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EUGENE MURRAY-AARON (1852-1940): FORGOTTEN FIRST EDITOR OF *ENTOMOLOGICAL NEWS*[1]

Kirkland A. Kenney,[2] Christine G. Galvagna,[3] and Jorge A. Santiago-Blay[4]

When author JASB took on the editorialship of *Entomological News* (November 2003), he decided to learn about the early history of the journal. Until recently, Henry Skinner, Editor from 1890 to 1920, was cited as the first Editor of *Entomological News*. However, upon opening the first issue of the journal, we noticed that Eugene Murray-Aaron, herein abbreviated EMA, got the first two issues (January and February 1890) off the ground when this journal was known as "Entomological News and Proceedings of the Entomological Section, Academy of Natural Sciences, Philadelphia." In addition to entomology, EMA had diverse professional interests including natural history, geography, cartography, travel, human biology, cycling, government, etc. Murray-Aaron's literary fiction and scientific journalism writings are direct and captivating, often reflecting strong views. What follows is an abstract on the life of EMA taken from a much larger manuscript in preparation.

Eugene Murray-Aaron was born in Norristown, a small city located northeast of Philadelphia, Pennsylvania (United States), on August 4, 1852. Reverend Samuel Aaron, an ardent advocate of temperance, antislavery, and scholarship in southeastern Pennsylvania and eastern central New Jersey during the middle third of the 19th century, was his step-grandfather. EMA served as the last Editor of Papilio (1884). Murray-Aaron's passion in entomology focused on skippers (Hesperiidae), an interest shared with his editorial successor of greater fame, Henry Skinner, with whom he co-authored only one paper (1889 *Canadian Entomologist* 21:126-131, 145-149). During the 1880s and early 1890s, EMA traveled extensively throughout the Caribbean, Central, and South America. His major natural history books, entitled *Butterfly Hunters in the Caribbees* (1884) and *The New Jamaica* (with E. M. Bacon, 1890) were undoubtedly conceived there. While the reasons for his brief tenure as Editor of *Entomological News* are not completely clear, there seems to have been differences of opinion between EMA, Skinner, and Philip Powell Calvert (third Editor of *Entomological News*) on the best use of the printed space in *Entomological News*. During 1893 and 1894, EMA was columnist for the Sunday science section of *The Los Angeles Times* and other major newspapers in the USA. Murray-Aaron served as geographic editor for the George F. Cram Company from 1899 to 1917. While EMA did not return to the scholarly study of insects, his love for entomology remained with him until his later years. At 82, EMA was reported gardening in Chicago (Illinois) and living with assistance from the government as his investments had become worthless. Eugene Murray-Aaron died on September 19, 1940.

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[1] Received on March 15, 2004. Accepted on March 16, 2004.

[2] Benington College, Bennington, Vermont 05201, U.S.A. E-mail: grntbuggly@aol.com.

[3] Bennington College, Bennington, Vermont 05201, U.S.A. E-mail: christinegalvagna@hotmail.com.

[4] Department of Paleobiology, MRC-121, National Museum of Natural History, P.O. Box 37012, Washington, DC 20013-7012, U.S.A. E-mail: santiago-blay@nmnh.si.edu.

DISCOVERY OF THE MILLIPED *PLEUROLOMA FLAVIPES* (POLYDESMIDA: XYSTODESMIDAE) IN TEXAS, AND OTHER RECORDS FROM WEST OF THE MISSISSIPPI RIVER[1]

Rowland M. Shelley,[2] Chris T. McAllister,[3] and Shelly B. Smith[3]

ABSTRACT: *Pleuroloma flavipes* Rafinesque, the westernmost representative of the east-Nearctic xystodesmid milliped fauna, is reported from Bowie County, Texas, the first record from this state. Other new localities from west of the Mississippi River are listed, one being a disjunct site in Lafayette Parish, Louisiana, approximately 200 mi (320 km) south of the contiguous range; it is believed to represent an allopatric population. These sites extend the distributions of the species, genus, tribe Rhysodesmini, and family some 75 mi (120 km) westward in Oklahoma; the published locality in Ellsworth County, Kansas, is the westernmost in the Central Plains for these taxa.

KEY WORDS: *Pleuroloma flavipes*, Polydesmida, Xysdodesmidae, Mississippi River, Texas, Oklahoma, Louisiana.

The milliped family Xystodesmidae occupies three areas of North America in addition to those in east Asia and the Mediterranean region of Europe, Africa, and the Middle East (Hoffman 1978, Fig. 2; Shelley 1987, Fig. 1): the eastern United States and southern Ontario and Québec, Canada, from the Central Plains eastward; the southern periphery of Texas to El Salvador; and along the Pacific Coast from southern Alaska to Los Angeles, extending eastward into western Montana. Two species occur outside these areas in the United States: *Stenodesmus tuobitus* (Chamberlin), in southern New Mexico and Culberson County, Texas, and *Rhysodesmus chisosi* Shelley, in Brewster County, Texas (Shelley 1987, 1989, 1992). The species with the greatest distribution in the family is *Pleuroloma flavipes* Rafinesque, which is the westernmost representative of the east-Nearctic fauna from the Oklahoma/Texas border northward. Including the records herein, its contiguous range encompasses some 985 mi (1,576 km), north/south, in the west, 584 mi (934 km) in the east, and 1,130 mi (1,808 km), east/west. The northernmost localities are in Cass County, North Dakota, Ingham County, Michigan, Essex County, Ontario, and Franklin County, Massachusetts; the southernmost are in Cleveland County, North Carolina, and Madison Parish, Louisiana; and the easternmost are from Franklin County, Massachusetts, and the western shore of Chesapeake Bay, Virginia (Shelley 1980, 1988; Hoffman 1999). Shelley (1980, 1990) predicted eventual discovery in northeastern Texas and shaded this corner of the state in his distribution map (1980, Fig. 29), and this prediction can now be confirmed, as the third author collected individuals of both sexes near Beaver Dams Community, Bowie County, in April 2002. They are deposited in the invertebrate collection of the North Carolina State Museum of Natural Sciences.

