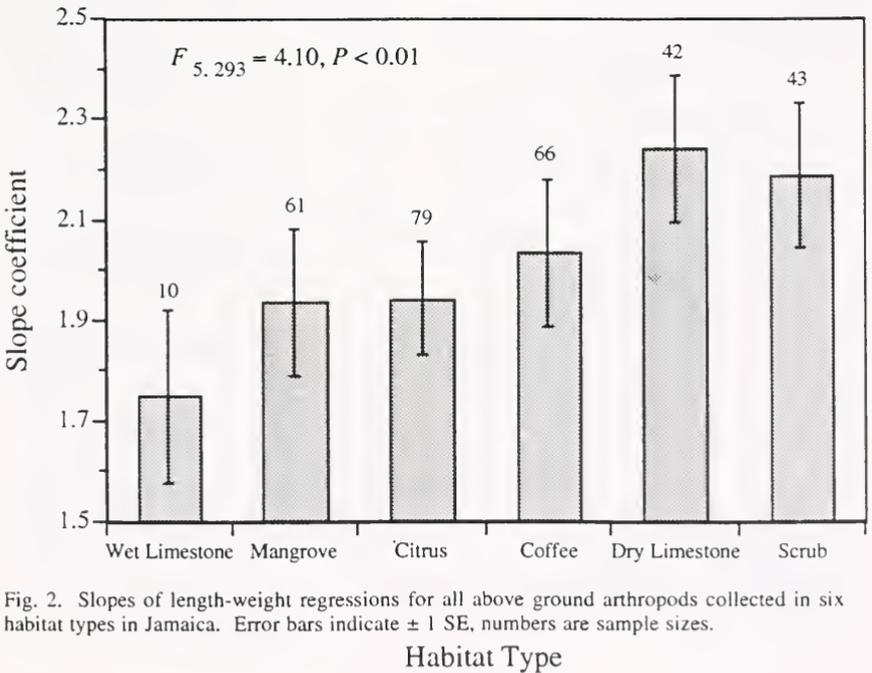


Fig. 2. Slopes of length-weight regressions for all above ground arthropods collected in six habitat types in Jamaica. Error bars indicate ± 1 SE, numbers are sample sizes.

Table 1. Study sites lettered by collection date, sorted by broad habitat types.

Study Site	Habitat Type	Lat.- Long.	Elevation Range	Site Description
A. Copse Mountain	Wet Limestone Forest	18°16'N 77°04'W	440-460 m	Tall, dense, old-aged wet forest fragment with several hurricane-formed gaps containing thick understories and vines
J. Marshall's Pen	Wet Limestone Forest	18°03'N 77°32'W	600-620 m	Second growth moist forest fragment with continuing minor disturbance
N. Windsor Cave	Wet Limestone Forest	18°21'N 77°30'W	230-240m	Diverse, tall, dense, mesophyllic forest within large, relatively undisturbed forested landscape
W. Ecclesdown	Wet Limestone Forest	18°05'N 78°54'W	210-320	Very wet forest at base of undisturbed forested mountains, limestone/shale soils
H. Portland Ridge Upper	Dry Limestone Forest	17°44'N 78°09'W	100-120 m	Undisturbed arid forest; site in a valley where air was more moist, soils deeper, and trees taller than in surrounding areas
K. Portland Ridge Lower	Dry Limestone Forest	17°44'N 78°09'W	80-100 m	Undisturbed arid forest; dense sub-canopy with vines, canopy thin and lacking large trees
O. Hellshire Hills	Dry Limestone Forest	17°51'N 78°12'W	10-20 m	Highly disturbed dry forest, dense thorny shrub layer, grasses in open areas
X. Great Bluff	Dry Limestone Forest	17°52'N 77°45'W	10-30 m	Disturbed very arid forest; canopy sparse, cacti abundant, thorny understory
F. Luana Point West	Thorn Scrub	18°02'N 77°55'W	0-10 m	Heterogeneous grazed thorny thicket with some tall remnant trees
L. Portland Cottage Inland	Thorn Scrub	17°45'N 77°10'W	0-10 m	Homogenous grazed Mimosaceae dry savannah
M. Portland Cottage Seaward	Thorn Scrub	17°45'N 78°10'W	0-10 m	Heterogeneous woodland of dry thorn thicket, dry forest, and coastal woodland
R. Luana Point East	Thorn Scrub	18°02'N 77°54'W	0-10 m	Dense, thorny logwood thickets interspersed with grassy openings

Study Site	Habitat Type	Lat.- Long.	Elevation Range	Site Description
P. Negril	Mangrove	18°11'N 76°43'W	0-10 m	Tall, old/middle-aged diverse mangrove swamp
S. Luana Point	Mangrove	18°02'N 77°54'W	0-10 m	Tall, mature black mangrove swamp in a landscape mosaic with thorn scrub
U. Portland Cottage	Mangrove	17°45'N 78°10'W	0-10 m	Short dense mangrove scrub with shallow open pools
V. Morant Point	Mangrove	18°04'N 78°57'W	0-10 m	Hurricane disturbed dense mangrove scrub thicket
B. Kew Park Ortanique	Citrus	18°16'N 77°04'W	290-300 m	Small, little-managed orchard surrounded by pasture, occasional remnant tall wet forest trees
C. Kew Park Orange	Citrus	18°16'N 77°04'W	300-310 m	Small little-managed orchard with small pockets of mesic trees and shrubs
E. Trout Hall	Citrus	18°08'N 77°20'W	220-230 m	Large intensively managed relatively young orchard with many narrow wet ravines
T. Comfort Hall	Citrus	18°10'N 77°34'W	200-210 m	Large, intensively managed orchard with small swampy hollows
D. Kew Park	Shade-coffee	18°16'N 77°04'W	300-310 m	Very young small plantation surrounded by wet forest and pasture; diverse short planted shade trees among several tall remnant forest trees
G. James Hill East	Shade-coffee	18°10'N 77°20'W	610-620 m	Moderately diverse area of plantation; tall, old shade trees of primarily two species, dense coffee understory with a small stream
I. James Hill West	Shade-coffee	18°10'N 77°20'W	610-620 m	Relatively homogenous area of plantation; relatively open understory with abundant banana trees

Study Site	Habitat Type	Lat.- Long.	Elevation Range	Site Description
Q. Baronhall	Shade-coffee	18°13'N 77°22'W	550-560 m	Large, old, homogenous plantation shaded by <i>Inga vera</i> ; wet forest, pasture, and pond near study area
Y. Coleyville	Shade-coffee	18°13'N 77°32'W	630-640 m	Small, young plantation shaded by <i>Inga vera</i> with many banana plants amongst coffee trees
Z. Luana Point West 2	Thorn Scrub	18°02'N 77°55'W	0-10 m	Homogeneous grazed thorny thicket, more closed canopy than site R.

Table 2.—Regression statistics for weight (mg) on length (mm) of Jamaican above ground arthropods.^a

Taxon	n	Length		B ₀ ± 1 SE	B ₁ ± 1 SE	r
		Range (mm)				
Aranae	20	1.1-15.1		-2.077 ± 0.343	2.039 ± 0.235	0.898
Orthoptera & Dictyoptera	32	2.0-19.6		-2.809 ± 0.331	2.125 ± 0.178	0.909
Orthoptera	12	2.2-19.6		-2.649 ± 0.595	2.036 ± 0.308	0.902
Dictyoptera	20	2.0-11.9		-2.974 ± 0.417	2.219 ± 0.229	0.916
Hemiptera	23	1.5-12.8		-3.167 ± 0.294	2.311 ± 0.219	0.917
Homoptera	52	1.1-8.2		-2.453 ± 0.143	1.876 ± 0.119	0.913
Coleoptera	51	1.2-12.1		-2.867 ± 0.226	2.166 ± 0.158	0.890
Lepidoptera	40	2.2-18.6		-3.268 ± 0.255	2.243 ± 0.130	0.942
Diptera	75	1.0-12.5		-2.462 ± 0.196	1.881 ± 0.146	0.833
Nematocera	21	1.0-4.8		-2.562 ± 0.244	1.373 ± 0.207	0.836
Other Diptera	54	1.2-12.5		-2.105 ± 0.178	1.805 ± 0.124	0.895
Hymenoptera	71	1.4-24.3		-3.556 ± 0.183	2.193 ± 0.110	0.923
Formicidae	21	1.6-9.9		-3.730 ± 0.298	2.103 ± 0.238	0.901
Other Hymenoptera	50	1.4-24.3		-3.295 ± 0.241	2.102 ± 0.132	0.917
Total Arthropoda						
Total Insecta (adult)	344	1.0-24.3		-2.842 ± 0.085	2.042 ± 0.055	0.895

^a Equation is Weight in mg = e^{B₀} (length in mm)^{B₁}

Table 3.—Regression statistics for weight (mg) on length (mm) of Jamaican leaf litter arthropods (data are from Strong and Sherry in press).^a

Taxon	n	Length		B ₀ ± 1 SE	B ₁ ± 1 SE	r
		Range (mm)				
Aranae	51	0.8-9.9		-3.197 ± 0.165	2.218 ± 0.122	0.933
Pseudoscorpiones	28	1.0-3.7		-3.742 ± 0.229	2.165 ± 0.232	0.878
"Arthropods" ^{nb}	50	1.5-44.0		-3.831 ± 0.380	2.014 ± 0.183	0.846
Dictyoptera	23	2.4-12.4		-4.289 ± 0.392	2.749 ± 0.232	0.933
Isoptera	75	3.3-5.6		-5.802 ± 0.800	3.177 ± 0.531	0.574
Dermaptera	7	5.8-13.6		-5.647 ± 1.214	2.494 ± 0.540	0.900
Hemiptera	14	2.0-10.5		-3.841 ± 0.263	2.794 ± 0.169	0.979
Coleoptera	75	1.3-14.0		-3.240 ± 0.195	2.513 ± 0.128	0.917
Formicidae	72	1.3-11.5		-4.102 ± 0.132	2.339 ± 0.102	0.939
Holometabolous Larvae	73	1.1-33.5		-5.735 ± 0.370	2.258 ± 0.182	0.827
Total Arthropoda	468	0.8-44.0		-3.257 ± 0.136	1.728 ± 0.084	0.690
Total Insecta	339	1.3-33.5		-3.178 ± 0.197	1.617 ± 0.121	0.589
Total adult Insecta	266	1.3-13.6		-3.893 ± 0.175	2.367 ± 0.117	0.780

^a Equation is Weight in mg = e^{B₀}(length in mm)^{B₁}

^b Includes Diplopoda, Chilopoda, and Isopoda

Table 4.—Slope coefficients (± 95% confidence intervals) of length (mm)-weight (mg) regressions from data collected in Jamaica versus wet and dry sites in Costa Rica^a (above ground arthropods only).

Taxon	Jamaica			Costa Rica, dry forest			Costa Rica, wet forest		
	n	slope	± 95% C.I.	n	slope	± 95% C.I.	n	slope	± 95% C.I.
Orthoptera ^b	32	2.125	0.363	25	1.65	0.47	10	1.96	0.94
Hemiptera	23	2.311	0.453	42	2.48	0.56	16	2.28	0.76
Homoptera	52	1.876	0.239	84	2.65	0.27	62	2.23	0.36
Coleoptera	51	2.166	0.317	150	2.11	0.17	171	1.91	0.19
Lepidoptera	40	2.243	0.263	29	2.50	0.30	7	1.32	1.34
Diptera	75	1.881	0.291	107	1.64	0.24	124	1.59	0.23
Formicidae	21	2.103	0.495	25	2.72	0.51	20	2.31	0.44
Other Hymenoptera	50	2.102	0.265	174	2.07	0.18	122	2.29	0.27
Total	344	2.042	0.108	498	2.16	0.09	535	2.11	0.13

^a Data from Schoener (1980)

^b Includes Dictyoptera

the primary factor determining regression slopes and arthropod shape. One possible explanation for this may be that many above ground arthropods fly to move or escape predators, and may have evolved elongated body shapes for favorable aerodynamics. In contrast, because leaf litter arthropods are primarily runners or walkers, they may be less constrained by aerodynamics, but may benefit from a more compact shape (higher slope) which could be easily maneuvered through leaf litter. In Formicidae and Aranae, which contain few flyers, above ground and leaf litter slopes were similar (overlapping 95% CIs). Conversely, in the other comparable taxa (Dictyoptera, Hemiptera, and Coleoptera), which do contain flyers, the 95% CIs of above ground insects fell below those of leaf litter insects, suggesting that means of locomotion do affect length-weight regression slopes in arthropods.

In conclusion, regression analyses suggested that Jamaican arthropods were relatively thin and light compared to those in drier temperate regions, but were similar to those in other regions of the wet tropics (Table 4). Within Jamaica, arthropods in wetter habitats tended to be long and thin relative to those in drier areas (Figure 2). These results are consistent with the hypothesis that selection has favored elongated body shapes in wet regions and habitats where arthropods are little constrained by desiccation. However, leaf litter arthropods, which are probably protected from desiccation, were relatively compact compared to those collected above ground, suggesting that other constraints, perhaps those imposed by means of locomotion, also affect arthropod shape.

ACKNOWLEDGMENTS

J. Camp, K. Karwacky, A. Medori, J. Pumilio, and J. Long provided invaluable assistance in the field. We thank R. and A. Sutton, P. Becksy, and P. Williams for hospitality and advice in Jamaica. A. Palmer, S. C. Jane, D. Reed, J. Minot, L. Barret, C. Gentile, the Coffee Industrial Board of Jamaica, E. Zaidie and members of the PWD gun club all gave permission to work on their land. Financial support was provided in part by an NSF grant to T. W. Sherry (Tulane University) and R. T. Holmes (Dartmouth College), Sigma Xi Grants-in-Aid of Research, the Chicago Zoological Society, the World Nature Association, Tulane's Neotropical Ecology Institute, and the Louisiana Educational Quality Support Fund. Carl Schaefer provided helpful correspondence, and Thomas Sherry, Stuart Bamforth, and two anonymous reviewers provided helpful editorial suggestions on the manuscript.

LITERATURE CITED

- Asprey, G. F. and R. G. Robbins. 1953. The vegetation of Jamaica. *Ecological Monographs* 23:359-413.
- Cooper, R. J. and R. C. Whitmore. 1990. Arthropod sampling methods in ornithology. *Stud. Avian Biol.* 13:29-37.
- Golley, F. B. 1961. Energy value of ecological material. *Ecology* 42:581-584.
- Harris, J. H. 1986. Microhabitat segregation in 2 desert rodent species - the relation of prey availability to diet. *Oecologia* 68:417-421.
- Hill, J. and G. D. Grossman. 1993. An energetic model of microhabitat use for rainbow trout and rosy side dace. *Ecology* 74:685-698.
- Hodar, J. A. 1996. The use of regression equations for estimation of arthropod biomass in ecological studies. *Acta Oecologica* 17:421-433.

- Janzen, D.** 1973. Sweep samples of tropical foliage insects: effects of seasons, vegetation types, elevation, time of day, and insularity. *Ecology* 54:687-708.
- Johnson, M. D.** 1999. Habitat relationships of migratory birds wintering in Jamaica, West Indies. Ph.D. dissertation, Tulane University, New Orleans, Louisiana, USA.
- Johnson, M. D.** 2000. Evaluation of an arthropod sampling technique for measuring food availability for forest insectivorous birds. *Journal of Field Ornithology* ?????
- Lack, D.** 1976. *Island biology illustrated by the land birds of Jamaica*. University of California Press, Berkeley and Los Angeles. 445 pages.
- Levings, S. C. and D. M. Windsor.** 1982. Seasonal and annual variation in litter arthropod populations. Pages 355-387 in *The ecology of a tropical forest: seasonal rhythms and long-term changes*. (E. G. Leigh, Jr., A. S. Rand, and D. M. Windsor, Eds.). Smithsonian Institution Press, Washington, D.C.
- McMahon, T.** 1973. Size and shape in biology. *Science* 179:1201-1204.
- Microsoft Corporation.** 1994. Microsoft Excel 5.0. Microsoft Corporation, Seattle, WA.
- Omland, K. E. and T. W. Sherry.** 1994. Parental care at nests of two age classes of male American Redstart: implications for female mate choice. *Condor* 96:606-613.
- Pearson, D. L. and J. A. Derr.** 1986. Seasonal patterns of lowland forest floor arthropod abundance in southeastern Peru. *Biotropica* 18:244-256.
- Pulido, F. J. and M. Diaz.** 1997. Linking individual foraging behavior and population spatial distribution in patchy environments: a field example with Mediterranean blue tits. *Oecologia* 111:434-442.
- Rogers, L. E., W. T. Hinds, and R. L. Buschbom.** 1976. A general weight vs. length relationship for insects. *Ann. Entomol. Soc. Am.* 69:367-369.
- Rogers, L.E., L. Buschbom, and C.R. Watson.** 1977. Length-weight relationships of shrub-steppe invertebrates. *Ann. Entomol. Soc. Am.* 70:51-53.
- Sage, R. D.** 1982. Wet and dry-weight estimates of insects and spiders based on length. *Am. Midl. Nat.* 108:407-411.
- Sample, B.E., R. J. Cooper, R. D. Greer, and R. C. Whitmore.** 1993. Estimation of insect biomass by length and width. *Am. Midl. Nat.* 129:234-240.
- Schoener, T.W.** 1980. Length-weight regressions in tropical and temperate forest-understory insects. *Ann. Entomol. Soc. Am.* 73:106-109.
- Schoener, T. W. and D. H. Janzen.** 1968. Some notes on tropical versus temperate insect size patterns. *Am. Nat.* 102:207-224.
- Strong, A. M. and T. W. Sherry.** Habitat-specific effects of food abundance on the body condition of Ovenbirds wintering in Jamaica. In press, *Journal of Animal Ecology*.
- Sokal, R. R. and F. J. Rohlf.** 1981. *Biometry*. 2nd ed. W. H. Freeman and Co. New York. 307 pages.
- Torok, J. and E. Ludvig.** 1988. Seasonal-changes in foraging strategies of nesting Blackbirds (*Turdus merula*, L.). *Behav. Ecol. and Sociobiol.* 22:329-333.
- Wilkinson, L.** 1989. SYSTAT: the system for statistics. SYSTAT, Evanston, Illinois. 638 pages.

SCIENTIFIC NOTE

MISSISSIPPI RECORD FOR *CURICTA SCORPIO*
(HEMIPTERA: NEPIDAE)¹Paul K. Lago²

During the past several years, I have had the opportunity to conduct various environmental surveys at the Stennis Space Center in southwestern Hancock County, Mississippi. Although these studies have, for the most part, not been centered on insects, I have taken the occasional opportunity to make small collections. Recently, while working through some of this collected material, I discovered a specimen of *Curicta scorio* Stål originally collected on 21 June 1991. The specimen was taken as it walked across a dirt path on a levee perhaps 2 meters above the edge of a small, shallow pond within the rocket testing facility. Since a breeding bird survey was the focus of my presence in the area, no attempt was made to collect additional specimens. Although capturing the specimen away from its normal aquatic habitat seemed unusual at the time, this species has been documented previously as occasionally occurring completely out of water (Sites and Polhemus, 1994).

Although not previously known from the state, Wilson (1958) included *Curicta drakei* Hungerford (= *C. scorio*) in his work on the aquatic and semiaquatic Hemiptera of Mississippi on the basis of the species being present in southeastern Louisiana (Hungerford, 1922; Ellis, 1952). Most recently, Sites and Polhemus (1994) and Keffer (1996), in his revision of New World species of the genus, indicated that the range of *C. scorio* in North America encompassed southeastern Texas and southern Louisiana. The Mississippi record presented here extends the range of the species modestly (about 95 kilometers) to the northeast of that previously known and is the first record east of the Pearl River.

The specimen has been placed in my personal collection.

ACKNOWLEDGMENTS

R. W. Sites kindly provided useful comments on the initial version of this manuscript. I wish to thank Al Watkins and Ron Magee for their support during my work at the Stennis Space Center.

LITERATURE CITED

- Ellis, L.L. 1952. The aquatic Hemiptera of southeastern Louisiana (exclusive of Corixidae). Amer. Midl. Natur. 48: 302-329.
- Hungerford, H.B. 1922. The Nepidae in North America north of Mexico. Univ. Kansas Sci. Bull. 14: 425-469.
- Keffer, S.L. 1996 Systematics of the New World waterscorpion genus *Curicta* Stål (Heteroptera: Nepidae) J. New York Entomol. Soc. 104: 117-215.
- Sites, R. W. and J.T. Polhemus. 1994. Nepidae (Hemiptera) of the United States and Canada. Ann. Entomol. Soc. Amer. 87: 27-42.
- Wilson, C.A. 1958. Aquatic and semiaquatic Hemiptera of Mississippi. Tulane Stud. Zool. 6(3): 113-170.

¹ Received December 10, 1999. Accepted February 4, 2000.

² Department of Biology, University of Mississippi, University, MS 38677.

ALLOCAPNIA POLEMISTIS (PLECOPTERA: CAPNIIDAE), NEW FOR MISSISSIPPI¹

Bill P. Stark², Mac H. Alford³, Samuel G. Tucker²

ABSTRACT: *Allocapnia polemistis* is recorded for the first time beyond the Black Warrior Uplift of Alabama, in Tishomingo Co., Mississippi. Scanning electron micrographs of the male genitalia are provided and the epiproct and 8th tergal process are compared with those of topotypes of *A. recta*, a closely related species.

Allocapnia polemistis was described by Ross and Ricker (1971) as a species endemic to the Black Warrior Uplift of Alabama. The original sample included 29 specimens (18♂ 11♀) from four sites in Marion, Walker and Winston counties; subsequent reports of Alabama stoneflies (Stark and Harris 1986) have not revealed additional records for *A. polemistis*, nor have reports from Mississippi (Stark 1979; Alford 1998) indicated the species occurs in that state. In 1996, we collected a single male specimen from Winston Co., Alabama. This specimen was examined with scanning electron microscopy in order to compare the epiproct structure of *A. polemistis* with other members of the *A. recta* complex (Tucker and Stark unpublished). More recently we collected specimens from a site in Tishomingo Co., Mississippi, and these were also studied with SEM. The data are here used to provide a more complete description of the male genital features for this rare species.

METHODS

Specimens stored in 80% ethanol were sonicated for 30 seconds, serially dehydrated to 100% ethanol and placed in two washes of hexamethyldisilazane for 30 minutes each. Specimens were attached to specimen stubs with double stick copper tape and sputter coated with gold-palladium before study with an AMRAY 1810D scanning electron microscope.

Allocapnia polemistis Ross and Ricker

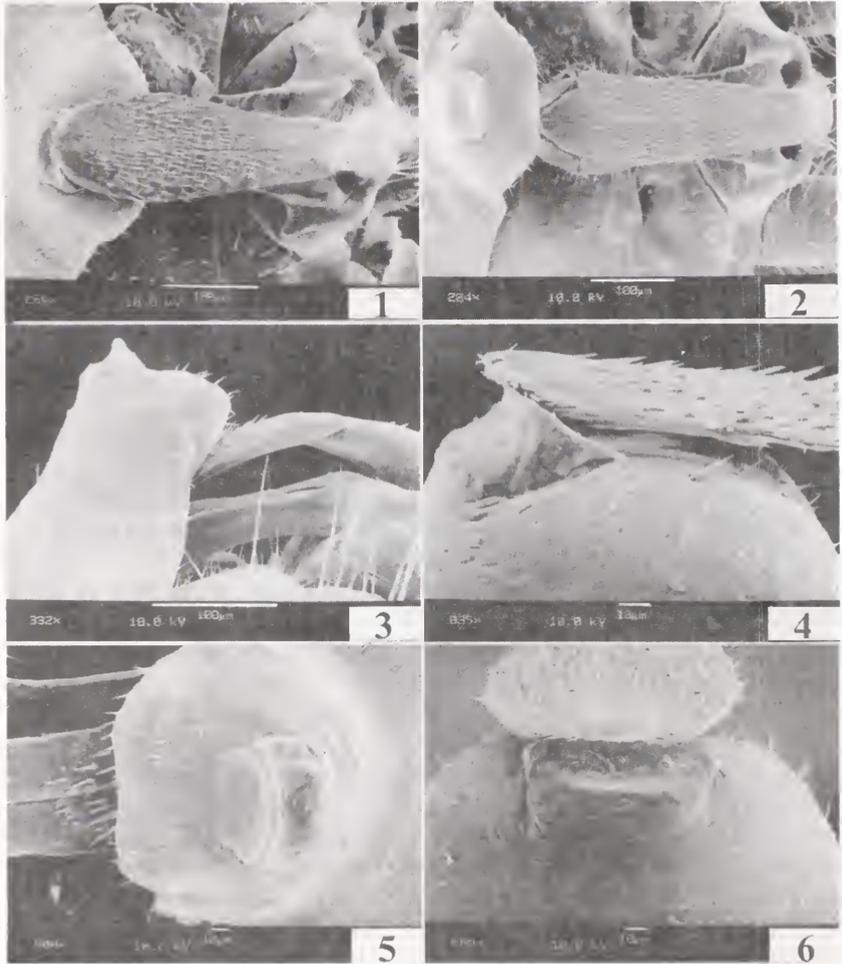
Allocapnia polemistis Ross and Ricker, 1971. Holotype ♂, 10 miles northeast of Jasper, Walker Co., Alabama.

Male.- Epiproct upper limb recurved; apical section of upper limb paddle shaped and armed with stiff backward directed bristles (Figs. 1-2). Apical section approximately 290 µm long and 100 µm wide. A median sulcus extends from apex to base; armature ends subapically. Dorsal process of tergum 8 extends approximately 250 µm above segments 7 and 9 (Fig. 3). Dorsolat-

¹ Received February 22, 2000. Accepted March 18, 2000.

² Dept. of Biology, Mississippi College, Clinton, MS 39058.

³ Dept. of Plant Biology, Cornell University, Ithaca, NY 14853.



Figs. 1-6. *Allocapnia polemistis* male genital features. 1-2. Dorsal limb of epiproct and 8th tergal process, dorsal aspect. 3-4. Lateral aspect of 8th tergal process. 5. Dorsal aspect of 8th tergal process. 6. Frontal aspect of 8th tergal process. (Figs. 1, 3-6. Tishomingo Co., MS., Fig. 2. Winston Co., AL.).

eral aspect abruptly flattened near apex to form an anterior, subapical shelf approximately 45 μm wide (Figs. 3-5). Dorsum of process terminates in a sharp slightly arcuate ridge approximately 75-80 μm wide (Figs. 5-6). Anterior shelf with a few scattered tubercles (Fig. 5). Caudad to the dorsal ridge, the process drops almost vertically to a large flat shelf bearing scattered setae at the posterior angles (Figs. 3-5).

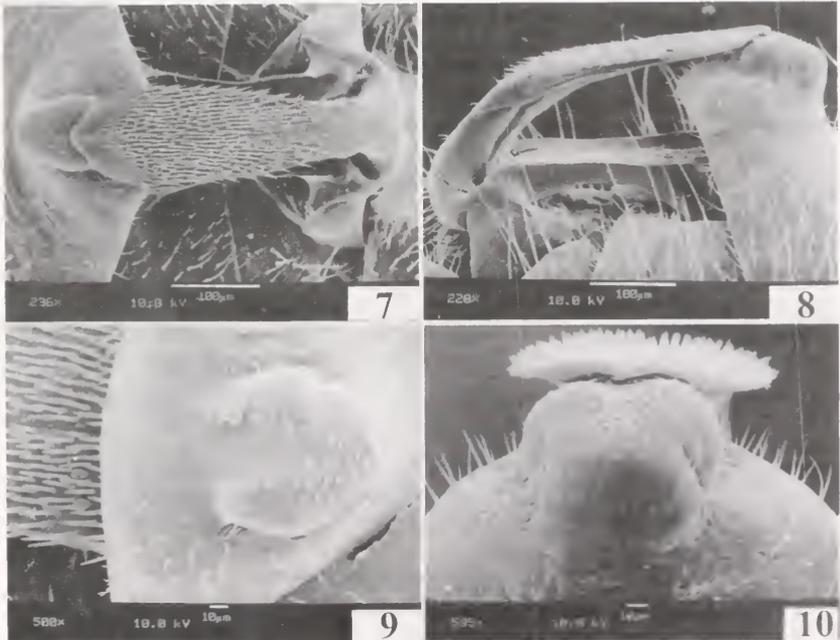
Material.- Alabama: Winston Co., Sipsey River near Natural Bridge, 20 January 1996, B.P. Stark, M.H. Alford, S.G. Tucker, 1♂. Mississippi: Tishomingo Co., Rock Quarry Creek, Tishomingo State Park, 4 January 2000, B.P. Stark, M.H. Alford, 3♂.

Allocapnia recta (Claassen)

Capnella recta Claassen, 1924. Holotype ♂, Ithaca, Tompkins Co., New York.

Allocapnia recta: Ross and Ricker, 1971.

Male.- Epiproct upper limb recurved; apical section of upper limb paddle-shaped and armed with stiff backward directed bristles (Figs. 7-8). Apical section approximately 290 μm long and 100 μm wide. A median sulcus extends from apex to base; armature ends subapically (Fig. 7). Dorsal process of tergum 8 terminates in a rounded plateau armed with tubercles which form a



Figs. 7-10. *Allocapnia recta* male genital features. 7. Dorsal limb of epiproct and 8th tergal process, dorsal aspect. 8. Epiproct and 8th tergal process, lateral aspect. 9. Dorsal aspect of 8th tergal process. 10. Frontal aspect of 8th tergal process.

V-shaped pattern on the dorsum (Figs. 9-10). Dorsolateral aspect of process without anterior shelf or dorsal ridge (Figs. 8-10).

Material.- New York: Tompkins Co., Cascadilla Creek, Ithaca, 13 December 1999, M.H. Alford, 10 ♂, 5 ♀.

DISCUSSION

The epiproct structure of *A. polemistis* is quite similar to that of *A. recta* (Ross and Ricker 1971; Alford 1998). The lateral and dorsal aspects of the apical section for these species have the same approximate dimensions and the armature is of the same type, although somewhat more developed in *A. recta* (Figs. 1, 7). The dorsal process, however, differs both in shape and in texture. *A. recta* topotype specimens lack an anterior shelf and ridge and the dorsal aspect is wide and tuberculate (Figs. 8-10) whereas *A. polemistis* has a distinct anterior shelf and thin dorsal ridge that lacks tubercles (Figs. 3-5).

The Mississippi specimens are the first records for *A. polemistis* outside the Black Warrior Uplift of Alabama and brings the number of *Allocapnia* species known for Mississippi to seven (Stark 1979). No other winter stoneflies were collected at the Tishomingo Co. site but *A. rickeri* was previously taken there (Stark 1979) and we collected *A. recta* at a nearby site (Indian Creek, Tishomingo Co., MS) on the same date that *A. polemistis* was collected.

ACKNOWLEDGMENTS

We thank B. C. Kondratieff (Colorado State University) and R. W. Baumann (Brigham Young University) for their helpful reviews of an earlier draft of this manuscript. This study was supported in part by the Howard Hughes Medical Institute, Undergraduate Biological Sciences Education Program Grant # 71195-538901.

LITERATURE CITED

- Alford, M. H. 1998. New records of *Allocapnia* (Plecoptera: Capniidae) from Mississippi and Louisiana, with accompanying scanning electron micrographs. Entomol. News 109:183-188.
- Ross, H. H. and W. E. Ricker. 1971. The classification, evolution, and dispersal of the winter stonefly genus, *Allocapnia*. Illinois Biol. Monog. 45:1-166.
- Stark, B. P. 1979. The stoneflies (Plecoptera) of Mississippi. J. Miss. Acad. Sci. 24:109-122.
- Stark, B. P. and S. E. Harris. 1986. Records of stoneflies (Plecoptera) in Alabama. Entomol. News 97:177-182.

ALKALOID CONTENT OF PARASITOIDS REARED FROM PUPAE OF AN ALKALOID-SEQUESTERING ARCTIID MOTH (*UTETHEISA ORNATRIX*)¹

C. Rossini^{2,5}, E. R. Hoebcke³, V. K. Iyengar², W. E. Conner⁴, M. Eisner², T. Eisner²

ABSTRACT: A number of parasitoids reared from pupae of *Utetheisa ornatrix*, an arctiid moth that sequesters pyrrolizidine alkaloids from its larval foodplant, were analyzed chemically to see whether they sequester pyrrolizidine alkaloids from this host. None proved to do so in substantial measure. The highest alkaloid concentration detected in a parasitoid was about one-tenth that in the host. The parasitoids were from Florida and North Carolina, and included four species of Tachinidae (*Lespesia aletiae*, *Lespesia* sp., *Chetogena claripennis*, and *Archytas aterrimus*), one species of Chalcididae (*Brachymeria ovata*), and an undescribed species of Ichneumonidae (*Corsoncus* sp.). The genus *Corsoncus* has not previously been recorded from the eastern USA.

The moth *Utetheisa ornatrix* (L.) (Arctiidae) sequesters pyrrolizidine alkaloids [henceforth referred to as alkaloid(s)] from its larval foodplants (legumes of the genus *Crotalaria*). It stores the compounds systemically, retains them through the pupal stage into adulthood, and as an adult, bestows them in part upon the eggs (Eisner and Meinwald 1995). We recently (January/February, 1999) had occasion to study a population of *U. ornatrix* at the Archbold Biological Station, Lake Placid, Highlands County, Florida, where the moth was abundant in the environs of stands of its primary local foodplant (*Crotalaria mucronata* Desvaux). We were able to rear a number of parasitoids from pupae of the moth. Specifically, from 40 pupae that we collected in the field, we obtained 6 specimens of Tachinidae [5 *Lespesia aletiae* (Riley) and 1 *Archytas aterrimus* (Robineau-Desvoidy)] and two of Ichneumonidae (*Corsoncus* sp.). To see whether these parasitoids sequester alkaloid from this host, we analyzed all specimens except one for alkaloid content. The exception was one individual of *Corsoncus* which was kept as a voucher specimen because we learned that the species is undescribed. We also analyzed the 26 adult *U. ornatrix* that emerged from the unparasitized pupae (6 pupae died without giving rise to either adult or parasitoid).

Extraction Procedure. The adult parasitoids and adult moths were weighed shortly after emergence and killed by freezing. Each was macerated and extracted with phosphate buffer (with riddelliine added as internal standard) for

¹ Received November 11, 1999. Accepted March 24, 2000.

² Department of Neurobiology and Behavior, Mudd Hall, Cornell University, Ithaca, NY 14853.

³ Department of Entomology, Comstock Hall, Cornell University, Ithaca, NY 14853.

⁴ Department of Biology, Reynolda Station, Wake Forest University, Winston-Salem, NC 27109.

⁵ Current address: Cátedra de Farmacognosia y Productos Naturales. Facultad de Química. Montevideo CC 1157. Uruguay.

24 h at room temperature while stirred. After centrifugation, the residue was re-extracted with phosphate buffer for another 24 h. The two extracts were pooled, filtered (0.45 μm filter membrane), and subjected to high performance liquid chromatography (HPLC).

Alkaloid Analyses. HPLC analyses were performed with a Hewlett-Packard HP 1090 Series II instrument, equipped with a diode array detector ($\lambda = 205$ nm), using a C-18 column (Keystone Sci. BDS Hypersil, 250 x 4.6 mm, 5 μm particle size, 120 Å bore size). Injection volume was 25 μl . The column was eluted at 40° C with a phosphate buffer-acetonitrile mixture (92 : 8; 1 ml/min). The phosphate buffer was prepared by dissolving 2.72 g of potassium phosphate (monobasic), 2 mL of triethylamine, and 0.4 mL of trifluoroacetic acid, in 4 L of water (HPLC grade). The pH was adjusted to 3.0 with phosphoric acid.

The identity of the *N*-oxide and free base of usaramine was confirmed by co-injection with authentic samples. The calibration curves for usaramine (*N*-oxide and free base) were constructed with riddelliine as internal standard. Sensitivity of detection by this technique was 25 ng alkaloid per sample.

RESULTS

As is clear from Fig 1, the 3 parasitoids did not acquire alkaloid at substantial levels. *Archytas aterrimus*, in fact, proved to be alkaloid-free, as did another individual of this species, also emergent from *U. ornatatrix*, but from North Carolina, that we analyzed earlier (Iyengar et al. 1999). *Lespesia aletiae* and

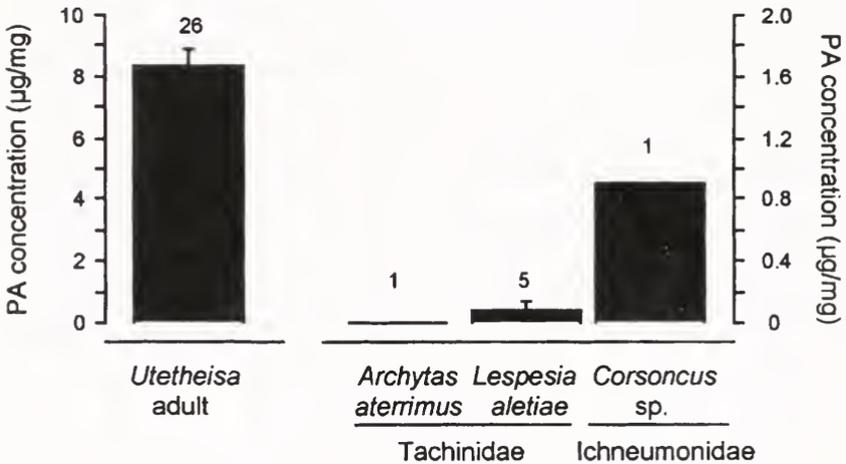


Fig. 1. Pyrrrolizidine alkaloid (usaramine) content of *Utetheisa* and its parasitoids. Numbers above columns give sample size; error bars give one standard error. Sample wet weight (mean \pm SE) was as follows: *Utetheisa* = 87.1 \pm 23.9 mg; *A. aterrimus* = 70.2 mg; *L. aletiae* = 17.0 \pm 2.0 mg; *Corsoncus* sp. = 13.9 mg.

Corsoncus sp. contained detectable quantities of alkaloid, but at levels lower by about an order of magnitude than the host. The specific alkaloid detected, both in *U. ornatix* and the parasitoids, was usaramine, the principal pyrrolizidine alkaloid in *C. mucronata* (Sauthon and Buckingham 1989). The alkaloid was present in the samples in both *N*-oxide and free base forms. The alkaloid values given in Fig. 1 are sums of the two forms.

CONCLUSIONS

Utetheisa ornatix is well protected by its acquired alkaloid, certainly against predation. The adult and larvae are protected against spiders (Eisner and Eisner 1991; González et al. 1999), and the eggs against ants and coccinellid beetles (Hare and Eisner 1993; Dussourd et al. 1988). In contrast, the vulnerability to pupal parasitism appears to be high. If the 20% parasitism rate manifested by our sample is indicative of the norm, then pupal loss to parasitism may be one of the chief sources of mortality in *U. ornatix*.

It is impossible to say whether the low levels of alkaloid acquired by *L. aletiae* and *Corsoncus* sp. might suffice to provide these parasitoids with some protection. But even if not, it would be erroneous to conclude that these insects derive no advantage from parasitizing an alkaloid-laden host. The protection they derive from spending their developmental period within a host that is chemically protected must in itself be adaptive. To be unprotected chemically as a winged adult, must not be nearly as disadvantageous as to be unprotected as a larva. It is possible, of course, that a parasitoid such as *Corsoncus* does derive some protection from what little alkaloid it contains. Spiders are extremely sensitive to pyrrolizidine alkaloids (González et al. 1999) and could conceivably find *Corsoncus* unpalatable.

The finding of an undescribed species of *Corsoncus* from the southeastern U.S. is noteworthy, since in the U.S. the genus was recorded previously from the Southwest only. The present species appears to be most similar to *C. minori* Gauld from Costa Rica (D. Wahl, pers. comm.).

Recently, we analyzed another set of pupal parasitoids from *U. ornatix*, but from a population of moths in Moore County, North Carolina. No wet weights were available for these parasitoids, so we were able to express alkaloid concentration values only as μg per mg dry weight. The parasitoids, and their body alkaloid concentration, were as follows (the alkaloid, where detected, was usaramine):

<i>Lespesia</i> sp. (Tachinidae)	0.46 $\mu\text{g}/\text{mg}$ (N = 1)
<i>Chetogena claripennis</i> (Tachinidae)	0.29 \pm 0.03 $\mu\text{g}/\text{mg}$ (N = 2)
<i>Brachymeria ovata</i> (Chalcididae)	no alkaloid detected (N = 2)

Evidently these parasitoids, like those from Florida, took up only minimal amounts of alkaloid from their host.

ACKNOWLEDGMENTS

Study supported in part by grant AI02908 (to T.E.) from the National Institutes of Health, and by a Johnson & Johnson Fellowship in Chemical Ecology (to C. R.). We are grateful to David Wahl (American Entomological Institute, Gainesville, FL) for identification of the ichneumonid parasitoid, *Corsoncus* sp., and for his comments on this species being new to science. This is paper number 167 in the series "Defense Mechanisms of Arthropods"; paper number 166 is V. Iyengar and T. Eisner: Female choice increases offspring fitness in an arctiid moth (*Utetheisa ornatrix*), Proc. Nat. Acad. Sci. USA (submitted).

LITERATURE CITED

- Dussourd, D.E., K. Ubik, C. Harvis, J. Resch, J. Meinwald, and T. Eisner. 1988. Biparental defensive endowment of eggs with acquired plant alkaloid in the moth *Utetheisa ornatrix*. Proc. Nat. Acad. Sci., USA 85: 5992-5996.
- Eisner, T. and M. Eisner. 1991. Unpalatability of the pyrrolizidine-alkaloid containing moth *Utetheisa ornatrix*, and its larva, to wolf spiders. Psyche 98: 111-118.
- Eisner, T. and J. Meinwald. 1995. The chemistry of sexual selection. Proc. Nat. Acad. Sci. USA 92: 50-55.
- González, A., C. Rossini, M. Eisner and T. Eisner. 1999. Sexually transmitted chemical defense in a moth (*Utetheisa ornatrix*). Proc. Nat. Acad. Sci. 96: 5570-5574.
- Hare, J. F. and T. Eisner. 1993. Pyrrolizidine alkaloid deters ant predators of *Utetheisa ornatrix* eggs: effects of alkaloid concentration, oxidation state, and prior exposure of ants to alkaloid-laden prey. Oecologia 96: 9-18.
- Iyengar, V. K., C. Rossini, E. R. Hoebeker, W. E. Conner, and T. Eisner. 1999. First record of the parasitoid *Archytas aterrimus* (Diptera: Tachinidae) from *Utetheisa ornatrix* (Lepidoptera: Arctiidae). Entomol. News. 110, 144-146.
- Sauthon, I. W. and J. Buckingham. 1989. Dictionary of Alkaloids. London, Chapman and Hall.

SOCIETY MEETING OF NOVEMBER 17, 1999

INVASIVE SPECIES

Dr. Randy Westbrooks, USDA

Jon Gelhaus, President, opened the meeting with a brief summary of the preceding Council meeting. He also noted that AES member and Calvert Award winner Andrew Short's discovery of Zorapterans in Delaware had been featured on the cover of the Entomological Society of America's newsletter.

The speaker of the evening Dr. Randy Westbrooks, Noxious Weed Coordinator, Division of Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Whiteville, NC, spoke about the growing problem of invasive species in the United States and around the world. He compared the planet Earth to a big supermarket, where trade is continually moving huge quantities of goods across oceans and among the continents. Along with the goods travel a wide range of plants, animals, fungi, etc. More and more of these exotic species are becoming established outside their native ranges; some are becoming serious pests, not only in agriculture but also in natural habitats. The Federal government views the degradation of open space and native communities as a serious threat. He discussed the February

(Continued on page 306)

FIRST RECORD OF NYCTERIBIIDAE (DIPTERA) IN VIRGINIA, AND A DISCUSSION OF THE HOST SPECIFICITY AND DISTRIBUTION OF *BASILIA BOARDMANI*¹

Christopher S. Hobson²

ABSTRACT: The family Nycteribiidae (Diptera) is recorded from Virginia for the first time. Four specimens of *Basilia boardmani* were collected from *Myotis austroriparius* at one site in southeastern Virginia during August 1996. Previous records of *B. boardmani* have been from *M. austroriparius* in Florida and Illinois. The identification of *Myotis lucifugus* by H. B. Morlan as a host for *B. boardmani* as reported in Peterson (1960), was shown to be erroneous by Davis and Rippey (1968). *Basilia boardmani* seems to be host specific to *M. austroriparius* in the eastern United States. Distributional information available for *B. boardmani* shows that the range of this species coincides with that of *M. austroriparius*.

In the eastern United States, the family Nycteribiidae (Diptera) is represented by one genus and three species (Whitaker and Easterla, 1974). Of these, only one, *Basilia boardmani* Rozeboom, is typically associated with *Myotis austroriparius* (Rhoads), commonly known as the southeastern myotis. It was first described from *M. austroriparius* from Florida (Rozeboom, 1934), where Rice (1957) reported it to be common, although less conspicuous than the streblid *Trichobius major* Coquillett. It has since been reported from Georgia on bats collected by H. B. Morlan (Peterson, 1960) that were erroneously identified as *Myotis lucifugus* (LeConte) (Davis and Rippey, 1968), and most recently from *M. austroriparius* from Illinois (Parmalee, 1955). Whitaker and Easterla (1974) provided the most recent summary of distributional information for *B. boardmani*.

On 8 August 1996, several colleagues and I captured 31 individuals of *M. austroriparius* in mist nets along the Blackwater River in Southampton County, Virginia. These bats were from a large maternity colony (372 bats counted) occupying a cavity in a large swamp tupelo (*Nyssa biflora*). This is the second record of *M. austroriparius* for Virginia and the first known maternity colony of this bat in the state (Hobson, 1998). Both adults and juveniles were captured, and each was briefly examined for ectoparasites. Several batflies, family Nycteribiidae, and a single bat bug (*Cimex adjunctus* Barber, order Heteroptera) were collected. The batflies (3 m, 1 f) were identified as *B. boardmani* based on the keys presented by Peterson (1960) and Whitaker and Easterla (1974). Identifications were verified by F. C. Thompson.

¹ Received March 24, 1998. Accepted October 2, 1998.

² Department of Conservation and Recreation, Division of Natural Heritage, 217 Governor Street, 3rd floor, Richmond, VA 23219.

The occurrence of *B. boardmani* on *M. austroriparius* in Virginia is of special interest because it further substantiates its host specific relationship with this bat and because it is the first record of any nycteribiid in the state extending the known range of the species approximately 995 km north from Georgia. Three specimens (2 m, 1 f) of *B. boardmani* have been deposited in the entomological collection of the U. S. National Museum of Natural History. The fourth, a male specimen, has been deposited in the entomological collection of the Field Museum of Natural History, Chicago.

Nearly all specimens of *B. boardmani* have been from *M. austroriparius*, although H. B. Morlan listed *M. lucifugus* as the host for specimens collected in Thomas County, Georgia (Peterson, 1960). This unvouchered record of *M. lucifugus* is highly questionable based on published range maps and additional review of the distribution of these two species of *Myotis* in the southeast by Davis and Rippey (1968). Several sources do not show *M. lucifugus* to occur anywhere near Thomas County, Georgia (Barbour and Davis, 1969; Harvey, 1992; Hamilton and Whitaker 1979), whereas others indicate that this species ranges as far south as the Georgia-Florida border (Burt and Grossenheider, 1976; Hall, 1981). Golley (1962) shows this species occurring in seven coastal plain counties in Georgia. However, all of the specimens reported from the coastal plain by him have been reidentified as *M. austroriparius* (Davis and Rippey, 1968), and records from southwestern Georgia are based on unvouchered records in a paper by Morlan (1952). It is particularly significant that Davis and Rippey (1968) found only *M. austroriparius* at Morlan's sampling site in Thomas County, Georgia, and that these authors state that it has not yet been established that *M. lucifugus* has ever occurred in coastal Georgia. From this information, it seems likely that *M. austroriparius* rather than *M. lucifugus* was the host from which nycteribiid flies were taken by Morlan in 1947. The first confirmed record of *M. austroriparius* in Georgia was that of Quay (1949), based on specimens he collected in Thomas County in 1944. Identification of these two *Myotis* species can sometimes be very difficult, particularly in the field.

If *B. boardmani* indeed parasitizes *M. lucifugus*, it would seem that the distribution of the parasite would coincide more closely with the distribution of that host. However, the little brown bat ranges well into eastern Canada and over much of the eastern and northeastern United States (Harvey, 1992; Barbour and Davis, 1969), and there are no known records for *B. boardmani* in any of these areas. In contrast, all known records of *B. boardmani* fall within the currently known range of *M. austroriparius*, and if Morlan's identification of the host was in error, then *M. austroriparius* would be the only known host for *B. boardmani*. Additional collections of dipteran ectoparasites from both *M. lucifugus* and *M. austroriparius* are needed to better determine the range and host specificity of *B. boardmani*.

ACKNOWLEDGMENTS

I wish to thank a number of people for their assistance in the collection of specimens and other data leading to this publication, including Judy Dunscomb, Kim Korth, and Sam Lindblom of the Virginia Chapter of The Nature Conservancy (TNC) who provided much needed logistical assistance and access to TNC property. Thanks to Richard L. Hoffman, Steven M. Roble, and especially John O. Whitaker, Jr., for providing taxonomic keys and other assistance in identifying the specimens. Thanks to staff and students at the Field Museum of Natural History for information on specimens in that collection. I would like to thank Steven M. Roble and John O. Whitaker, Jr., for reviewing previous versions of this manuscript. Thanks to F. C. Thompson for verifying the identity of *B. boardmani* specimens collected in Virginia.

LITERATURE CITED

- Barbour, R. W., and W. H. Davis.** 1969. Bats of America. Lexington: Univ. Press Ky. 286 pp.
- Burt, W. H., and R. P. Grossenheider.** 1976. A field guide to the mammals. 3rd edition. Boston: Houghton Mifflin.
- Davis, W. H., and C. L. Rippey.** 1968. Distribution of *Myotis lucifugus* and *Myotis austroriparius* in the southeastern United States. J. Mammal. 49: 113-117.
- Golley, F. B.** 1962. Mammals of Georgia: A Study of Their Distribution and Functional Role in the Ecosystem. Athens: Univ. of Georgia Press. 218 pp.
- Hall, E. R.** 1981. Mammals of North America. Second Edition. Volumes 1 and 2. New York: John Wiley and Sons, Inc., 1373 pp.
- Harvey, M. J.** 1992. Bats of the Eastern United States. Arkansas Game and Fish Commission, U.S. Fish Wild. Serv., and Tenn. Technol. Univ. 46 pp.
- Hobson, C. S.** 1998. Bat Records from Southeastern Virginia, Including a New Resident Species, *Myotis austroriparius* (Chiroptera: Vespertilionidae). Banisteria, 12: 18-23.
- Morian, H. B.** 1952. Host relationships and seasonal abundance of some southwest Georgia ectoparasites. Amer. Midl. Nat., 48: 74-93.
- Parmalee, P. W.** 1955. A Nycteribiid Fly New to Illinois. J. Parasitol. 41: 322.
- Peterson, B. V.** 1960. New distribution and host records for bat flies, and a key to the North American species of *Basilia* Ribeiro (Diptera: Nycteribiidae). Proc. Entomol. Soc. Ont. 90: 30-37.
- Quay, W. B.** 1949. Notes on mammals of Thomas County, Georgia, with two state records. J. Mammal. 30: 66-68.
- Rice, D. W.** 1957. Life history and ecology of *Myotis austroriparius* in Florida. J. Mammal. 38: 15-32.
- Rozeboom, L. E.** 1934. A new nycteribiid from Florida. J. Parasitol. 20: 315-316.
- Whitaker, J. O., Jr., and D. A. Easterla.** 1974. Batflies (Streblidae and Nycteribiidae) in the eastern United States, and a new nycteribiid record from Saskatchewan. Entomol. News 85: 221-223.

LIFE HISTORY AND BEHAVIOR OF THE AFRICAN BUSH GRASSHOPPER, *PHYMATEUS VIRIDIPES* (ORTHOPTERA: PYRGOMORPHIDAE) IN CAPTIVITY¹

Tohko Kaufmann²

ABSTRACT: The number of molts in *Phymateus viridipes* is 6 times in males, 7 times in females. Although males were sexually mature at emergence, females were not mature until 2 months after emergence. Oviposition began 2 months after the first mating and lasted 2-3 months. With a diet of *Brassica oleracea acephala*, a female produced an average of 4 eggpods, each containing an average of 162 eggs. Both nymphs and adults aggregate closely by touching and mounting each other.

In and around the Rift Valley town of Nakuru, in the western central region of Kenya, grasslands and forests abound. The place looks like an ideal habitat for grasshoppers. Yet, my search for them from 1988 to 1992 are mostly unsuccessful except for occasional individuals of small species. Then, suddenly, in 1997, I found a group of about 20, 3rd instar hoppers of *Phymateus viridipes* Stal in broad leaves of a wild plant in a bush inside Lake Nakura National Park. Three months later, I found another group of 1st instar hoppers of the same species deep in a dense bush, several km from Nakuru town. These are the only occasions I have found this African bush grasshopper in my almost 12 years' stay in Kenya working as an entomologist.

Literature on this large, green, bizarre-looking insect is scanty. This paper presents some basic research on the biology and behavior observed in cages.

MATERIALS AND METHODS

Thirty plus young nymphs were collected from the 2 sites mentioned above. They were housed in round wire-gauze cages, 60 cm high and 30 cm in diameter, with 5 cm of soil at the bottom. As foodplant, the leaves of kale, *Brassica oleracea acephala* were provided, simply because they are readily available throughout the year. When the nymphs became adults, they were transferred to a large wire-gauze cage, 85 cm high and 100 cm in diameter with 10 cm soil at the bottom. All the cages were placed in my open patio where they received direct sunlight from 9 a.m. to 5 p.m. daily. The range of temperatures during this study was 14° C - 42° C, and that of relative humidity, 50% -100%.

LIFE HISTORY

Eggs: The eggs are cylindrical, pale yellow, about 60 mm long and 1 mm

¹ Received August 11, 1999. Accepted October 31, 1999.

² P.O. Box 3880, Nakuru, Kenya, Fax: 000254-37-210188.

wide at center. The incubation period was 4-5 months depending on the weather conditions of the year.

Nymphs: The first instar nymphs were black and measured 6-7 mm long. A pale beige stripe running dorsally from head to the posterior end of the body appeared in the second instar, followed by whitish pink dots on the thorax in the third instar. The body color became more pronounced as nymphs grew so that in the fifth instar, the entire body was speckled with white and pink dots and the dorsal stripe turned golden yellow. Wing pads became visible in the third instar; they were green. In the sixth instar, yellow and orange dots also appeared, and at this stage, the nymphs closely resembled those of *Zonoceros variegatus* L. (Kaufmann, 1965).

Males molted 6 times, lasting an average of 120 days from eclosion to emergence, while females molted 7 times taking an average of 153 days for the same period. According to De Lotto (1951), however, both sexes of *P. viridipes* had 7 instars.

Adults: All adults are long-winged and green except the hind wings which are scarlet.

Females became sexually mature 2 months after emergence, followed by mating, while males were mature at emergence. The first oviposition was observed 2 months after the first mating. Eggs were laid along the edges of the cage avoiding the central area. A female spent 30-90 min. to lay a batch of eggs including the first 10-15 min. to dig a hole in which to oviposit. After oviposition, the egg-holes were kept open. However, since females tend to lay eggs close to each other, these holes became quickly obliterated by their activities. The oviposition period lasted 2-3 months.

Egg-pods are beige brown measuring 6 cm long and 1 cm wide. The largest numbers of eggs were concentrated on or near the top of the egg-pod. The number of eggs per pod ranged from 60 to 231 with an average of 162, and each female produced an average of 4 pods so that the average number of eggs per female was 648. The mature ovaries of *P. viridipes* contained 200 ± 10 at a time. Consequently, 80% of the eggs were laid each time. Chapman (1961) reported that an egg pod of this species collected in southern Ghana had 282 eggs.

An adult female lived an average of 211 days (166-265), while male's average was 300 (297-305) days.

BEHAVIOR

Aggregation: The nymphs of this species are strongly gregarious and move about the cage as a group, depending on the position of the sun, choosing the sunniest spot to aggregate. Nymphs gather close together, touching as well as sitting on top of each other, thus forming a dense aggregation. Even feeding takes place as a group; when one jumps to the foodplant, others follow one by

one. After feeding, they leave the plant in the same manner.

Adults aggregate similarly, but since they are larger and heavier, group formation takes place on or near the ground. As in nymphs, close physical contacts among individuals of both sexes occur. Because males are considerably smaller and lighter, as many as 3 males were often seen sitting on the back of one female. No kicking or other expression of irritation has been observed among the congregating adults.

Aggregation occurred both in small and large cages. The cause of it may be twofold, namely: phototropism and visual attraction to movement.

P. viridipes is strongly phototropic and individuals follow the movement of the sun until the ground temperature rises to 32° C. In *Zonocerus variegatus* (Kaufmann, 1965), *Locusta migratoria migratorioides* (Ellis et al, 1962), *Schistocerca gregaria* (Kennedy, 1939) and others, the movement of the nymphs leaving the outbreak area attracts other nymphs in the close vicinity. Thus, the pioneer marchers are followed by other nymphs. *P. viridipes* is not known to migrate in bands either as nymphs or as adults, but the pattern of aggregation is the same; when one moves to a sunny spot, the one which is in the immediate vicinity optically recognizes the movement and follows the first. The second is followed by the third, and so on.

Sun-basking: Sun-basking, unlike aggregation, is an individual act which usually occurs in the morning when the sunrays first hit the cage floor around 9 a.m. The grasshoppers have roosted overnight and are still sluggish at this hour; their body temperature, therefore, must rise to a certain point, before the daily activity begins. The orientation of the body, directly facing the sun is as follows:

(1) Body lies flat, parallel to the ground surface with head pulled in, and antennae touching the ground (Fig. 1a). This posture warms up the entire dorsal surface.

(2) Head and thorax are raised toward the sun with antennae lifted up. This warms the ventral surface of the thorax (Fig. 1b).

(3) Head and thorax are raised much higher so that the ventral surface of the abdomen is also exposed to the sun (Fig. 1c).

(4) Crawls to shade and assumes a normal posture (Fig. 1d).

In rain: Grasshoppers perch on the upper part of the cage or that of tall upright plants with heads pointing upwards, thus exposing the minimum surface to the rain. Artificial sprinkling of water in the cage produced the same result.

Feeding: Feeding takes place when the atmospheric temperature rises to 20° C. Usually on sunny mornings, it begins around 9 a.m. and ends about 4 p.m. During this period, feeding occurs at any time. On cloudy or rainy days, little or no food is eaten, thus, development depends on daily weather conditions. As a foodplant, kale, *Brassica oleracea acephala* was well received and

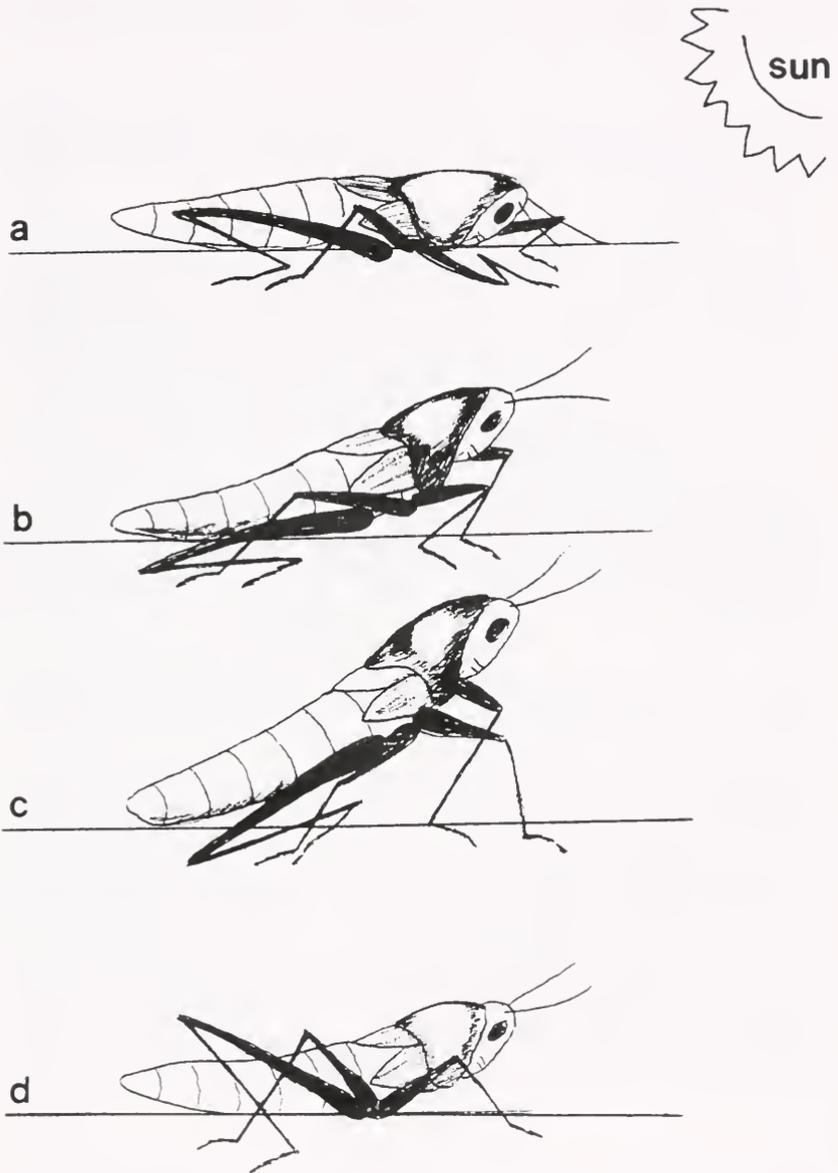


Fig. 1. A last instar *P. viridipes* basking in the sun: a, warming the entire dorsal surface; b, warming the ventral surface of thorax; c, warming the entire ventral surface; d, normal posture in shade.

no molting failure occurred on this diet. In captivity, flowers of marigold, cosmos, and astor were also readily eaten.

Late instar nymphs, when defecating during feeding, raised their abdominal tips upward and expelled fecal pellets by force. The pellets, as the result, first flew up before falling to the ground. Since feeding nymphs aggregate, such a behavior may be an adaptation to prevent fecal matter from accumulating on foodplants.

Roosting: On sunny days, roosting took place daily between 4 and 5 p.m., and lasted until around 9 a.m. of the following day on the upper part of the cage or that of tall plants. It is an inactive, immobile period when temperatures fall as low as 14° C during the night. The orientation of the roosting grasshoppers is the same as during the rain; head pointing upward. When the temperature rises to 20° C in the morning, the insects leave the roosting place to bask in the sun.

When females became fully gravid and too heavy to climb any vertical object, they roosted on or near the ground, while males remained higher up.

Migration: As in *Zonocerus elegans* Thumberg (Kaufmann, 1969), no mass migration, either as nymphs or as adults has ever been reported. However, migration may occur independently and individually. This is especially true with the males of *P. viridipes* which are lighter in weight and tend to fly readily when experimentally released from the cage.

ACKNOWLEDGMENT

I thank K. H. Chung for his kind help in building the large cages used for this research.

LITERATURE CITED

- Chapman, R. F. 1961. The egg pods of some tropical African grasshopper (Orthoptera: Acrididae). II. Egg pods from grasshoppers collected in southern Ghana. *J. Entomol. Soc. S. Africa*. 24:259-284.
- De Lotto, G. 1951. Osservazioni sulla biologia del *Phymateus viridipes* St. (Orth. Acrididae). *Riv. Agric. subtrop.* 45:8-18.
- Ellis, P. E. & Pearce, A. 1962. Innate and learned behavior patterns that lead group formation in locust hoppers. *Anim. Behav.* 10:305-318.
- Kaufmann, T. 1965. Observations on aggregation, migration and feeding habits of *Zonocerus variegatus* in Ghana. *Ann. Entomol. Soc. Amer.* 58(4):426-436.
- Kaufmann, T. 1972. Biology and feeding habits of *Zonocerus elegans* in central Tanzania. *Amer. Mid. Nat.* 87(1):165-171.
- Kennedy, J. S. 1939. The behavior of the desert locust (*Schistocerca gregaria*) in an outbreak center. *Trans. R. Entomol. Soc. Lond.* 89:385-542.

GENUS *FESTELLA* (ORTHOPTERA: TETTIGONIIDAE) WITH DESCRIPTION OF *F. RAMMEI* SP. N.¹

Battal Çıplak²

ABSTRACT: The genus *Festella* was previously monotypic having only *F. festae*. A new species *Festella rammei* sp. n. is described and a key to both species presented including drawings of diagnostic characters. An evaluation is given about the relationships and distribution of the genus.

Festella is a monotypic genus established by Giglio-Tos (1894) to include *Ctenodecticus festae* Giglio-Tos (Giglio-Tos, 1893) from Palestine. Later, Ramme (1951) recorded this species from the south-eastern part of Turkey, though it is now obvious that there are many distinct differences between the populations from Palestine and Turkey.

Festella has a restricted distribution. It has been mentioned on only a few occasions, and only in lists dealing with Tettigoniidae (Kirby, 1906; Caudell, 1908; Rentz & Colless, 1990; Naskrecki & Otte, 1999).

Festella can be defined mainly by a combination of the following characters: broad (about 3 times as wide as scapus) and protrude (beyond scapus) fastigium, cylindrical pronotum, unarmed prosternum, fore tibia unarmed on dorso-anterior margin and armed with 4 spines on dorso-posterior margin, hind tibia with 4 apical spurs ventrally and plantulae much longer than metatarsus and up-curved ovipositor.

Relationships of the genus with other genera have been referred to in two studies (Caudell, 1908; Rentz & Colless, 1990). Caudell (1908) placed *Festella* in Decticiti with following genera, *Tettigonia* Linnaeus (including *Decticus* Serville and *Medecticus* Uvarov), *Idionotus* Scudder, *Psorodonotus* Brunner von Wattenwyl, *Clinopleura* Scudder, *Peranabrus* Scudder, *Plagiostira* Scudder. Rentz & Colless (1990) placed the genus in Platycleidini (the tribus is used by these authors in a much wider sense than the original usage by Zeuner, 1941) and Naskrecki & Otte (1999) followed this classification. In the phylogenetic tree produced by Rentz & Colless (1990; Fig. 3), the relationships of the genus occurs as (*Festella* + *Pterolepis* Rambur) + (*Elasmocercus* Chopard + *Bergiola* Stshelkanovtzev). According to the same authors, however, *Elasmocercus* and *Bergiola* belong to the Tettigoniini and not to the Platycleidini.

The object of this paper is to describe *Festella rammei* sp. n. and present a key to species of *Festella*, providing figures for both the new species and for

¹ Received January 31, 2000, Accepted March 18, 2000.

² Department of Biology, Faculty of Arts & Sciences, Akdeniz University, 07058 Antalya, Turkey.

F. festae. Some remarks are given concerning relationships and distribution of the genus.

Genus: *Festella* Giglio-Tos, 1894

Festella Giglio-Tos, 1894: 3.

Genus type: *Ctenodecticus festae* Giglio-Tos, 1893

Description.- Giglio-Tos (1894).

Key to Species:

- 1- Male cercus straight, with strong tooth medially on inner side (Fig. 1); male anal tergum with relatively short processes (Fig. 2); fifth sternum of female unmodified, subgenital plate with a deep quadrangular incision at hind margin (Fig. 4). . *festae*
 — Male cercus S shaped, toothed apically (Figs 7A,B,C); male anal tergum with long processes (Fig. 6); fifth sternum of female with a prominent tubercle in second half (Figs 9, 10), subgenital plate with a deep elliptical incision (Fig. 11) . *rammei* sp. n.

***Festella festae* (Giglio-Tos, 1893)**

(Figs 1-4, Table 1)

Ctenodecticus festae Giglio-Tos, 1893: 15. *Syntypes*, male(s) and female(s): PALESTINE, Haifa, Tiberias (Museo Zoologico di Torino, Italy) (not examined).

Material examined.- PALESTINE, Chedara, 16.vii.1931, 1 male, 1 female (R. Ebner) (Museum fur Naturkunde, Berlin); Reheboth, nr Jaffa, 1 female (J. Aharoni) (BM 1921-136); Kalan Saura, Tul Kareem, 14.vi.1922, 1 female (nymph) (P. A. Buxton) (BM 1923-530); Kakum, Tul Kareem, 15.vi.1922, 1 female (nymph) (P. A. Buxton) (BM 1923-530); Emek, ix, 1924, 1 female (W. S. Bodenheimer) (BM 1923-530); 1 female (W. S. Bodenheimer) (BM 1940-144); ISRAEL, 4 km east to Ashnath (st 11), 5.x.61, 1 male, 1 female (M. P. Pener) (BM 1964-184) (The Natural History Museum, London).

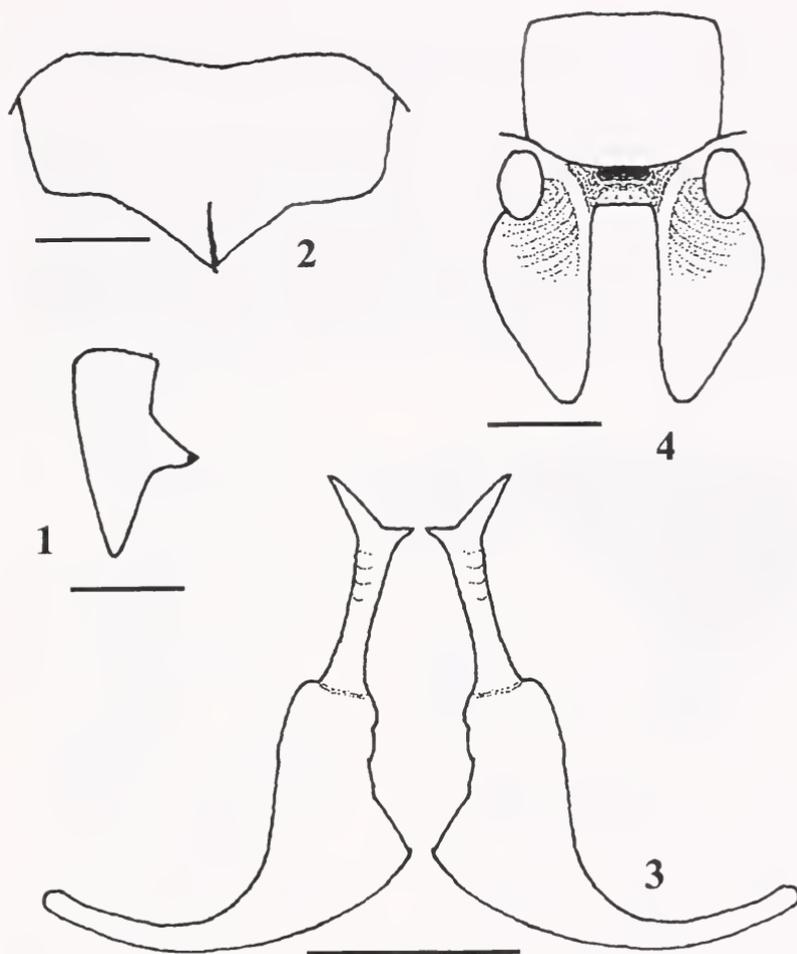
Description.- Giglio-Tos (1893) (figures are original).

Diagnosis.- Similar to the *F. rammei* sp. n. in general appearance, but differs in the male cercus with an internal tooth medially; male anal tergum with short processes; titillator with large basal arms and two spines on apical arms; the female fifth sternum without tubercle and the relatively small lateral sclerite of subgenital plate.

Table 1. Measurements for species of the genus *Festella* (in mm)

		Pronotum	Tegmina	Hind Femur	Ovipositor	Body Length
<i>F. festae</i>	male	6.9-7	2.1	22-24	—	20-24
	female	7	—	26-27	15-16.7	24-27
<i>F. rammei</i>	male	6.9-7.1	2-2.3	22.5-24.5	—	20-22
	female	6.9-7.8	—	24.5-26.5	14.7-17	20-23

(own measurements on material examined)



1-4 *Festella festae* 1- Male cercus (scale = 1 mm). 2- Male anal tergum (scale = 1 mm). 3- Titillators (scale = 1 mm). 4- Female subgenital plate (scale = 1 mm).

***Festella rammei* Çıplak sp. n.**

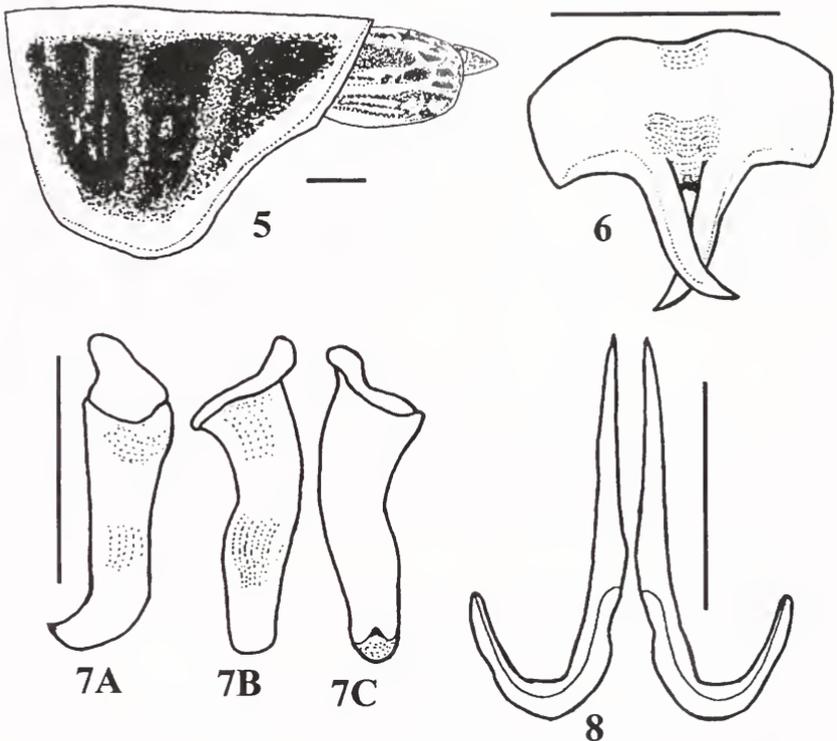
(Figs 5-12, Table 1)

Material examined.- *Holotype*, Male: TURKEY, Adana, Kozan, Taurus, 400 m, 14-15.vii.1937 (W. Ramme) (Museum für Naturkunde, Berlin). *Paratypes*: 7 males, 13 females, the same data as the type; Hatay, Iskenderun, Uluçınar, 24.vii.1976, 1 male (S. Salman); Hatay,

Dursunlu Köyü, 100 m, 18.vi.1995, 1 male (nymph); Hatay, Belen Geçidi, 740 m, 19.vi.1995, 2 males (nymphs), 1 female (nymph); Hatay, Belen, Taş Boğazı, 230 m, 19.vi.1995, 1 male (nymph) (B. Çıplak) (Akdeniz University, Zoological Museum, Antalya, Turkey).

Description (holotype, male).- Fastigium broad, about three times as wide as scapus and slightly protruding beyond it. Pronotum cylindrical, slightly raised above, without median and lateral carinae, lateral lobes slightly tapering ventrally, caudal margin widely obtuse. Tegmina short, barely reaching end of first abdominal tergum, narrowly rounded apically; hind femur long, swollen in the base, with 8-9 spinules on internal margin ventrally; plantulae of hind tibiae almost reaching second tarsal joint. Anal tergum large, furrowed medially, with few setae, with two long and incurved processes, deeply and narrowly incised medially; cerci strong, S shaped in basal 3/4, also curved before apex in a right angle, with a apical spine; subgenital plate longer than wide, with slender long styli. Titillators long, slender and smooth, apical arms straight and strongly tapering towards apex, basal arms roundly upcurved.

Female (paratype).- Barely larger than male. Fifth sternum with a strong projection in

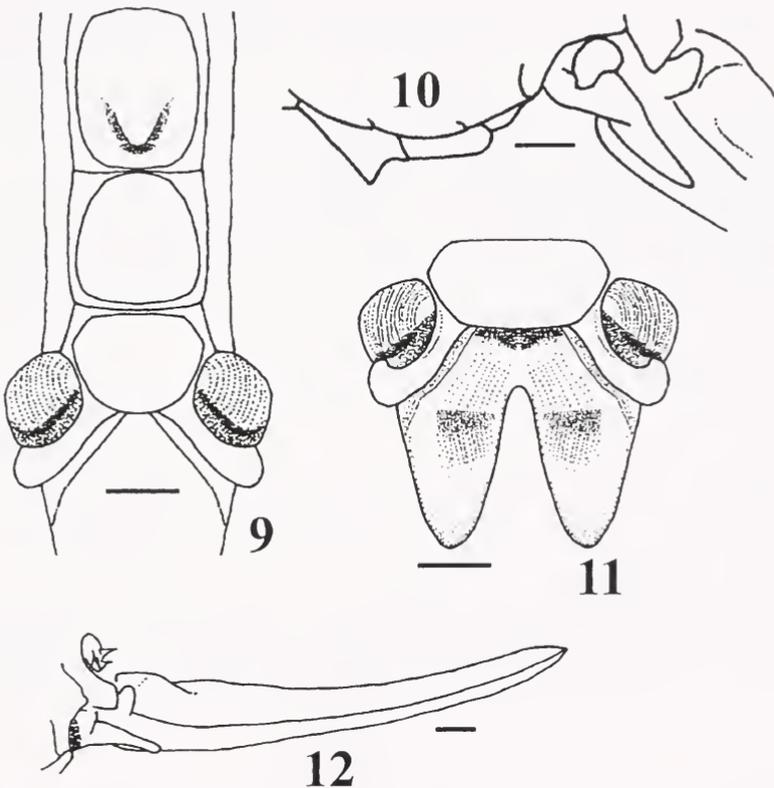


5-12 *F. ramnei* sp. n. 5- Male pronotum and tegmina, lateral view (scale = 1 mm). 6- Male anal tergum (scale = 1 mm). 7- Male cercus, A) lateral view B) dorsal view C) ventral view (scale = 1 mm). 8- Titillators (scale = 1 mm).

second half, sixth and seventh sterna not modified; subgenital plate with a deep-elliptical incision, lobes tapering apically, with lateral sclerites and rounded plates above them. Ovipositor longer than half of hind femur, strong, slightly upcurved.

Coloration.- Dirty yellow with blackish-brown lateral band, extending along each side from behind the eyes down the paranota (except light margin), to tip of abdomen. Hind femur with dark narrow stripe along middle of externo-medial area. Ovipositor slightly darker on margins.

Remarks.- *Festella rammei* sp. n. differs from *F. festae*, as described in the key, especially in the morphology of the male cerci and anal tergum, female fifth sternum and subgenital plate. However, overall habitus, measurements and coloration are very similar in both species.



9- Female fifth, sixth and seventh sterna, ventral view (scale = 1 mm). 10- Female fifth, sixth and seventh sterna and subgenital plate, lateral view (scale = 1 mm). 11- Female subgenital plate (scale = 1 mm). 12- Ovipositor (scale = 1 mm).

Etymology.- Named after Willy Ramme, who made many contributions to our knowledge on Orthoptera of Turkey.

DISCUSSION

Our current understanding of the phylogenetic relationships of Tettigoniinae bush-crickets is mainly based on morphological characters. However, there is no general agreement about the higher categories, and still no distinct synapomorphies for tribes or groups have been reported. Since the characters used for defining relationships of the genera are mostly incongruent within the subfamily, it will require extensive analyses to establish a reliable phylogenetic scheme.

Separation of Decticiti in key to genera established by Caudell (1908) is based on combination of the following characters: presence of apical spine on dorso-external margin of fore tibia, unarmed prosternum and two pairs of apical spurs of post tibiae apico-ventrally. Caudell, used 4 or 5 (more than 3) spines of fore tibia dorso-posteriorly to separate *Festella*, *Tettigonia* (including *Decticus* and *Medecticus*), *Idionotus*, *Psorodonotus*, *Clinopleura*, *Peranabrus*, *Plagiostira* from other genera of the Decticiti.

Rentz and Colless (1990) have a very different suggestion for relationship of the genus. Though in their phylogenetic tree the genus occurs as sister group with *Pterolepis* and these two genera share a common ancestor with *Elasmocercus* and *Bergiola*, they did not mention any synapomorphy shared by these genera. Additionally, they placed the genus in Platyceidini and Naskrecki & Otte (1999) followed this classification.

Though the phylogeny of the Tettigoniinae is in very premature state and characters are mostly incongruent, relationships of the genus with other genera can be defined on presence of 4 spines on dorso-posterior margin of the fore tibia. When this character is considered, *Festella* can be included in a group with the following genera of Tettigoniinae; *Anabrus* Haldeman, *Bucephaloptera* Ebner, *Capnobotes* Scudder, *Cryptophyllicus* Hebard, *Decticus*, *Ectopistidectes* Rentz, *Medecticus*, *Peranabrus*, *Pterolepis* and *Rhacocleis* Fieber.

This group of eleven genera, though they all share having 4 apical spines on the dorso posterior margin of the fore tibia, seems to be a heterogenous group in respect of many characters which have been used widely for separation within the genera of Tettigoniinae such as width of fastigium, lateral carinae of pronotum, armature of prosternum, male and female wing types, spines of fore tibia on dorso-anterior margin, number of ventro-apical spurs and length of plantulae of hind tarsus. The presence of prosternal spines is a character that separates *Capnobotes* (except 1 species, see Rentz & Birchim, 1968), *Cryptophyllicus*, *Ectopistidectes*, *Pterolepis* and *Rhacocleis* from the remaining 6 genera and *Festella*. However, when these genera are grouped according

to the number of apico-ventral spurs of the hind tibia, *Festella* remains with *Anabrus*, *Bucephaloptera*, *Capnobotes*, *Clinopleura*, *Cryptophyllicus*, *Decticus* and *Medecticus* by having 2 pairs each, while the other four genera have 1 pair each.

The length of the plantulae on the hind tarsi is the character that grouping *Festella* with Eurasian genera and separating them from American genera and *Ectopistidectes*. Plantulae are less long as half of the length of metatarsus (at most as long as half of it) in *Anabrus*, *Capnobotes*, *Clinopleura*, *Cryptophyllicus*, *Ectopistidectes*, and *Peranabrus*, but they are 3/4 length or longer in the other five genera and *Festella*. Among all of these genera, plantulae are as long as the metatarsus in *Bucephaloptera* and almost as long as the first two segments in *Festella*. Another character shared by *Festella*, *Bucephaloptera*, *Pterolepis* and *Rhacocleis* and separating them from *Decticus*, *Medecticus*, *Ectopistidectes* and American genera is absence of the lateral carinae of the pronotum.

As can be seen from the evaluation given above, *Festella* always groups with *Bucephaloptera* while it has one or more differences from others. Thus, it can be proposed that these two genera are closely related within Tettigoniinae (it is premature to say sister groups before a phylogenetic analysis of all genera of the subfamily has been done). *Festella* differs from all genera which have 4 spines on dorso-posterior margin of fore tibia by having wide but protruding fastigium, apterous female, plantulae of hind tibia much longer than metatarsus (almost reaching second tarsal joint), deeply divided female subgenital plate. Among these characters, null wings and deeply divided subgenital plate of the female seems unique. The protruding fastigium separates the genus from the genera given above, but is also shared by some of African (e.g. *Alfredectes* Rentz) and Australian (e.g. *Austroductes* Rentz) genera of the Tettigoniinae.

Two species of *Festella* are distributed on eastern coasts of the Mediterranean (Levant). *F. festae* is found in the south, in wet or dry shrubgrassland and its nymphs appear in early May and molt to adults as late as August (Ayal et al., 1999). *Festella rammei* sp. n. is recorded from the north part of the eastern Mediterranean coasts (south of Turkey, Hatay and Adana provinces, and possibly north-western Syria), associated with maqui vegetation. Its nymphs appear in early June and molt to adult in July. Thus, the genus is a typical Mediterranean faunal element, as mentioned by Ayal et al. (1999).

ACKNOWLEDGMENTS

I am most grateful to Michael Ohl and Isolde Dorant (Berlin-Germany) for allowing me to use facilities of Museum für Naturkunde, Berlin. I thank Klaus-Gerhard Heller (Erlangen-Germany) and Roy Turkington (Vancouver-Canada) for their helpful comments or linguistic correction on earlier version of manuscript. I also acknowledge Judith Marshall (NHM, London, U.K.) for sending information about specimens in The Natural History Museum.

This study was supported by The Scientific and Research Council of Turkey (TÜBİTAK) and Deutscher Akademischer Austauschdienst (DAAD).

LITERATURE CITED

- Ayal, Y., Broza, M. and Pener, M.P. 1999. Geographical distribution and habitat segregation of bushcrickets (Orthoptera: Tettigoniidae) in Israel. *Isr. J. Zool.* 45: 49-64.
- Caudell, A.N. 1908. Orthoptera, fam. Locustidae, subfam. Decticinae. *Genera Insectorum*, 72: 1-43.
- Giglio-Tos, E. 1893. Viaggio del Dr. E. Festa in Palestina, nel Libano e regioni vicine V. *Boll. Mus. Zool. Anat. Comp. R. Università Torino*, 8: 1-20.
- Giglio-Tos, E. 1894. Viaggio del Dott. E. Festa in Palestina, nel Libano e regioni vicine XII. *Boll. Mus. Zool. Anat. Comp. R. Università Torino*, 9: 1-4.
- Kirby, W.F. 1906. A synonymic Catalogue of Orthoptera, Vol. 2, Longmans & Co. London.
- Naskrecki, P. and Otte, D. 1999. An illustrated catalog of Orthoptera, Vol. I. Tettigonoidea (Katydids or bush-crickets) (CD ROM). Available from Orthopterists' Society at Acad. Nat. Sci. of Phila., Publ. on Orthopteran Diversity.
- Ramme, W. 1951. Zur Systematik, Faunistik und Biologie der Orthopteren von Südost-Europa und Vorderasien. *Mitt. Zool. Mus. Berlin*, 27: 1-431 pp.
- Rentz, D.C.F. and Colless, D.H. 1990. A classification of the shield-backed katydids (Tettigoniinae) of the World. Pp. 352-382 in Bailey & Rentz (Eds): *The Tettigoniinae: biology, systematics and evolution*. Crawford House Press, Bathurst.
- Rentz, D.C.F. & Birchim, J. D. 1968. Revisionary studies in the Nearctic Decticinae. *Mem. Pacific Coast Entomol. Soc.*, 3: 1-173.
- Zeuner, F.E. 1941. The classification of the Decticinae hitherto included in *Platycleis* Fieb. or *Metrioptera* Wesm. (Orthoptera, Saltatoria). *Trans. R. Entomol. Soc. London*, 91: 1-50.
-
-

(Continued from page 290)

1999, Executive Order on invasive species, and the formation of national and state councils to coordinate efforts to combat their establishment and spread. He cited Delaware's efforts as a model for other states.

Dr. Westbrooks stressed the relatively low level of preparedness of the U.S. to meet the invasive species threat. For example, the Bureau of Land Management has a budget of less than three million dollars to combat alien weeds on 270 million acres of Federal rangeland. He described his own experiences in quarantine and inspection, trying to stem the flow of exotics through our sea and airports. He cited the more advanced efforts of other countries such as Australia's AQIS. His talk was illustrated with numerous slides of exotic invaders, the habitats they are taking over and the work of APHIS inspectors.

In other notes of entomological interest, Roger Fuester pointed out that the publication of a name for the Holly Azure butterfly was reported on National Public Radio. He also commented on the continuing spread of the Asian longhorn beetle, an exotic pest of street and shade trees.

William J. Cromartie,
Corresponding Secretary

**ALLOTRICHOSIPHUM (HOMOPTERA:
GREENIDEIDAE), A NEWLY RECORDED GENUS
FROM CHINA, AND DESCRIPTION OF
A NEW SPECIES¹**

G. X. Qiao²

ABSTRACT: The aphid genus, *Allotrichosiphum*, is newly recorded from China. A new species, *Allotrichosiphum castanopse*, is described. The type is deposited in Zoological Museum, Institute of Zoology, the Chinese Academy of Sciences.

The aphid genus, *Allotrichosiphum*, was erected by Takahashi in 1962 from the type species, *Trichosiphum kashicola* (Kurisaki, 1920), collected on *Quercus glauca* and *Q. acuta* in Japan. Within the classification of the Aphidoidea, *Allotrichosiphum* is regarded as a member of the subfamily Greenideinae, within the family Greenideidae. Takahashi (1962) provided a generic key to the genera within Greenideinae. Raychaudhuri et al. (1973) studied aphids from eastern India and described a new species, *Allotrichosiphum assamense*, on *Quercus dealbata* in Assam, India. Both species also recognized by Eastop and Hille Ris Lambers (1976), remain distributed in Japan and India. Blackman and Eastop (1994) studied aphids on the world's trees, and included two species, *assamense* and *kashicola*, in the genus *Allotrichosiphum* on *Quercus*.

Remaudière and Remaudière (1997) confirmed that there were two species in this genus in the world. In this paper, a new species, *Allotrichosiphum castanopse*, on *Castanopsis hicklii* is described from Guangxi Autonomous Region, China. The type is deposited in the Zoological Museum, Institute of Zoology, the Chinese Academy of Sciences.

Aphid terminology in this paper generally follows Takahashi (1962). The unit of measurements in this paper is in millimeters (mm).

RESULTS AND DISCUSSION

Allotrichosiphum Takahashi, new record in China

Allotrichosiphum Takahashi, 1962, Trans. Shikoku Entomol. Soc. 7(3): 70, by original description; Raychaudhuri, Ghosh, Banerjee and Ghosh, 1973, Knotyu 41(1): 54; Ghosh and Agarwala, 1993, Zoological Survey of India, Part 6: 61.

Type species: *Trichosiphum kashicola* Kurisaki, 1920, by original description.

¹ Received November 16, 1999. Accepted March 17, 2000.

² Institute of Zoology, the Chinese Academy of Sciences, 19 Zhongguancun Road, Haidian, Beijing 100080, P. R. China.

Diagnosis. - Body narrow, not strongly sclerotized, pale, without spinules on lateral areas of venter of abdomen. Dorsal setae not numerous, distinctly capitate or multi-forked, spatulate, and somewhat dilated at tip. Front tubercle distinct. Antennae much shorter than body, 5 segmented, with some long capitate setae; processus terminalis as long as, or a little longer than basal part of segment V. Siphunculi very long, slender, not reticulated, with spinules on apical and basal parts and many long setae. Cauda rounded at apex. Abdominal segments III-VI fused together. Hind tibiae with spinules scattered on distal part, without ridges. First tarsal segment chaetotaxy: 7, 7, 7.

Distribution. - China, Japan, India.

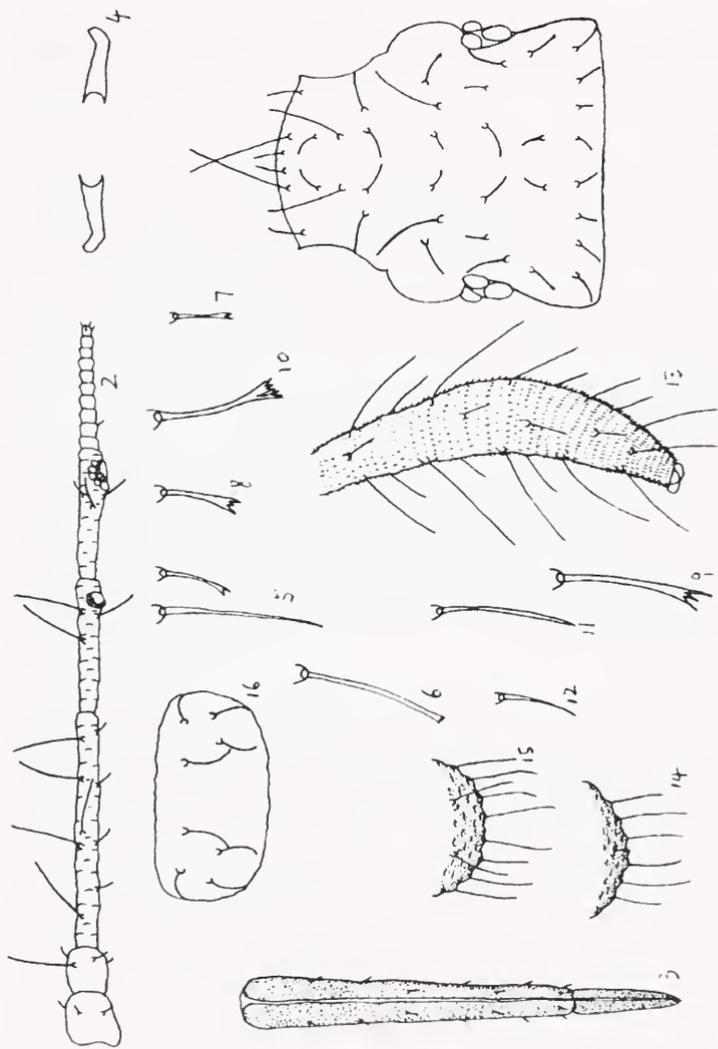
Host plants. - *Quercus glauca*, *Q. acuta*, *Q. dealbata* and *Castanopsis hicklii* (Fagaceae).

Allotrichosiphum castanopse, NEW SPECIES

(Figs. 1-16)

Apterous viviparous female.- Body long elliptical. Measurements: body 1.300 in length, 0.500 in width. Antenna 0.700, length of segments I-V: 0.051, 0.041, 0.232, 0.129, 0.113 + 0.103, respectively. Ultimate rostral segment 0.206 in length, segment IV 0.169 in length, segment V 0.036 in length. Hind femur 0.237, hind tibia 0.371, second hind tarsal segment 0.082. Siphunculus 0.443 in length.

Mounted specimen. - Head, thorax and abdomen slightly brown, apical part of antennal segments III, IV and V, apical part of rostrum, distal part of tibiae and second tarsi brown, others pale. Siphunculi darken brown at media, basal and distal parts slightly pale. Dorsum of body with spinules, venter of abdomen with faint spinules. Head fused with prothorax. Eyes multifaceted, with ocular tubercles. Spiracles small and round, closed; spiracular plates indistinct. Mesosternal furca with two separated arms, length of single arm 0.062, 1.50 times antennal segment II. Dorsal setae fewer and shorter, bi-forked to multi-forked at tip; length of the longest abdominal dorsal setae 0.052, 2.50 times widest diameter of antennal segment III; length of the shortest one 0.010. Ventral setae on abdomen fine and short, capitate or sharp at tip, length of the longest ventral setae 0.031, 1.50 times widest diameter of antennal segment III. Head with 3 pairs of cephalic setae (a pair of longer setae among them), 4 pairs of spinal, 2 pairs of pleural and 1 pair of marginal setae; pronotum with 4 pairs of spinal, 2 pairs of pleural and 3 pairs of marginal setae; mesonotum with 5 pairs of spino-pleural and 4 pairs of marginal setae; metanotum with 1 pair of spinal, 2-3 pleural and 2 pairs of marginal setae; abdominal tergite I with 9 long and short setae; tergites II-VI each with 7, 17, 13, 13 and 11 spino-pleural setae, 2, 3, 3, 4 and 2 pairs of marginal setae, respectively; tergites VII and VIII each with 2 setae. Length of cephalic setae 0.072, length of marginal setae on abdominal tergite I 0.031, length of dorsal setae on tergite VII 0.057, which of dorsal setae on tergite VIII 0.067, 3.50 times, 1.50 times, 2.75 times and 3.25 times widest diameter of antennal segment III, respectively. Media front slightly developed. Antennae 5 segmented, slender, 0.54 times body length; length in proportion of segments I-V: 23, 18, 100, 56, 49 + 58, respectively; processus terminalis 1.18 times base of the segment. Antennal setae slightly long, thick, stout or slightly capitate at tip, antennal segments I-V each with 5, 5, 9, 3, 1 + 4 setae, respectively; length of setae on antennal segment III 0.067, 3.25 times widest diameter of the segment. Primary rhinaria round, ciliated. Antennal segments III-V imbricated. Rostrum reaching abdominal segment II, ultimate rostral segment long dagger-shaped, 8.00 times its basal width, 2.50 times second hind tarsal segment; segments IV and V distinctly segmented, length of segment IV 4.71 times length of segment V; ultimate rostral segment with 8 pairs of fine and short setae, 6 pairs of accessory setae among them. Legs normal, femora and second tarsi with imbrication. Hind femur about as long as antennal segment III. Hind tibia 0.29 times body length. Length of setae on hind tibia 0.031, 1.20 times middle width of the segment. First tarsal segment chaetotaxy: 7, 7, 7. Siphunculi banana-shaped, curved outwards, gradually more distinctly spinulose apically.



Figs. 1-16 *Allorrichosiphum castanopse*, sp. nov. Apterous viviparous female: 1, dorsal view of head and prothorax; 2, antenna; 3, ultimate rostral segment; 4, mesosternal furca; 5, cephalic setae; 6, setae on antennal segment III; 7, dorsal setae on pronotum; 8, setae on abdominal tergite I; 9, cauda; 10, setae on tergite VII; 11, setae on tergite VIII; 12, ventral setae of abdomen; 13, siphunculus; 14, cauda; 15, anal plate; 16, genital plate.

about 0.34 times body length, 5.70 times its widest diameter; with 32 long setae; length of setae 0.124, 1.60 times its widest diameter. Cauda transversely semi-oval, with 7 setae. Anal plate circular at apex, with 10 setae. Genital plate transversely square shaped, with 8 sickle-shaped setae.

Holotype. – Apterous viviparous female, No. Y6527-1-1-3, April 25, 1981, Guangxi Autonomous Region (Bobei County, N22.2°, E109.9°, Alt. 200m), collected by He Yandong, on *Castanopsis hicklii*; paratypes 3 alaroid nymphs, No. Y6527, other data same as holotype.

Etymology. – The new species is named for *Castanopsis*, the host on which it was collected.

Diagnosis. - The new species is allied to *Allotrichosiphum assamense* (Raychaudhuri et al.) and *A. kashicola* (Kurisaki), but differs from them as shown in the following key (Apterous viviparous female).

1. Body pear shaped, its length 2.00 times its width; dorsal setae of body very setae; setae on abdominal tergite VIII not discernible *Allotrichosiphum assamense*
 Body narrow, its length about 2.60 times its width; dorsal setae of body shorter; setae on abdominal tergite VIII distinct 2
2. Head with 3 pairs of dorsal setae; ultimate rostral segment with 1 pair of accessory setae; dorsal setae of body capitate, apical dilated part globular; cephalic setae capitate at tip *A. kashicola*
 Head with 7 pairs of dorsal setae; ultimate rostral segment with 6 pairs of accessory setae; dorsal setae of body multi-forked; cephalic setae sharp at tip *A. castanopse*, sp. nov.

Remark. – The information on *Allotrichosiphum assamense* and *A. kashicola* come from their original descriptions (apterous viviparous females unknown; apterous forms are fundatrices).

ACKNOWLEDGMENTS

Qiao Gexia thanks Zhang Guangxue (Institute of Zoology, the Chinese Academy of Sciences, 19 Zhongguancun Road, Haidian, Beijing 100080 P. R. China) for some comments to the manuscript and He Yandong for his collection. The work was sponsored by the National Natural Sciences Foundation of China (grant No. 39700015), a grant for special fund of systematic and evolutionary biology, CAS to a biological and technical innovation grant from the Chinese Academy of Sciences (Grant No. C2999084).

LITERATURE CITED

- Blackman, R.L. and V.F. Eastop.** 1994. Aphids on the World's trees. An identification and information guide. CAB International, Wallingford, UK. 904pp.
- Eastop, V. F. and D. Hille Ris Lambers.** 1976. Survey of the World's aphids. The Hague, 576pp.
- Ghosh, A. K. and B. K. Agarwala.** 1993. Fauna of India. Homoptera: Aphidoidea, Part 6, Subfamily Greenideinae. Zool. Surv. India, Calcutta, 60-64.
- Kurisaki, M.** 1920. A new species and the variation of the wing veins of Aphididae in Japan. Insect World 24: 297-301.
- Takahashi, R.** 1962. Key to genera and species of Greenideini of Japan, with descriptions of a new genus and three species (Homoptera: Aphididae). Trans. Shikoku Entomol. Soc. 7(3): 65-73.

- Raychaudhuri, D. N., M. R. Ghosh, M. Banerjee, and A. K. Ghosh. 1973. Studies on the aphids (Homoptera: Aphididae) from eastern India XIV. One new genus, two new subgenera and fifteen new species of Greenideini. *Kontyu*, 41(1): 53-73.
- Remaudière, G. and M. Remaudière. 1997. Catalogue of the World's Aphididae. Homoptera Aphidoidea. INRA, Paris, 1-473.
-
-

(Continued from page 312)

endeavor. Otherwise, those who rely on species geographic information are left with potentially important observations that remain insupportable anecdotes or hearsay, and the biological discipline that tolerates such reporting is open to the valid disclaim of others. This issue would be resolved to a large extent if editors of the many scientific journals that publish species lists, faunal and floristic accounts, or geographic records in any form or context insist that supporting data always be provided by authors.

Editor's P.S. to foregoing essay. Although this essay was received as an unsolicited paper, as editor of *Entomological News*, and with the permission of the above author, I append the following statement.

Entomological News aims to be, primarily, a taxonomic journal for short papers on entomology. As stated in each issue, "manuscripts on taxonomy, systematics, morphology, ecology, behavior, and similar aspects of insect life and related terrestrial arthropods are appropriate for submission".

With this as my guide, over the years I have been reluctant to accept papers that are little more than simple checklists, and have repeatedly so advised potential authors. To be considered for publication in *Entomological News*, papers need to provide specific data including date and specific geographic site of collection (the simple naming of a county or other political entity is not sufficient), and the name of the museum or other institution where the specimen(s) is (are) deposited. Papers that do not provide these data are of little value in a scientific journal, for without these data it would be very tedious to nearly impossible to locate reported new records, records could not be verified, and it would be more difficult to re-collect specimens from the same locality for future research. Thus, papers lacking these data usually are not accepted unless there are some compelling reasons to give them favorable consideration. This will continue to be the editorial policy of this journal.

H.P.B.

SCIENTIFIC NOTE
REPORTING SPECIES RECORD DATA^{1,2}

W. P. McCafferty³

Part of the recent upsurge in biodiversity related research has been the reporting of records of species occurring in particular geographic areas or in politically formulated regions such as nations, states, or provinces. Such reports can contribute to assessments of species ranges, and ultimately to evaluations of the commonness of species and the vulnerability of species and their habitats. Besides this potential value to environmental assessment and management, species distributional data also have important applications for geographic information systems analyses, taxonomy, and biogeographical research. Because new records of species are regularly published in Entomological News, it is an appropriate venue for an essay dealing with a continuing and disturbing problem associated with the reporting of species geographic record data.

For many groups of organisms, electronic databases are being established at various centers in order to manage species geographic data along with other data related to biodiversity. Significantly, the completeness and usefulness of such biodiversity databases and the applications of distributional data as discussed above are reliant in part on data incorporated from the vast and invaluable published literature.

Species distributional data are scientific data, and as such must be presented similarly to any other kind of scientific data and be subject to the same kinds of constraints and evaluations. For example, if geographic records are not presented in such a way that they can be checked, reproduced, or even potentially falsified in some manner, then they arguably are not scientific and are not reliable in any scientific sense. When species geographic records are published in anecdotal form, for example, by simply mentioning that a species was seen from some area or by listing species for the first time as part of region's fauna or flora without providing any accompanying locale and collecting data, those records cannot be regarded as scientific data and thus cannot be integrated into databases nor used in further research or applications. If the material and related data supporting the records are not delineated so they can be subjected to tests of authenticity and accuracy, then such records can be referenced only, if at all, as incomplete and tenuous. Moreover, it is of paramount importance that the material on which any records are published be cited with respect to their place of deposition, and that the material be identified in such a manner that it can be located in the future. Because accurate identification of species may be difficult or contentious or may have been in the past, relative to the taxonomic group involved, and because there is still an emerging taxonomy in many groups, materials and the associated data upon which records are based must be tractable for any necessary re-examination. This is equivalent or tantamount to reproducibility in other fields of science.

Unfortunately, published papers continue to appear that putatively establish geographic records for species by simply listing the species without providing any corroborating data to support the records and without mentioning any material examined. I maintain that such records are not acceptable unless, at a minimum, they are accompanied by collection and deposition data. Exceptions to similar kinds of requirements are not made in other scientific fields, and exceptions should not be made in the case of biotic record reporting. General adherence to such a stipulation would help legitimize this aspect of biodiversity research as a bona fide scientific

(Continued on page 311)

¹ Received and accepted January 13, 2000.

² Published in association with the North American Mayfly Inventory Database Project, Department of Entomology, Purdue University, supported by National Science Foundation Grant DEB-9901577.

³ Department of Entomology, Purdue University, West Lafayette, IN 47907.

BOOK REVIEW

FIRE ANTS. Stephen W. Taber. 2000. Texas A & M University Press. 368 pp. 78 b&w photos, 32 line drawings, Bib. Index. \$29.95 cloth.

Stephen Taber has gone out fishing on the flood tide of fire ant literature, and has hauled in a ton of facts. Tossed in gleaming heaps on the deck of his 368-page book, these facts fill the entomologist with admiration, as well as with gratitude that any personal obligation to troll the murky depths of a hundred journals is thus obviated. Here, laid out in a row, are the ant-conquered southern states, extending east and west from the Alabama entry point. Here, still feebly and reflexively gasping and flipping their tails, are the bloated and ignominious fire ant eradication programs. Here are the problems of fire ant taxonomy, still tangled in a snarl of fishing line, but out in the open. The entomologist is not the only beneficiary of this bounty; the journalist should be equally pleased. News items, such as, "Fire Ants Kill Easter Chicks at Local Pet Store," a headline that the journalist belatedly realizes hardly requires actual text, can be nicely padded out with educational bits on the potency of fire ant venom and the murder of hatchling quail out in the countryside.

While delighted to see this huge harvest of information all in one place, I would not want my understanding of fire ants to depend on this book. One can read the entire volume and still lack answers to reasonable questions about fire ants. Why are fire ants, especially the imported species, so much more aggressive around the nest than most other ants? How, exactly, do they so successfully displace other species? Why do they spread so rapidly in some regions and much slower in others? Why are some areas within their range wall-to-wall fire ants, while other areas have few nests? What forces brought about the decline of the devastating outbreaks of tropical fire ants in the Caribbean, and does this decline offer hope elsewhere? Symptomatic of this weakness in synthesis, the overviews of past and future fire ant scenarios seem questionable. The statement that one of the now-rejected chemical controls "might have done the job" strikes me as one of those retroactive fantasies of omnipotence typical of we middle-aged males. By the time such control was begun, the red imported fire ant had dispersed widely. Even if we modern experts had been in charge, we could not have stopped a widespread, highly mobile, generalist species that reproduces rapidly, is easily relocated by commerce, and is beautifully preadapted to the habitat disturbances diagnostic of the ecological niche of our own species. The vision, complete with map, of future distribution shows the red imported fire ant sweeping up the West Coast to Canada. This seems highly unlikely; the extremes of temperature in Seattle might not be too cold for fire ants, but the northern west coast marine climate is unfavorable to a broad spectrum of ants for other reasons.

It is easy for inaccuracies to creep in when one is dealing in an uncritical and nonselective way with a large literature (the list of references takes up 56 pages of tiny print). For this reason, one needs to exercise judgement before quoting from the book. For example, Ernst Mayr did not actually state or imply that "the introduction of an exotic is good for all but the invader's closest competitors because the presence of an additional species increases biodiversity." Ants would not make "ideal pollinators" were it not for pollen-inhibiting chemicals, because ants travel everywhere on foot, automatically making them lousy pollinators, irrespective of their body chemistry. The function of the elaiosome on seeds of a species of violet is not to "save its seeds from fire ant predation." Polygyne fire ant nests that bud off daughter nests are not an example of "asexual reproduction." In the key to species one must check the "dorsolateral junction of the propodeum," a hitherto unknown feature, which is absent from the glossary. There are many more of these little mistakes, and also many places where it would be easy to get the wrong impression about some aspect of fire ant biology.

I do not recommend this book for the more sensitive myrmecologist, who would find cause to cringe and twitch on almost every page. For tougher specialists, this book is a great labor-saving compendium.

Mark A. Deyrup
Archibald Biological Station
Lake Placid, FL

SOCIETY MEETING OF FEBRUARY 23, 2000

SOCIAL INSECT COLONIES: PARASITES INSIDE AND OUT

Dr. Jay D. Evans

Bee Research Lab. USDA-ARS Beltsville, MD

President Jon Gelhaus began the meeting by requesting approval of Howard Boyd's nomination to Emeritus Membership in the Society. All members present approved.

The evening's speaker was Dr. Jay Evans of the USDA, who described his researches on parasites of social insects. His work deals with both noxious and beneficial social Hymenoptera, from fire ants to honeybees. Social insects, including ants, bees, wasps, termites, are ecologically dominant in many habitats worldwide. He noted the great diversity of forms among the castes of social insects and the importance of mutualistic relationships to colonies. Some ants, for example, protect immature Lepidoptera (mostly Lycaenidae) and Homoptera in exchange for liquid nectars provided by these mutualists. Bees have long-standing mutualisms with flowering plants (and humans).

Conventional parasites include mites, beetles, and some Lepidoptera, while pathogens include viruses, bacteria, protozoa and fungi. Honey bees suffer from each of these parasite and pathogen groups, although mites in the genus *Varroa* are arguably the most important. Current control methods include physical changes to bee hives, breeding for resistant bees, and the use of chemical controls. He illustrated a recent invasive parasite of bees, a small nitidulid beetle from South Africa that entered Florida in 1998 and is now spreading.

Social insect colonies are also vulnerable to attack or theft by other social insects. Ants, for example, often raid each other's resources and some species effectively enslave the workers of other colonies. Most intriguing are examples of parasitism and conflict between nestmates in the same social insect colony. In many ants and bees, workers retain developed ovaries and often compete with their own queens for reproduction. In other species, workers shift investment toward their closest relatives. These conflicts have been untangled by using a combination of behavioral observations, colony surveys, and parentage analyses using genetic markers. Dr. Evans detailed some of his own research on social parasitism within multi-queen ant colonies. In these colonies, queens compete for reproduction with each other and with a subset of fertile (male-producing) workers. Also, he described his efforts to understand the genetic basis of queen development in honeybee colonies. One of the key findings is that workers have more novel genes switched on than do queens, perhaps because they differ more from the ancestral hymenopteran stock. Many of these differently expressed genes appear to be related to nutrition. His talk was illustrated by many slides of the species he described.

Ross Lang, recent Calvert award winner, will participate in the 2nd APCE Youth Science Festival in July, sponsored by Science Service. Ross was nominated with 70 other youth, of whom only 20 were selected. The purpose of attending the festival is for youth to expand their educational and world perspectives and to be involved in an international science cooperation program at an early age. In other news of entomological interest, several members and guests noted unusually early appearances of insects during the opening days of January 2000. These included, green darner, *Anax junias*, in New Jersey, January 2nd (Hal White), Tree hoppers, Homoptera: Membracidae, on oak in Delaware on January 1st (Charles Bartlett), *Shistocerca americana*, American locust, in large numbers in southern New Jersey, also January 1st (Dale Schweitzer).

William J. Cromartie,
Corresponding Secretary

SOCIETY MEETING OF MARCH 22, 2000**SEXUAL SELECTION, SELFISH GENES, AND THE EVOLUTION OF
SEXUAL DIMORPHISM IN STALK-EYED FLIES****Dr. Jerry Wilkinson****Dept. of Biology, University of Maryland**

Dr. Wilkinson based his presentation on ten years' study of stalk-eyed flies. Eight families of Diptera show varying degrees of elongation of the head into eye stalks. Diopsid flies are unique in having the antennae at the end of the stalks. Five dipteran families possess "antlers," which males use for fighting, and four of these also have eye stalks. He illustrated this with a remarkable series of slides of antlered tephritid males.

Dr. Wilkinson went on to describe the known mechanisms for the evolution of exaggerated traits like eyestalks, including male contest resolution, female choice involving direct benefit and female choice involving indirect benefit. The problem, he said, is to establish which of the possible factors operate in particular cases. In the Diopsidae, eye stalks are found in both sexes, and dimorphism between males and females has evolved at least five times and been lost once. In Southeast Asia, monomorphic forms are solitary, while dimorphic forms typically form large mating aggregations on roots along streams, where males that succeed in displacing their rivals may mate with up to 25 females. He showed examples of these from his field studies in Malaysia.

Lab studies indicate that both male competition and female choice operate in sexually dimorphic diopsid species. The outcome of contests between males is decided by eyestalk length independent of body size. In addition, choice experiments conducted in the lab show that females of species with dimorphic eyestalks prefer males with longer eyestalks. Females of species with monomorphic eyestalks exhibit no preference.

A key prediction of indirect benefit female choice models of sexual selection is that a genetic correlation should arise between a male trait and female preference. Dr. Wilkinson described experiments to establish whether a genetic correlation exists between female preference for males with long eyestalks and eyespan itself. Females from lines in which males were selected for long eyespan showed a preference for long eyestalk males while females from lines selected for short eyespan showed a preference for short eyestalk males.

The question that remained, he continued, was, "does the trait affect fitness?" In these flies another factor must then be considered: peculiar sex ratios, with nearly twice as many females as males. Test matings show that males determine the sex-ratio of their progeny and that dimorphic species have males that produce many daughters. The male propensity to produce daughters is itself determined by the female, and selection for long eyestalks reduces it. Dr. Wilkinson concluded that the sex bias trait must be associated with a "driving" x-chromosome, which it is advantageous for females to avoid by preferentially mating with males bearing the x-linked trait for long eyestalks. Reciprocal crosses between selected lines indicate that eyestalk length exhibits X-linkage as this model assumes. Thus the evolution of eyestalks in at least some species of diopsid flies appears to result from sexual selection on an exaggerated trait which indicates sex ratios due to the presence of a sex-linked selfish gene.

William J. Cromartie,
Corresponding Secretary

SOCIETY MEETING OF APRIL 26, 2000

HISTORICAL OVERVIEW OF GYPSY MOTH IN NORTH AMERICA

Roger W. Fuester

Beneficial Insects Lab., USDA,-ARS, Newark, DE

The meeting began with the introduction of three new honorary members, elected by the Executive Council at its business meeting. Dr. Dan Otte from the Academy of Natural Sciences was present at the meeting. The other two were Dr. Dale Bray of the University of Delaware and Dr. David Rentz of the CSIRO, Australia. All are longtime members and contributors to the A.E.S. This was followed by the Calvert Award presentation.

The speaker, Roger Fuester, began by pointing out that the gypsy moth has been the subject of massive attention and a vast range of control strategies, yet it now occurs from New England to Michigan's Upper Peninsula to the Outer Banks of North Carolina. Among the driving forces in the story have been human-induced changes in forest composition and the wide range of host plants and habitats suited to the moth. Following a brief, illustrated description of the Gypsy moth's biology, he gave a detailed discussion of its history.

After the Civil War, when New England's cotton mills were idle, Leopold Trouvelot, a Harvard astronomer hoped to hybridize the gypsy moth with native silk moths to begin a new industry. Instead, moths escaped. Not until 1889, however, did they attract public notice. The next year, the first of many appropriations of public money was made to control the pest. By 1893, lead arsenate was being used, and the gypsy moth was spurring development of spraying equipment. Mr. Fuester illustrated these early efforts with many remarkable photographs. By 1900, eradication efforts in Massachusetts were apparently successful, and the program was discontinued, but this turned out to be a major error. Populations increased soon thereafter; the decline had been just the first of many cycles of innocuous population, to be followed by release, outbreak and another decline.

In 1906, after five years of increasing and spreading outbreaks, the U.S. government became involved, and the importation of natural enemies started. The 1920's and 30's saw efforts to contain the spread behind the Adirondacks and Allegheny Plateau, but lack of funds during World War II allowed it to break out in Pennsylvania. DDT began to be used in the late 1940's. It was used widely in the 1950's to combat severe outbreaks and further spread, following a new seven-point program of surveillance, control and research. The last year of DDT use was 1958, when, in another innocuous phase, only about 250 acres were defoliated. After that, *Silent Spring* led to substitution of Sevin, and the 60's saw further range expansion as well as studies of new controls including BT and pheromones. Massive outbreaks in 1969 stimulated an "accelerated program" in the early 1970's, with more funds and redirected research efforts. This became an "expanded program" by the mid-70's aimed at other forest insect pests as well.

The area defoliated in outbreaks continued to increase relentlessly, largely due to range expansion, and by 1981, reached nearly 13 million acres, an all-time record. BT and Dimilin replaced Sevin in suppression programs and remain the materials of choice at present. In 1989, the outbreak in Massachusetts and Connecticut collapsed from an epizootic of a fungus *Entomophaga maimaiga*, originally introduced in 1911. After it spread across New England in the 1990's, defoliation there ceased until recently. The current situation, Mr. Fuester concluded, is of growing populations, defoliation and treated areas in much of the eastern U.S. and an uncertain future. Despite over a century of effort, the story is far from concluded.

In notes of entomological interest, Jane Ruffin described the decline of falcate orange-tip butterflies, probably due to the spread of the alien garlic mustard, which females lay eggs on but larvae cannot eat. Dale Schweitzer added that the West Virginia white butterfly is in danger of extinction from the same cause. He also commented on the destruction by the prolonged mid-winter cold spell of the American locusts that had been seen along Delaware Bay in early January.

William J. Cromartie,
Corresponding Secretary

When submitting papers, all authors are requested to (1) provide the names of two qualified individuals who have critically reviewed the manuscript *before* it is submitted and (2) suggest the names and addresses of two qualified authorities in the subject field to whom the manuscript may be referred by the editor for final review. All papers are submitted to recognized authorities for final review before acceptance.

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.

Illustrations: For maximum size and definition, full page figures, including legends, should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4 1/2 x 6 1/2 inches. Authors will be charged for all text figures and half-tones at the rate of \$20.00 each, regardless of size.

Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in The Entomologist's Library on books dealing with taxonomy, systematics, morphology, physiology ecology, behavior and similar aspects of insect life and related arthropods. Books on applied, economic and regulatory entomology, on toxicology and related subjects will not be considered.

Study notices, want items and for sale notices are published in The Entomologist's Market Place .

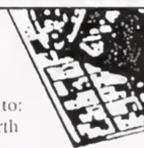
Page charges: For society members, a charge of \$20.00 is made for each published page of an article, plus costs of all illustrations. For non-society members, the page charge is \$25.00 per page. If any charges are not paid within 120 days of billing, authors will be charged an additional \$5.00 per page. Papers may be published ahead of their regularly scheduled time at a cost of \$35.00 per page.

Unemployed and retired amateur and scientist members of the American Entomological Society who are without institutional support or are not subsidized by grants and who are without funds for publishing may apply for financial assistance at the time their manuscript is submitted. Such application must include an explanation of the author's status (unemployed or retired). Page charges for these individuals are negotiable, with a minimum of \$10.00 per page.

Reprints: (without covers) may be ordered when corrected page proofs are returned to the editor. Schedule of reprint costs will appear on order form.

This publication is available
in microform from University
Microforms International.

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.



The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at \$1.00 per line, payable in advance to the editor. Notice of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

Two New Entomology Books from: ASSOCIATED PUBLISHERS, P. O. Box 140103, Gainesville, FL 32614-0103. FAX: 1-904-371-4071.

A PHYLOGENETIC ANALYSIS OF THE MAJOR LINEAGES OF THE CRAMBINAE AND OF THE GENERA OF CRAMBINI OF NORTH AMERICA (Lepidoptera: Pyralidae). By Bernard Landry. *Memoirs on Entomology International*, Vol. 56, May 1995. 248 pages ISBN: 1-56665-056-9, Price US \$45.00.

TORYMINAE (Hymenoptera: Torymidae): A REDEFINITION, GENERIC CLASSIFICATION, AND ANNOTATED WORLD CATALOG OF SPECIES By E. E. Grissell. *Memoirs on Entomology International*, Vol. 57. May 1995. 480 pages. ISBN: 1-56665-057-7. Price US \$60.00.

TWO NEW ENTOMOLOGICAL WORKS appeared recently in *Memoirs on Entomology, International* Series that was started in 1995 to publish authoritative monographic works on insects and other arthropods on a world-wide basis.

THE THRIPS OF CENTRAL AND SOUTH AMERICA: AN INTRODUCTION. By Laurence Mound & Rita Marullo, Vol. 6, 1996. 488 pages. Price \$65.00.

THE ERIOPHYOID MITES OF CHINA: AN ILLUSTRATED CATALOG & IDENTIFICATION KEYS (ACARI: MESOSTIGMATA: ERIOPHYOIDEA). By Xiaoyue Hong & Zhi-Qiang Zhang. Vol. 7, 1996, 328 pages. Price \$45.00.

FIVE VOLUMES were published in 1995 on Crambinae, Toryminae, Rove beetles, Shore flies and Eupelminae. Please inquire details. Personal discount available. Associated Publishers, PO Box 140103, Gainesville, FL 32614-4071. Fax 352-371-4071.

INSECTS OF PERU from Madre de Dios, Apurimac, Cusco and other good places. Please write for wholesale price list to: Rainer Marx, Triererstr. 726, 52078 Aachen, GERMANY.

OBRA TAXONÒMICA DEL DR. FRANCESC ESPAÑOL by A. Viñolas, O. Escolà & J. Vives. Volume 7 (1995) of the monograph series *Treballs del Museu de Zoologia* published by the Zoology Museum of Barcelona. Compilation and systematic updating of more than 500 species, 110 pages, 4 b/w photographs, 48 drawings, ISSN 0211-0687. Price 1200 Spanish Pesetas (supplement airmail: Europe: 200 pts, rest of the world: 500 pts). Fax: +34-3-3104999 (Publications dept.).

SPECIMEN PREPARATION: Bugpuncher wants to help you with your backlog of specimens! Years of experience in all orders; specializing in Skippers. References available; low rates. E-mail for information: Bugpuncher@aol.com

FOR SALE: Hundreds of unpinned, unidentified scarabs from Africa, many species, A+ quality, inquiries welcome, selling in lots or in toto only please. Contact: W. David Garrahan, Jr., Cornell University, Clara Dickson Hall, Room 3563, Ithaca, NY 14853-2401, e-mail (preferred): wdg2@cornell.edu

WANTED: Taxonomic and distributional literature dealing with insects and other arthropods likely to be found in Louisiana and environs. Needed for future checklisting project. Collections, single papers. State price. Jerry G. Walls, 657 Second St., Trenton, NJ 08611. 609-394-1038. Gyretes@prodigy.net

ENTOMOLOGICAL NEWS

A new species of <i>Automeris</i> (Lepidoptera: Saturniidae) from central Mexico	Manuel A. Balcázar-Lara	317
A new species of <i>Sephinooides</i> (Heteroptera: Coreidae) from Ecuador	H. Brailovsky, G. Couturier	322
A new species of <i>Coelidiana</i> (Homoptera: Cicadellidae) from the Galapagos Islands	Paul H. Freytag	325
Two new species of the genus <i>Whitfieldiellus</i> (Hymenoptera: Braconidae) from Brazil	S.M. Barbalho, A.M. Penteado-Dias	328
A new species of <i>Sinella</i> (Collembola: Ento- mobryidae) from China	W. Fang, K.A. Christiansen	332
A new species of <i>Anisocentropus</i> (Trichoptera: Calamo- ceratidae) from Sri Lanka	Oliver S. Flint, Jr.	337
Description of late instar larvae of <i>Diaulota pacifica</i> (Coleoptera: Staphylinidae)	H-J. Kim, J-Y. Ryu, K-J. Ahn	341
Invertebrates inhabiting wetland monocots damaged by Lepidoptera	J.R. Keiper, M. Sanford, J. Giannino, W.E. Walton	348
New southerly distribution records for the Boreal carrion beetle, <i>Nicrophorus vespilloides</i> (Coleoptera: Silphidae)	F.F. Purrington, R.L. Davidson	355
Range extension, ecological notes, and new records of <i>Pycnopsyche indiana</i> (Trichoptera: Limnephilidae) from Florida	A.K. Rasmussen, D.R. Denson	359
Occurrence of the tiger beetle <i>Cicindela cursitans</i> (Coleoptera: Carabidae) in northwestern Minnesota	P.P. Tinerella, D.A. Rider	367
Fecundity of male <i>Blattella germanica</i> (Blattaria: Blattellidae) exposed to multiple virgin females	C. Curtis, I. Huber, R.E. Calhoon	371
Notations on South American Baetidae (Ephemeroptera)	W.P. McCafferty	375
<i>Pseudocloeon aquacidum</i> : a new subjective synonym of <i>P. latum</i> (Ephemeroptera: Baetidae)	C.R. Lugo-Ortiz, F.C. de Moor	380
Heat relief behavior by <i>Kleidocerys ovaris</i> (Hemiptera: Lygaeidae) in urban southern California	R.S. Vetter, D.C. Hawks	382
SCIENTIFIC NOTES:		
<i>Chondromorpha xanthotrichia</i> , a new milliped for continental United States	Rowland M. Shelley	370
Behavior of the beetle inquiline, <i>Cremastocheilus saucius</i> , and its host ant, <i>Pogonomyrmex occi- dentalis</i> , during entrance into the ants' nest	Shaharra J. Usnick	385
FOUR AMER. ENTOMOL. SOC. MEMBERS HONORED		387
BOOK REVIEWS		366, 384
BOOKS RECEIVED AND BRIEFLY NOTED		331, 340, 358
PUBLISHER'S STATEMENT		388
MAILING DATES for Vol. 111, 2000		388
INDEX for Vol. 111, 2000		389

ENTOMOLOGICAL NEWS is published bi-monthly except July-August by The American Entomological Society at the Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A. AES office phone: 215-561-3978; e-mail: aes@ansp.org; website: <http://www.ansp.org/aes>.

The American Entomological Society holds regular membership meetings on the fourth Wednesday in October, November, February, March, and April. The November, February and April meetings are held at the Academy of Natural Sciences in Philadelphia, Pa. The October and March meetings are held at the Department of Entomology, University of Delaware, Newark, Delaware.

Society Members who reside outside the local eastern Pennsylvania, southern New Jersey, and Delaware area are urged to attend society meetings whenever they may be in the vicinity. Guests always are cordially invited and welcomed.

Officers for 1999-2000: President: Jon K. Gelhaus; Vice-President: Susan B. Whitney; Recording Secretary: Charles R. Bartlett; Corresponding Secretary: William J. Cromartie; Treasurer: Howard P. Boyd.

Publications and Editorial Committee: Howard P. Boyd, Chr., D. Otte, and Norman E. Woodley.

Previous editors: 1890-1920 Henry Skinner (1861-1926); 1921-1944 Philip P. Calvert (1871-1961); 1945-1967 R.G. Schmieder (1898-1967); 1968-1972 R.H. Arnett, Jr.; 1973-4/1974 R.W. Lake.

Subscriptions: *Private subscriptions for personal use of members of the Society, domestic and foreign: \$10.00 per year postpaid. Subscriptions for non-members \$25.00. Subscriptions for institutions such as libraries, laboratories, etc., domestic: \$20.00 per year postpaid; foreign: \$22.00 per year post-paid. Communications and remittances regarding subscriptions should be addressed to ENTOMOLOGICAL NEWS, The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa. 19103-1195, U.S.A.*

Back issues of most numbers may be obtained by writing to the office of The American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, Pa., 19103-1195, U.S.A.

Membership dues: \$15.00 per year (regular); \$10.00 per year (student).

Manuscripts and all communications concerning same should be addressed to the editor: Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A. Manuscripts will be considered from any authors, but papers from members of the American Entomological Society are given priority. It is suggested that all prospective authors join the society. All manuscripts should follow the format recommended in *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers*, Sixth Edition, and should follow the style used in recent issues of ENTOMOLOGICAL NEWS. Three double-spaced, typed copies of each manuscript are needed on 8 1/2 x 11 paper. The receipt of all papers will be acknowledged and, if accepted, they will be published as soon as possible. Articles longer than eight printed pages may be published in two or more installments, unless the author is willing to pay the entire costs of a sufficient number of additional pages in any one issue to enable such an article to appear without division.

Editorial Policy: Manuscripts on taxonomy, systematics, morphology, physiology, ecology, behavior and similar aspects of insect life and related terrestrial arthropods are appropriate for submission to ENTOMOLOGICAL NEWS. Papers on applied, economic and regulatory entomology and on toxicology and related subjects will be considered only if they also make a major contribution in one of the aforementioned fields.

(Continued on inside of back cover)

Postmaster: *If undeliverable, please send form 3579 to Howard P. Boyd, 232 Oak Shade Road, Tabernacle Twp., Vincentown, New Jersey 08088, U.S.A.*

SECOND CLASS POSTAGE PAID AT VINCENTOWN, NEW JERSEY, 08088, U.S.A.

A NEW SPECIES OF *AUTOMERIS* (LEPIDOPTERA: SATURNIIDAE) FROM CENTRAL MEXICO¹

Manuel A. Balcázar-Lara²

ABSTRACT: *Automeris michoacana*, new species, is described from Michoacan State, Mexico. It is differentiated from its nearest allies within the *A. io* group.

The study of specimens of saturniids from mid-elevation montane forests in central and south Mexico has resulted in the discovery of several new species, with apparently very small ranges. This new species belongs in the *Automeris io* group proposed by Lemaire (1973), within the *A. iris* subgroup which includes five described species: *A. iris* (Walker), *A. lemairei* Beutelspacher, *A. boudinotiana* Lemaire, *A. daudiana* Druce, and *A. stacieae* Lemaire & Wolfe (Lemaire, 1986; Beutelspacher B., 1990; Lemaire & Wolfe, 1993). At least another two species remain to be described within the later subgroup which is characterized by the yellow or gray periocellar area and a continuous postmedial line on the upper side of the forewings (Lemaire, 1973; Balcázar-Lara, in press).

Automeris michoacana NEW SPECIES

(Figs. 1-2)

Description. Forewing length: ♂ 34–37 mm (\bar{x} = 35.75, n = 4). Male.- *Head*: salmon color; frontal area cinnamon. Labial palpi three-segmented, salmon color. Antennae cinnamon, quadripectinate almost to the apex. *Thorax*: cinnamon; legs cinnamon; tibiae very hairy. Hind tibia with one pair of apical spurs. *Abdomen*: cinnamon, dorsally weakly ringed with reddish. *Forewing*: elongate; dorsally pale pinkish buff. Antemedial line very faint. Postmedial line dark brown, straight, continuous; reaching costa about 6–8 mm from apex; not underlined. Submarginal band absent. Discal spot slightly darker than rest of the wing, surrounded with five to seven small black dots. Forewing ventrally cinnamon rufous, with a pale pinkish area along the inner side of the wing. Antemedial line absent. Postmedial line clearly marked, reaching costa about 4–5 mm from apex, dark cinnamon brown, straight. Discal spot strong, black around a small white center. Veins slightly clearer than remainder of wing. *Hindwing*: dorsally pale pinkish buff, with a brick red to pinkish area along the inner margin. Postmedial line black, concave. Submarginal band cinnamon; basomedial area brick red to pink; costal area pale pinkish; marginal area cinnamon rufous; inner side brick red; fringes ferruginous; area between postmedial line and submarginal band yellow ochre; ocellus typical of the *A. io* group, black with central diffuse white spot, ventrally cinnamon rufous; costal area same as rest of wing. Postmedial line dark cinnamon, convex. Discal spot weak, a small white dot without black; black ring of dorsal ocellus weakly visible; veins slightly clearer than the rest of wing. *Male genitalia*. Uncus very prominent, bent ventrally, with five apical folds (very strong and asymmetrical). Uncus with a

¹ Received April 5, 2000. Accepted May 1, 2000.

² Universidad de Colima, Facultad de Ciencias, Apdo. Postal 25, Av. 25 de Julio #965, Col. Villas San Sebastián, Colima, Colima 28000, MÉXICO.

E-mail: mabl@cgc.ucol.mx



small projection pointing backwards. Valves with two lobes, apical process bent medially, inner spine prominent. Gnathos reduced to a subtrapezoidal plate. Saccus very long (narrow). Vinculum with anterolateral edges prominent. Aedeagus straight, delicate (very short).

Female. Unknown.

Type Material. Holotype: ♂; Mexico, Michoacán, 3 km S Tacámbaro, N 19° 14' W 101° 27' 30", 1600 m; 14 June 1985; M. Balcázar L. CNIN, Mexico. Paratypes: 3 ♂♂; same data as holotype. Other specimen examined: 1 ♂; Mexico, Michoacán, Uruapan, "Centro de Estudios Forestales"; June 1977. CNIN, Mexico.

Deposition of types.- The holotype and two paratypes are deposited in the National Collection of Insects (CNIN), Instituto de Biología, UNAM; one paratype will be deposited in the United States National Museum.

Etymology. This species is named in honor of the Universidad Michoacana de San Nicolás de Hidalgo, the university where I earned my B.S. when I collected the type series.

Distribution.- The known specimens of *A. michoacana* were collected at an elevation of 1600 m in pine-oak forests, with semi-warm climate (annual average temperature above 18° C) and a coefficient rainfall/temperature above 55 (García, 1973). Both known localities are in the Eje Volcánico biogeographic province *sensu* Álvarez & La Chica (1974) on the southern slope, close to the Balsas River Basin province (Depresión del Balsas).

Flight period.- All known specimens were collected in June.



Fig. 1. Habitus of *Automeris michoacana* Balcázar, new sp. Holotype ♂ (forewing length: 37 mm).

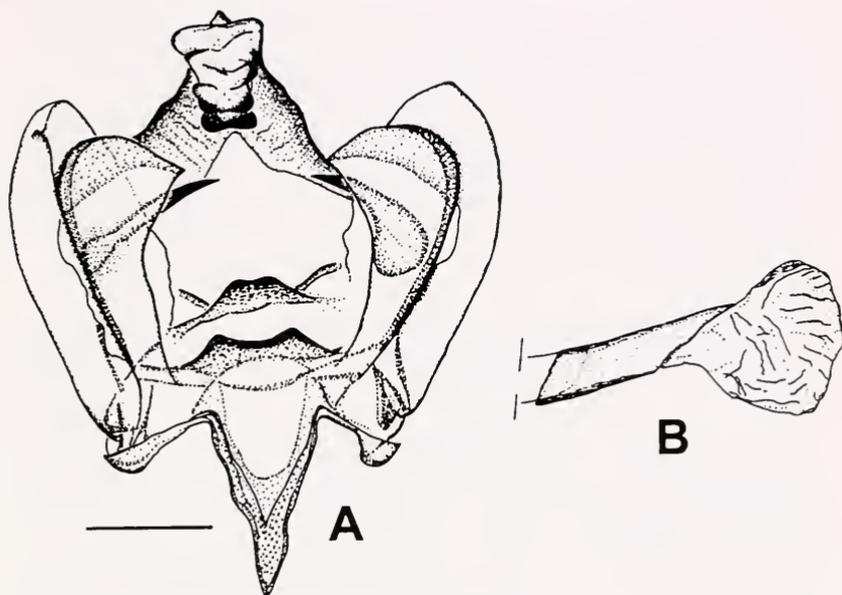


Fig. 2. Male genitalia of *Automeris michoacana* Balcázar, new sp.: A. ventral view, B. Aedeagus, vesica everted, bulbus ejaculatorius sectioned. Holotype. (line = 1 mm).



Fig. 3. Known distribution of *Automeris michoacana* Balcázar, new sp.

Key to species of *Automeris io* group found in Mexico (males).

1. Postmedial line of forewing upper side continuous 2
 Postmedial line of forewing upper side lunular 5
- 2(1). Forewing elongate 3
 Forewing not elongate 4
- 3(2). Antennae rusty yellow; postmedial line of forewing upper side concave; postmedial line of forewing upper side proximally underlined with white; postmedial line of forewing under side pink *Automeris boudinotiana*
 Antennae cinnamon; postmedial line of forewing upper side straight; postmedial line of forewing upper side not underlined; postmedial line of forewing under side dark cinnamon brown *Automeris michoacana* n. sp.
- 4(2). Postmedial line of forewing upper side usually straight; uncus folded; uncus tip, distally, as wide as or wider than tegumen *Automeris lemairei*
 Postmedial line of forewing upper side usually slightly curved basally before reaching costa; uncus strongly folded, uncus tip, distally, narrower than tegumen . *Automeris iris*
 Postmedial line of forewing upper side usually "s" shaped, curved basally towards the costa and distally towards the anal margin; uncus not folded . . *Automeris daudiana*
 Postmedial line of forewing upper side outwardly bent towards the costa; uncus slightly folded *Automeris stacieae*
- 5(1). Forewing elongate 6
 Forewing not elongate 8
- 6(5). Forewing ventrally cadmium yellow, to buff-yellow; hindwing ventrally yellow, or buff yellow 7
 Forewing ventrally clay color to cinnamon rufous; hindwing ventrally clay color to cinnamon rufous *Automeris hebe*
 Forewing ventrally pink; hindwing ventrally pink *Automeris eogena*
- 7(6). Abdomen dull yellow to brownish orange; forewing external margin not oblique; submarginal band of forewing upper side absent; veins of hindwing underside same color as rest of wing *Automeris dandemon*
 Abdomen pink to red; forewing external margin slightly oblique; submarginal band of forewing upper side lunular; veins of hindwing underside reddish pink *Automeris melmon*
- 8(5). Postmedial line of forewing upper side reaching costa about up to 6 mm from apex *Automeris colenon*
 Postmedial line of forewing upper side reaching costa about 7 mm from apex or more *Automeris io*

Discussion. *Automeris michoacana* can be separated from other members of the *A. io* group with a continuous postmedial line on the upper surface of the forewings by the following combination of characters: more elongate forewings (the external margin is about three fourths the length of the anal margin); and the almost straight postmedial line of the forewing upperside. Most specimens of *A. lemairei* have a straight postmedial line, but they can be separated by the ground color of the forewing which varies from yellow to tan color, but is never pale pinkish buff as in *A. michoacana*. The postmedial line of the forewing is slightly curved basally before reaching costa in most specimens of *A. iris*; "s" shaped, curved basally towards the costa and distally towards the anal margin in most *A. daudiana*; outwardly concave in *A. boudinotiana*; and outwardly bent towards the costa in *A. stacieae*. This latter

species can be further separated by the more pointed apex of the forewings. *A. iris* has clearly less elongate forewings than this new species. *A. daudiana* is the largest species in the subgroup. *A. boudinotiana* lacks the black dots that surround the discal spot of the forewings upperside in the rest of the species.

Within the *A. iris* subgroup there are three tendencies regarding the uncus: in *A. boudinotiana* and *A. daudiana* the uncus lacks apical folds; *A. iris*, *A. lemairei* and *A. michoacana* have a strongly folded uncus; and *A. stacieae* is intermediate.

ACKNOWLEDGMENTS

This paper was possible in part thanks to Comisión Nacional de Biodiversidad (CONABIO, Mexico) grant FB269/h021/96, and Dirección General del Personal Académico, Universidad Nacional Autónoma de México (DGAPA, UNAM) grant IN201497.

LITERATURE CITED

- Alvarez, T. & F. de Lachica. 1974. Zoogeografía de los vertebrados de México, pp. 219-275. In: El escenario geográfico. Recursos naturales. México: Panorama histórico y cultural. Volume II. Instituto Nacional de Antropología e Historia, Mexico.
- Balcázar-Lara, M. in press. A new *Automeris* from the Manantlan Reserve in Mexico (Saturniidae: Hemileucinae). Fla. Entomol.
- Beutelspacher B., C. R. 1990. Una especie nueva mexicana de *Automeris* Hübner (Lepidoptera: Saturniidae). An. Inst. Biol. UNAM 61:313-316.
- García, E. 1973. Modificaciones al Sistema de Clasificación Climática de Köppen, 2nd Edition. Instituto de Geografía, México, D. F. 246 pp.
- Lemaire, C. 1973. Révision du genre *Automeris* Hübner et des genres voisins. Biogéographie, Éthologie, Morphologie, Taxonomie (Lep. Attacidae) (Suite), Mem. Mus. Natl. Hist. Nat. (Paris) Sér. A. Zool. 79:233-422.
- Lemaire, C. 1986. Description d'un nouvel *Automeris* Mexicain (Lepidoptera, Saturniidae, Hemileucinae). Rev. Fr. Entomol. (N.S.) 8:85-87.
- Lemaire, C. & K. L. Wolfe. 1993. Two new *Automeris* from western Mexico (Lepidoptera: Saturniidae: Hemileucinae). Trop. Lep. 4:39-44.

A NEW SPECIES OF *SEPHINIOIDES* (HETEROPTERA: COREIDAE) FROM ECUADOR¹

Harry Brailovsky², Guy Couturier³

ABSTRACT: A new species, *Sephinioides formosus*, collected in *Astrocaryum urostachys* (Palmae), is described from Ecuador and compared with *S. ugaldei*, the only known species of the genus.

Brailovsky (1996) erected the genus *Sephinioides* and mentioned certain characters to distinguish it from other genera of Leptoscelidini. This Neotropical genus is characterized by having the pronotal disc convex, and anteriorly cleft, anterolateral margins coarsely crested, humeral angles produced into a short or elongate spine, femora unarmed and hemelytral membrane extending far from the apex of abdomen.

Sephinioides was previously known from a single Costa Rican species, *S. ugaldei*. In the present paper a second species collected in Ecuador is described. Members of this genus are apparently restricted to feeding on members of the Palmae, and specimens of the new species were collected on the palm *Astrocaryum urostachys*.

Sephinioides formosus, NEW SPECIES

Figure 1

Description.- Male. Dorsal coloration. Head (apex of tylus reddish orange), antennal segments I to IV, pronotum, scutellum (apex reddish orange), clavus (inner border reddish orange), corium, and hemelytral membrane black; connexivum and abdominal segments bright orange; external face of ocellar tubercle yellow. **Ventral coloration.** Head, rostral segments I to IV, collar, anterior and posterior lobe of metathoracic peritreme and legs black; thorax, abdominal sterna and genital capsule bright orange with following areas black: prosternum, mesosternum, and metasternum, one large discoidal spot on propleura, mesopleura and metapleura, a short quadrate spot at anterior third of upper margin of metathorax, inner surface of acetabulae, and three rows of discoidal spots located on abdominal sterna III to VII.

Structure. Thorax. Pronotum. Declivent; collar wide; disc convex; anterior lobe behind callus with two lateral humps; frontal angles crested with spines; anterolateral margins coarsely crested with short and large spines; humeral angles produced laterally into a broad and short spine slightly turning backward; posterolateral margins convex, sinuate, with upper half irregularly crested and inner half smooth; posterior margin straight, smooth; calli transversally depressed, anteriorly raised. **Scutellum.** As long as wide.

Genital capsule. Posteroventral margin shallowly concave between large, blunt lateral lobes; intermediate margin sinuate at each side.

¹ Received April 20, 2000. Accepted May 21, 2000.

² Departamento de Zoología, Instituto de Biología, UNAM, Apartado Postal No. 70153, México, 04510 D.F. México.

³ ORSTOM, Institut français de recherche scientifique pour le développement en coopération, 213, rue La Fayette, F-75480 Paris Cedex 10, France.

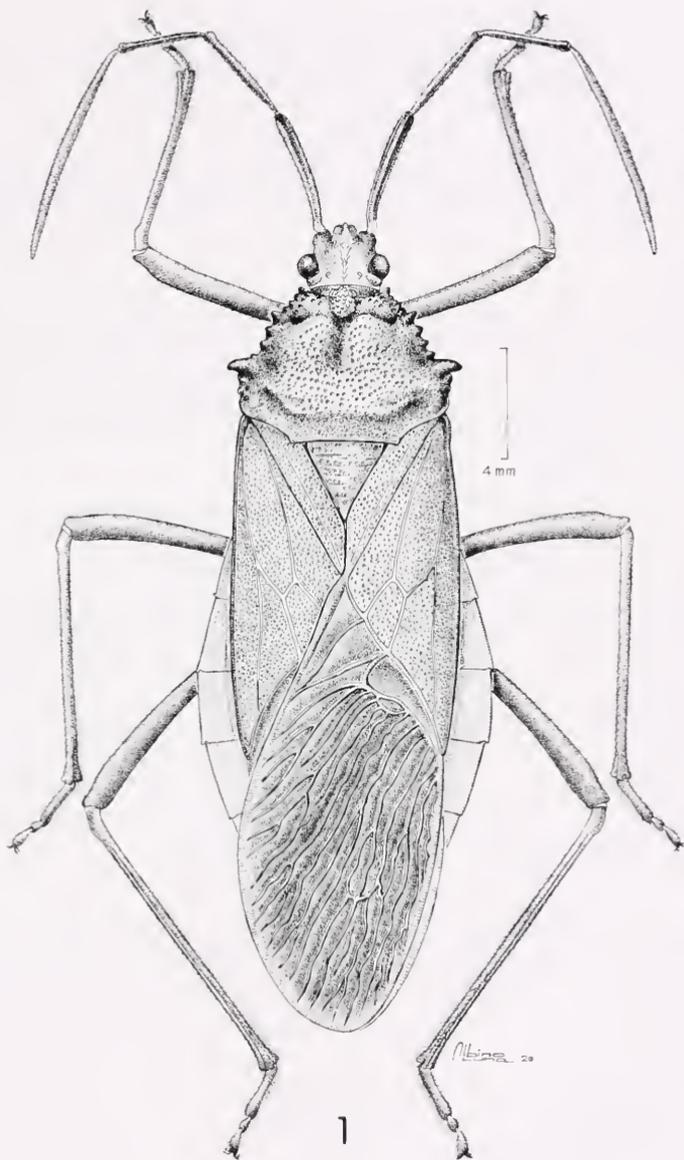


Fig. 1. Dorsal view of *Sephinioides formosus* NEW SPECIES

Female. Unknown.

Measurements. Male (in mm). Head length 2.20, width across eyes 3.04, interocular space 1.68, interocellar space 0.82, preocular distance 1.44; length of antennal segments: I, 4.52, II, 3.68, III, 2.66, IV, 7.68. Pronotum: Total length 6.20, width across frontal angles 2.40, width across humeral angles 8.24. Scutellar length 2.50, width 2.50. Total body length 30.16.

Type material. Holotype: male, Ecuador, Shushufindi, X-10-1999, L. Reynaud. Deposited in Museum National D' Histoire Naturelle, Paris, France (MNP). **Paratype:** 1 male, same location as holotype. Deposited in Colección Entomológica, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM). The specimens were collected on *Astrocaryum urostachys* (Palmae).

Biology.- *Astrocaryum urostachys* is the only host known for *S. formosus*. *Astrocaryum urostachys* is a multistemmed palm, up to 10 m high, with large pinnate leaves 5-7 m long. It grows in seasonal swamp forests as well as on periodically flooded alluvial soils, along river margins. In the Ecuadorean Amazonian region this palm is preserved in the pastures after deforestation. This species is endemic to the western Amazonia, in Ecuador and northern Peru (Kahn and Millan, 1992; Kahn in press).

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

Comparative notes.- The only other previously known species, *S. ugaldei* Brailovsky is characterized by having the connexival segments bright orange with posterior third of segments III to VI black, the pronotal disc broadly convex, the humeral angles acutely produced into an elongate spine, hemelytral membrane dark with metallic blue-green iridescence, and male genital capsule with the posteroventral margin shallowly concave between short and blunt lateral lobes. *Sephinoioides formosus* new species, has the connexival segments III to VI entirely bright orange, the pronotal disc not broadly convex, the humeral angles produced laterally into a broad and short spine, hemelytral membrane entirely black, and male genital capsule with the posteroventral margin shallowly concave between large and blunt lateral lobes.

ACKNOWLEDGMENTS

The field work was supported by the Institut de Recherche pour le Développement in Quito. We are indebted to F. Kahn for his helpful assistance and L. Reynaud, who collected the new species. We extend our sincere gratitude to Albino Luna for the dorsal-view illustration.

LITERATURE CITED

- Brailovsky, H. 1996. A new genus and a new species of Leptoscelidini (Heteroptera: Coreidae) from Costa Rica. Proc. Entomol. Soc. Wash. 98: 215-220.
Kahn, F. El género *Astrocaryum* en el Peru. Biota 100 (in press).
Kahn, F., and B. Millan. 1992. *Astrocaryum* (Palmae) in Amazonia. A preliminary treatment. Bull. de l' Institut Francais d' etudes Andines 21 (2): 459-530.

**A NEW SPECIES OF *COELIDIANA*
(HOMOPTERA: CICADELLIDAE)
FROM THE GALAPAGOS ISLANDS^{1,2}**

Paul H. Freytag³

ABSTRACT: A new species of *Coelidiana* is described from the Galapagos Islands. This species is similar to other species of the genus, except for color pattern and male genitalia. This species is presently known only from the Galapagos Islands. It appears likely that it came from the coastal area of Ecuador and probably occurs on some host plant that was also introduced.

Kramer (1967) reviewed the genus *Coelidiana* Oman and included 15 species as well as three species considered to be of uncertain generic placement. DeLong & Kolbe (1975) added an additional species. The genus with 19 possible species occurs from Mexico south to Brazil and Peru. This new species is the first species of the subfamily to occur in the Galapagos Islands. It is a likely introduction from the coastal area of Ecuador as it has only recently been collected on the Islands and the genus is poorly known along the coastal area of South America.

Coelidiana krameri, NEW SPECIES

A pale yellow species with a brown area along the edge of the forewing along the commissure and the appendix.

Length of males 4.5 to 5.2 mm., females 5.2 to 6.0 mm.

Crown produced and bluntly rounded, about as long at middle as basal width between eyes. Crown longer than pronotum.

Color: generally pale yellow with few markings (Fig. 1). Venation of forewing obscure, except for some apical longitudinal veins, brown; inner margin of forewing from sides of scutellum to near apex of claval vein, then along appendix, brown.

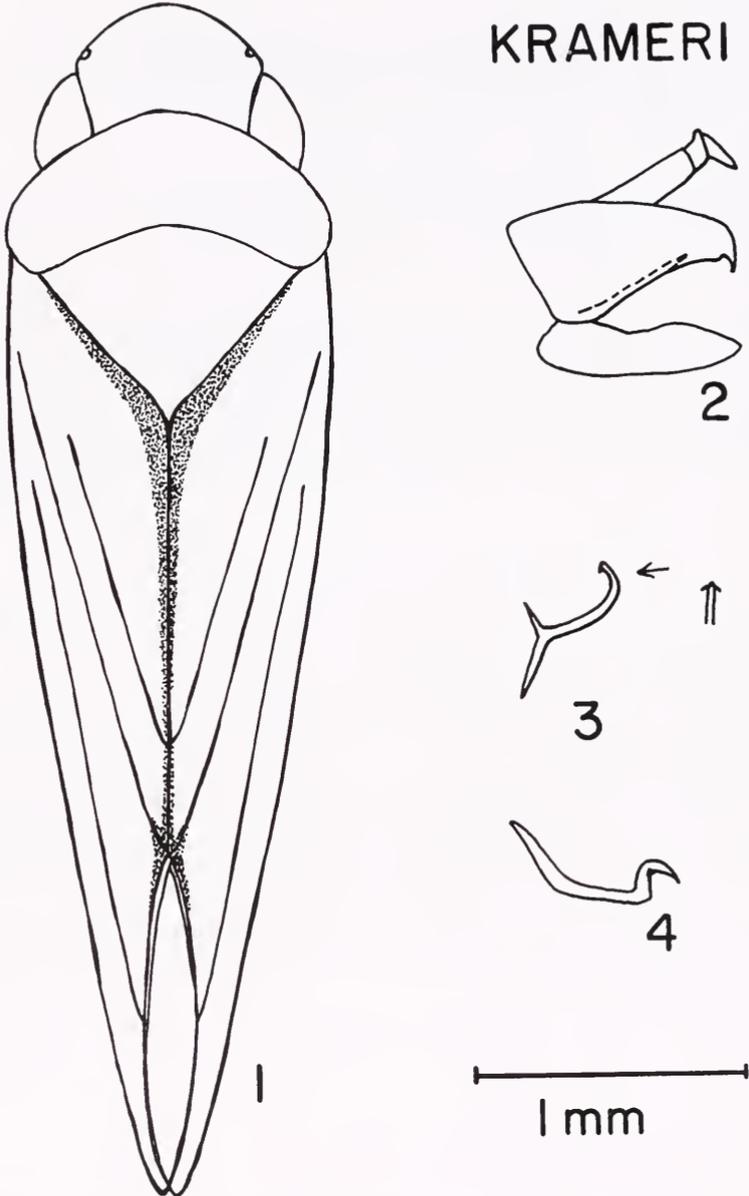
Terminalia: Female sternum VII posterior margin with three pointed projections, 1 at mid-line and 1 on each side halfway between mid-line and lateral margin. Male pygofer apex (Fig. 2) narrowing to a ventrally projecting short spine; ventral margin thickened almost spine-like near apex. Valve and subgenital plates fused; subgenital plates fused to near apex, lacking macrosetae. Style (Fig. 4) elongate, with a sharp "claw" at apex. Aedeagus (Fig. 3) in lateral view, with an expanded base, narrow shaft that distally curves dorsad, with a pair of very small lateral processes at apex.

Specimens: Holotype male from Galapagos Islands: Santa Cruz Island, 1.7 km. North of Santa Rosa, 1-30-V-1991, 550m., *Scalesia* forest, malaize-FIT, S. & J. Peck, 91-113. Paratypes: 13 males, 5 females same data as holotype. Holotype and one female paratype in the Ecuador Na-

¹ Received March 9, 2000, Accepted May 10, 2000.

² This paper is published with approval of the Director of the Kentucky Agricultural Experiment Station as journal article no. 00-08-46.

³ Department of Entomology, University of Kentucky, Lexington, KY 40546-0091.



Figures 1-4 *Coelidiana krameri* new species, male. Fig. 1. Dorsal view. Fig. 2. Lateral view of genital capsule. Fig. 3. Lateral view of aedeagus, with ventral view of apex. Fig. 4. Lateral view of style. All drawn to same scale.

tional Museum; five males and one female paratype in the Canadian National Collection; one male and one female paratype in the University of Kentucky Collection; six males and one female paratype in the California Academy of Sciences Collection.

A total of 96 specimens have been seen, including the type material. All are in alcohol, and from the Island of Santa Cruz, except for one male and one female from the Island of Isabela, and two females from the Island of Floreana. The specimens that are not types are deposited in the following collections: The University of Kentucky, the British Museum, the Canadian National Collection, the California Academy of Sciences, and the Bishop Museum. Specific data on all specimens can be obtained from the author or from any of the above museums.

Remarks: the claw-like form of the male style is typical for the genus *Coelidiana*. This species most resembles *spina* DeLong in that both species lack a ventral spine on the male pygofer. *C. krameri* differs in having the apical spine much shorter and the aedeagus has a minuscule pair of lateral apical processes. The processes of the aedeagus would slightly expand the description of the genus to include this species. The host plant of this species is unknown.

Etymology: this species is named for James P. Kramer who did so much work on this subfamily.

ACKNOWLEDGMENTS

I wish to thank Stewart B. Peck, Carleton University, Ottawa, Canada for providing all specimens. His recent and excellent collecting in the Galapagos Islands yielded all known specimens of this species.

LITERATURE CITED

- DeLong, D. M. and A. B. Kolbe 1975. Three new species of Neocoelidiinae (Homoptera: Cicadellidae) from Panama and Peru. *J. Kans. Entomol. Soc.* 48(1):124-126.
- Kramer, J. P. 1967. New Neotropical Neocoelidiinae with keys to the species of *Coelidiana*, *Xenocoelidia*, and *Nelidiana* (Homoptera, Cicadellidae). *Proc. Entomol. Soc. Wash.* 69(1): 31-46.

TWO NEW SPECIES OF THE GENUS *WHITFIELDIELLUS* (HYMENOPTERA: BRACONIDAE) FROM BRAZIL¹

S.M. Barbalho², A. M. Pentead-Dias³

ABSTRACT: Two new species of the genus *Whitfieldiellus*, *W. nigricephalus* and *W. xanthellus*, are described from Brazil.

The subfamily Doryctinae belongs to the cyclostome Braconidae (Ichneumonoidea) with a circular oral opening and concave clypeus. It is characterized by the presence of a row of short spines on the fore tibia, a flange at the apico-lateral edges of the propleuron the dorsal valve of the ovipositor with a double node at the apex and a basal tubercle on the hind coxae in some genera. The Doryctinae is one of the largest subfamilies with more than 140 genera distributed worldwide. The genus *Whitfieldiellus* contains large and colorful species with distinctive notched scape and hind wing venation with vein m-cu recurved.

This is a contribution to a long term study of the subfamily for Brazil. Examining accumulated material in collections we have found two new species in that genus.

Key to species of the genus *Whitfieldiellus*:

- 1- Oral opening large, diameter twice length of malar space; wings with two infusate bands; hind wing with vein r-m 2/3 length of 1-M *W. variegatus* (Marsh, 1993)
Oral opening shorter, diameter about equal to malar space; wings entirely hyaline or with only one infusate band at apex (Figures 1, 2) 2.
- 2- Mesoscutum and vertex smooth and shining (Figure 3); notauli smooth (Figure 3); propodeum as in Figure 5 *W. nigricephalus* n. sp.
Mesoscutum strigate (Figure 4); notauli scrobiculate (Figure 4); propodeum as in Figure 6 *W. xanthellus* n. sp.

Genus *Whitfieldiellus* Marsh

Whitfieldia Marsh, 1993. Preoccupied by *Whitfieldia* Davidson 1882.

Whitfieldiellus Marsh 1997. New name for *Whitfieldia* Marsh 1993.

Type species. *Whitfieldia variegata* Marsh.

¹ Received March 29, 2000. Accepted April 24, 2000.

² Faculdade de Medicina, Universidade de Marília. Av. Higino Muzzi Filho, 1001, Marília, SP, Brasil.

³ Departamento de Ecologia e Biologia Evolutiva, Universidade Federal de São Carlos, CP 676, CEP 13 565-905, São Carlos, SP, Brasil.

Redescription. Body length, 10.0-12.0 mm; oral opening variable; eye large; apical rim of scape notched on outer side (fig. 1); occipital carina not meeting hypostomal carina; mesonotum declivous anteriorly; notauli indicated by smooth or scrobiculate grooves; sternaulus forming a shallow smooth line; propodeum variable; first metasomal tergum longer than apical width, raised median area lined by distinct lateral carinae; second metasomal tergum with median area at base margined laterally by distinct carinae; ovipositor longer than metasoma; hind coxa with basal tooth; fore tibia with scattered row of chaetobothria; fore wing with r-m present, vein 1cu-a variable; cell 2CU variable, vein 2cu-a absent or represented by fuscous spot; hind wing with vein M+CU and vein r-m length variable, vein M+CU equal to 1-M, vein m-cu curved at apex toward wing tip.

Distribution. Occurs in Mexico, Central America and Brazil.

Comments. The notched scape and the recurved m-cu are distinctive for this genus.

Whitfieldiellus nigricephalus, NEW SPECIES

(Figs 1, 2, 4, 6)

Holotype, female. Head with occipital carina present, but not meeting hypostomal one; face areolate-rugose; vertex, frons and temples smooth; face height slightly longer than eye height; face width 1.6 times longer than eye width; oral opening half of eye height; eye width 2 times temple width; malar space equal to oral opening; scape with expanded flap on apical anterior edge (fig. 1).

Mesosoma (figs 4, 6) completely smooth and shining except for carinae; mesonotum declivous anteriorly; mesoscutum midlobe more elevated than sidelobes; notauli smooth and running parallel to the scutellum (Figure 4); sternaulus only a slightly smooth mark; propodeum with a smooth pentagonal cell (Figure 6); fore tibia with a row of many long chaetobothria; hind coxae with a very short basal tubercle.

Fore wing (fig. 2) with vein m-cu joining 2-M before 2-RS; r-m vein present; first subdiscal cell open at apex; M+CU not sinuate; 1 cu-a reaching vein 1CU beyond M; 2cu-a absent at apex; second submarginal cell short; 3RSa vein shorter than r vein; apical third infuscated. Hind wing (fig. 2) with M+CU equal in length to 1-M; r-m about 1/3 of 1M.

Metasoma with T1 1.5 times longer than apical width; T1 slightly strigate and with dorsal carina extending to apex; T2 strigate and with two converging carinae; T3 smooth and with a shallow groove enclosing circular area at base; remaining terga smooth and shining; ovipositor longer than body.

Body yellow, except for head, antenna, apex of mandibles, apex of metasoma, ovipositor sheaths, hind legs (except apex of tibia) and last tarsal segment of fore and mid legs black; fore wing hyaline and apex infuscated, hind wing hyaline, stigma and veins yellow.

Body length: 10mm.

Distribution. Barra do Tapirapé, MT, Brasil

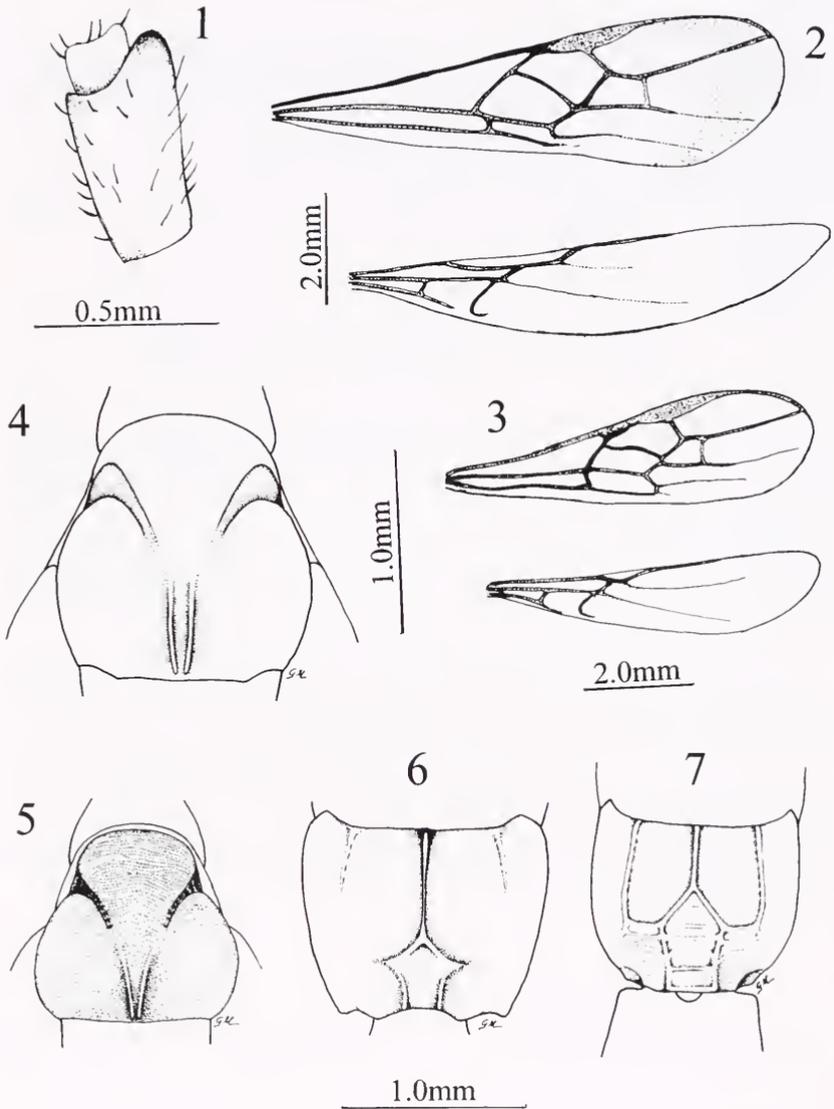
Specimen examined. Barra do Tapirapé, MT, Brasil, November, 1964; B. Malkin, col. Deposited in DCBU (Universidade Federal de São Carlos, Departamento de Ecologia e Biologia Evolutiva).

Etymology. The name of the species refers to its head color.

Whitfieldiellus xanthellus, NEW SPECIES

(Figs. 3, 5, 7)

Holotype, female. Agrees with the description of *W. nigricephalus*, n. sp. except as follows: vertex and mesoscutum strigate (fig. 5); notauli scrobiculate (fig. 5); propodeum with strigate



Whitfieldiellus nigricephalus n. sp. 1. scape; 2. wings; 4. mesoscutum; 6. propodeum.

Whitfieldiellus xanthellus n. sp. 3. wings; 5. mesoscutum; 7. propodeum.

cell (fig. 7); all terga of metasoma strigate; first subdiscal cell closed at apex; Icu-a interstitial to 1M; body and legs yellow, except antennae, apex of mandibles, last tarsal segments of fore and mid legs, black; apex of hind tibiae and hind tarsal segments infuscated; apex of ovipositor and its sheaths infuscated; wings hyaline (fig. 3); stigma brown.

Distribution. Paranapebas, Serra Norte, PA, Brasil.

Specimen examined. Paranapebas, Serra Norte, PA, November, 1985. Deposited in DCBU (Universidade Federal de São Carlos, Departamento de Ecologia e Biologia Evolutiva).

Etymology. The name of the species refers to its yellowish color.

ACKNOWLEDGMENTS

Thanks to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), for financial support. Also to Paul M. Marsh and Robert A. Wharton for comments and suggestions to the manuscript.

LITERATURE CITED

- Marsh, P. M.** 1993. Description of New Western Hemisphere Genera of the Subfamily Doryctinae (Hymenoptera: Braconidae). *Contrib. Amer. Entomol. Inst.* 28 (1): 1-58.
- Marsh, P. M.** 1997. Replacement names for Western Hemisphere Genera of Doryctinae (Hymenoptera: Braconidae). *Proceed. Entomol. Soc. Wash.*, 99 (3): 586.
-

BOOKS RECEIVED AND BRIEFLY NOTED

PARASITOID POPULATION BIOLOGY. M.E. Hochberg & A.R. Vies, editors. 2000. Princeton University Press, Princeton, NJ 08540. 366 pp. Cloth \$75.00; Paper \$24.25.

Presentations by seventeen international specialists on the subject of insect parasitoids and the diversity in their life styles. After a general introduction, the book treats the subject in three main sections: population dynamics, population diversity, and population applications, including their value as agents in biological control.

INSECT PREDATOR-PREY DYNAMICS. LADYBIRD BEETLES AND BIOLOGICAL CONTROL. A.F.G. Dixon. 2000. Cambridge University Press. 257 pp. Hardcover \$74.95.

This volume explores the basic biology of ladybird beetles, their association with their prey, and its effect on development rate and body size. Optimal foraging theory, field observations, and laboratory experiments are used to illustrate how ladybird larvae maximize their rate of energy intake, and ladybird adults their fitness. The interdependence of these life history parameters is then used to develop a simple predator-prey model.

A NEW SPECIES OF *SINELLA* (COLLEMBOLA: ENTOMOBRYIDAE) FROM CHINA¹

Wang Fang², Kenneth A. Christiansen³

ABSTRACT: A new species, *Sinella* (*Sinella*) *wui*, is described from Qinghai Province, China. It is very similar to *S. (S.) triocula* Chen & Christiansen 1993 in many aspects; however, the eye position, chaetotaxy on Abd. I & II, mental setae X, X₄, make separation easy.

So far, among 84 known species in the genus *Sinella* (*s.l.*), 27 are known from China, but none from Qinghai. A new species, *Sinella* (*Sinella*) *wui*, from this region is described here. The chaetotaxy patterns, setae and macrochaetae designations used in this paper are after Chen & Christiansen (1993, 1997).

Sinella (*Sinella*) *wui*, NEW SPECIES

(Figs. 1-13)

Maximum body length 2.7 mm.

Color: white to pale yellow.

Head: Eyes 3+3 in dark blue patches but clearly separate (Fig. 2). Antennae 1.45 - 1.67 X length of cephalic diagonal. Ant. III organ not clearly seen. Labral setae 4/5, 5, 4, all smooth. External differentiated seta of labial appendage well developed, straight or slightly curved, much thicker than normal setae, with tip exceeding apex of same papilla by 0.50-0.60 of its length (Fig. 3). Seta R of labial triangle smooth to weakly ciliate, about 0.5 as long as seta M₁; M₁ supplementary seta is present in 3 of the 11 specimens seen, ciliate, about as long as seta R (Fig. 4 & 5). Mental setae G₁₋₄ & H₂₋₄ smooth; setae X, X₂, X₃ & X₄ ciliate, respectively 1.36, 1.71, 1.44 and 1.23 times the length of seta R of labial triangle; X₄ supplementary 1,2 rarely present, ciliate (Fig. 4).

Macrochaetae and large mesochaetae: Head — group I 4, group II 5; Th. II — group I 1, group II 4, group III 3 (rarely 4), group IV 2 (rarely 3), group V 4+5 (rarely 5+5), group VI 0; Th. III — group I 6 (rarely 7), group II 9-10, group III 3, group IV 4; Abd. I — usually 5 on each side arranged in pattern V (Fig. 6), rarely 6 in pattern II; Abd. II — 3 in M₃ arch and 1 lateral on each side, additional macrochaeta (M_{3ei}) always present and very close to M₃ arch (Fig. 7); Abd. III — 2+2 dorso-central and 3 lateral on each side; Abd. IV — 14 dorso-central arranged in pattern I, and 6 lateral arranged in pattern III on each side (Fig. 1).

Legs: Trochanteral organ setae 12-13. Inner differentiated setae of tibiotarsus "smooth" with ciliations more closely appressed to setal axis than in *S. triocula*. Outstanding inner macrochaeta of tibiotarsus one on the fore leg and two on the hind leg, acuminate but tapered only at extreme tip. If one setae at 0.25-0.35 from base; if two, the basal seta about 0.12-0.27 from base, the distal one at 0.47-0.66 from base. (Fig. 8). Unguis with 4 inner teeth, basal paired two unequal, outer one large; basal median tooth long and sharply pointed, about 0.35-0.44 way from base to apex of unguis; distal median tooth often present, very tiny. Unguiculus with large outer tooth. Tenent hair apparently longer than unguiculus, strongly clavate (Fig. 9).

Ventral tube: with 12 ciliate setae on anterior face (Fig. 10), 12-14 smooth setae on posterior, 6-7 smooth setae on each lateral flap (Fig. 11).

¹ Received March 24th, 2000. Accepted May 10, 2000.

² Department of Biology, Nanjing University, Nanjing 210093, P.R. China.

³ Department of Biology, Grinnell College, Grinnell, IA 50112.

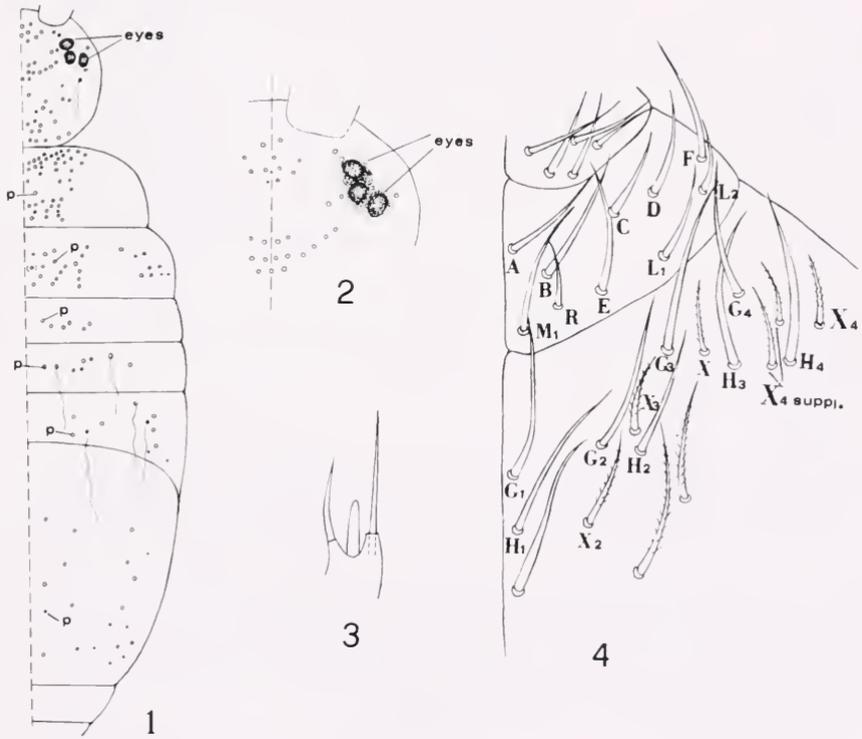
Furcula: Manubrium without smooth setae, manubrial plaque with 3-4 ciliate setae and 2-3 pseudopores on each side (Fig. 12). Mucronal apical tooth 2.3-2.6 X as long as subapical tooth, the latter with tip at slightly less than half way from base to apex of mucro. Uncrenulate dens about 1.3-1.5 X length of mucro. Mucronal basal spine with tip slightly exceeding midway from subapical to apical tooth (Fig. 13).

Male genital plate not seen.

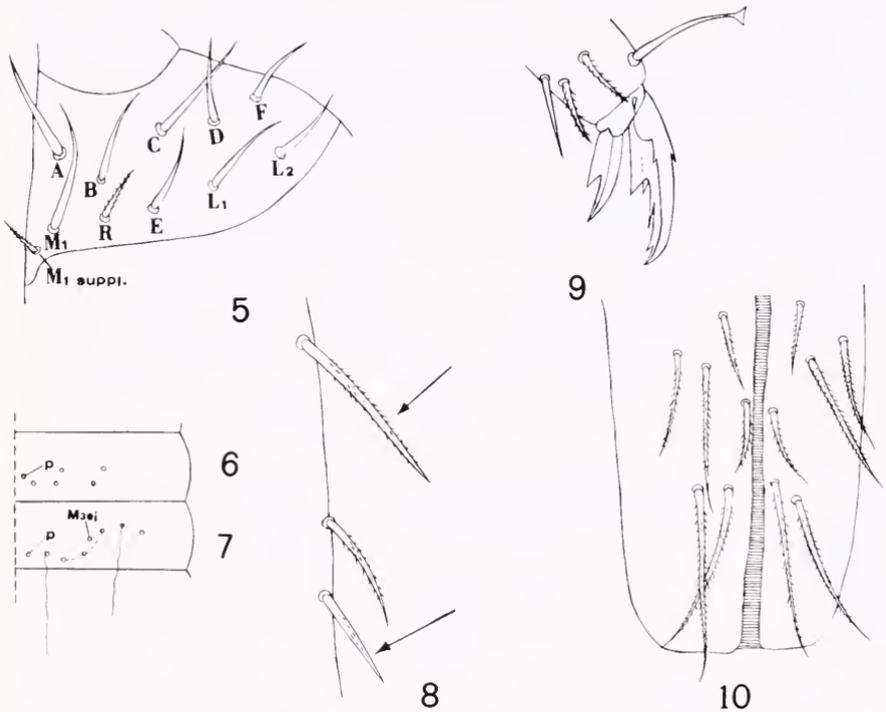
Types: Holotype female, paratypes 10 females, P. R. China: Qinghai: Xining City, altitude 2250-2330m, VI-3-1997, collection number 8654, coll. by Wu Ming. Deposited in Department of Biology, Nanjing University, China.

Ecology: Found only at the type locality, living with *Pseudosinella* in an ant nest under green hedge.

Etymology: Named after Mr. Wu Ming who furnished the type specimens.



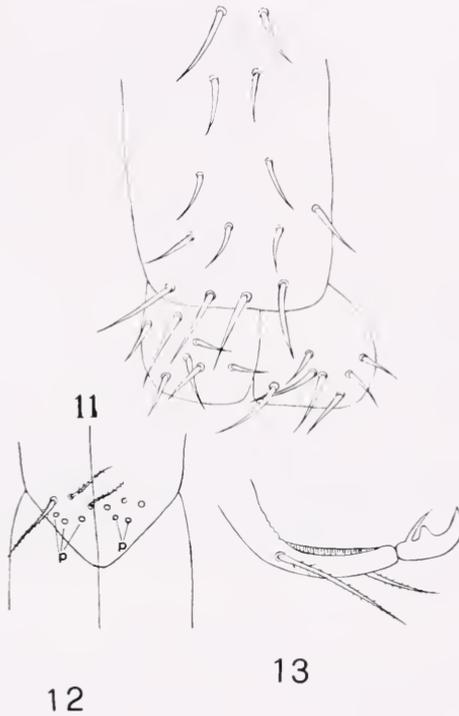
Figs. 1-4 *Sinella (Sinella) wui*, sp. nov. 1. semi-diagrammatic eyes and dorsal chaetotaxy; 2. eyes; 3. external differentiated seta of labial appendage; 4. typical labial and mental chaetotaxy.



Figs. 5-10. *Sinella (Sinella) wui*, sp. nov. 5. rare variant labial chaetotaxy; 6. dorsal chaetotaxy of Abd. I; 7. dorsal chaetotaxy of Abd. II; 8. inner tibiotarsal setae; 9. hind foot complex; 10. anterior face of ventral tube.

Remarks: The new species differs from all known species in two characters. One is the typical pattern of dorsal macrochaetae on Abd. I with 5 macrochaetae on each side arranged in a new pattern (for convenience, named as pattern V); rarely with 6 in pattern II. The other character is the mucronal basal spine length, the tip of which slightly exceeds the midpoint from the apex of subapical to apical tooth, therefore, belonging to pattern II (Chen & Christiansen, 1993); however, it is apparently longer than those in pattern I which tip reaches at most only slightly exceeding the subapical tooth; however, it is clearly the shortest in pattern II in all known species with tip reaching at least near the apex of the apical tooth.

In the genus *Sinella* (*s.l.*), there are five species with 3+3 eyes: *triocula*, *straminea*, *hexophthalma*, *sexoculata*, *pseudostraminea*, all in *Sinella (Sinella)*, only 2 of them were reported from China: *S. (S.) straminea* Folsom 1899 and *S. (S.) triocula* Chen & Christiansen 1993. It is easy to separate the new species from the 3+3-eyed Japanese species *straminea* (redescribed by Yosii, 1942), in having 2+2 dorsal macrochaetae on Abd. III whereas they are 1+1 in



Figs. 11-13. *Sinella (Sinella) wui*, sp. nov. 11. posterior face and lateral flap of ventral tube; 12. manubrial plaque; 13. apex of dens and mucro.

straminea. This species may be the same as that identified as *straminea* by Denis (1929) from China (Peking), both having a long, pointed basal median tooth of the unguis and a long mucronal basal spine. Both features are very different from Folsom's original Japanese *straminea*, as redescribed by Yosii in 1942 which has a short mucronal spine, a very small median unguis tooth and lacks an apical tooth as well as having a different eye configuration.

The new species is closely related to *Sinella (S.) triocula* in sharing many characters, such as chaetotaxy on Abd III & IV; however, it differs from the latter as below.

Character	<i>triocula</i>	<i>wui</i>
Eye position	front 2 touching each other and separate from hind one	separate
Dorsal macrochaetae on Abd. I	7(6), pattern I(II)	5(6), pattern V(II)
Dorsal macrochaeta M _{3ei} on Abd. II	absent	present
Mental setae X, X ₄	smooth	ciliate
Mental setae X/R, X ₄ /R	0.6, 0.54	1.23, 1.3
Mucronal basal spine	short (pattern I)	long (pattern II)

ACKNOWLEDGMENTS

The study was supported by the National Nature Science Foundation of China (No. 39970097). We thank Liu Ren-hua in Nanjing University, who made the final drawings for this paper. We also thank Wu Ming in the Beijing Institute of Zoology, Academia Sinica, who made the specimens available. Thanks are also given to Chen Jian-xiu in the Department of Biology, Nanjing University, China, for his useful help to our work. Publication of this work was made possible by a grant from Grinnell College.

LITERATURE CITED

- Chen, J. X. & K. A. Christiansen.** 1993. The genus *Sinella* with special reference to *Sinella S.S.* (Collembola : Entomobryidae) of China. *Oriental Insects* 27: 1-54.
- Chen, J. X. & K. A. Christiansen.** 1997. Subgenus *Coecobrya* of the Genus *Sinella* (Collembola: Entomobryidae) with Special Reference to the Species of China. *Ann. Entomol. Soc. Amer.* 90(1):1-19.
- Folsom, J.W.** 1899. Japanese Collembola Pt.II. *Proc. Amer. Acad. Art Sci.*, 34: 261- 274.
- Yosi, R.** 1942. Japanische Entomobryinen. II. *Collemb. Arch. Naturgesch. (N.F.)*, B10:476-495.
- Denis, J.R.** 1929. Notes sur les Collemboles récoltés dans ses voyages par le Prof. F. Silvestri. Seconde Note sur les Collemboles D'Étreme Orient. *Bull. Lab.Zool. Gen. Agrar. Porici* 22: 305-320.

**A NEW SPECIES OF ANISOCENTROPUS
(TRICHOPTERA: CALAMOCERATIDAE)
FROM SRI LANKA¹**

Oliver S. Flint, Jr.²

ABSTRACT: *Anisocentropus atropurpureus* from the island of Sri Lanka is described and the male genitalia figured. It is closely related to *A. annulicornis* differing primarily in its purplish-black wings and orange body, and lowland distribution.

The trichopteran fauna of Sri Lanka (earlier Ceylon, Taprobane, or Serendib) has been relatively well studied, with the last and most complete study by Schmid (1958). In this he described two new species in the family Calamoceratidae: *Anisocentropus ittikalama* and *Ganonema elyakatuwa* and listed another six species from the literature: *A. decipiens* (Ulmer 1915), *A. brevipennis* (Ulmer 1915), *A. annulicornis* (Hagen 1858), *A. immunis* McLachlan (1863), *G. pallicorne* McLachlan (1866), and *G. falcata* (Banks 1913). In the most recent study on Asian calamoceratids, Malicky (1994) reduced this number of species to three: *A. ittikalama*, *A. annulicornis*, and *G. falcata*. He synonymized (correctly) *A. decipiens* with *A. annulicornis*, *G. elyakatuwa* with *G. falcata* and discounted the records of *A. brevipennis*, *A. immunis*, and *G. pallicorne* as clearly misidentifications because the types of all these species are from Indonesia. It seems quite probable that the records of *A. brevipennis* and *A. immunis* are misidentifications of *A. ittikalama*. If the *Ganonema* is correct generically then it probably pertains to *G. falcata*. In addition to the three species recognized above, Kimmins (1963) described *Nieterella hageni* from Ceylon but was unable to decide if it belonged in the Leptoceridae, Calamoceratidae or Odontoceridae. It was left in the Leptoceridae, and, although its correct placement is unsettled, it seems unlikely to be a calamoceratid.

The Smithsonian Ceylon Insect Project in Sri Lanka (material in the National Museum of Natural History, Smithsonian Institution = NMNH) captured many specimens of *A. ittikalama* and *G. falcata*, and single specimens of *A. annulicornis* and *N. hageni*. However, five specimens of a totally differently appearing species of *Anisocentropus* were also taken. The forewings are fuscous with purple reflections and the body mostly orange, a coloration quite unlike any other insular species. However, when the genitalia were cleared and compared with its congeners, there appeared to be no significant differ-

¹ Received February 4, 2000. Accepted April 24, 2000.

² Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-0105 USA.

ence between these structures in the new species and *A. annulicornis*. Further study of the whole insect has convinced me that these do represent two species and the new one is described below.

Anisocentropus atropurpureus, NEW SPECIES

Figures 1-5

This species is easily distinguished by sight from the other Sri Lankan species of *Anisocentropus*. Its forewings are fuscous with purpurescent reflections and the body is orange. Its insular congeners are brown, either pale or mottled darker brown with broadly triangular forewing, while *Ganonema* is fuscous with elongate, falcate forewings. Considering the male genitalia, this and *A. annulicornis* are clearly sibling species, the differences in these structures being minimal: the basodorsal "horns" of the tenth tergum being proportionately broader and the tip of this segment being more strongly decurved in *A. atropurpureus*. However, with only a single example of *A. annulicornis* for comparison one has no way to assess possible variation in these structures. The size, appearance and distribution of the two species offers obvious differences. *A. annulicornis* is slightly larger, the forewing length (male) being 17 mm, as opposed to 10.5-12 mm in *A. atropurpureus*. The coloration is very different in the two, *A. annulicornis* being light brown, and the body pale yellowy brown. In *A. atropurpureus* the wings are fuscous with purplish reflections, the head and thorax are orange, with the vertex mostly fuscous. In addition, the forewings of both sexes have a transverse, dense band of black hair at about a third of the distance from the base to apex of the wing and in the costal cell for the basal half; this band contrasts strongly with the nearly bare membrane on each side of it. *A. annulicornis* is a high elevation species: the type is from Rambodde at "3500 bis 4000 Fuss über dem Meere" (1065-1220 m), its synonym, *A. decipiens*, is from Pattipola "6500-7500 Fufs" (1980-2285 m), the NMNH specimen from Horton Plains at 6600' (2010 m). The examples of *A. atropurpureus* are from, generally, much lower elevations: 490-530 m (Sinharaja), 400 feet (122 m, Kanneliya), and Enselwatte ca 900 m.

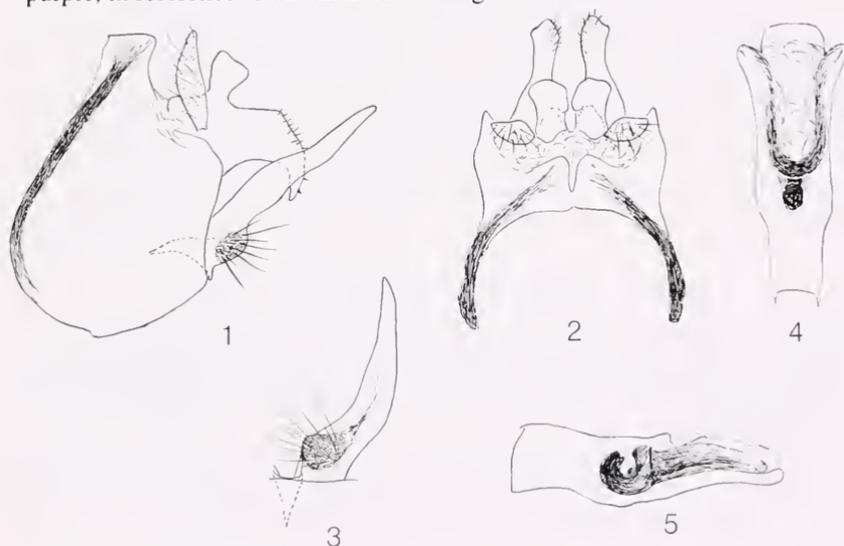
MALE.-Length of forewing 12 mm. Color, purply-fuscous and orange: head orange frontally, vertex fuscous shading to orange posteriorly, maxillary palpi fuscous, covered with dense, fuscous hair; scape and pedicel fuscous, flagellar segments fuscous with spot of white hair apicodorsally on each segment; thorax orange, legs orange with tibiae and tarsi fuscous with fuscous hair, hind tibia with fringe of long, silky, fuscous hair; abdomen dark, discolored; forewing fuscous with purply reflections, with transverse, dense band of fuscous setae at third of distance from base to apex, basad and apicad to which membrane glabrous and shining, costal cell from near base to beyond midlength densely packed with fuscous setae, hind wing with rows of sparse silky hair on veins Cu₁ and 1, 2, and 3A; with a well developed hair pencil in anal angle composed of grey, long, silky hair. Spurs 2, 4, 3; outer spurs much shorter than inner. No modification of abdominal terga. Genitalia (Figs. 1, 2): Ninth segment rounded anteroventrally; dorsum raised and narrowly cleft apicomeresally. Cercus elongate oval, erect. Tenth tergum with

basodorsal lobe about as long as high, slightly enlarged apicad, lateral plate elongate, broad basally, with apex sharply angled ventrad. Inferior appendage long, slender, with an enlarged basal knob bearing enlarged setae (Fig. 3). Phallus elongate, ventral margin slightly sinuate; internally with a curled, tubular, central lobe giving rise to elongate, apicolateral sclerites (Fig. 5), lyre-shaped in dorsal aspect (Fig. 4); apicoventral plate thin in lateral aspect, apex broadly rounded in dorsal aspect.

FEMALE.-Length of forewing, 10.5-11 mm. Color and wing vestiture as in male; lacking hair fringe on hind tibia and hair pencil in hind wing. Spurs 2, 4, 3.

MATERIAL EXAMINED.-Holotype, male: Sri Lanka, Mata[ra District], Enselwatte, 25 May 1975, S.L. Wood & J.L. Petty. NMNH. Paratypes: Rat[napura District], Sinharaja Jungle, 3 mi [4.8 km] S Weddagala, 490-530 m, 22-23 September 1977, K.V. Krombein, P.B. Karunaratne, T. Wijesinhe, M. Jayaweera, taken in Malaise trap, 1♂. Gal[le District], Kanneliya, 22-23 May 1975, S.L. Wood & J.L. Petty, 1♂; Kanneliya Jungle, 11-16 January 1975, K.V. Krombein, P.B. Karunaratne, P. Fernando, N.V.T.A. Weragoda, 1♀; Udugama, Kanneliya Jungle, 400 feet [112 m], 6-12 October 1973, K.V. Krombein, P.B. Karunaratne, P. Fernando, J. Ferdinando, at black light, 1♀. Holotype and 1♂, 1♀ paratypes in NMNH; 1♂, 1♀ paratypes in National Museum, Colombo.

ETYMOLOGY.-An adjective, from the Latin, ater-black and purpura-purple, in reference to the distinctive wing color.



Figures 1-5. *Anisocentropus atropurpureus* n. sp., male genitalia. 1, lateral; 2, dorsal; 3 inferior appendage, posteroventral; 4, phallus, dorsal; 5, phallus, lateral.

ACKNOWLEDGMENTS

The author is indebted to a Smithsonian Research Foundation Grant and the Fluid Research Funds, K.V. Krombein, principal investigator, for support that allowed him and the other collectors to work in Sri Lanka. The comments of an anonymous reviewer are greatly appreciated.

LITERATURE CITED

- Banks, N.** 1913. Synopses and descriptions of exotic Neuroptera. Trans. Am. Entomol. Soc. 39: 201-242.
- Hagen H.** 1858. Synopsis der Neuroptera Ceylons. Verh. kaiserlich-königlichen zool. bot. Ges. Wien 8: 471-488.
- Kimmins, D.E.** 1963. On the Leptocerinae of the Indian sub-continent and north east Burma (Trichoptera). Bull. Br. Mus. (Nat. Hist.), Entomol. 14:262-316.
- Malicky, H.** 1994. Ein Beitrag zur Kenntnis asiatischer Calamoceratidae (Trichoptera). Z. Arbeitsgem. Österr. Entomol. 46: 62-79.
- McLachlan, R.** 1863. On *Anisocentropus*, a new genus of exotic Trichoptera, with descriptions of five species, and of a new species of *Dipseudopsis*. Trans. Entomol. Soc. London 1 (ser. 3): 492-496, pl. XIX.
- McLachlan, R.** 1866. Descriptions of new or little-known genera and species of exotic Trichoptera; with observations on certain species described by Mr. F. Walker. Trans. Entomol. Soc. London 5 (ser. 3): 247-278, pl. XVII-XIX.
- Schmid, F.** 1958. Trichoptères de Ceylan. Arch. Hydrobiol. 54: 1-173.
- Ulmer, G.** 1915. Trichopteren des Ostens, besonders von Ceylon und Neu-Guinea. Dtsch. Entomol. Z. 1915: 41-75.
-
-

BOOKS RECEIVED AND BRIEFLY NOTED

EMBIA, CONTRIBUTIONS TO THE BIOSYSTEMATICS OF THE INSECT ORDER EMBIIDINA, PARTS 1 AND 2. E.S. Ross. 2000. California Academy of Sciences, San Francisco, CA. 8 $\frac{1}{2}$ x 11 format. 36 pp. Paper. \$18.60 incl. shipping.

In two parts. Part 1: Origin, Relationships and Integumental Anatomy of the Insect Order Embiidina. Part 2: A Review of the Biology of Embiidina. EMBIA is a new publication intended to serve as the outlet for the author's long-shelved manuscripts on Embiidina. Very well illustrated.

GROUND BEETLES AND WRINKLED BARK BEETLES OF SOUTH CAROLINA. Janet C. Ciegler. 2000. Clemson University, Clemson, SC. 8 $\frac{1}{2}$ x 11 format. 149 pp. Paper.

Adults of 102 genera and 49 species and subspecies of Carabidae, including Cicindelini, that have been reported from or are likely to occur in South Carolina are discussed, plus two genera and four species of Rhyssodidae. Keys to genera and to species, diagnostic diagrams to aid in keying; a description of each species; and data on range, season, and collection within the state are included.

DESCRIPTION OF LATE INSTAR LARVAE OF *DIAULOTA PACIFICA* (COLEOPTERA: STAPHYLINIDAE)¹

Hye-Jin Kim, Jee-Yeon Ryu, Kee-Jeong Ahn²

ABSTRACT: Late instar larvae of *Diaulota pacifica* are described for the first time. A key is provided for separation of the known species of late instar larvae of East Asian *Diaulota*, and illustrations of diagnostic features are presented. Late instar larvae of *D. pacifica* are compared with those of *D. aokii* and *D. uenoi*. The differences of urogomphi are hypothesized as good characters to distinguish these species.

Members of the aleocharine genus *Diaulota* Casey are confined to the rocky headlands of the Pacific Coast of the Holarctic Region. The genus was first described and characterized by Casey (1893) based on *D. densissima* from the coast of Alaska. Since then, eight species have been described by Moore (1956a, 1956b, 1972), Sawada (1955, 1971) and Ahn (1996) from the coast of North America, Japan, and Alaska, respectively.

Also, Moore (1956b) described late instar larvae of four North American species (*D. densissima* Casey, *D. fulviventris* Moore, *D. harteri* Moore, and *D. vandykei* Moore). Ahn (1996) discussed biology and ecology of this genus and described late instar larvae of two East Asian species [*D. aokii* Sawada and *D. uenoi* (Sawada)] and redescribed the four North American species.

In this paper we describe late instar larvae of *D. pacifica* for the first time, present differences among three East Asian *Diaulota* species, and provide a modified key with illustrations for identification.

MATERIALS AND METHODS

Preparation of permanent microscopic slides for late instar larvae was performed by using techniques described by Ashe (1986) and Ahn and Ashe (1996). Terms and chaetotaxic system for late instar larvae follows Ashe and Watrous (1984). Materials for this study are deposited in the Chungnam National University Insect Collection, Daejeon City, Korea (CNUIC).

Description of Late Instar Larvae of *Diaulota pacifica*

Diagnostic Combination. Larvae of *D. Pacifica* are distinguished from all other described *Diaulota* larvae by the combination of: maxilla with most

¹ Received March 28, 2000. Accepted May 29, 2000.

² Department of Biology, Chungnam National University, Daejeon City 305-764, Republic of Korea.

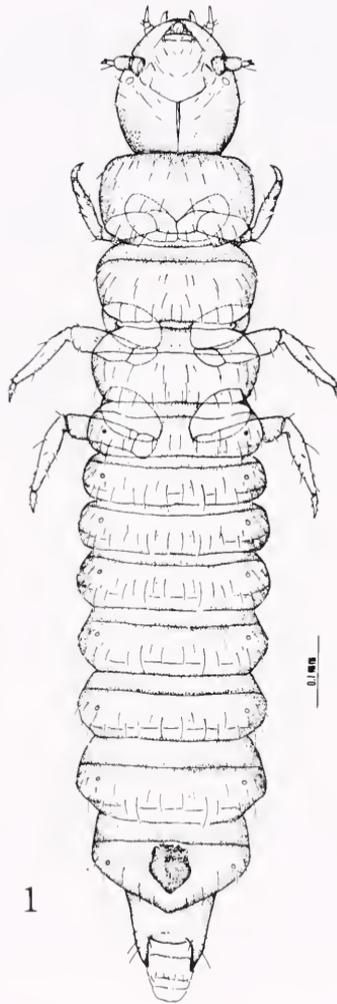


Fig. 1. Late instar larvae of *Diaulota Pacifica* Sawada. Habitus.

basal seta on malar surface pointed (Fig. 8); urogomphus fused to main body, without large thickened and sclerotized spine (Fig. 13); point longer than its width at subapical base; distance from minute seta to subapical seta 0.9-1.0 times length of point (Fig. 13); and minute seta shorter than point width of subapical base.

Description. Length 1.7-2.0 mm. General body shape (Fig. 1) elongate, flattened, parallel-sided. Color variable: reddish brown, or brown.

HEAD. About as long as wide. Chaetotaxy (Figs. 2 and 3) with frontal, epicranial, temporal, lateral, and ventral regions complete (Fd1-Fd3, Fl1-Fl4, Fm1, Ed 1-Ed3, E11-E13, Em1-Em3, T1-T2, L1-L3, V11-V14, and V1-V2 all present), 2 additional L setae present, campaniform sensilla Fc1- Fc2, Ec1-Ec2, P1-P4, Lc1-Lc3, and Vc1-Vc2 present. Antenna (Fig. 4) with 3 articles; article 1 about 0.8 times as long as wide, with 5 campaniform sensilla around apical margin; article 2 about 1.5 times length of article 1; article 3 about 0.7 times length of article 2; article 2 with 3 solenidia in addition to sensory appendage; sensory appendage robust, inflated, acorn-shaped and faintly fenestrate, its length shorter than that of article 3; IIS1 spiniform, short, 0.5 times as long as IIS2, IIS2 elongate, digitiform, about as long as sensory appendage.

MOUTHPARTS. Labrum (Fig. 5) with 4 additional setae on each side, and 3 campaniform sensilla present; seta Ld2 very short, robust and inflated. Mandible (Fig. 6) with 5 serrations on internal edge (2 between apex and median tooth, 3 between median tooth and base; 2 setae in basi-lateral half, distal seta very small and basal seta large and long). Mala (Fig. 8) with large seta most basal, pointed; article 1 of maxillary palpus elongate, 1.1 times as long as wide; article 2 about 0.6 times as long as article 1; article 3 about as long as article 1 and 2 together. Labial palpus (Fig. 7) with 2 articles, article 2 about 2.0 times as long as article 1.

THORAX. Pronotum (Fig. 9) transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1-A5, L1-L5, P1-P5, Da1-Da3, Db1-Db3, Dc1-Dc3, and Dd1-Dd2 all present), campaniform sensilla C1-6 present. Mesonotum (Fig. 10) transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1-A5, L1 and L4, P1-P5, Da2 and Da3, Db1-Db3, Dc2, and Dd2 all present), campaniform sensilla C1, C3, C4, C5, and C6 present. Metanotum (Fig. 11) similar to mesonotum. Tarsus with 2 robust dorsal spines.

ABDOMEN. Abdominal tergites I-VII transverse; abdominal tergite I chaetotaxy with anterior, lateral, posterior and discal rows complete (A2, A4, A5, L1 and L4, P1-P5, Da2, Db2, Dc2, and Dd2 all present). Urogomphus (Fig. 13) long, about as long as tergite IX, without large thickened and sclerotized spine, apex pointed, apical point longer than width of point at subapical base, distance from minute seta to subapical seta 0.9-1.0 times length of point, minute seta shorter than point width of subapical base.

Material Examined. Korea. Gyeongsangnam-do: Geojedo Island, Gabaeri, 3 VII 1998, K.-J. Ahn, H.-J. Kim and J.-Y. Ryu, ex inside empty barnacles on rocks in low tide (CNUIC, 12).

Remarks. The larvae were collected in association with adults in Geojedo Island; therefore, we have described them as probable late-instar larvae of *D. pacifica*.

The differences of urogomphi among members of the Korean *Dialota* species are presented in Table 1.

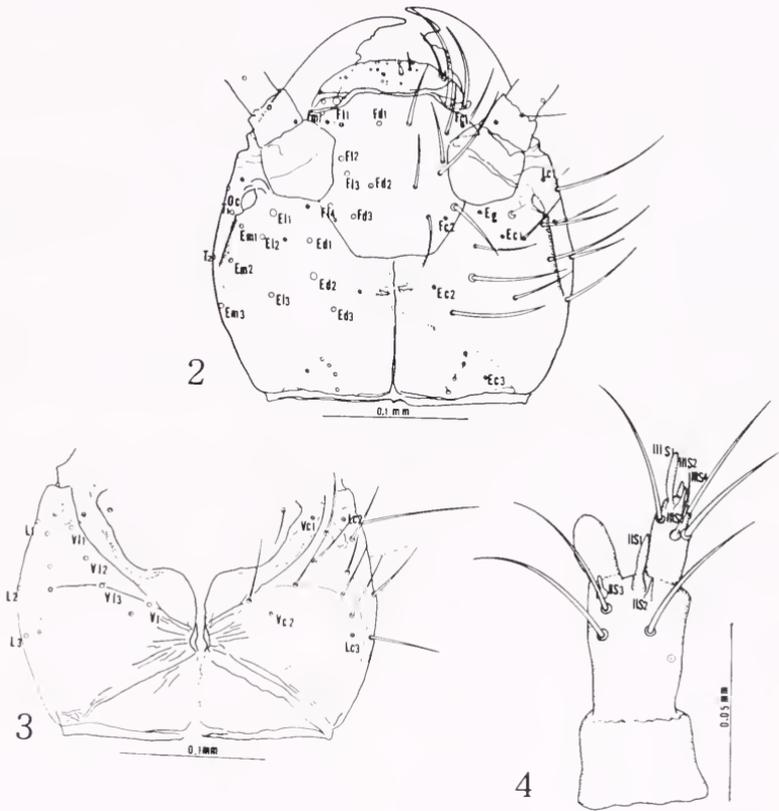
Table 1. The differences of urogomphi among members of the East Asian *Dialota* species.

	<i>D. aokii</i>	<i>D. pacifica</i>	<i>D. uenoi</i>
Shape of external line	Sinuate	Almost straight	Almost straight
Thickened and sclerotized seta	Present	Absent	Absent
Length of minute seta	Longer than width of subapical base	Longer than width of subapical base	Shorter than width of subapical base

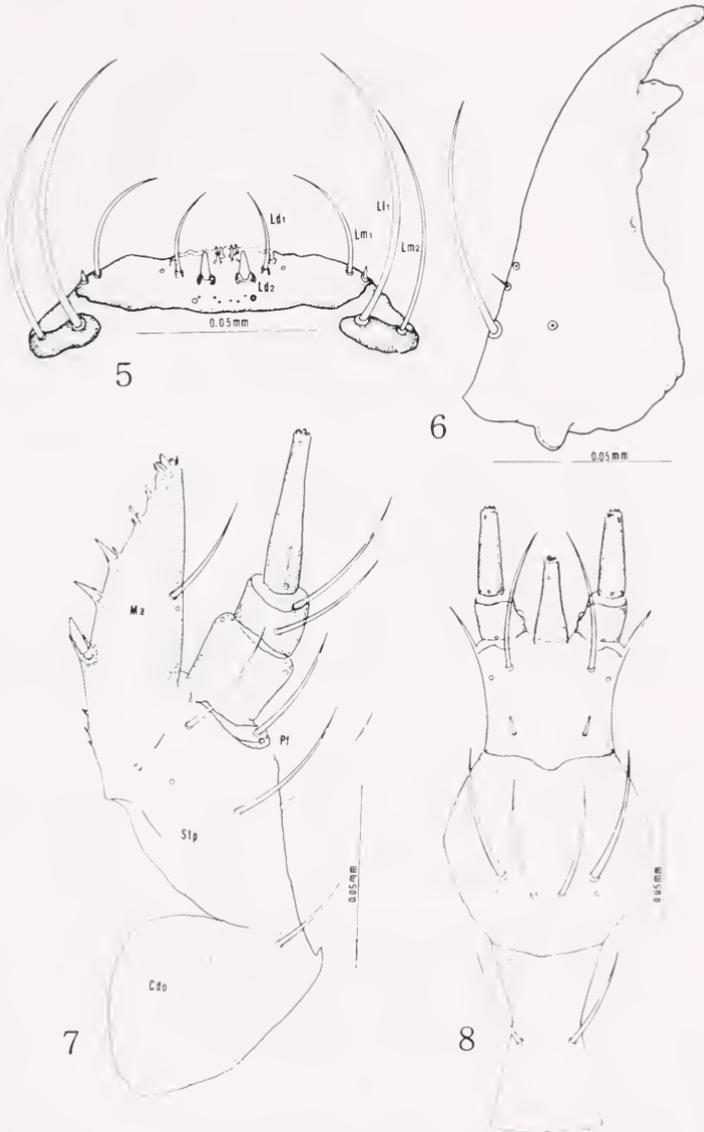
Key to the species of late instar larvae of *Diaulota*

(modified from Ahn, 1996: 276)

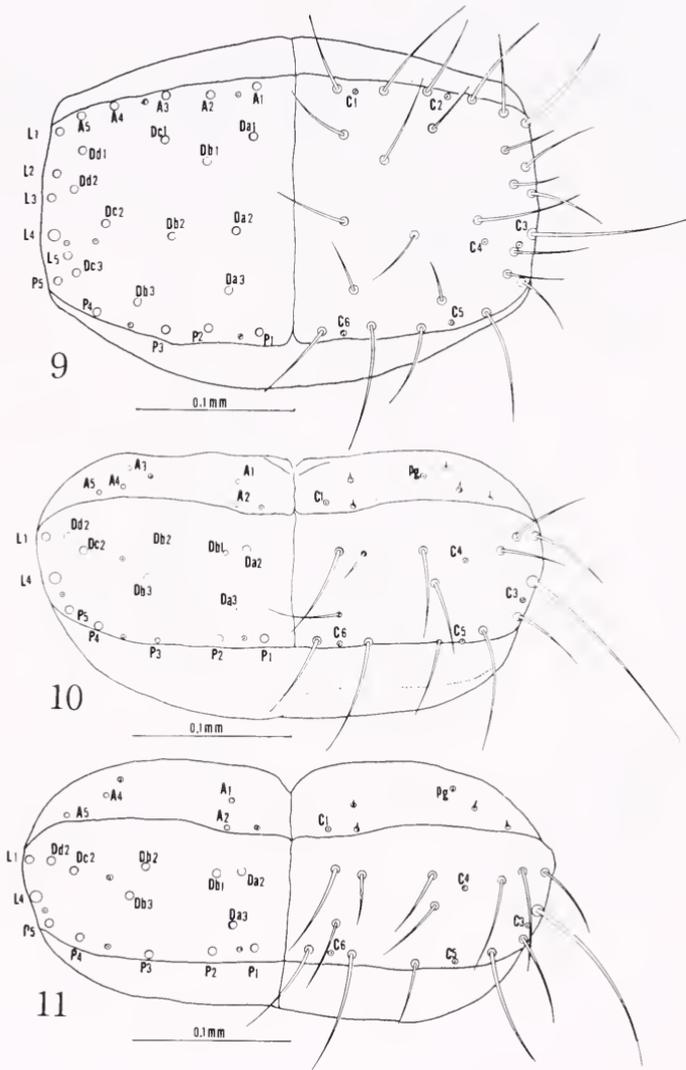
- 1 Urogomphus without thickened and sclerotized seta 5
 1' Urogomphus with thickened and sclerotized seta 2
 2 Most basal seta of right mala pointed (Fig. 8) *D. aokii*
 2' Most basal seta of right mala not pointed, knife-shaped 3
 (3 and 4 as in Ahn, 1996.)
 5 Minute seta of urogomphus shorter than point width of subapical base *D. uenoi*
 5' Minute seta of urogomphus longer than point width of subapical base *D. Pacifica*



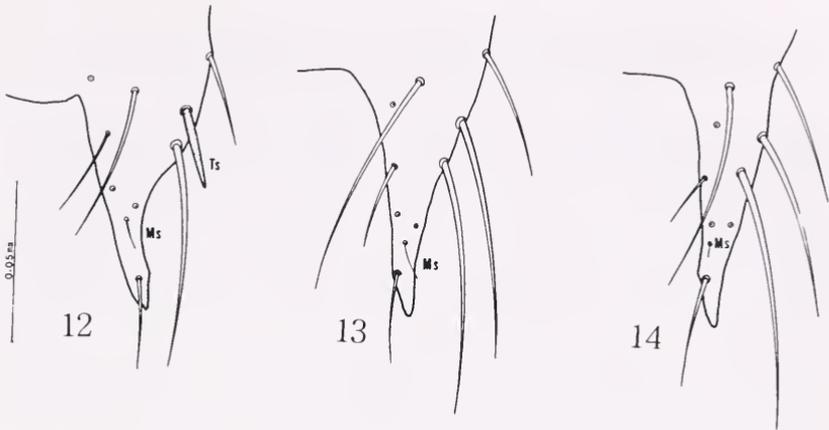
Figs. 2-4. Late instar larvae of *D. Pacifica*. 2, Head, dorsal aspect; 3, head, ventral aspect; 4, antenna, dorsal aspect. Symbols according to Ashe and Watrous (1984).



Figs. 5-8. Late instar larvae of *D. Pacifica*. 5, Labrum, dorsal aspect; 6, mandible, dorsal aspect; 7, labium, dorsal aspect; 8, maxilla, dorsal aspect. Symbols according to Ashe and Watrous (1984).



Figs. 9-11. Late instar larvae of *D. Pacifica*. 9, Pronotum, dorsal aspect; 10, mesonotum, dorsal aspect; 11, metanotum, dorsal aspect. Symbols according to Ashe and Watrous (1984).



Figs. 12-14. The urogomphi of the East Asian *Diaulota* species. 12. *D. aokii*; 13. *D. Pacifica*; 14. *D. uenoi* (Ts-thickened and sclerotized seta, Ms-minute seta).

ACKNOWLEDGMENTS

We thank Joseph-Jin Chang (Institute of Marine Biology, Geojedo Island, Korea) for allowing us to use his facilities and providing logistics during the collecting trip. This research was supported by KRF (1999-015-DI0088) awarded to K.-J. Ahn.

LITERATURE CITED

- Ahn, K.-J. 1996. A review of *Diaulota* Casey (Coleoptera: Staphylinidae: Aleocharinae), with description of a new species and known larvae. Col. Bull. 50(3): 270-290.
- Ahn, K.-J. and J. S. Ashe. 1996. Phylogeny of the intertidal aleocharine tribe Liparocephalini (Coleoptera: Staphylinidae). Syst. Entomol. 21: 99-114.
- Ashe, J. S. 1986. Structural features and phylogenetic relationships among larvae of genera of gyrophaenine staphylinids (Coleoptera: Staphylinidae: Aleocharinae). Fieldiana: Zoology. 30: 1-60.
- Ashe, J. S. and L. E. Watrous. 1984. Larval chaetotaxy of Aleocharinae (Staphylinidae) based on a description of *Atheta coriaria* Kraatz. Col. Bull. 38(2): 165-179.
- Casey, T. L. 1893. Coleopterological notices V. Ann. N. Y Acad. Sci. 7: 281-606.
- Moore, I. 1956a. A revision of the Pacific coast Phytosi with review of the foreign genera (Coleoptera: Staphylinidae). Trans. San Diego Soc. Nat. Hist. 12: 103-152.
- Moore, I. 1956b. Notes on some intertidal Coleoptera with descriptions of the early stages (Carabidae, Staphylinidae, Malachiidae). Trans. San Diego Soc. Nat. Hist. 12: 207-230.
- Sawada, K. 1955. Marine insects of the Tokara islands VIII. Family Staphylinidae (Coleoptera). Pub. Seto Mar. Biol. Lab. 5: 81-87.
- Sawada, K. 1971. Aleocharinae (Staphylinidae, Coleoptera) from the intertidal zone of Japan. Pub. Seto Mar. Biol. Lab. 19: 81-110.

INVERTEBRATES INHABITING WETLAND MONOCOTS DAMAGED BY LEPIDOPTERA¹

J. B. Keiper^{2,3}, M. Sanford², J. Jiannino², W. E. Walton²

ABSTRACT: We report twelve orders and 18 families representing at least 20 species of invertebrates taken from cattail (*Typha* sp.) and bulrush (*Schoenoplectus californicus*) plants damaged by larval *Bellura obliqua gargantua* (Lepidoptera: Noctuidae) in southern California. Of the invertebrate taxa taken, 60% were scavenger/detritivores, 15% were predators, 10% were secondary herbivores, and 5% were primary herbivores. Seven aquatic invertebrate taxa gained access to the interior areas of plants after holes formed by feeding noctuid larvae became inundated by fluctuating water levels. Diptera was the most species-rich order encountered in mines, with six families and at least seven species represented.

California bulrush (*Schoenoplectus californicus* [Meyer] Sojak) and cattails (*Typha* sp.) grow prolifically in southern California wetlands and frequently form dense monocultural stands. During studies of the Prado Constructed Wetlands near Corona (CA, Riverside Co.), we noticed a number of plant stems with holes created by larval feeding. These plants were damaged by phytophagous larvae of *Bellura obliqua gargantua* (Dyar) (Lepidoptera: Noctuidae). This is a subspecies whose range is restricted to the area around the Santa Ana River of southern California.

Bellura obliqua Walker was studied intensively in Minnesota where the first two instars mined cattail leaves while third instars were stem borers (Penko and Pratt 1986a, 1986b, 1987). Damaged plants attracted a variety of secondary invaders. Surveys of the insects associated with cattails reported at least 40 species of stem borers, leaf miners, seed head predators, and secondary invaders from the eastern and northwestern United States (Claassen 1921, Cole 1931), but no comparable data are available for southwestern North America. The invertebrate fauna of constructed wetlands from the southwestern United States is not well known (Keiper and Walton 1999), and it is reasonable to assume that the assemblage and biology of secondary invaders of monocots in this region differs from that found in more northern latitudes. Herein, we give an annotated list of the invertebrates associated with California bulrush and cattails damaged by the larval feeding of *B. o. gargantua*, and provide biological observations.

MATERIALS AND METHODS

The Prado Constructed Wetlands is a mosaic of 46 individual marshes interconnected by water control structures, and measures 121.5 ha. Cattails and

¹ Received November 28, 1999. Accepted May 1, 2000.

² Dept. of Entomology, Univ. of California, Riverside, CA, 92521.

³ Current address: Dept. of Invertebrate Zoology, Cleveland Museum of Natural History, 1 Wade Oval, Cleveland, OH 44106.

California bulrush grow in most of the shallow areas and represent approximately 75% of the vegetative growth. The marsh receives water diverted from the Santa Ana River and acts as a biofilter for potential drinking water. During normal operations, the wetlands are inundated year round.

Bulrush and cattail plants that exhibited feeding damage were collected from the wetlands during 1998-1999 by cutting the plant slightly above the sediment surface. We returned samples of each plant to the laboratory where they were split open and examined under a dissecting microscope to procure specimens of *B. o. gargantua* and any secondary invaders that took advantage of damaged epithelial tissue to gain access to the plant interior. Most specimens were placed in 70% ethanol, but larval Diptera were first fixed in KAA solution for 24 hours and then transferred to ethanol. Undetermined eggs, larvae, and pupae were placed in petri dishes with decaying plant tissue for rearing to the adult stage for identification and to obtain biological observations. All immature stages were kept at approximately 19-21°C and a 16:8 light:dark photoperiod. Information on feeding habits and ecology was obtained through direct observation in the field and laboratory, or taken from Borror et al. (1989), Thorp and Covich (1991), and Merritt and Cummins (1996). Representative specimens are maintained in the collection of the senior author, or were deposited in the University of California - Riverside Entomology Research Museum and Carnegie Museum of Natural History.

RESULTS AND DISCUSSION

Twelve orders and 18 families representing at least 20 species of invertebrates were taken from cattail and bulrush plants; *B. o. gargantua* was the only insect primary herbivore found mining these plants in the Prado Constructed Wetlands. One species of invertebrate was taken from bulrush only, 16 from cattails only, and three from both plants (Table 1).

Lepidoptera

Bellura obliqua gargantua (Dyar) (Noctuidae)- Larvae and pupae were taken from both bulrush and cattails; no evidence suggested that larvae leave the plant before pupation. Bulrush tunnels were linear, approximately 40 cm long and 0.9 cm diameter, and affected nearly half of the tissue along the damaged length ($n = 2$ plants, 22-IX-1998). A single entrance hole, presumably created by a third instar, was present at one end of the damaged area. Cast larval exuviae were found adjacent to pupae; larvae were similarly positioned at the end. Larval feeding created masses of frass and brown senescent plant tissue. Infested cattail plants exhibited similar damage, but damaged areas were frequently amorphous due to the overlapping nature of the densely layered leaves near the basal end of the plant. This caused the outer epithelial layer to become compromised in several places during feeding ($n = 35$ plants, 22-IX-1998, 19-

VI-1999, 26-IX-1999). One pupa from bulrush and two from cattails were reared to the adult stage.

Collembola

Sminthuridae - Many undetermined sminthurid springtails were found in cattail plants from June-September 1999.

Dermaptera

Forficula auricularia L. (Forficulidae) - Four adult earwigs were taken from two cattail plants (19-VII-1999, 23-VII-1999). Lepidopteran feeding created large openings in both plants which probably allowed access for the earwigs. Both plants were in areas where receding water levels probably allow terrestrial insects to gain access to the plants.

Odonata

Anax sp. (Aeshnidae) - A single early instar nymph was collected from a damaged cattail plant with a hole below the water level (19-VII-1999); fluctuating water levels probably submerged the hole and filled part of the lepidopteran tunnel with water. The nymph likely moved into the plant where predators are less abundant but prey are present.

Homoptera

Aphididae - Numerous undetermined aphids were found in most bulrush and cattail plants where they appeared to gain access through the damaged plant tissue. Specimens were taken or observed consistently from July-September 1999. Adults and immatures fed in the area of senescing plant tissue up to 20 cm from the hole, but it was not determined if they were sucking plant juices or ingesting liquid from the masses of decaying tissue.

Coleoptera

Philonthus caurinus Horn (Staphylinidae) - Adults were found in cattail plants where they probably hunted soft-bodied invertebrates (19-VII-1999, 26-VII-1999). Eight eggs were taken near lepidopteran exit holes, while five adults were observed deeper in the tunneled areas.

Enochrus sp. (Hydrophilidae) - A single adult was taken from within a cattail stem where it probably entered through an inundated hole (19-VII-1999). The aquatic adults are detritivores.

Hymenoptera

Iridomyrmex humilis (Mayr) (Formicidae) - Large colonies of the Argentine ant were observed in apparently old desiccated tunnels. Plants with dried damaged areas were taken from a portion of the marsh drained from May - June 1999. The ants probably colonized the stems within dense stands of cattails after the benthic area dried. However, colonies appeared to remain active even after the area was flooded. Workers traveled between plants using fallen vegetation.

Diptera

Chironomidae - Early instars of two undetermined species of midge were found in cattail stems whose damaged tissues were inundated by rising water levels

(19-VII-1999). Individuals of both species had burrowed into the soft senescing plant tissue where they probably fed as collector/gatherers.

Psychodidae - Twenty-two moth fly larvae were taken from submerged cattail stems and keyed to *Pericoma* sp. or *Telmatoscopus* sp. using Merritt and Cummins (1996); the two genera are apparently indistinguishable in the larval stages. Both genera have larvae that are aquatic and feed as collector/gatherers. Larvae were collected in areas of stems above the water level. The environment inside the damaged stems is quite moist due to plant juices and decaying tissue allowing these aquatic scavengers to survive (19-VII-1999, 26-VIII-1999).

Eristalis sp. (Syrphidae) - Thirteen "rat-tailed maggots" were taken from cattail plants whose damaged tissues were inundated (19-VII-1999, 26-VIII-1999). The larvae respire with an elongate breathing tube which they extend to the water surface. Larvae did not have access to the water surface outside of the cattail stem, but most likely extended their tubes to obtain oxygen from air trapped inside the upper portion of the tunneled area. Larvae are collector/gatherers, and perhaps fed on the decaying tissue and frass present.

Allograpta obliqua Say (Syrphidae) - Larval *A. obliqua* were occasionally found hunting aphids on the exterior of bulrush plants (7-X-1998, 21-VI-1999). One plant stem exhibiting feeding damage was split open revealing a third instar *A. obliqua* larva moving within the lepidopteran tunnel approximately 20 cm from the hole (22-IX-98); the tunnel was replete with aphids. The larva was brought back to the laboratory where it consumed an unknown number of aphids prior to pupating. This and one other larva taken from the exterior of a plant pupated, and each exhibited a pupal duration of 7 days.

Odontomyia sp. (Stratiomyiidae) - Five soldier fly larvae were taken from inundated stems where they probably fed on decaying plant tissues (19-VII-1999).

Chaetopsis massyla Walker (Otitidae) - Thirty five larvae and one puparium of *C. massyla* were taken from three cattail plants (19-VII-1999, 23-VII-1999, 26-VIII-1999). The puparium was reared to the adult stage. Larvae are known secondary stem borers of cattail plants (Allen and Foote 1992), and probably obtain their nutriment from the bacteria and fungi associated with the decaying vegetation and lepidopteran frass.

Typopsilopa nigra (Williston) (Ephydriidae) - Numerous eggs, maggots, and puparia of *T. nigra* were taken from both bulrush and cattail from June - September 1999. Immatures infested lepidopteran tunnels along the entire length and larvae fed on the browning, senescent tissues and frass. More than 20 third instars and 20 puparia were reared to the adult stage in the laboratory. This species was found in nearly all plants damaged by the feeding of *B. o. gargantua*.

Other invertebrates

Mollusca: Gastropoda - Three terrestrial slugs were collected from mines in

cattail plants near the water's edge (19-VII-1999).

Hyalella azteca (Saussure) (Amphipoda: Hyalellidae) - Numerous adults and immatures were observed in submerged cattail stems; they probably experienced a reduced predator presence here (June - September 1999). Although juvenile amphipods are frequently associated with brightly lit environments where they exploit microbial (bacterial and algal) food resources (Thorp and Covich 1991), photonegative adults probably used the darkened areas within damaged plants to feed on decaying organic matter.

Isopoda - Ten terrestrial isopods were found in three cattail plants close to the water's edge. They probably gained access to the tunneled plants via fallen vegetation and scavenged within them (19-VII-1999).

Acari - Numerous terrestrial mites were observed in many cattail and bulrush stems damaged by lepidopteran feeding. It is unknown if the species present are parasitic, predatory, or scavengers.

Questionable associations

Collection of adult insects in the Prado Constructed Wetlands often produced *Elachiptera nigriceps* Loew (Diptera: Chloropidae) which was reported by Cole (1931) to have emerged from cattail stalks from Michigan. We assume it is a secondary stem borer in the wetlands. *Anthomyza* sp. (Anthomyzidae) were also taken, and are suspected of having associations with wetland monocots.

CONCLUSIONS

Of the 20 invertebrate taxa procured from cattails and bulrush, 60% were scavenger/detritivores, 15% were predators, 10% were secondary herbivores, and 5% were primary herbivores (Table 1); the feeding habits of the mites and aphids were not determined. Diptera was the most species-rich order taken from the mines, representing 40% of the taxa. *Bellura obliqua gargantua*, *T. nigra*, and *C. massyla* were the only three taxa that exhibited trophic specificity for these wetland monocots, but it is unknown if the aphids collected are associated with other plant species. *Typopsilopa nigra* and *C. massyla* appear to thrive in the presence of monocots damaged by lepidopteran feeding, but our laboratory rearings indicate that these species will feed on plant tissue damaged by any means. All other invertebrate taxa encountered probably invaded the mines opportunistically where they took advantage of the heterotrophic food sources or the protection from predators and abiotic pressures, and are not reliant upon the presence of *B. o. obliqua*. Although the Prado Constructed Wetlands never dries completely, lepidopteran mines may provide a refuge for some invertebrates from marshes that dry periodically. Mined cattails produced a more species rich invertebrate fauna than California bulrush (Table 1).

The genus *Bellura* appears to require taxonomic revision, and it is probable that at least some subspecies will attain full species status (J. E. Rawlins, personal communication). Although the genus has been shown to attack cattails (Penko and Pratt 1986a), this is the first report of its use of bulrush as a host plant. The restriction of *B. o. gargantua* to a small geographic range and its unique habit of boring bulrush stems provide biological support for the necessity of a systematic revision of the genus.

Table 1. Invertebrates collected from bulrush and cattail plants damaged by lepidopteran feeding in a southern California constructed wetlands.

Taxa	Bulrush	Cattail	Trophic association			
			1 ⁰ herb.	2 ⁰ herb.	scavenger	predator
Lepidoptera						
<i>Bellura obliqua gargantua</i>	X*	X	X			
Collembola						
Sminthuridae		X*			X	
Dermaptera						
<i>Forficula auricularia</i>	X*				X	
Odonata						
<i>Anax</i> ¹		X*				X
Homoptera						
Aphididae ²	X	X				
Coleoptera						
<i>Philonthus caurinus</i>		X*				X
<i>Enochrus</i> ¹		X*			X	
Hymenoptera						
<i>Iridomyrmex humilis</i>		X*			X	
Diptera						
Chironomidae (2 spp.) ¹		X			X	
Psychodidae ¹		X			X	
<i>Eristalis</i> ¹		X*			X	
<i>Allograpta obliqua</i>	X*					X
<i>Odontomyia</i> ¹		X*			X	
<i>Chaetopsis massyla</i>		X		X		
<i>Typopsilopa nigra</i>	X*	X*		X		
Others						
<i>Hyalella azteca</i> ¹		X*			X	
Isopoda		X*			X	
Acari ²		X*				
Gastropoda		X*			X	

¹ Invader of submerged mines only.

² Unknown trophic association.

* Previously unreported use of plant.

ACKNOWLEDGMENTS

We thank Dave Hawks (UC-Riverside), Les Greenberg (UC-Riverside), Alfred Newton (Chicago Field Museum of Natural History), and Martin Hauser (Illinois Natural History Survey) for help identifying challenging specimens; F. Christian Thompson (Smithsonian Institution), John E. Rawlins (Carnegie Museum of Natural History), and B. A. Foote (Kent State University) provided useful information on *Allograpta*, *Bellura*, and acalyprate Diptera, respectively. L. H. Gould, Parker D. Workman (UC-Riverside), and two anonymous reviewers proofread and improved the manuscript. These observations were made during a larger investigation of the Prado Constructed Wetlands funded by the Orange County Water District and the Northwest Mosquito and Vector Control District; Brian Baharie (OCWD) kindly allowed access to the marsh.

LITERATURE CITED

- Allen, E. J. and B. A. Foote. 1992. Biology and immature stages of *Chaetopsis massyla* (Diptera: Otitidae), a secondary invader of herbaceous stems of wetland monocots. Proc. Entomol. Soc. Wash. 94: 320-328.
- Borror, D. J., C. A. Triplehorn, and N. F. Johnson. 1989. An introduction to the study of insects, 6th ed. Harcourt Brace College Publishers, San Diego.
- Claassen, P. W. 1921. *Typha* insects: their ecological relationships. Mem. Cornell Univ. Ag. Res. Sta. 47: 457-531.
- Cole, A. C. 1931. *Typha* insects and their parasites. Entomol. News 42: 6-11, 35-39.
- Keiper, J. B. and W. E. Walton. 1999. Biology and morphology of the mature larva of *Oxyethira arizona* Ross (Trichoptera: Hydroptilidae). Pan-Pac. Entomol. 75: 212-220.
- Merritt, R. W. and K. W. Cummins. 1996. An introduction to the aquatic insects of North America, 3rd. ed. Kendall/Hunt Publishing Co., Dubuque.
- Penko, J. M. and D. C. Pratt. 1986a. The growth and survival of early instars of *Bellura obliqua* (Lepidoptera: Noctuidae) on *Typha latifolia* and *Typha angustifolia*. Great Lakes Entomol. 19: 35-42.
- Penko, J. M. and D. C. Pratt. 1986b. Effects of *Bellura obliqua* on *Typha latifolia* productivity. J. Aq. Plant Management 24: 24-27.
- Penko, J. M. and D. C. Pratt. 1987. Insect herbivory in Minnesota (USA) *Typha* stands. J. Freshwater Ecol. 4: 235-244.
- Thorp, J. H. and Covich, A. P. 1991. Ecology and classification of North American freshwater macroinvertebrates. Academic Press, Inc. New York.

NEW SOUTHERLY DISTRIBUTION RECORDS FOR THE BOREAL CARRION BEETLE, *NICROPHORUS VESPILLOIDES* (COLEOPTERA: SILPHIDAE)¹

Foster Forbes Purrington², Robert L. Davidson³

ABSTRACT: We report the boreal carrion beetle, *Nicrophorus vespilloides*, from wetlands in Illinois, West Virginia, and western Pennsylvania.

Nicrophorus vespilloides Herbst (Coleoptera: Silphidae) has a wide Holarctic distribution in northern coniferous forests (Hatch 1928). In North America it is recorded from Kodiak Island (but not the Aleutians) and continental Alaska to British Columbia, Yukon Territory, Northwest Territories and eastward across southern Canada to mainland and insular Newfoundland (Anderson and Peck 1985, Peck and Miller 1993). In the conterminous United States Anderson and Peck (1985) show it (by shaded-area distribution map) from north-eastern North Dakota eastward through the upper Midwest region (Minnesota, Wisconsin, Michigan) into Pennsylvania and New York, and in all six New England states.

Here we report the first authentic records of *N. vespilloides* from Illinois and West Virginia. We add to the single far eastern Pennsylvanian record (Peck and Kaulbars 1987) with records from two western sites in the Allegheny National Forest.

COLLECTING SITES

Illinois. An insect diversity assessment was undertaken during the 1999 field season in a partially wooded wetland at Spring Bluff Forest Preserve, Winthrop Harbor, Lake County, Illinois. This site is managed by the Lake County Forest Preserve District, which commissioned the study; biodiversity research was organized and managed by Floyd Catchpole (Hey & Associates, Inc. Libertyville, IL).

Spring Bluff Forest Preserve (42°29'N, 87°49'W, elevation: 190 m), along the Lake Michigan shoreline, is part of a remnant dune and swale topography including open sand woodland dominated by black oak, *Quercus velutina* Lam., with a grassy understory interlaced with pockets of wet prairie, *Carex* spp. meadows and ephemeral pools.

¹ Received April 10, 2000. Accepted May 20, 2000.

² Department of Entomology, The Ohio State University, 1735 Neil Avenue, Columbus, OH 43210.

³ Section of Invertebrate Zoology, The Carnegie Museum of Natural History, 4400 Forbes Avenue, Pittsburgh, PA 15213-4080.

West Virginia. Cranesville Swamp Preserve (managed by The Nature Conservancy of West Virginia) is situated in Preston County, West Virginia, and Garrett County, Maryland (39°32'N, 79°29'W). It was assayed for insect diversity by the Carnegie Museum of Natural History during the 1995 season. This 547 ha. property straddles the West Virginia - Maryland state line, but all insects were taken in West Virginia. The collecting site is a high elevation (778 m) evergreen wetland containing an acidic bog plant community marked by boreal relicts (Rawlins et al. 1996). The flora here is characterized by American larch (tamarack), *Larix laricina* (DuRoi) Koch, *Sphagnum* spp. mosses, creeping snowberry, *Gaultheria hispidula* (L.) Bigelow, and winterberry, *Ilex verticillata* (L.) Gray [Fuller et al. 1974; Venable (no date)].

Pennsylvania. Two sites in the Allegheny National Forest in western Pennsylvania not far from the Ohio border in Forest County were inventoried for insects in 1996. Buzzard Swamp Beaver Pond (2.5 km ESE of Marienville, 41°27'N, 79°06'W, elevation: 480 m) is a shrubby marshland adjacent to the open water of an active beaver pond. Important plants are northern wild-raisin, *Viburnum cassinoides* L., northern arrowwood, *V. recognitum* Fern., black cherry, *Prunus serotina* Ehrh., quaking aspen, *Populus tremuloides* Michx., *Sphagnum* spp. mosses, and *Carex* spp. sedges (Rawlins et al. 1999).

Lower Penoke Alder Marsh is located 3.9 km WSW of Pigeon (41°31'N, 79°05'W, elevation: 510 m). Its flora is similar to Buzzard Swamp Beaver Pond but contains considerable speckled alder, *Alnus rugosa* (DuRoi).

Voucher specimens of *N. vespilloides* from Illinois are maintained by FFP at the Ohio State University Department of Entomology, Columbus; those from West Virginia and Pennsylvania are housed at the Carnegie Museum of Natural History, Pittsburgh.

RESULTS AND DISCUSSION

Three *N. vespilloides* adults were taken by pitfall trap at the Spring Bluff Forest Preserve study site in Winthrop Harbor on 30 August 1999. These are the first authentic records of this carrion beetle species from Illinois. Congeners trapped at this site were *N. tomentosus* and *N. orbicollis*, in approximately equal numbers.

At Cranesville Swamp Preserve in West Virginia, 23 *N. vespilloides* were taken between 20 July and 27 September 1996, the first records of the species from this state and the southernmost reported locality for the species. All but one were captured by flight intercept trap (and one by pitfall). As this swamp straddles the Maryland - West Virginia state boundary, there is little doubt that *N. vespilloides* also occurs in Maryland. The only other *Nicrophorus* taken at this site were two *N. defodiens*.

Twenty adult *N. vespilloides* were taken in western Pennsylvania in 1996. Seventeen were taken at Buzzard Swamp Beaver Pond from June to Septem-

ber, 10 by flight intercept trap (June, July, early August), and seven in pitfalls (late August and September). Three others were taken at Lower Penoke Alder Marsh in July. Congeners at Buzzard Swamp Beaver Pond included a dozen *N. orbicollis* and a few each of *N. pustulatus*, *N. sayi*, and *N. tomentosus*. Congeners trapped at Lower Penoke Alder Marsh included 30 *N. orbicollis*, 10 *N. tomentosus* and a few each of *N. pustulatus*, *N. sayi*, and *N. defodiens*.

While the Pennsylvania *N. vespilloides* we note are not new records for that state, they represent a significant southern addition to the distributions of this species reported by Peck and Kaulbars (1987), who note it from only a single site in far eastern Pennsylvania.

The Peck and Miller (1993) Silphidae catalog lists *N. vespilloides* from Illinois. However, according to Stewart B. Peck (*in litt.*), there is in fact no record for this species from that state.

Other recent literature on *Nicrophorus* contains some discrepancy and inconsistency regarding *N. vespilloides* distribution records. For example, in the Anderson and Peck (1985) treatise on carrion beetles and the Agyrtidae, the species is shown by shaded-area map to occur in all six New England states. The Peck and Kaulbars (1987) synopsis of United States Silphidae uses a distribution map with dots that show New England *N. vespilloides* only in Maine, New Hampshire, and Massachusetts. Peck and Miller (1993) concur.

We speculate that further insect surveys in high wetlands of the southern Allegheny, Appalachian, and Blue Ridge Mountains as well as at lower elevations in northern Ohio will likely uncover relict populations of *N. vespilloides*. Possible sites are Dolly Sods and Spruce Knob in eastern West Virginia and high bogs and marshes in Great Smoky Mountains National Park (eastern Tennessee and western North Carolina).

ACKNOWLEDGMENTS

We thank Cathy Drake, Dave Horn, George Keeney, and Adrienne Smith for helpful comments on early drafts of the manuscript. Robert Acciavatti, Robert Androw, John Rawlins, and Chen Young, our colleagues in the Carnegie Museum surveys, gave valuable help in developing data bases, data entry, specimen preparation, and fieldwork. Margaret Thayer, Field Museum of Natural History, Chicago, kindly confirmed that no specimens of *Nicrophorus vespilloides* from Illinois are represented in Field Museum collections. Partial funding for this research was provided by Lake County Forest Preserve District Insect Study Project No. 99050 to Hey & Associates, Inc., Libertyville, IL (Floyd Catchpole, manager).

LITERATURE CITED

- Anderson, R.S. and S.B. Peck. 1985. The carrion beetles of Canada and Alaska (Coleoptera: Silphidae and Agyrtidae). The insects and arachnids of Canada, Pt. 13, Agric. Can. 121 pp.
- Fuller, K.B., P.S. Frank, Jr., and D.B. Fuller. 1974. The Cranesville pine swamp. Educ. Series 105, Nat. Res. Inst., Univ. MD Press. 25 pp.
- Hatch, M.H. 1928. Silphidae II. In: Coleopterum Catalogus, W. Junk, Berlin 7(95):63-154.

- Peck, S.B. and M.M. Kaulbars.** 1987. A synopsis of the distribution and bionomics of the carrion beetles (Coleoptera: Silphidae) of the conterminous United States. *Proc. Entomol. Soc. Ont.* 118:47-81.
- Peck, S.B. and S.E. Miller.** 1993. A catalog of the Coleoptera of America north of Mexico, family Silphidae. USDA Agric. Handbook 529-28. 25 pp.
- Rawlins, J.E., C.W. Bier, S.A. Thompson, R.A. Androw, R.L. Davidson, and C.W. Young.** 1999. Temporal and spatial relationships of non-target insects in wetlands associated with outbreaks of the forest tent caterpillar on the Allegheny National Forest, Pennsylvania. (unpublished report) Carnegie Mus. Nat. Hist. 347 pp.
- Rawlins, J.E., C.W. Young, and R.L. Davidson.** 1996. Arthropod survey in four different habitat types in West Virginia. (unpublished report) Carnegie Mus. Nat. Hist. 329 pp.
- Venable, N.J.** (no date). Cranesville Swamp. Series 815, WV Renewable Resources Unique Areas, USDA Coop. Ext. Serv., WV Univ. Press. 32 pp.
-
-

BOOK RECEIVED AND BRIEFLY NOTED

THE GENUS *RHIPICEPHALUS* (ACARI: IXODIDAE): A GUIDE TO THE BROWN TICKS OF THE WORLD. J.B. Walker, J.E. Keirans, & I.G. Horak. 2000. Cambridge University Press. 8 1/2 x 11 format. 643 pp. Hardcover \$105.00.

This definitive reference provides identification keys for adult ticks from the Afrotropical regions and elsewhere. For nymphs and larvae, unique plates have been compiled in which line drawings of the capitula of similar species are grouped together to facilitate identification. Brief, well illustrated descriptions of the known stages of every species are given, plus information on their hosts, distribution, and disease relationships

**RANGE EXTENSION, ECOLOGICAL NOTES, AND
NEW RECORDS OF *PYCNOPSYCHE INDIANA*
(TRICHOPTERA: LIMNEPHILIDAE)
FROM FLORIDA¹**

Andrew K. Rasmussen², Dana R. Denson³

ABSTRACT: New records of *Pycnopsyche indiana* are reported from Florida, including records from the Florida peninsula that represent a significant southern range extension. The taxonomy and geographic distribution for *P. indiana* is reviewed. Southern Gulf Coastal Plain populations are widespread but uncommon, showing a disjunct distribution. In Florida, *P. indiana* is most often found associated with tannic streams and rivers. Tannic streams with intact broadleaf riparian vegetation within the southern Gulf Coastal Plain are postulated as being important refugia for populations of this species. Ecological and biological notes are given for the southern-most known population. Loss of intact riparian broadleaf forests will likely result in negative impacts on scattered populations of *P. indiana* within the southern Gulf Coastal Plain.

The limnephilid caddisfly genus *Pycnopsyche* is comprised of seventeen nominal species that are primarily eastern Nearctic in distribution. *Pycnopsyche* spp. are typically associated with temperate deciduous forest (Ross 1963) and are common inhabitants of cool, small to large streams with moderate to swift current, or the littoral zone of oligotrophic lakes (Flint 1960). Larvae are usually found associated with accumulations of allochthonous organic material and detritus. Larval cases are of various shapes, and may be constructed of small sticks, leaf and bark pieces, gravel, and sand (Wojtowicz 1982; Wiggins 1996). *Pycnopsyche* larvae are primarily classified as shredder-detritivores and play an important trophic role in the processing of autumn leaves (Wiggins 1996), although they may also consume periphytic algae as scrapers (Williams & Williams 1982; Martin et al. 1991). After reaching the terminal instar, larvae are known to remain inactive for extended periods as prepupae (Cummins 1964; MacKay 1972; 1977). Larvae and adults of two or more species of *Pycnopsyche* are commonly collected together and larval species identity is often difficult to determine in these situations. Adults of *Pycnopsyche* are stout-bodied with tannish, brown to orange wings that provide cryptic coloration adaptive for their emergence and flight, which is often during autumn months when deciduous leaves are changing colors and being shed.

Although a number of ecological studies have been conducted on *Pycnopsyche* spp. (e.g., Cummins 1964; MacKay 1972, 1977; MacKay & Kalf 1973; Wallace et al. 1992), mostly in the northern temperate zone, none has

¹ Received September 13, 1999. Accepted November 13, 1999.

² Laboratory of Aquatic Entomology, Florida A&M University, Tallahassee, FL 32307-4100.

³ Surface Water Monitoring Section, Florida Department of Environmental Protection, Orlando, Florida 32803.

specifically focused on *P. indiana* (Ross). In this paper we give a summary of the taxonomy and geographic distribution of *P. indiana*. Also, we report new records of *P. indiana* from Florida and provide biological and ecological notes for a disjunct population from peninsular Florida.

Taxonomic Summary

The male and female of *Pycnopsyche indiana* (Ross) were first described by Ross (1938) in the genus *Stenophylax*. Later, Ross (1944) placed *S. indiana* within the genus *Pycnopsyche* and included a key to males and females for 6 species including *P. indiana*. Betten (1950) revised the genus and included keys, descriptions, and figures for males and females of 14 species. In Betten's revision he recognized the *Pycnopsyche lepida* group, which includes *P. lepida* (Hagen), *P. subfasciata* (Say), and *P. indiana*. Flint (1960) presented the first comprehensive treatment of Nearctic limnephilid larval taxonomy wherein he provided larval subfamily, generic, and in some cases species level delimitation. Although Flint (1960) had not examined larvae of *P. indiana* and several other species, he did attempt to separate the *P. lepida* group from other *Pycnopsyche* species based on case construction and the number of setae on the sternum of the first abdominal segment. Wojtowicz (1982) provided the first and only larval description for *P. indiana* in his thorough review of adults and larvae within the genus. His conclusion concerning larval identity was that *Pycnopsyche* larvae could not be reliably identified to species unless reared to the adult stage. He also postulated that the *P. lepida* group is recently evolved as evidenced by their close interspecific similarities and the apparent presence of intermediates between species in non-Coastal Plain populations.

Geographic Distribution of *Pycnopsyche indiana* (Ross)

Pycnopsyche indiana has been reported from 17 states: Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Missouri, New York, Ohio, South Carolina, Tennessee, Texas, Virginia, and West Virginia (Fig. 1). Populations of *P. indiana* within the Gulf Coastal Plain are widespread but quite uncommon. For instance, Harris et al. (1991) recorded *P. indiana* from 23 localities in Alabama with only 4 Coastal Plain records and only 1 record from the lower Coastal Plain near Florida. *Pycnopsyche indiana* was listed as rare by Holzenthal et al. (1982) in their survey of the Limnephiloidea of Mississippi and southeastern Louisiana. They collected *P. indiana* from only 1 locality, a small spring-fed blackwater stream in southeastern Louisiana. Within the Gulf Coastal Plain of Georgia, Wojtowicz (1982) reported *P. indiana* from several counties in central Georgia but none from southern Georgia Coastal Plain counties. However, *Pycnopsyche indiana* has been collected from the Gulf Coastal Plain in central Georgia within the Flint River drainage in Crawford County (J.C. Morse, pers. comm). *Pycnopsyche indiana* appears to be more common in the Atlantic Coastal Plain of Georgia

and South Carolina where it has been collected from a number of sites within the Savannah River drainage basin (Sherberger 1970; Morse et al. 1980).

Based on collections held at Florida A&M University (FAMU) and data from the Florida Department of Environmental Protection's Biological Database, the genus *Pycnopsyche* has heretofore been collected from 25 Florida counties, mostly within the northern part of the state (Fig. 1). Adult collections housed at FAMU indicate the presence of only 2 species in Florida (*P. antica* [Walker] and *P. indiana*) (Pescador et al. 1995; Rasmussen and Pescador, unpublished data). Gordon (1984) reported *P. antica* (as *P. scabripennis sensu lato*) and *P. guttifer* as occurring in Florida. However, re-examination of adult males identified by Gordon as *P. guttifer* showed them to be *P. antica*. Of the two *Pycnopsyche* species known to occur in Florida (*P. antica* and *P. indiana*), *P. antica* is the more common among adult collections and is usually found in North Florida associated with clear, spring-fed headwater streams.



Figure 1. Geographic distribution of *Pycnopsyche indiana*, including US state records and collection localities within Florida.

Within Florida, Wojtowicz (1982) reported *P. indiana* only from 1 unnamed locality in Okaloosa County in the western Florida panhandle. Because of the rarity of *P. indiana* within the southern Coastal Plain our recent discovery of a population of *P. indiana* within peninsular Florida merits its recognition. In this report we also provide biological and ecological data relative to this disjunct population and also report on *P. indiana* collected from 3 other localities within the western Florida panhandle.

RESULTS

New Florida Records of *Pycnopsyche indiana* (Ross)

Florida: Calhoun Co., Chipola River at Hwy. 20, 7.xi.1972, P.H. Carlson, 1 adult female. Okaloosa Co., Shoal River at US 90, 2 mi. E Crestview, 16.x.1997, M.L. Pescador & A.K. Rasmussen, 1 adult male. Okaloosa Co., East Turkey Hen Creek at Eglin Air Force Base Rd 601, N30°39'27", W86°34'05", 28.x.1998, M.L. Pescador & A.K. Rasmussen, 1 adult male. Seminole Co., Roberts Branch at Curryville Road, Southeast of Chuluota, N28°37'23", W81°04'01", D.R. Denson, 1 larva collected 12.ix.1997; same as above, 4 larvae collected 23.x.1997; same as above, 1 adult female (reared from pupa) collected 20.xi.1997; same as above, 1 larva collected 15.i.1998; same as above, 1 larva collected 9.ii.1998.

Interestingly, *P. indiana* adults from the Florida panhandle localities listed above were collected, using blacklights, along with *P. antica*. This indicates that the 2 species are sympatric within certain situations. However, our records indicate that *P. antica* is the only *Pycnopsyche* species occurring from spring-fed headwater areas originating within North Florida sandhill habitat. The *Pycnopsyche indiana* listed above were collected from spring-fed habitats from low-lying areas within mixed- pine and hardwood forests. A number of *Pycnopsyche* larvae (not listed above), collected from several blackwater rivers (e.g., Aucilla and Econfiná rivers) in the eastern Florida panhandle, which we examined are very likely to be *P. indiana*, but larval rearings and/or adult collections need to be done before making definitive species determinations.

Species identifications of larvae collected in Roberts Branch, Seminole County were based on the close agreement of larval morphology with the description of the larva of *P. indiana* presented by Wojtowicz (1982). The larval identity and species present in Roberts Branch was further confirmed by the adult female that emerged from a mature pupa which was collected. The other *Pycnopsyche* known to occur in Florida, *P. antica*, can be reliably separated from *P. indiana* if based upon last instar larvae or adult males and females. Last instar *P. indiana* are 5-10 mm shorter than last instar *P. antica*. However, case construction and setal characters are variable and show overlap between the two species.

Ecological and Biological Notes Concerning Roberts Branch (Seminole Co., FL) Population of *Pycnopsyche indiana* (Ross)

Roberts Branch, located in southern Seminole County, Florida (N 28°37'23", W 81°04'01") near the town of Chuluota, is a small tributary of the St. Johns River. Originating in cypress wetlands in eastern Orange County near the town of Bithlo, Roberts Branch flows through deciduous forest and marsh, as well as low-density cattle pasture in some reaches. The sampling site upstream of Curryville Road is in an undeveloped forested section. The floodplain of this small (approximately 3 to 5 m width) darkly tannic stream is broad and flat, thus the water level varies less than a meter between wet and dry seasons. Stream depth ranges from 0.1 to 1.0 m, but averages about 0.5 m. Stream velocity averages about 0.3 m sec⁻¹. The water in the stream is acidic, with a mean pH value of 4.46 su. The Secchi depth is usually equal to or greater than the total depth of the stream. Dissolved oxygen varies considerably with the season, but averages about 5.5 mg/L overall. Measured water temperatures have ranged from a low of 16.9°C in January to nearly 25°C in August. The aquatic macrophyte community here is unusually diverse for a small stream of this type. Within the 100-m stretch sampled, the following aquatic/riparian macrophytes were noted: *Peltandra* sp., *Pontederia* sp., *Orontium aquaticum*, *Sphagnum* sp., *Woodwardia* sp., *Osmunda cinnamomea*, *Saururus cernuus*, and *Hydrocloa* sp.

Pycnopsyche indiana larvae were collected at Roberts Branch using a D-frame aquatic dipnet. In each instance, they were found in association with the root mass of streamside *Woodwardia* spp. ferns and/or small woody debris that had collected beneath them. Larval length, head width measured between the eyes, and case length for the larvae collected is given in Table 1. One mature pupa was collected 20.ix.1997. This specimen was kept alive and emerged as an adult female the same night. The two smallest larvae collected in early 1998 are likely to be offspring of adults that emerged sometime November-December. The sizes of the two larvae collected in 1998 (Table 1) suggest rapid larval growth during the first few months after hatching. Larval cases for the 5 last instars collected in 1997 were cylindrical and mainly composed of bark and other bits of woody material. Larval cases for the two earlier instars were shorter (Table 1), triangular in cross-section, and loosely made of cut leaf pieces.

Table 1. Measurements of *Pycnopsyche indiana* larvae collected at Roberts Branch, Seminole Co., Florida.

Collection Date	No. of Individuals	Body Length (mm)	Head Width (mm)	Case Length (mm)
12.ix.1997	1	16.0	1.2	21.0
23.x.1997	4	16.0-21.0	1.2-1.3	18.0-22.0
15.i.1998	1	11.0	0.7	15.0
9.ii.1998	1	14.8	1.1	18.0

The second author (DRD) has attempted numerous times unsuccessfully to collect *Pycnopsyche* at Roberts Branch since it was last taken there in February 1998. There are a number of junkyards near the extreme headwaters of the stream, and residential development is accelerating downstream from there. It is possible that habitat degradation and destruction has caused or will cause the extirpation of this species from the Florida peninsula.

The conditions present at Roberts Branch seem to be especially suitable to the success of trichopterans. In addition to *P. indiana*, the second author (DRD) has collected the following caddisfly larvae here: *Cernotina* sp., *Chimarra* sp., *Hydropsyche* sp., *Molanna tryphena* Betten [also probably the southernmost collection point for this species], *Nectopsyche pavida* (Hagen), *Oecetis georgia* Ross, *O. nocturna* Ross, *Nyctiophylax* sp., *Polycentropus* sp., *Triaenodes ignivius* (Walker), and *T. perna* Ross. An adult male of *T. perna* was also collected. This is an unusually large number of trichopteran taxa for a small stream in this area of the state. However, with the exceptions of the dipterans and odonates (with 33 and nine taxa, respectively, collected at Roberts Branch to date), most other macroinvertebrate groups are not so well represented. For example, only two mayflies (*Eurylophella doris* [Traver] and *Acerpenna pygmaea* [Hagen]), five beetles, one megalopteran (*Corydalus cornutus* [Linnaeus]), and one mollusk (*Ferrissia hendersoni* Walker) have been collected here. The low pH probably accounts for the scarcity of mollusks. Other macroinvertebrate groups are likewise represented by only one or a few taxa.

DISCUSSION

The close ecological association of *Pycnopsyche* with temperate deciduous forests leads one to believe that *Pycnopsyche* geographic distributions are largely a reflection of the past and present distribution of deciduous forests (Ross 1963). Certainly Pleistocene events, which caused catastrophic changes in the size and location of temperate forests, also created similar changes in species distributions of forest insects such as *Pycnopsyche*. Areas of the southern Coastal Plain were believed to have been key refugia for deciduous forests during the Pleistocene (see review of Watts 1980), and it is quite likely that the southern Coastal Plain, especially areas with watershed connections to the Eastern highlands, harbored greater species diversity and abundance of *Pycnopsyche* than at the present time.

Presently, *Pycnopsyche* spp. are largely restricted in the southern Coastal Plain to streams that are heavily influenced by groundwater inputs. Thermally buffered habitats such as these provide the only habitats where cool-adapted taxa such as *Pycnopsyche* are able to survive (Ross 1956). At the extreme southernmost (i.e., Florida) limits of the genus, *P. antica* and *P. indiana* are the only known representatives. *Pycnopsyche antica* are most commonly encountered in headwater reaches of clear streams of spring-seep origin.

Pycnopsyche indiana, on the other hand, occurs in more tannic low-lying streams and rivers. The presence of the Roberts Branch disjunct population of *P. indiana* in peninsular Florida further supports the notion that tannic streams with intact riparian broadleaf forests are important refugia in the southern Coastal Plain for scattered relict populations of *P. indiana*. Intact riparian broadleaf forests function both to lower potential maximum stream temperatures and to provide allochthonous energy inputs (leaves and coarse woody debris), thus driving detrital-based food chains in which *Pycnopsyche* are important components (Grubs and Cummins 1996). Greater sampling efforts, including adult collecting, are needed to better understand the distribution and habitat requirements of southern-disjunct populations of *P. indiana*. Furthermore, conservation and sound watershed management practices that protect specialized habitats are vital for the survival of isolated populations of this species. Clearly, *P. indiana* would be a candidate for listing as a threatened/ endangered species in the state of Florida.

ACKNOWLEDGMENTS

We thank J.C. Morse (Clemson University) and M.L. Pescador (Florida A&M University) for suggestions and critique of the manuscript. Also, we acknowledge J.C. Morse for kindly providing unpublished records of *P. indiana* from the southeastern Coastal Plain.

This research was partially supported by a research grant (Flax 91004) from CSREES-USDA to Florida A&M University.

LITERATURE CITED

- Betten, C.** 1950. The genus *Pycnopsyche* (Trichoptera). *Ann. Entomol. Soc. Am.* 43:508-522.
- Cummins, K.W.** 1964. Factors limiting the microdistribution of larvae of the caddisflies *Pycnopsyche lepida* (Hagen) and *Pycnopsyche guttifer* (Walker) in a Michigan stream. *Ecol. Monogr.* 34:271-295.
- Flint, O.S., Jr.** 1960. Taxonomy and biology of Nearctic limnephilid larvae (Trichoptera), with special reference to species in eastern United States: *Entomol. Am.* 40:1-117.
- Gordon, E.A.** 1984. The Trichoptera of Florida: A preliminary survey. Pp. 161-166 in J. C. Morse, ed. *Proceedings of the Fourth International Symposium on Trichoptera*, Dr. W. Junk Publ., The Hague.
- Grubbs, S.A. and K.W. Cummins.** 1996. Linkages between riparian forest composition and shredder voltinism. *Arch. Hydrobiol.* 137:39-58.
- Harris, S.C., P.E. O'Neil, and P.K. Lago.** 1991. Caddisflies of Alabama. *Geol. Surv. Ala. Bull.* No. 142. 442 pp.
- Holzenthal, R.W., S.C. Harris, and P.K. Lago.** 1982. An annotated checklist of the caddisflies (Trichoptera) of Mississippi and Southeastern Louisiana. Part III: Limnephiloidea and Conclusions. *Proc. Entomol. Soc. Wash.* 84(3):513-520.
- MacKay, R.J.** 1972. Temporal patterns in life history and flight behaviour of *Pycnopsyche gentilis*, *P. luculenta*, and *P. scabripennis* (Trichoptera: Limnephilidae). *Can. Entomol.* 104:1819-1835.
- MacKay, R.J.** 1977. Behavior of *Pycnopsyche* (Trichoptera: Limnephilidae) on mineral substrates in laboratory streams. *Ecology* 58:191-195.
- MacKay, R.J. and J. Kalf. J.** 1973. Ecology of two related species of caddis fly larvae in the organic substrates of a woodland stream. *Ecology* 54:499-511.

- Martin, I.D., W.D. Taylor, and D.R. Barton.** 1991. Experimental analysis of density dependent effects on two caddisflies and their algal food. *J. North Am. Benthol. Soc.* 10(4):404-418.
- Morse, J.C., J.W. Chapin, D.D. Herlong, and R.S. Harvey.** 1980. Aquatic insects of Upper Three Runs Creek, Savannah River Plant, South Carolina. Part I: Orders other than Diptera. *J. Ga. Entomol. Soc.* 15:73-101.
- Pescador, M.L., A.K. Rasmussen, and S.C. Harris.** 1995. Identification manual for the caddisfly (Trichoptera) larvae of Florida. Fla. Dep. Environ. Protect., Tallahassee, Florida. 132 pp. + appendices.
- Ross, H.H.** 1938. Descriptions of new North American Trichoptera. *Proc. Entomol. Soc. Wash.* 40(5)117-124.
- Ross, H.H.** 1944. The caddis flies, or Trichoptera, of Illinois. *Ill. Nat. Hist. Surv. Bull.* 23:1-326.
- Ross, H.H.** 1956. Evolution and classification of mountain caddisflies. Univ. Ill. Press, Urbana. 213pp.
- Ross, H.H.** 1963. Stream communities and terrestrial biomes. *Arch. Hydrobiol.* 59:235-242.
- Sherberger, F.F.** 1970. Distribution of the family Limnephilidae (Trichoptera) on the Savannah River Drainage Basin. M.S. thesis, Univ. Ga, Athens. 61 pp.
- Wallace, J.R., F.D. Howard, H.E. Hays, and K.W. Cummins.** 1992. The growth and natural history of the caddisfly *Pycnopsyche luculenta* (Betten) (Trichoptera:Limnephilidae). *J. Freshw. Ecol.* 7:399-405.
- Watts, W.A.** 1980. The late Quaternary vegetation history of the Southeastern United States. *Annu. Rev. Ecol. Syst.* 11:387-409.
- Wiggins, G.B.** 1996. Larvae of the North American caddisfly genera (Trichoptera) (2nd edition). Univ. Toronto Press, Toronto, Canada, 457 pp.
- Williams, D.D. and N.E. Williams.** 1982. Morphological and dietary variations in a riverine population of *Pycnopsyche guttifer* (Trichoptera: Limnephilidae). *Aquat. Insects* 4:21-27.
- Wojtowicz, J.A.** 1982. A review of the adults and larvae of the genus *Pycnopsyche* (Trichoptera: Limnephilidae) with revision of the *Pycnopsyche scabripennis* (Rambur) and *Pycnopsyche lepida* (Hagen) Complexes. PhD dissertation, Univ. Tenn. 292 pp.
-
-

BRIEF BOOK REVIEW

FACTS NOT FEAR: Teaching children about the environment. 1999. M. Sanera, Ph.D. and J. S. Shaw. Regnery Publishers. 269 pp; 15 figs., 10 tables. \$15 paper.

Interest in environmental issues has been increasing in recent decades. Unfortunately, most of the 269 texts and reference books that these authors reviewed contained more political and emotional content than scientific facts. The 18 chapters in this book present both sides on recycling, acid rain, global warming, biodiversity, ozone, and many other related subjects. Each chapter has been reviewed by several recognized authorities for accuracy, and each fact and quotation is supported by footnoted citations to the original source. Although written primarily for middle-school science teachers, anyone interested in the environment will find this well-researched book very educational.

W. H. Day

OCCURRENCE OF THE TIGER BEETLE *CICINDELA CURSITANS* (COLEOPTERA: CARABIDAE) IN NORTHWESTERN MINNESOTA^{1,2}

Paul P. Tinerella, D. A. Rider³

ABSTRACT: The range of the tiger beetle, *Cicindela cursitans*, is extended into northwestern Minnesota.

The tiger beetle, *Cicindela cursitans* LeConte, is reported for the first time from Minnesota. This rare cicindelid beetle has previously been reported from several neighboring states: South Dakota (Kirk and Balsbaugh 1975), North Dakota (Boyd and Associates 1982), and Iowa (Bousquet and Laroche 1993). It has also been reported from the following states: Nebraska (Meserve 1936); Kansas (Willis 1970); Arkansas, Louisiana, and Mississippi (Graves and Pearson 1973); Indiana (Knisley et al 1987); Ohio (Graves and Brzoska 1991); and Alabama, Illinois, Kentucky, and Tennessee (Bousquet and Laroche 1993).

Cicindela cursitans is a small (6-8 mm), elongate, flightless tiger beetle, which superficially resembles ants (Graves and Brzoska 1991). Its small size will distinguish it from all other eastern North American tiger beetle species except *C. celeripes* LeConte. The distinct lateral line and the pale, only slightly metallic legs will separate *C. cursitans* from *C. celeripes*. The notably expanded elytral apices of *C. celeripes* are also diagnostic for that species (Willis 1968, Graves and Brzoska 1991). Variation of the elytral maculations seen in *C. cursitans* was noted and discussed by Graves and Brzoska.

Distribution records of *C. cursitans* and *C. celeripes* indicate sympatry of these tiger beetles in the central portion of the lower Great Plains (Bousquet and Laroche 1993). As far as is known, both species occur in similar habitats: these being wet, sparsely vegetated prairies; in proximity to water, on soil composed of a clay/sand mixture (Montgomery and Montgomery 1931, Willis 1970, Graves and Pearson 1973, Knisley et al 1987, Graves and Brzoska 1991).

During the years from 1995 through 1999, 65 specimens of *C. cursitans* were collected from the Bluestem Prairie Complex, Clay County, western Minnesota [46° 50' 45"N, 96° 27' 45"W]. The Bluestem Prairie Complex is a 4000 acre (1619 ha) prairie preserve containing various tallgrass prairie

¹ Received April 12, 2000; Accepted May 5, 2000.

² Approved as North Dakota Insects Publication No. 18 Schafer-Post Series.

³ Department of Entomology, North Dakota State University, Fargo, ND 58105.

regimes of dry, mesic, and wet prairie. This preserve is managed primarily by periodic burning, but alternate management techniques (hay and grazing) are being investigated on adjacent lands.

MATERIALS AND METHODS

All specimens recorded from this study were collected from pitfall traps. The pitfall traps used in this study were a modification of the type described by Durkis and Reeves (1982), in which a 70 cm length of lawn edging was placed between two 16 oz (473 ml) cups. No covers or aprons were used with this pitfall trap design. In 1995, a total of six transects, each consisting of five pitfall trap stations, were established on the Bluestem Prairie Complex. In 1996, six additional transects were established, and the total number of pitfall trap stations was reduced to three on all transects. Transects were placed on, and duplicated over dry, mesic, and wet prairie sites.

Within these 12 transects, *C. cursitans* was collected on two transects; one wet (W1) and one mesic (M1). These two transects are adjacent and lie approximately 300 yards (274 m) apart. Transect W1, the southernmost transect within the preserve, contained three pitfall trap stations; w1, w2, and w3. A total of 64 specimens was collected from stations w1 (61 individuals) and w2 (3 individuals). On the M1 transect (m1, m2, m3), one individual was collected from the m2 pitfall trap station. The m1 and m3 stations lie in areas of topographic lows and highs (respectively) and differ from the m2 station considerably in seasonal moisture content. All specimens were collected during July and August with the highest number of individuals (60 specimens), being collected over three dates (VII-14, VII-31, and VIII-18) during 1997 (w1, w2). Two specimens each were collected in 1995 (w1) and 1996 (m1, w2); in 1998 one specimen was collected (w1).

DISCUSSION

Two factors are considered as possible explanation for the occurrence of the 60 specimens collected in 1997. First, in 1997, heavy regional spring flooding was experienced due to excessive snow accumulations from the previous winter. Standing flood waters could have indeed inundated areas not normally suitable for *C. cursitans*. Second, the developmental cycle of *C. cursitans* may have been a factor. Tiger beetles require from 1 to 4 years for maturation (Graves and Brzoska 1991), and at present, data regarding the developmental life cycle of *C. cursitans*, or related taxa, are unknown. Further pitfall trapping would be necessary for investigation of life cycles.

In general, the transects of collection (W1 and M1) contain similar vegetational components and moisture gradients, that is, they are seasonally moist, often with the soil profile saturated. However, the notable difference between these two transects is the physiographic variation; inducing differing moisture regimes between pitfall trap stations on the M1 transect. Transect W1 borders an irrigation ditch, which throughout the spring and summer months is often

filled with water. On the M1 transect, the m2 pitfall trap station conditions are similar to those of the w1 and w2 pitfall trap stations; with the area in immediate proximity to the m2 pitfall trap station often being seasonally inundated. The limited occurrence of *C. cursitans* within the Bluestem Prairie Complex may indicate its high degree of specificity to particularly suitable wet prairie habitat. Likewise, its occurrence on transect areas managed by periodic burning (2-4 year cycles) may also serve to indicate its affinity for native (non-invaded), wet tallgrass prairie. Lack of previous collection records in Minnesota is likely due to factors such as the size of *C. cursitans*, the typical tiger beetle collector not visiting suitable habitats, and the use of specific sampling techniques (pitfall traps) for collection. Its apparent overall lack of abundance is probably due to the fragmented nature of such suitable prairie habitat, as well as its limited ability to disperse over great distances (Graves and Brzoska 1991). The 65 specimens of *C. cursitans* have been deposited in the North Dakota State Insect Reference Collection.

ACKNOWLEDGMENTS

Particular thanks are extended to Robert B. Carlson (Dept. of Entomology, NDSU), Gary K. Clambey Dept. of Botany, NDSU) and Donald P. Schwert (Dept. of Geosciences, NDSU) for review and comments pertaining to the manuscript. The helpful comments of two anonymous reviewers, as well as the editor, served to improve the manuscript. Thanks are also extended to Brian Winter, the Minnesota Chapter of the Nature Conservancy, for access to the Bluestem Prairie Complex. Financial support for this research was provided by the Minnesota Chapter of the Nature Conservancy, The Wisconsin Department of Natural Resources, and the Minnesota Department of Natural Resources, Nongame Wildlife Fund.

LITERATURE CITED

- Bousquet, Y. and A. Larochelle.** 1993. Catalogue of the Geadephaga (Coleoptera: Trachypachidae, Rhysodidae, Carabidae, including Cicindelini) of America North of Mexico. Mem. Entomol. Soc. Can. (167): 1-397.
- Boyd, H. P. and Associates.** 1982. Checklist of the Cicindelidae- The Tiger Beetles. Plexus Publishing, Inc. Marlton, NJ.
- Durkis, T. J. and R. M. Reeves.** 1982. Barriers increase efficiency of pitfall traps. Entomol. News. 93: 25-28.
- Graves, R. C., and D. W. Brzoska.** 1991. The tiger beetles of Ohio (Coleoptera: Carabidae). Bull. Ohio Biol. Surv. 8(4): 42 pp.
- Graves, R. C., and D. L. Pearson.** 1973. The tiger beetles of Arkansas, Louisiana, and Mississippi (Coleoptera: Cicindelidae). Trans. Amer. Entomol. Soc. 99: 157-203.
- Kirk, V. M. and E. U. Balsbaugh Jr.** 1975. A list of the beetles of South Dakota. Agric. Exp. Stat. So. Dak. State Univ. Tech. Bull. # 42. 139 pp.
- Knisley, C. B., Brzoska, D. W., and J. R. Schrock.** 1987. Distribution, checklist, and key to adult Tiger beetles (Coleoptera: Carabidae) of Indiana. Proc. In. Acad. Sci. 97: 279-294.
- Meserve, F. G.** 1936. The Cicindelidae of Nebraska (Coleoptera). Entomol. News. 57:270-275.
- Montgomery, B. E. and R. W. Montgomery.** 1930. Records of Indiana Coleoptera. I. Cicindelidae. Proc. In. Acad. Sci. 40: 357-359.
- Willis, H. L.** 1968. Artificial key to the species of *Cicindela* of North America north of Mexico. J. Kans. Entomol. Soc. 41(3): 303-317.
- Willis, H. L.** 1970. The Cicindelidae of Kansas. Cicindela. 2(1): 1-27.

SCIENTIFIC NOTE

***CHONDROMORPHA XANTHOTRICA*,
(POLYDESMIDA: PARADOXOSOMATIDAE) A NEW
MILLIPED FOR THE CONTINENTAL UNITED STATES¹**

Rowland M. Shelley²

The family Paradoxosomatidae, the largest in the class Diplopoda, is indigenous to every inhabited continent except North America. However, it is well represented there by three introduced species: *Oxidus gracilis* (C. L. Koch), now occurring continent wide and frequently undergoing local population explosions producing astronomical numbers; *Asiomorpha coarctata* (Saussure), in Florida, Louisiana, and Texas; and *Akamptogonus novarae* (Humbert and Saussure), from several localities in coastal California (Hoffman 1979, 1999; Shelley et al. 1998). To these may now be added *Chondromorpha xanthotricha* (Attems) on the basis of a male collected by R. O. Albert, 14 January 1962, on the Nueces River, 4 mi (6.4 km) S Mathis, San Patricio County, Texas (North Carolina State Museum of Natural Sciences collection). This species, readily distinguished by the papillose, setose dorsum, is known from Jamaica, Haiti, Puerto Rico, Guadeloupe, Trinidad, and Suriname in the Neotropics as well as Fiji, New Caledonia, Western Samoa, the Philippines, and Guam in the Pacific region (Jeckel 1963, Santiago-Blay and Velez 1985, Shelley and Lehtinen 1998, Hoffman 1999). With its discovery in Texas, all the allochthonous paradoxosomatids in the Neotropics have now been encountered in the Nearctic region. Comparative illustrations of all these paradoxosomatids are available in Shelley and Lehtinen (1998).

LITERATURE CITED

- Hoffman, R. L.** 1979. An Australian polydesmoid milliped in San Francisco (Paradoxosomatidae). *Wasmann J. Biol.*, 37:55-58.
- Hoffman, R. L.** 1999. *Checklist of the Millipeds of North and Middle America*. Va. Mus. Nat. Hist. Spec. Pub. No. 8:1-584.
- Jeckel, C. A. W.** 1963. Diplopoda of Guiana (1-5). Studies on the Fauna of Suriname and other Guyanas, 4:1-157.
- Santiago-Blay, J. A., and M. J. Velez.** 1985. *Chondromorpha xanthotricha*: A new record of polydesmid millipede (Diplopoda: Paradoxosomatidae) and the geographical distribution of the three known paradoxosomatids of Puerto Rico. *Carib. J. Sci.*, 21:137-141.
- Shelley, R. M., and P. T. Lehtinen.** 1998. Introduced millipeds of the family Paradoxosomatidae on Pacific Islands (Diplopoda: Polydesmida). *Arthropoda Selecta*, 7(2):81-94.
- Shelley, R. M., S. B. Bauer, and S. F. Swift.** 1998. The milliped family Paradoxosomatidae in the Hawaiian Islands (Diplopoda: Polydesmida). *Bishop Museum Occ. Pap.* No. 56:43-53.

¹ Received June 16, 2000. Accepted June 16, 2000.

² Research Laboratory, North Carolina State Museum of Natural Sciences, 4301 Reedy Creek Road, Raleigh, North Carolina 27607.

FECUNDITY OF MALE *BLATTELLA GERMANICA* (BLATTARIA: BLATTELLIDAE) EXPOSED TO MULTIPLE VIRGIN FEMALES¹

Caroline Curtis^{2, 3} Ivan Huber² Robert E. Calhoun⁴

ABSTRACT: In a pilot study of male fecundity, nine newly emerged male German cockroaches, *Blattella germanica* (L.), were exposed to serial batches of 2 to 10 virgin females throughout their lifetime. A total of 341 females were used. Only 27 of the females were successfully inseminated by six of the males, ultimately producing 72 oothecae from which 2110 nymphs hatched. A batch size of five to seven females proved optimal. Two males sired the largest number of progeny (898 and 864 offspring).

Literature on German cockroach, *Blattella germanica* (L.) male reproduction is limited (Roth & Dateo 1964, 1965; Ueda et al. 1969; Cochran 1979; Mullins and Keil 1980; King and Bennett 1989). These studies explored male reproductive success with a male being exposed to a single female at a time. Females typically produce 155-233 offspring from up to 6 oothecae (cited by Ross & Mullins 1995, from a variety of sources).

However, we found no record of male *B. germanica* fecundity based on simultaneous exposure to multiple females, a more realistic expectation in field situations. This preliminary study was designed to determine the maximum number of offspring which a single male could sire. Increased knowledge of German cockroach male reproductive biology may prove useful for improvement of control tactics.

MATERIALS & METHODS

Sixth instars of *B. germanica* were sexed following the criteria of Ross & Cochran (1960), keeping them in separate containers until adulthood to ensure virginity. At adult emergence, one male and a fixed number (range 2-10) of females were placed into pint (475 ml) unwaxed ice cream cartons with clear lids. The surface area (bottom and side) of these cartons available for walking was 362 cm². They were left in the container for a set number (range 7-20) of days. Each male was introduced to between 1 and 14 batches of virgin females. The subjects were kept at a photoperiod of 12:12h (L:D), fed Purina

¹ Received March 9, 2000. Accepted April 24, 2000.

² Biology M120A, Fairleigh Dickinson Univ., Madison, NJ 07940. Mailing address: 520 Lincoln St., Boonton, NJ 07005. Email: ivan@randomtech.com

³ Presently a graduate student at Florida International Univ., Biology, Bldg. O.E., Miami, FL 33199. Email: cgcurt@aol.com

⁴ Biology, Queens College, City Univ. of New York, Flushing NY 11367.
Email: rtcqc@cunyvm.cuny.edu

Dog Chow® and given water ad libitum. Humidity and room temperature were not controlled. After removal of the male, each female was kept in solitary confinement throughout her lifespan and her oothecal and offspring production were recorded. Each batch of removed females was replaced with new virgins at intervals throughout the male's lifespan. Since this was a pilot study, only 9 male subjects were used over the 14-month period it took to complete. Means with standard errors and correlation coefficients were calculated.

RESULTS

Six males sired an average of $351.7 \pm \text{SE } 153.4$ offspring (range 22-898) (Table 1).

Table 1. Male Reproductive Performance.
Males are ranked by adult lifespan.

Male	Adult lifespan, d	No. of batches of females exposed	Mean +/- SE, d, exposure to females	Age, d, at last mating	Fertile females	Fertile oothecae	Total females available	Total nymphs hatched
G	15	1	15.00 ± 0.0	N/A	0	0	4	0
A	24	3	7.00 ± 0.0	N/A	0	0	27	0
F	44	4	10.25 ± 2.18	17	1	4	19	126
C	70	9	8.33 ± 0.9	N/A	0	0	59	0
B	72	11	6.54 ± 0.45	14	2	3	75	94
E	168	12	15.25 ± 1.53	33	1	1	36	22
D	216	13	13.31 ± 0.79	33	1	3	26	106
I	247	7	15.28 ± 1.21	89	10	31	57	898
H	287	8	13.88 ± 0.97	117	12	30	39	864

N/A = Not Applicable because no offspring were produced.

The number of inseminations producing viable progeny per fertile male was $4.5 \pm \text{SE } 1.9$ which agrees with Ueda et al. (1969) on average matings of $10.0 \pm \text{SE } 5.0$. Although the males lived from 15 to 287 days, copulation did not continue throughout the lifespan. The longest surviving male, H, produced 864 progeny and had his last successful copulation at 117 days. Even this number of offspring was exceeded, however, by male I. There is a significant

correlation ($r = 0.785$, $P < .05$) between male lifespan and number of offspring, but none between numbers of females available and number of offspring ($r = 0.269$) (Table 1). Table 2 shows the relationship between the female batch size and total number of fertile females. Five to seven was optimal with another peak at two.

Table 2. Female Batch Size and Reproductive Success

Batch size	No. of batches	Total females	Fertile females	Proportion fertile females
2	14	28	3	0.107
3	13	39	1	0.026
4	4	16	1	0.063
5	14	70	12	0.171
6	1	6	2	0.333
7	3	21	2	0.095
8	6	48	0	0.000
9	7	63	3	0.048
10	6	60	3	0.050

DISCUSSION

While our aim was to determine the maximum fecundity of male German cockroaches, the lack of successful inseminations remains puzzling. Also, the role of females in reproductive dynamics (courtship, mating and insemination) is poorly understood. Four males lived longer than 150d (Table 1). The normal life expectancy range of males is 90-140d with peak sexual competitiveness at 11-13d (Ross & Mullins 1995). Ueda et al. (1969) observed that copulations decrease with increasing male age. Although this is not detectable in the reproductive history of male H, there is a hint of such a decline in male I (unpubl. data). Five males died well below the average age and were least successful as sires. Due to a lack of video equipment, we are uncertain when mating occurred and must therefore rely on counts of viable offspring to identify successful matings. One-third of the males sired no offspring and a further third inseminated a single female. The females laying viable eggs had an average adult lifespan of $225d \pm SE 11.6$ (unpubl. data) within the range of 140-280d for laboratory studies cited by Ross & Mullins (1995).

The optimum batch size of females for mating in this study was five to seven (Table 2). Greater crowding in pint containers reduced the proportions of fertile females, but why smaller numbers of females showed a generally lower success rate of inseminations is not obvious. The small number of replications precludes more analysis. Further studies with containers of various sizes and proportions could be enlightening.

Numerous questions suggest themselves in the relatively unexplored area of cockroach male fecundity. Counts of sperm in the testes should be com-

pared with counts in all spermatophores produced as well as in spermathecae. Larger studies should be carried out using more males. The protocol for these might include sacrificing females at regular intervals to check insemination rates and times. Such studies have been carried out in the Mediterranean fruit fly (Yuval et al. 1996), one aim of which was to improve sterile insect control tactics. While induced sterilization techniques have limited application in German cockroach control (Gold 1995), insect growth regulators (IGRs) have several effects, one of which is male sterility (Bennett and Reid 1995).

ACKNOWLEDGMENTS

We are very grateful to E.P. Benson, P.A. Zungoli, B.R. Rao and M. Slaff who reviewed our manuscript and offered many helpful suggestions.

LITERATURE CITED

- Cochran, D.G.** 1979. A genetic determination of insemination frequency and sperm precedence in the German cockroach. *Entomol. Exp. Appl.* 26:259-266.
- Bennett, G.W. and B.L. Reid.** 1995. Insect growth regulators, Ch. 11 In Rust, M.K., J.M. Owens & D.A. Reiersen, eds. *Understanding and Controlling The German Cockroach*. Oxford Univ. Press, New York, NY.
- Gold, R.E.** 1995. Alternate Control Strategies, Ch. 13 In Rust, M.K., J.M. Owens & D.A. Reiersen, eds. *Understanding and Controlling The German Cockroach*. Oxford Univ. Press, New York, NY.
- King, J.E. and G.W. Bennett.** 1989. Comparative activity of fenoxycarb and hydroprene in sterilizing the German cockroach (Dictyoptera: Blattellidae). *J. Econ. Entomol.* 82:833-838.
- Mullins, D.E. & C.B. Keil.** 1980. Paternal investment of urates in the cockroach. *Nature* 283:567-569.
- Ross, M.H. & D.G. Cochran.** 1960. A simple method for sexing nymphal German cockroaches. *Ann. Entomol. Soc. Amer.* 53:550-551.
- Ross, M.H. & D.E. Mullins.** 1995. Biology, Ch. 2 In Rust, M.K., J.M. Owens & D.A. Reiersen, eds. *Understanding and Controlling The German Cockroach*. Oxford Univ. Press, New York, NY.
- Roth, L.M. & G.P. Dateo Jr.** 1964. Uric acid in the reproductive system of males of the German cockroach, *Blattella germanica*. *Science* 146:782-784.
- Roth, L.M. & G.P. Dateo Jr.** 1965. Uric acid storage and excretion by accessory glands of male cockroaches. *J. Ins. Physiol.* 11:1023-1029.
- Ueda, S., M. Izutsu & S. Ishii.** 1969. The reproduction of the German cockroach, *Blattella germanica* and the effect of metopa on it. *Jap. J. Appl. Entomol. Zool.* 13:70-77.
- Yuval, B., S. Blay & R. Kaspi.** 1996. Sperm transfer and storage in the Mediterranean fruit fly (Diptera: Tephritidae). *Ann. Entomol. Soc. Amer.* 89:486-492.

NOTATIONS ON SOUTH AMERICAN BAETIDAE (EPHEMEROPTERA)¹

W. P. McCafferty²

ABSTRACT: *Deceptiviosa angolina*, comb. n., is the last of the South American species previously placed in either *Baetis* or *Pseudocloeon* to be recombined. All valid South American Baetidae species historically classified as such are non *Baetis* complex species now residing in 10 different genera. *Americabaetis albinervis*, *A. bruchi*, *Fallceon inops*, and *Moribaetis socius* are newly considered nomina dubia.

A total of 32 currently valid species of South American mayflies were originally described, or subsequently placed in, the *Baetis* complex genera *Baetis* Leach or *Pseudocloeon* Klapálek. All of these species may be considered in the family Baetidae, except for what is now known as *Hexagenia albivitta* (Walker) (family Ephemeridae) and what most assuredly is incorrectly known as *Ecdyonurus guttatus* (Pictet) (family inquirenda), both of which were originally described as *Baetis*. Of the 30 valid species of South American Baetidae previously known as *Baetis* or *Pseudocloeon*, all but one have been recombined with non *Baetis* complex genera (see below). Of the 29 previously recombined species, 17 were originally described as *Baetis*, and eight were originally described as *Pseudocloeon*, leaving two that were subsequently recombined with *Baetis*, two that were subsequently recombined with *Pseudocloeon*, and one that had been subsequently recombined with both *Baetis* and *Pseudocloeon* (Table 1). Only *Bernerius incus* Waltz and McCafferty had been known historically by an informal name associated with these genera (*Baetis* sp. B Berner). All other associations involved nominal species.

In addition to the valid species epithets that had been associated with *Baetis* or *Pseudocloeon* (Table 1), *Americabaetis peterseni* and *Fallceon murphyae* include replacement epithets for the following original names for South American Baetidae that proved to be primary junior homonyms: *Cloeon brunneum* Esben-Petersen (subsequently associated with *Pseudocloeon*) and *Baetis melleus* Needham and Murphy, respectively.

In addition to the recombined extractions from *Baetis* and *Pseudocloeon* among South American Baetidae, *B. gloriosus* Navás is now a junior subjective synonym of *Callibaetis fasciatus* (Pictet); *B. opacus* Navás and *B. virellus* Navás are similarly equivalent to *C. zonalis* Navás; *B. weiseri* Navás is equivalent to *Andesiops peruvianus* (Ulmer); and *B. sp. 1* Roback is equivalent to *Mayobaetis ellenae* (Mayo). With respect to *C. zonalis*, I had initially considered it the subordinate synonym of *C. opacus* (Navás) (originally *Baetis*) based on page priority (McCafferty 1996). However, I realized shortly thereafter

¹ Received March 31, 2000. Accepted May 10, 2000.

² Department of Entomology, Purdue University, West Lafayette, IN 47907.

that Gillies (1990) may have intended to invoke first revisor's prerogative in considering *C. zonalis* the senior synonym (even though he had not stated such), and therefore now accept that interpretation. With respect to the present review, I have placed *C. zonalis* as a footnoted species in Table 1, because it is the only South American species to be represented previously as a *Baetis* complex genus by a junior synonymy only.

The bases for all of the previous recombinations of South American Baetidae originally or subsequently regarded as *Baetis* or *Pseudocloeon* shown in Table 1 are reviewed as follows: For the species previously placed in *Baetis* that have been recombined with *Americabaetis* Kluge, see Lugo-Ortiz and McCafferty (1999a) (see also Lugo-Ortiz and McCafferty 1996b); for those recombined with *Andesiops* Lugo-Ortiz and McCafferty, see Lugo-Ortiz and McCafferty (1999b); for those recombined with *Bernerius* Waltz and McCafferty, see Waltz and McCafferty (1987a); for those recombined with *Callibaetis* Eaton, see Gillies (1990); for those recombined with *Camelobaetidius* Demoulin, see Lugo-Ortiz and McCafferty (1999a); for those recombined with *Cloeodes* Traver, see Waltz and McCafferty (1987b) and Lugo-Ortiz and McCafferty (1999a); for those recombined with *Fallceon* Waltz and McCafferty, see Lugo-Ortiz and McCafferty (1999a); for those recombined with *Mayobaetis* Waltz and McCafferty, see Waltz and McCafferty (1985) and Lugo-Ortiz and McCafferty (1996a); and for those recombined with *Moribaetis* Waltz and McCafferty, see Lugo-Ortiz and McCafferty (1999a). For the species previously placed in *Pseudocloeon* that have been recombined with *Americabaetis*, see Lugo-Ortiz and McCafferty (1996b, 1999a) and for those recombined with *Cloeodes*, see Waltz and McCafferty (1987b), Waltz (1993), and Lugo-Ortiz and McCafferty (1999a).

Only the Chilean species *Baetis angolinus* Navás, among the South American Baetidae previously associated with a *Baetis* complex genus name, has not been recombined. *Baetis angolinus* clearly does not belong to the genus *Baetis*, or any other genus of the *Baetis* complex, an otherwise widespread baetid lineage that is not represented in South America and is only very poorly represented by boreal-derived species in Central America (e.g., McCafferty 1998, Lugo-Ortiz et al. 1999).

Navás (1933) based *B. angolinus* on a subimago that could generally be deemed nondescript, except for its hindwing shape and venation, and a peculiar reticulate series of crossveins in the distal inter-costal area of the forewings, along with elongate marginal intercalaries in the forewings. For the most part, baetid adults worldwide have not been associated with reticulate forewing venation. Some *Callibaetis* in North and Central America have some inter-costal reticulation, but the inter-costal area itself is relatively narrower than that in *B. angolinus*, and reticulation is not of the same type. In *B. angolinus* there are six crossveins fairly uniformly divided and forming cellules. Also none of the forewings of South American *Callibaetis* illustrated, for example,

by Gillies (1990), demonstrate inter-costal reticulation. More importantly, the small, narrow hindwings of *B. angolinus* lack crossvenation and are clearly not the type of hindwing found in *Callibaetis*.

Another possible genus that has hindwings similar to those of *B. angolinus* and that also has a similar small costal process in the basal third of the hindwing is *Moribaetis*. *Moribaetis* is also one of a very few genera of baetids that has some crossvenation in the distal inter-costal area of the forewings (e.g., McCafferty and Lugo-Ortiz 1998). None of the species of *Moribaetis* presently known as alate stages, however, demonstrate reticulation or inter-costal cellules as does *B. angolinus*.

Lugo-Ortiz and McCafferty (1999b) recently described three related new genera (*Andesiops*, *Deceptiviosa*, and *Nanomis*) indigenous to cool or gradient streams in the Andes and Patagonia (high altitudes or temperate latitudes) of South America. These genera tend to show some remarkable convergence in larval morphology with some unrelated *Baetis* complex genera such as *Acentrella* Bengtsson (Holarctic), *Demoreptus* Lugo-Ortiz and McCafferty (Afrotropics), and *Tanzaniella* Gillies (Afrotropics). *Andesiops*, *Deceptiviosa*, and *Nanomis*, however, may be related to the non *Baetis* complex Australian genus *Edmundsiops* Lugo-Ortiz and McCafferty (Lugo-Ortiz and McCafferty 1999b, 1999c). *Andesiops* and *Deceptiviosa* were described from both larvae and adults, the latter of which were shown to possess the peculiar reticulate crossvenation in the distal inter-costal area of the forewings that is similar to that of *B. angolinus*. Unfortunately, Lugo-Ortiz and McCafferty (1999b) had not been aware of *B. angolinus* at the time *Andesiops* and *Deceptiviosa* were described. It is now clear that *B. angolinus* most probably belongs to one of these genera. Navás (1933) had additionally indicated that the marginal intercalary veins in the forewings of *B. angolinus* were long. Lugo-Ortiz and McCafferty (1999b) had also found this particular additional trait in *Deceptiviosa*, but not *Andesiops*. I therefore am confident in placing Navás's species in *Deceptiviosa* as *D. angolina* (Navás), comb. n.

The new combination should be regarded as provisional (as essentially most South American baetid recombinations are for various reasons) because of the lack of comparative male adult and larval material of *D. angolina*. Nonetheless, the forewings match well as do the general coloration and size given by Navás (1933) and Lugo-Ortiz and McCafferty (1999b). Also, the Chilean locality of *D. angolina* is consistent with the distribution of *Deceptiviosa*.

Deceptiviosa angolina can be distinguished from *D. torrens* Lugo-Ortiz and McCafferty, the only other species of *Deceptiviosa* known in alate stages, by the hindwings. Those of *D. angolina* are narrower and lack the first longitudinal vein as well as the short third longitudinal vein. The forked vein and its long unattached intercalary in the hindwings of *D. angolina* are similar to the vein 2 system in *D. torrens*.

Lugo-Ortiz and McCafferty (1999a) indicated that several species of South

American Baetidae are dubious. Gillies (1990) had previously considered *Callibaetis abundans* (Navás) (originally *Baetis*) as a nomen dubium. Because *D. angolina* is based on a single subimago, one might argue that this species should also be considered a nomen dubium. Navás (1933) stated that his single subimago was a female; however Alba-Tercedor and Peters (1985) listed the specimen as a male. Gloria Masso, the curator at the Museo de Zoología del Ayuntamiento (Barcelona, Spain) has confirmed for me that the single specimen is indeed a male, and thus Navás had reported the sex incorrectly. Nonetheless, the wing venation of the combined fore- and hindwings, at least for the present, is enough to distinguish this species among the known South American baetid fauna, and a declaration of nomen dubium is yet uncalled for.

Although their generic assignment can be made with confidence, there indeed remain some South American baetids for which it would be virtually impossible to establish any known morphological criteria for species recognition that may be associated with them. These species are best regarded as nomina dubia based on the study of Lugo-Ortiz and McCafferty (1999a). They include *Americabaetis albinervis* (Navás), *A. bruchi* (Navás), *Fallceon inops* (Navás), and *Moribaetis socius* (Needham and Murphy). As reviewed by Lugo-Ortiz and McCafferty (1999a), in the case of each of the above species, existent descriptions are inconsequential at the species level because they either were incompletely written or were based on subimagos, and either critical body

Table 1. South American species of Baetidae formerly associated with the genera *Baetis* or *Pseudocloeon*. *Those subsequently associated with *Baetis* or *Pseudocloeon*. **Associated with *Baetis* only via a junior synonym.

PREVIOUS BAETIS

- * *Americabaetis oldendorffi* (Weyenbergh)
- Andesiops peruvianus* (Ulmer)
- Bernerius incus* Waltz & McCafferty
- Callibaetis abundans* (Navás)
- * *Callibaetis fasciatus* (Pictet)
- ** *Callibaetis zonalis* Navás
- Camelobaetidium alcyoneus* (Traver)
- Camelobaetidium coveloae* (Traver)
- Camelobaetidium dryops* (Needham & Murphy)
- Camelobaetidium tantillus* (Needham & Murphy)
- Cloeodes aymara* (Traver)
- Cloeodes nocturnus* (Navás)
- * *Cloeodes stelzneri* (Weyenbergh)
- Deceptiviosa angolina* (Navás), comb. n.
- Fallceon inops* (Navás)
- Fallceon murphyae* (Hubbard)
- Fallceon yaro* (Traver)
- Mayobaetis ellenae* (Mayo)
- Moribaetis aneto* (Traver)
- Moribaetis comes* (Navás)
- Moribaetis socius* (Needham & Murphy)

PREVIOUS PSEUDOCLOEON

- Americabaetis albinervis* (Navás)
- Americabaetis bridarolli* (Navás)
- Americabaetis bruchi* (Navás)
- * *Americabaetis jorgenseni* (Esben-Petersen)
- * *Americabaetis oldendorffi* (Weyenbergh)
- * *Americabaetis peterseni* (Hubbard)
- Americabaetis weiseri* (Navás)
- Cloeodes anduzei* (Traver)
- Cloeodes binocularis* (Needham & Murphy)
- Cloeodes turbinops* (Needham & Murphy)
- Cloeodes venezuelensis* (Traver)

parts are missing (specimens broken or female only) from existent types or the type specimens themselves are no longer available.

Other species among those previously considered in *Baetis* or *Pseudocloeon* that were treated by Lugo-Ortiz and McCafferty (1999a) and whose types have yet to be found include *A. bridarolli* (Navás), *A. jorgenseni* (Esben-Petersen), and *A. oldendorffi* (Weyenbergh). More intensive searching may uncover types of these possible candidates for nomina dubia.

ACKNOWLEDGMENTS

I thank J. Alba-Tercedor (Granada, Spain) and G. Masso (Barcelona, Spain) for their aid in checking the type of *D. angolina*, and R. D. Waltz (Indianapolis, Indiana) for his review of an early draft. This paper has been given Purdue Agricultural Research Program Journal No. 16258.

LITERATURE CITED

- Alba-Tercedor, J. and W. L. Peters. 1985. Types and additional specimens of Ephemeroptera studied by Longinos Navás in the Museo de Zoología del Ayuntamiento, Barcelona, Spain. *Aquat. Insects* 7: 215-227.
- Gillies, M.T. 1990. A revision of the Argentine species of *Callibaetis* Eaton (Baetidae; Ephemeroptera). *Rev. Soc. Entomol. Argentina* 48: 15-39.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1996a. Phylogeny and classification of the *Baetodes* complex (Ephemeroptera: Baetidae), with description of a new genus. *J. N. Am. Benthol. Soc.* 15: 367-380.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1996b. Taxonomy of the Neotropical genus *Americabaetis* (Insecta: Ephemeroptera: Baetidae). *Stud. Neotrop. Fauna Environ.* 31: 156-169.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1999a. Revision of South American species of Baetidae (Ephemeroptera) previously placed in *Baetis* Leach and *Pseudocloeon* Klapálek. *Ann. Limnol.* 35: 257-262.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1999b. Three new genera of small minnow mayflies (Insecta: Ephemeroptera: Baetidae) from the Andes and Patagonia. *Stud. Neotrop. Fauna Environ.* 34: 88-104.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1999c. *Edmundsiops instigatus*: a new genus and species of small minnow mayflies (Ephemeroptera: Baetidae) from Australia. *Entomol. News* 110: 65-69.
- Lugo-Ortiz, C. R. and W. P. McCafferty and R. D. Waltz. 1999. Definition and reorganization of the genus *Pseudocloeon* (Ephemeroptera: Baetidae), with new species descriptions and combinations. *Trans. Am. Entomol. Soc.* 34: 88-104.
- McCafferty, W. P. 1996. Emendations to the *Callibaetis* (Ephemeroptera: Baetidae) of South America. *Entomol. News* 107: 230-232.
- McCafferty, W. P. 1998. Ephemeroptera and the great American interchange. *J. N. Am. Benthol. Soc.* 17: 1-20.
- McCafferty, W. P. and C. R. Lugo-Ortiz. 1998. The adult of *Moribaetis macaferti* (Ephemeroptera: Baetidae). *Entomol. News* 109: 117-121.
- Navás, L. 1933. Algunos insectos de Chile. *Rev. Chilean Hist. Nat. Pur Aplic.* 37: 230-234.
- Waltz, R. D. 1993. *Cloeodes binocularis* (Ephemeroptera: Baetidae), a new combination for a Neotropical species of *Pseudocloeon* s. auctt. *Entomol. News* 104: 233-234.
- Waltz, R. D. and W. P. McCafferty. 1985. *Moribaetis*: a new genus of Neotropical Baetidae (Ephemeroptera). *Proc. Entomol. Soc. Wash.* 87: 239-251.
- Waltz, R. D. and W. P. McCafferty. 1987a. Generic revision of *Cloeodes* and description of two new genera (Ephemeroptera: Baetidae). *Proc. Entomol. Soc. Wash.* 89: 177-184.
- Waltz, R. D. and W. P. McCafferty. 1987b. Revision of the genus *Cloeodes* Traver (Ephemeroptera: Baetidae). *Ann. Entomol. Soc. Am.* 80: 191-207.

**PSEUDOCLOEON AQUACIDUM: A NEW
SUBJECTIVE SYNONYM OF *P. LATUM*
(EPHEMEROPTERA: BAETIDAE)¹**

C. R. Lugo-Ortiz, F. C. de Moor²

ABSTRACT: *Pseudocloeon aquacidum* is determined to be a junior subjective synonym of *P. latum*.

Agnew (1961) described *Baetis latus* (Ephemeroptera: Baetidae) from one male adult, one female subimago, and an unspecified number of larvae from the Great Berg River, Western Cape, South Africa. Recently, Lugo-Ortiz et al. (1999) transferred the species to *Pseudocloeon* Klapálek. Agnew's (1961) description of the larvae is too general and obviates several important morphological features, and his drawings of one of the labial palps (Agnew 1961: Fig.3c) and two of the gills (Agnew 1961: Figs. 3d,e) are too sketchy to allow reliable comparisons with actual specimens. As a consequence, since its description, *P. latum* has been somewhat enigmatic and a considerable source of confusion among taxonomists and freshwater ecologists.

We have discovered that *Pseudocloeon aquacidum* (Lugo-Ortiz and McCafferty), originally described from larvae from several localities in Kenya and South Africa under *Labiobaetis* Novikova and Kluge (Lugo-Ortiz and McCafferty 1997), is equivalent to *P. latum*. Our discovery is based on the examination of four of the larval paratypes of *B. latus* and numerous larvae housed in the Albany Museum (Grahamstown, South Africa) previously identified either as *P. aquacidum* or *P. latum*. All specimens examined possessed a distinctive distolateral process on the antennal scapes, a single submarginal dorsal row of five to seven branched setae on the labrum, right and left mandibles with 3 + 4 incisors, a distomedially concave maxillary palp segment 2, a broad and blunt distomedial process on labial palp segment 2, hindwingpads, and well-tracheated gills on abdominal segments 1-7. Moreover, we could not identify any morphological features or coloration differences that would distinguish specimens assigned to either species. We therefore consider *P. aquacidum* a junior subjective synonym of *P. latum*. The synonymy for *P. latum* is now as follows:

¹ Received January 13, 2000. Accepted March 30, 2000.

² Department of Freshwater Invertebrates, Albany Museum, Somerset Street, Grahamstown 6139, South Africa.

Baetis latus Agnew 1961: 16.

Labiobaetis aquacidus Lugo-Ortiz and McCafferty 1997: 242. **New synonym.**

Pseudocloeon latum (Agnew): Lugo-Ortiz et al. 1999: 24.

Pseudocloeon aquacidum (Lugo-Ortiz and McCafferty): Lugo-Ortiz et al. 1999: 24. **New synonym.**

In addition, Harrison and Elsworth (1958) and Oliff (1960) refer to *P. latum* as *Baetis* sp. B and *Baetis* sp. 2, respectively (Agnew 1961).

The description and figures provided by Lugo-Ortiz and McCafferty (1997: Figs. 1-13) for *P. aquacidum* should be consulted to identify *P. latum* properly.

The range of *P. latum* extends considerably from southern Africa to Kenya (Agnew 1961, Lugo-Ortiz and McCafferty 1997). According to Harrison and Elsworth (1958), Oliff (1960), Agnew (1961), Chutter (1963, 1970), Oliff and King (1964), and Palmer (1996), *P. latum* is found in slow-flowing waters, or out of current, in marginal vegetation.

ACKNOWLEDGMENTS

We thank R. Toms (Northern Flagship Institution, Pretoria, South Africa) for allowing us to study paratype material of *B. latus*.

LITERATURE CITED

- Agnew, J. D. 1961. New Baetidae (Ephem.) from South Africa. *Novos Taxa Entomol.* 25: 3-18.
- Chutter, F. M. 1963. Hydrobiological studies on the Vaal River in the Vereeniging Area. Part I. Introduction, water chemistry and biological studies on the fauna of habitats other than muddy bottom sediments. *Hydrobiol.* 21: 1-65.
- Chutter, F. M. 1970. Hydrobiological studies in the catchment of the Vaal Dam, South Africa. Part I. River zonation and the benthic fauna. *Int. Rev. Ges. Hydrobiol.* 55: 445-494.
- Harrison, A. D. and J. F. Elsworth. 1958. Hydrobiological studies on the Great Berg River, Western Cape Province. Part I. General description, chemical studies and main features of the flora and fauna. *Trans. R. Soc. S. Afr.* 35: 125-225.
- Lugo-Ortiz, C. R. and W. P. McCafferty. 1997. *Labiobaetis* Novikova & Kluge (Ephemeroptera: Baetidae) from the Afrotropical region. *Afr. Entomol.* 5: 241-260.
- Lugo-Ortiz, C. R., W. P. McCafferty, and R. D. Waltz. 1999. Definition and reorganization of the genus *Pseudocloeon* (Ephemeroptera: Baetidae) with new species descriptions and combinations. *Trans. Amer. Entomol. Soc.* 125: 1-37.
- Oliff, W. D. 1960. Hydrobiological studies on the Tugela River system. Part I. The main Tugela River. *Hydrobiol.* 14: 281-385.
- Oliff, W. D. and J. L. King. 1964. Hydrobiological studies on the Tugela River System. Part IV. The Mooi River. *Hydrobiol.* 24: 567-583.
- Palmer, R. W. 1996. Invertebrates in the Orange River, with emphasis on conservation and management. *S. Afr. J. Aquat. Sci.* 22: 3-51.

HEAT RELIEF BEHAVIOR BY *KLEIDOCERYYS OVALIS* (HEMIPTERA: LYGAEIDAE) IN URBAN SOUTHERN CALIFORNIA¹

Richard S. Vetter², David C. Hawks²

ABSTRACT: Adults of the lygaeid, *Kleidocerys ovalis*, sought relief from excessive ambient heat during short periods of hot weather by clustering on exposed nailheads on a shaded apartment building wall. This is an intriguing use of human structures during a period of physiologic stress.

The Mediterranean climate of southern California is characterized by hot, dry summers and mild winters. The sparse annual precipitation primarily falls during the winter months. The Los Angeles basin is speckled with a mosaic of habitat types over a rather compact distance, and variables such as summer maximum temperatures may, on the same day, range from 25°C along the coast to 45°C in the deserts 200 km away. In Riverside, California (about 100 km east of Los Angeles), summer daily maximum temperatures typically range between 35° and 41°C.

During two consecutive years, a brief heat wave pushed temperatures above 42°C. Daily highs were 44.5°C (29 August 1998) and 43°C (6 August 1997 and 30 August 1998). At midday of these excessively warm periods, small (3 mm in length) adult lygaeids were observed clustering in many of the depressions associated with the exposed nailheads on the walls of a shaded, wood-covered apartment building (Fig. 1). Prior to and after the periods of the intense heat (when daily high temperatures were less than 42°C), they were never observed on the building. We believe that the nailheads driven into the structure conducted the cooler temperatures of the building interior, and offered thermal respites from both the exposed wood and the habitat in which the lygaeids existed before temperatures rose. Unfortunately, we did not record temperatures of the nailheads. The lygaeids also were noticed on the windows of air-cooled apartments. Specimens were collected and identified as *Kleidocerys ovalis* Barber. Sampling from three of the 6-mm diameter nailheads revealed clusters of 7, 13, and 14 *K. ovalis* individuals.

The vegetation nearest the apartment wall consists of grass, ivy, privet shrubbery (*Ligustrum japonicum*), and trees of sycamore (*Platanus*), gum (*Eucalyptus*), and alder (*Alnus*). During periods of normal August temperatures (daily highs of 32°-37°C), the vegetation was sampled to determine from which plants the *K. ovalis* individuals might have originated. On 21 August 1999, 4 netsweeps of alder yielded 12 adults of *K. ovalis*, while 20 sweeps of

¹ Received February 18, 2000. Accepted May 18, 2000.

² Department of Entomology, Univ. Calif. Riverside, Riverside, CA 92521.



Fig. 1. Close-up of at least 7 *Kleidocerys ovalis* clustered on a nailhead.

the ivy produced only 3 *K. ovalis*. Several sweepings in privet (10 Sept 1998) yielded only one additional specimen. Sweeps of the other vegetation yielded no lygaeids. Despite the area having the usual complement of urban arthropods (common flies, earwigs, crickets, etc.), no other insect was observed on the nailheads. During these unusually hot days, these other creatures presumably sought shelter in the shade and the cool soil beneath the ivy and in other relatively cool locations. It is rather intriguing that the *Kleidocerys* were capable of locating the small, point-source nailheads in such significant numbers where normally they are not found on the apartment building surface.

Apparently, *K. ovalis* can tolerate a wide range of habitat types and environmental variables. In his *Kleidocerys* revision, Barber (1953) lists localities for *K. ovalis* in Canada, throughout the northern United States from New England to Washington, and southward into Utah, Colorado, California and Arizona. However, temperatures above 40°C approach the known upper limit of physical heat tolerance for most arthropods (Bligh 1976). Finally, we recognize that this behavior is an artifact of the urbanized world, and is presented here as an entomological curiosity.

Voucher specimens of *Kleidocerys ovalis* have been deposited in the Entomology Research Museum, University of California, Riverside.

ACKNOWLEDGMENTS

We thank D. Yanega and G. Ballmer for reviewing an earlier draft of this manuscript.

LITERATURE CITED

- Barber, H. G.** 1953. A revision of the genus *Kleidocerys* Stephens in the United States. Proc. Entomol. Soc. Wash. 55: 273-283.
- Bligh, J.** 1976. Temperature regulation. In: Environmental Physiology of Animals. J. Bligh, J.L. Cloudsley-Thompson, and A. G. MacDonald, eds. John Wiley & Sons, New York, pp. 415-430.
-
-

BOOK REVIEW

DRAGONFLIES: BEHAVIOR AND ECOLOGY OF ODONATA. 1999. Philip S. Corbet. Cornell University Press. 829 pp. Hard. \$93.00.

The publication of *A Biology of Dragonflies* in 1962 established Philip S. Corbet as a world authority of the Odonata. His sequel, reviewed here, is an incredible tour de force – Corbet's magnum opus. Its scholarship is impeccable. The attention to detail in cross-referencing, citations, and organization make this encyclopedic volume accessible and useful. It is hard to imagine that a single author ever again will have such a thorough command of the Odonata to achieve such a broad synthesis.

Having lived in Europe, Africa, North America, and New Zealand, Corbet has worldwide field experience and knows personally most of the major workers who typically study the Odonata of a particular region. These contacts enrich the volume through numerous personal communications. Many tables and well-selected black and white illustrations reinforce the text. Colleagues from around the world provided the high quality color plates that occupy sixteen pages in the middle of the book.

In the year since this book was published, it has become the standard reference in the field. An Internet list-serve <dragonflies@listbot.com> entertains international discussions on the Odonata with topics ranging from migration and mating behavior to mosquito control and collisions with high-flying jets. What is amazing and sometimes stifling is that a substantial proportion of these topics are covered in Corbet's book with relevant citations and insightful discussion. Frequently, a lively exchange of speculation will be terminated by, "see Corbet page ___" or by Corbet himself referring to his book. Now, when new issues are raised, they often include a short summary of what Corbet says.

There is no doubt that this is one book that anyone with a serious or even casual interest in the Odonata should have. Those concerned by the high price of books should know that this book was kept under \$100 through contributions from many members of the Dragonfly Society of the Americas (Daigle, 1998) and others around the world who feared the delayed publication of an abridged version.

Corbet, P. S. 1962. *A Biology of Dragonflies*. Witherby, London.

Daigle, J. 1998. Membership donates to Corbet book. ARGIA 10(4), 32-33.

Harold B. White, III
103 Radcliffe Dr.
Newark, DE 19711

SCIENTIFIC NOTE
**THE BEHAVIOR OF THE BEETLE INQUILINE,
CREMASTOCHEILUS SAUCIUS, AND ITS HOST ANT,
POGONOMYRMEX OCCIDENTALIS, DURING ENTRANCE
INTO THE ANTS' NEST¹**

Shaharra J. Usnick²

Alpert (1994) noted the behavior of several *Cremastocheilus* species (Coleoptera: Scarabaeidae) while they were entering the nest of their host ants. However, Alpert did not mention specific behaviors of *Cremastocheilus saucius* LeConte and their ant host, *Pogonomyrmex occidentalis*, while the beetle entered the ants' nest. This note discusses the behavior of this *Cremastocheilus* beetle inquiline. In addition, I discuss the behavior of their host ants while the beetles attempted to enter the ants' nests.

The genus *Cremastocheilus* (Coleoptera: Scarabaeidae) contains 5 subgenera and 12 species groups (Alpert 1994) and is restricted to North America. The beetles' preferred habitats are inside the nests of ants. These relationships are generally not mutually beneficial because the beetle adults eat ant brood to survive.

Ants of both formicine (primarily *Formica*, *Myrmecocystus*, *Lasius*, and *Camponotus* species) and myrmicine (primarily *Pogonomyrmex*, *Messor*, and *Aphaenogaster* species) subfamilies are the preferred hosts of *Cremastocheilus* species (Alpert 1994). These ant genera have common traits that make them good hosts, including vegetable material mixed with the soil inside the nest, populous colonies with enough ant brood to support several adult beetles, and abundant nests in open areas (Alpert 1994).

The host ants frequently attack *Cremastocheilus* adults, both inside and outside the nests (Alpert 1994). These attacks are especially fierce by *Pogonomyrmex* species. When attacked, all *Cremastocheilus* play dead. Letisimulation is when the beetles remain motionless for long periods of time. Some *Cremastocheilus* use letisimulation to their advantage by allowing the host ants to carry them into the nests.

In the Southwest, the beetles' activity and dispersal are triggered by summer rains. After mating on the ant mound, the adult beetles lay the eggs inside the nests' vegetative matter and then the adults die. The larvae survive inside the ant nests by feeding on stored vegetative debris and the adults. The newly eclosed adults survive inside the nest over the winter by eating ant brood.

The following observations on *C. saucius* were made on June 6, 1998, at the USDA Agricultural Research Service (ARS) Central Plains Experimental Range (CPER), which is located approximately 60km northeast of Fort Collins, Colorado. I was researching *Pogonomyrmex occidentalis* Cresson (Hymenoptera: Formicidae) foragers when I noticed the beetle inquilines, which I later identified as *Cremastocheilus saucius* (MacKay 1983), near the nest entrance. Following is a description of the beetle inquilines behavior as they entered the nest of *P. occidentalis*.

The first beetle flew onto the nest near the edge of the dome. The beetle then ran and entered the nest. The ants did not react to the beetle until it had entered the nest entrance, then the ants attacked the beetle and tried to extract the beetle from the nest by pulling on its' legs. The ants were unsuccessful in removing the beetle. In the following forty-five minute period, six more beetles landed on the mound and attempted to enter the nest. Only two of these six beetles were successful in entering the nest. Two pairs of beetles copulated on the edge of the mound before

¹ Received December 23, 1999. Accepted May 29, 2000.

² USDA Agricultural Research Service, Southern Weed Science Research Unit, 141 Experiment Station Road, Stoneville, MS 38776

they attempted to enter. All the beetles, including the successful ones, were viciously assaulted by up to eight ants at a time. The ants attacked the unsuccessful beetles until they retreated to the edge of the mound where the ants continued the defense of their nest. The ants primarily attacked the beetles' legs and attempted to drag the beetles away from the nests. The two beetles that eventually successfully entered the nest, did so despite continued attacks by the ants.

After watching these beetles, I examined additional ant nests in this location. I found six additional nests that had beetles near them. The beetles were either being actively attacked by the ants or were injured on the edge of the ant mounds. Interestingly, although this site has a large number of ant nests of various sizes and ages, I found beetles only on the older more established nests. I found no beetles on ant nests that were one or two years old.

In addition, during late October of 1998, for an unrelated study, I dug up several *P. occidentalis* nests using a backhoe. In the extracted dirt piles, I found two adult beetles. Lavigne (1969), at various times of the year, also found these beetles surviving inside the *P. occidentalis* nests. I placed voucher specimens of the beetles in the University of Colorado Museum.

LITERATURE CITED

- Alpert, G.D. 1994. Symbiotic Relationships among *Cremastocheilus* and Ants, *Sociobio*. 25(1):1-278.
- Lavigne, R.J. 1969. Bionomics and Nest Structure of *Pogonomyrmex occidentalis* (Hymenoptera: Formicidae), *Ann. Entomol. Soc. Am.* 62(5):1166-1175.
- MacKay, W.P. 1983. Beetles Associated with the Harvester Ants *Pogonomyrmex montanus*, *P. subnitidus*, and *P. rugosus* (Hymenoptera: Formicidae), *Coleop. Bull.* 37(3): 239-246.
-
-

(Continued from page 387)

member of the Society's Executive Council.

Howard received his BS in biological sciences from Boston University and his MS in entomology from the University of Delaware. Following a career as an executive with the Boy Scouts of America, he has devoted himself to research in the Cicindelidae (Coleoptera) and to teaching and studying in the New Jersey Pine Barrens, on which he has become an authority. He recently donated his 26,000-specimen cicindelid collection to the Carnegie Museum. He has published over a dozen papers on the Cicindelidae. He has authored two books, *A Field Guide to the Pine Barrens of New Jersey* and *A Pine Barrens Odyssey*, and has a third volume in press on *The Wild Flowers of the Pine Barrens*.

William J. Cromartie
Corresponding Secretary

FOUR SOCIETY MEMBERS HONORED

Bray, Otte, Rentz elected Honorary Members

Boyd elected Emeritus Member

Four long time members of The American Entomological Society were honored recently by the Society. On April 26, 2000, the Society elected Drs. Dale Bray, Daniel Otte, and David Rentz to Honorary Membership in the Society in recognition of the eminent distinction each has attained in the field of entomology. Society bylaws provide for such recognition up to a maximum of twenty Honorary Members.

Dr. Dale Bray, Department of Entomology and Applied Ecology, University of Delaware, Emeritus, has contributed greatly to entomology by his teaching and by his leadership of the department. Dr. Bray was an outstanding and popular teacher of a wide variety of entomology courses at the University for over three decades. He served as Chair of the department from 1958 to 1980, during which time he initiated the Ecology Section of the department, offering the department's first wildlife and environmental courses in the 1970s, and was responsible for considerable faculty expansion. As a result, the department grew to have the largest undergraduate enrollment in its history, and Delaware led the nation in undergraduate enrollments in entomology. Many of his students went on to earn MS and PhD degrees.

Both Dr. Daniel Otte, Curator, Department of Entomology, Academy of Natural Sciences, Philadelphia, and Dr. David Rentz, Chief Research Scientist, Division of Entomology, CSIRO, Australia, are distinguished world authorities in the Orthoptera, Dr. Otte specializing in the Acrididae and the Gryllidae, Dr. Rentz in the Tettigoniidae. The publication records of both researchers are impressive.

Starting in 1967, Dr. Dan Otte has published nearly 60 journal articles, 13 books, and a major website for access to Orthoptera species. His manuals for North American grasshoppers have set a standard for information and aesthetics and have allowed countless individuals the ability to identify these insects, many of which are of important economic or conservation value. He documented a major explosion of speciation in Hawaiian crickets, thereby adding to our knowledge of how speciation occurs. In the early 1990s he undertook the monumental task of developing a species catalog for Orthoptera which is now nearing completion. In addition to all this, Dan has served as Editor of the Society's *Transactions* since 1979.

Starting in 1962, Dr. David Rentz has published over 70 journal articles on the Orthoptera in addition to ten books and monographs, including two volumes on the Tettigoniidae of Australia. His volume on Australian orthopteroid insects entitled *Grasshopper Country* has been acclaimed as an outstanding work on invertebrate zoology. He has also produced several CD-ROM and audiodisk guides. Dr. Rentz has been active in many organizations and committees including the IUCN and the International Association of Sound Archives. While at the Academy of Natural Sciences of Philadelphia in the 1970s, Dave served as Corresponding Secretary and Vice President of The American Entomological Society in 1971 and 1972, and went on to serve as President of the Society in 1973 and 1974.

On February 23, 2000, Howard Boyd was elected to Emeritus Membership in recognition of his long term membership and service to the Society. An Emeritus Member is any member of the Society, over the age of 65 and a member of the Society for 15 years, who has contributed outstanding service to the A.E.S. No more than five living Emeritus Members are permitted according to the A.E.S. bylaws. Howard became a member of the Society in January, 1939 and has been active in various capacities in the Society since 1970, having served as Vice President (1975-76), President (1977-81), and Treasurer (1994-present). He took over the position of Editor of the Society's *Entomological News* with the May-June, 1974 issue and has continued in this role to the present. Early in his editorship, he established a peer-review system for *Ent. News* which has contributed to a marked improvement in the quality of papers published. Howard continues to serve actively as a

(Continued on page 386)

STATEMENT OF OWNERSHIP, MANAGEMENT & CIRCULATION

1. Title of publication: ENTOMOLOGICAL NEWS
2. Date of filing October 1, 2000.
3. Frequency of issue: Bimonthly (every other month) except July and August
4. Location of known office of publication: 232 Oak Shade Rd., Tabernacle Twp., Vincentown PO, New Jersey 08088
5. Location of the headquarters or general business offices of the publishers: 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103-1195
6. Name and address of publisher, editor and managing editor:
 Publisher: American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, PA. 19103-1195. Editor; Howard P. Boyd, 232 Oak Shade Rd Tabernacle Twp, Vincentown PO, New Jersey, 08088
7. Owner: American Entomological Society, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103-1195
8. Known bondholders, mortgagees and other security holders owning or holding one percent or more of total amount of bonds, mortgages and other securities: None
9. For optional completion by publishers mailing at the regular rates: signed
10. For completion by nonprofit organizations authorized to mail at special rates: The purpose, function and nonprofit status of this organization and the exempt status for Federal income tax purposes:
 Have not changed during preceding 12 months (checked)

	Average No. Copies Each Issue During Preceding 12 Months	Actual Number of Copies of Single Issue Published Nearest to Filing Date
11. EXTENT AND NATURE OF CIRCULATION		
A. TOTAL NO. COPIES PRINTED	800	800
B. PAID CIRCULATION		
1. SALES THROUGH DEALERS AND CARRIERS STREET VENDORS AND COUNTER SALES	0	0
2. MAIL SUBSCRIPTIONS	625	621
C. TOTAL PAID CIRCULATION	625	621
D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS. SAMPLES, COMPLI- MENTARY, AND OTHER COPIES	0	0
E. TOTAL DISTRIBUTION	175	179
F. OFFICE USE, LEFTOVER, UNACCOUNTED, SPOILED AFTER PRINTING.	175	179
G. TOTAL	800	800
12. I certify that the statements by me above are correct and complete. Signed: Howard P. Boyd, editor.		

MAILING DATES
VOLUME 111, 2000

No.	Date of issue	Pages	Mailing Date
1	Jan. & Feb.	1-76	May 5, 2000
2	Mar & Apr.	77-148	May 30, 2000
3	May & June	149-232	July 6, 2000
4	Sept. & Oct.	233-316	October 23, 2000
5	Nov. & Dec.	317-392	December 29, 2000

INDEX – Volume 111

- Acentrella feropagus*, n.sp., formal new name for No. Amer. *A. lapponica* 137
- Acrulogonia*, rev. of genus, with descripts. of n.sp. 107
- Aegithus melaspis*, new distrib. data & 1st record of gregarious behavior from Mexico 21
- Ahn, K.-J. 341
- Alba-Tercedor, J., W.P. McCafferty 137
- Acentrella feropagus*, n.sp., formal new name for No. Amer. *A. lapponica*
- Alexander, K.D., M.R. Whiles 1
- A n.sp. of *Ironoquia* from an intermittent slough of central Platte Riv., NE
- Alford, M.H. 283
- Allocapnia polemistic*, new for MS 283
- Allotrichosuphum*, a newly recorded genus from China, & descript of a n.sp. 307
- Altica chalybaea*, on the type series 233
- Amer. Entomol. Soc., meet. reports 76, 290, 314, 315, 316, 387
- Amer. Entomol. Soc., four members honored 387
- Anisocentropus*, n.sp. from Sri Lanka 337
- Apobaetis*, a new Nearctic sp. 265
- Arce-Perez, R., R. Novelo-Gutierrez 196
- 1st record of genus *Psephenops* from Mexico, with descript of a n.sp.
- Asilidae 84
- Automeris*, n.sp. of from cent. Mexico 317
- Babycurus*, a n.sp. from no. Oman 185
- Baetidae 45, 133, 137, 140, 143, 259, 265, 375, 380
- Baetiella* in Hong Kong, with descript. of a n.sp. 143
- Balcazar-Lara, M.A. 317
- N.sp. of *Automeris* from cent. Mexico
- Barbalho, S.M., A.M. Pentead-Dias 25
- Platydyctes*, a new doryctinae genus from Brazil
- Two n.sp. of genus *Whitfieldiellus* from Brazil 328
- Bartlett, C.R. 120
- Annotated list of planthoppers of Guana Is., B.W.I.
- Basilisa boardmani*, host specificity & distrib. of, & 1st record of Nycteribiidae in VA 291
- Baumgardner, D.E. 60
- Baumgardner, D.E., W.P. McCafferty 49
- Leptohyphes zalope*, a polytypic North & Cent. Amer. sp.
- Beckemeyer, R.J., R.E. Charlton 84
- Distrib. of *Microstylus morosum* & *M. galactodes*; significant range extensions
- Belostoma foveolatum*, descript. of male & new records of *B. costalimai* & *B. stollii* 159
- Blattella germanica*, fecundity of male exposed to multiple virgin females 371
- Blera*, a new Oriental sp. 181
- Bologna, M.A. 74
- Book review 313, 366, 384
- Books received & briefly noted 31, 48, 59, 73, 237, 242, 331, 340, 358
- Bordontilla*, n.sp. of, & a new record of, from Chile 32
- Boyd, H.P. 224
- Established validity of *Cicindela scutellaris*
- Braconidae 25, 328
- Brailovsky, H. 97
- A new genus & 3 n.sp. of the tribe Spathophorini
- Brailovsky, H., G. Couturier 322
- N.sp. of *Sepinioides* from Ecuador
- Buthidae 185
- Calamoceratidae 337
- Calhoon, R.E. 371
- Calleida purpurea*, 1st report of, & note on its occurrence on pasque flower 193
- Capniidae 283
- Carabidae 8, 193, 367
- Charlton, R.E. 84
- Chilopoda 250
- Chondromorpha xanthotrichia*, new milliped or continental U.S. 370
- Christiansen, K-A. 332
- Chrysomelidae 233
- Cicadellidae 107, 116, 255, 325
- Cicindela cursitans* in no. west MN 367
- Cicindela scutellaris*, establish validity of 224
- Ciplak, B. 299
- Genus *Festella*, with descript of *F. rammei*
- Coelidiana*, n.sp. of from Galapagos Is. 325
- Cokendolpher, J.C., W.D. Sissom 243
- Further contribs. to study of *Dalquestia*
- Coleoptera 8, 21, 74, 171, 193, 196, 224, 233, 341, 355, 367, 385
- Collembola 332
- Conner, W.E. 287
- Coreidae 322
- Cotinus*, n.sp. of, & key to I.D. Mexican sp. 171
- Couturier, G. 322

- Cremastocheilus Saucius*, behavior of beetle inquiline & its host ant, *P. occidentalis*, during entrance into ants nest 385
- Cromartie., W.J. 76, 290, 314, 315, 316, 387
- Curicta scorpio*, MS record for 282
- Curtis, C., I. Huber, R.E. Calhoun 371
Fecundity of male *Blattella germanica* exposed to multiple virgin females
- Dalquestia*, further contribs. to study of 243
- Davidson, R.L. 355
- Deloya, C., S. Ibanez-Bernai, C. Nogueira 171
A n.sp. of *Cotinus* & key to I.D. of Mexican sp.
- de Moor, F.C. 380
- Denson, D.R. 359
- Diалота pacifica*, descrip. of late instar larvae 341
- Diptera 84, 181, 291
- Dubois, M.B. 13
Monomorium minimum sp. group: gyne number & longevity
- Dudgeon, D. 143
- Eisner, M., & T. 287
- Elasmognathus helferi*, holotype of lace bug found 223
- Entomobryidae 332
- EphemereUidae 39
- Ephemeroptera 39, 45, 49, 60, 133, 137, 140, 143, 259, 265, 375, 380
- Erotylidae 21
- Fang, W., K.A. Christiansen 332
A n.sp. of *Sinella* from China
- Festella*, genus, with descrip. of *F. rammei* 299
- Flint, O.S. Jr. 337
A n.sp. of *Anisocentropus* from Sri Lanka
A n.sp. of *Leptonema* of *occidentale* group from Madagascar 177
- Formicidae 13, 201, 385
- Freytag, P.H. 325
- Freytag, P.H. 255
Genus *Kunzella*, & a closely related new genus, *Youngszella*
- Froeschner, R.C. 223
Found: holotype of lace bug *Elasmognathus helferi*
- Fulgoroidea 120
- Glossosoma nigrrior*, larva, pupa, & adults of, with review of east. No. Amer. sp. 149
- Godoy, C., M.W. Nielson 107
Rev. of leafhopper genus *Acrulogonia* with descripts. of n.sp.
N.sp. of *Schildola* from Costa Rica 116
- Goulet, H. 238
- Greenideidae 307
- Harris, S.C., A.D. Huryn 77
New & rare microcaddisflies from east. U.S.
- Hawks, D.C. 382
- Haynes, C.G. 206, 215
- Hemiptera 67, 97, 120, 159, 223, 282, 382
- Heteroptera 67, 97, 159, 223, 322
- Hicks, M.B., C.G. Haynes 206
Ann. list of Trichoptera in Bankhead Nat'l. For. in n.w. AL
Ann. list of Trichoptera in black belt region of west-cent. AL 215
- Hobson, C.S. 291
1st record of Nycteriibiidae in VA & disc. of host specificity & distrib. of *Basilia boardmani*
- Hoebcke, E.R. 287
- Homoptera 107, 116, 120, 255, 307, 325
- Huber, I. 371
- Huryn, A.D. 77
- Hydropsychidae 177
- Hydroptilidae 77
- Hymenoptera 13, 25, 32, 201, 238, 328, 385
- Ibanez-Bernal, S. 171
Ironoquia, n.sp. of from intermittent slough of cent. Platte Riv., NE 1
- Iyengar, V.K. 287
- Jacobus, L.M., W.P. McCafferty 39
Variability of larvae of *Serratella serrata*
- Jamaican arthropods, length-weight relationships 270
- Jiannino, J. 348
- Johnson, M.D., A.M. Strong 270
Length-weight relationships of Jamaican arthropods
- Kaufmann, T. 294
Life hist. & behavior of African bush grasshopper, *Phymateus viridipes* in captivity

Keiper, J.B., M. Sanford, J. Giannino, W.E. Walton	348	Nardi, G., M.A. Bologna	74
Invertebrates inhabiting wetland monocots damaged by Lepidoptera		Cantharidin attraction in <i>Pyrochroa</i>	
Kight, S.L.	67	Navarrete-Heredia, J.L., R. Novelo-Gutierrez	21
Altered photocyclic regimes influence duration of maternal care in burrower bug		New distrib. data & 1st record of gregarious behavior for <i>Aegithus melaspis</i> from Mexico	
Kim, H.-J., J.-Y. Ryu, K.-J.-Ahn	341	Nepidae	282
Descrip. late instar larvae of <i>Diaulota pacifica</i>		<i>Nicrophorus vespilloides</i> , new so. distrib. records for	355
<i>Kleidocerys ovalis</i> , relief behavior of in so. Calif.	382	Nielson, M.W.	107, 116
<i>Kunzella</i> genus & closely related new genus <i>Youngszella</i>	255	Nogueira, G.	171
		Notice	254
		Novelo-Gutierrez, R.	21, 196
		Nycteribiidae	291
Lago, P.	282	Opiliones	243
New MS record for <i>Curicta scorpio</i>		Orthoptera	294, 299
Lepidoptera	287, 317, 348	<i>Otostigmus scabricauda</i> , maternal care in Neotropical centipede	259
<i>Leptohyphes zalope</i> , a polytypic No. & Cent. Amer. sp.	49	<i>Paracloeodes</i> , n.sp. from Mexico	133
<i>Leptonema</i> , a n.sp. of <i>occidentale</i> group, from Madagascar	177	Paradoxosomatidae	370
LaSage, L.	233	Penteado-Dias, A.M.	25, 328
On the type series of <i>Altica chalybaea</i>		<i>Phymateus viridipes</i> , life hist. & behavior of in captivity	294
Limnephilidae	1, 359	Pitts, J.P.	32
Long, L. S.	45	N.s.p. & new record of <i>Bordontilla</i> from Chile	
Lowe, G.	185	<i>Platydyoryctes</i> , a new doryctinae genus from Brazil	25
A n.sp. of <i>Babycurus</i> from no. Oman		<i>Plauditus grandis</i> , a new small minnow mayfly from TN	45
Lugo-Ortiz, C.R., F.C. de Moor	380	Plecoptera	283
<i>Pseudocloeon aquacidum</i> , new subjective synonym of <i>P. latum</i>		<i>Pogonomyrax occidentalis</i> , foraging distance of, on grazed & ungrazed shortgrass prairies in CO	201
Lygaeidae	382	<i>Pogonomyrax occidentalis</i> , host ant of beetle inquiline, <i>C. saucius</i> , behavior of during entrance into ants' nest.	385
Machado, G.	250	Polydesmida	370
Maternal care in Neotropical centipede <i>Otostigmus scabricauda</i>		<i>Psephenops</i> , 1st record of from Mexico, with descrip. of a n.sp.	196
Mailing dates, Vol. 111, 2000	388	<i>Pseudocloeon aquacidum</i> , new subjective synonym for <i>P. latum</i>	380
McCafferty, W.P.	39, 49, 133, 137	Publisher's statement	388
McCafferty, W.P.		Purrrington, F.F.	8
A new Nearctic <i>Apobaetis</i>	265	A new <i>Selenophorus</i> from Rio Grande in TX	
Notations on So. Amer. Baetidae	305	Purrrington, F.F., R.L. Davidson	355
Reporting species record data	312	New so. distrib. records for Boreal carrion beetle <i>Nicrophorus vespilloides</i>	
McCafferty, W.P., R.P. Randolph	259	<i>Pycnopsyche indiana</i> , range extension, ecological notes, & new records of, from Fla	359
Further contribs. to spatulate-clawed Baetidae			
Melolonthidae	171		
<i>Microstylum morosum</i> & <i>M. galactodes</i> , distrib. of & significant range extensions	84		
Monocots damaged by Lepidoptera inhabited by invertebrates, in wetlands	348		
<i>Monomorium minimum</i> sp. group: gyne number & longevity	13		
Morse, J.C.	149		
Mutellidae	32		

Pyrgomorphidae	294	Tenthredinidae	238
<i>Pyrochroa</i> , cantharidin attraction in	74	Tettigoniidae	299
Qiao, G.X.	307	Thompson, F.C.	181
<i>Allotrichosiphum</i> , a newly recorded		A new Oriental <i>Blera</i>	
genus from China, & descrip. of a n.sp.		Tinerella, P.P.	193
Randolph, R.P.	259	1st report of <i>Calleida purpurea</i> in	
Randolph, R.P., W.P. McCafferty	133	MN & note on its occurrence on	
A n.sp. of <i>Paracloeodes</i> from Mexico		pasque flower	
Rasmussen, A.K., D.R. Denson	359	Tinerella, P.P., D.A. Rider	367
Range extension, ecological notes, &		Occur. of tiger beetle <i>Cicindela</i>	
new records of <i>Pycnopsyche indiana</i>		<i>cursorians</i> in no.west MN	
from Fla		Tingidae	223
Ribeiro, J.R.I.	159	Tong, X., D. Dudgeon	143
Descrip. of male <i>Belostoma foveo-</i>		<i>Baetiella</i> in Hong Kong, with	
<i>latum</i> & new records of <i>B. costalimai</i>		descrip. of a n.sp.	
& <i>B. stollii</i>		Trichoptera	1, 77, 149, 177, 206, 215, 227, 337, 359
Rider, D.A.	367	Tucker, S.G.	283
Rossini, C. et al	287	Usnick, S.J.	
Alkaloid content of parasitoids reared		Behavior of beetle inquiline,	385
from pupae of an alkaloid-sequestering		<i>Cremastocheilus saucius</i> , & its host	
arctiid moth		<i>P. occidentalis</i> during entrance into	
Ruiter, D.E.	227	ants' nest	
New descripts. & distrib. records for		Foraging distance of <i>Pogonomyrmex</i>	201
east. No. Amer. caddisflies		<i>occidentalis</i> on grazed & ungrazed	
Ryu, J.-Y.	341	shortgrass prairies in CO	
Sanford, M.	348	Vetter, R.S., D.C. Hawks	382
Saturniidae	317	Relief behavior by <i>Kleidocerys ovalis</i>	
Scarabaeidae	385	in urban so. Calif.	
<i>Schildola</i> , n.sp. from Costa Rica	116	Walton, W.E.	348
Sclerosomatidae	243	Whiles, M.R.	1
Scolopendromorpha	259	<i>Whitfieldiellus</i> , two n.sp. of, from	328
Scorpiones	185	Brazil	
<i>Selenophorus</i> , new from Rio Grande, TX	8	Wiersema, N.A.	140
<i>Sephinooides</i> , a n.sp. of from Ecuador	322	New combo for two No. Amer. small	
<i>Serratella serrata</i> , variability in	39	minnow mayflies	
larvae of		Wiersema, N.A., D.E. Baumgardner	60
Shelley, R.M.	370	Distrib. & taxonomic contributions	
<i>Chondromorpha xanthotricha</i> , new		to Ephemeroptera fauna of Mexico	
millipede for continental U.S.		& Cent. Amer.	
Silphidae	355	Wiersema, N.A. L.S. Long	45
<i>Sinella</i> , n.sp. of from China	332	<i>Plauditus grandis</i> , new small minnow	
Sissom, W.D.	243	mayfly from TN	
Smith, D.R., H. Goulet	238	Wymer, D.A., J.C. Morse	149
<i>Monosoma pulverata</i> , an alder-feeding		Larva, pupa, & adults of <i>Glossosoma</i>	
sawfly new to No. Amer.		<i>nigrior</i> , with review of east. No.	
Society meet. reports	76, 290, 314, 315, 316, 387	Amer. sp.	
Staphylinidae	341	<i>Youngszella</i> , new genus closely related	255
Stark, B.P., M.H. Alford, S.G. Tucker	283	to genus <i>Kunzella</i>	
<i>Allocapnia polemistis</i> , new for MS			
Strong, A.M.	270		
Syrphidae	181		

When submitting papers, all authors are requested to (1) provide the names of two qualified individuals who have critically reviewed the manuscript *before* it is submitted and (2) suggest the names and addresses of two qualified authorities in the subject field to whom the manuscript may be referred by the editor for final review. All papers are submitted to recognized authorities for final review before acceptance.

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.

Illustrations: For maximum size and definition, full page figures, including legends, should be submitted as nearly as possible in a proportion of 4/6. Maximum size of printed illustration, including all legends, is 4 1/2 x 6 1/2 inches. Authors will be charged for all text figures and half-tones at the rate of \$20.00 each, regardless of size.

Books for review and book publication announcements should be sent to the editor, Howard P. Boyd. For address, see under "manuscripts" above. Literature notices, books received and short reviews will be published in The Entomologist's Library on books dealing with taxonomy, systematics, morphology, physiology ecology, behavior and similar aspects of insect life and related arthropods. Books on applied, economic and regulatory entomology, on toxicology and related subjects will not be considered.

Study notices, want items and for sale notices are published in The Entomologist's Market Place.

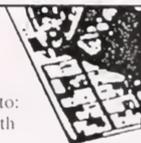
Page charges: For society members, a charge of \$20.00 is made for each published page of an article, plus costs of all illustrations. For non-society members, the page charge is \$25.00 per page. If any charges are not paid within 120 days of billing, authors will be charged an additional \$5.00 per page. Papers may be published ahead of their regularly scheduled time at a cost of \$35.00 per page.

Unemployed and retired amateur and scientist members of the American Entomological Society and students who are without institutional support or are not subsidized by grants and who are without funds for publishing may apply for financial assistance at the time their manuscript is submitted. Such application must include an explanation of the author's status (unemployed retired, or student). Page charges for these individuals are negotiable, with a minimum of \$10.00 per page.

Reprints: (without covers) may be ordered when corrected page proofs are returned to the editor. Schedule of reprint costs will appear on order form.

This publication is available
in microform from University
Microforms International.

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.



The Entomologist's Market Place

Advertisements of goods or services for sale are accepted at \$1.00 per line, payable in advance to the editor. Notice of wants and exchanges not exceeding three lines are free to subscribers. Positions open, and position wanted notices are included here and may be referred to by box numbers. All insertions are continued from month to month, the new ones are added at the end of the column, and, when necessary, the older ones at the top are discontinued.

Two New Entomology Books from: ASSOCIATED PUBLISHERS, P. O. Box 140103, Gainesville, FL 32614-0103. FAX: 1-904-371-4071.

A PHYLOGENETIC ANALYSIS OF THE MAJOR LINEAGES OF THE CRAMBINAE AND OF THE GENERA OF CRAMBINI OF NORTH AMERICA (Lepidoptera: Pyralidae). By Bernard Landry. *Memoirs on Entomology International*, Vol. 56, May 1995. 248 pages ISBN: 1-56665-056-9, Price US \$45.00.

TORYMINAE (Hymenoptera: Torymidae): A REDEFINITION, GENERIC CLASSIFICATION, AND ANNOTATED WORLD CATALOG OF SPECIES By E. E. Grissell. *Memoirs on Entomology International*, Vol. 57. May 1995. 480 pages. ISBN: 1-56665-057-7. Price US \$60.00.

TWO NEW ENTOMOLOGICAL WORKS appeared recently in *Memoirs on Entomology International* Series that was started in 1995 to publish authoritative monographic works on insects and other arthropods on a world-wide basis.

THE THRIPS OF CENTRAL AND SOUTH AMERICA: AN INTRODUCTION. By Laurence Mound & Rita Marullo. Vol. 6, 1996. 488 pages. Price \$65.00.

THE ERIOPHYOID MITES OF CHINA: AN ILLUSTRATED CATALOG & IDENTIFICATION KEYS (ACARI: MESOSTIGMATA: ERIOPHYOIDEA). By Xiaoyue Hong & Zhi-Qiang Zhang. Vol. 7, 1996. 328 pages. Price \$45.00.

FIVE VOLUMES were published in 1995 on Crambinae, Toryminae, Rove beetles, Shore flies and Eupelminae. Please inquire details. Personal discount available. Associated Publishers, PO Box 140103, Gainesville, FL 32614-4071. Fax 352-371-4071.

INSECTS OF PERU from Madre de Dios, Apurimac, Cusco and other good places. Please write for wholesale price list to: Rainer Marx, Triererstr. 726, 52078 Aachen, GERMANY.

OBRA TAXONÒMICA DEL DR. FRANCESC ESPAÑOL by A. Viñolas, O. Escolà & J. Vives. Volume 7 (1995) of the monograph series *Treballs del Museu de Zoologia* published by the Zoology Museum of Barcelona. Compilation and systematic updating of more than 500 species. 110 pages, 4 b/w photographs, 48 drawings, ISSN 0211-0687. Price 1200 Spanish Pesetas (supplement airmail: Europe: 200 pts, rest of the world: 500 pts). Fax: +34-3-3104999 (Publications dept.).

SPECIMEN PREPARATION: Bugpuncher wants to help you with your backlog of specimens! Years of experience in all orders; specializing in Skippers. References available; low rates. E-mail for information: Bugpuncher@aol.com

FOR SALE: Hundreds of unpinned, unidentified scarabs from Africa, many species. A+ quality. inquiries welcome, selling in lots or in toto only please. Contact: W. David Garrahan, Jr., Cornell University, Clara Dickson Hall, Room 3563, Ithaca, NY 14853-2401, e-mail (preferred): wdg2@cornell.edu

WANTED: Taxonomic and distributional literature dealing with insects and other arthropods likely to be found in Louisiana and environs. Needed for future checklisting project. Collections, single papers. State price. Jerry G. Walls, 657 Second St., Trenton, NJ 08611. 609-394-1038. Gyretes@prodigy.net

SMITHSONIAN INSTITUTION LIBRARIES



3 9088 00941 6025