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[2] Research Lab., North Carolina State Museum of Natural Sciences, 4301 Reedy Creek Rd., Raleigh, NC 27607, U.S.A. E-mail: rowland.shelley@ncmail.net.

[3] Biology Department, Texas A&M University-Texarkana, Texarkana, TX 75505, U.S.A.; CTM, E-mail: chris.mcallister@tamut.edu.

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Pleuroloma flavipes was described and fully illustrated by Shelley (1980), as part of a generic revision; the characteristic configuration of the gonopods, the male copulatory appendages, is shown in Fig. 11. It is a component of the tribe Rhysodesmini, otherwise represented in Texas by *Rhysodesmus texicolens* (Chamberlin), in the Rio Grande Valley (Cameron, Hidalgo, Starr, Webb, and Willacy counties); *R. chisosi*, in the Chisos Mountains, Big Bend National Park; and *S. tuobitus*, in McKittrick Canyon, Guadalupe Mountains National Park (Hoffman 1970; Shelley 1987, 1989). Shelley (1990) reported *S. tuobitus* from Hidalgo County, around 984 mi (1,574 km) southeast of McKittrick Canyon, but this locality is implausible and is herewith deleted pending confirmation with fresh material. As in all rhysodesminines, the somatic features of *P. flavipes* are highly variable, while the gonopods are relatively constant. It is one of the few xystodesmids north of the Rio Grande that can be reliably identified from females as well as males because of the diagnostic lobes on the caudal margins of the sterna, which are apically broad in the Bowie County specimens, in contrast to the subtriangular lobes in the North Carolina individual illustrated by Shelley (1980, Fig. 6). The species exhibits three color patterns - bimaculate, trimaculate, and banded - and the Texas specimens are bimaculate with a black dorsal base color and yellow paranota.

New localities for *P. flavipes* from west of the Mississippi River expand the distributions of the species, genus, tribe, and family westward by around 75 mi (120 km) in Oklahoma (Fig. 1). The range west of the Mississippi is shown in the accompanying map; the westernmost localities are in Noble County, Oklahoma (cited herein), Ellsworth County, Kansas (Shelley 1980), and Cuming and Lincoln counties, Nebraska (Kenyon 1893), with that in Kansas, located near the center of the state, forming the western limits for the species, genus, tribe, and family. No records are available from South Dakota, but *P. flavipes* surely occurs in the eastern periphery, along the Missouri, Big Sioux, and Minnesota Rivers. The new locality in Louisiana is detached from the contiguous area by around 200 mi (320 km). While *P. flavipes* may yet be discovered in intervening parishes, much of this area, particularly the Kisatchie National Forest in Grant, Natchitoches, Rapides, and Winn parishes, has been well collected without the discovery of a single individual. Consequently, we believe that an allopatric population exists in southern Louisiana. Published records from west of the Mississippi River are cited by Shelley (1980), and new ones are listed below. Acronyms of repositories are as follows:

EIL – Zoology Department, Eastern Illinois University, Charleston.
FMNH – Field Museum of Natural History, Chicago, Illinois.
FSCA – Florida State Collection of Arthropods, Gainesville.
ISU – Entomology Department, Iowa State University, Ames.
MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.
NCSM – North Carolina State Museum of Natural Sciences, Raleigh.

NDSU – Entomology Department, North Dakota State University, Fargo.

NMNH – National Museum of Natural History, Smithsonian Institution, Washington, DC.

OKSU – Emerson Entomological Museum, Oklahoma State University, Stillwater.

OMNH – Sam Noble Oklahoma Museum of Natural History, University of Oklahoma, Norman.

PMNH – Peabody Museum of Natural History, Yale University, New Haven, Connecticut.

TBMNH – Thomas Burke Museum of Natural History, University of Washington, Seattle.

UAAM – University of Arkansas Arthropod Museum, Fayetteville.

UCD – Bohart Entomological Museum, University of California at Davis.

UCO – Biology Department, University of Central Oklahoma, Edmond.

UMN – Department of Entomology, University of Minnesota, St. Paul.

UMO – Enns Entomological Museum, University of Missouri, Columbia.

VMNH – Virginia Museum of Natural History, Martinsville.

WTAMU – Department of Life, Earth, and Environmental Sciences, West Texas A&M University, Canyon.

NEW RECORDS

ARKANSAS: *Jackson Co.*, Newport, ♂♂, ♀♀, 2 April 1961, D. Combs (FSCA). *Phillips Co.*, St. Francis Nat. For., Storm Creek Lake Area, 4♂, 6♀, 16 June 1999, R. M. Shelley (FMNH, NCSM). *Sebastian Co.*, Ft. Smith landfill, 4♂ but huge numbers in forest/pasture ecotone, 16 June 1994, C. E. Carlton (UAAM).

IOWA: *Boone Co.*, Ledges St. Pk., ♂, ♀, 4 June 1984, R. E. Lewis (NCSM). *Delaware Co.*, Delhi, 2♂, ♀, date and collector unknown (PMNH). *Dickinson Co.*, Cayler Prairie, ♂♂, ♀♀, date and collector unknown (ISU). *Hancock Co.*, Pilot Knob For., 6♂, 5♀, H. W. Levi (MCZ). *Henry Co.*, Mt. Pleasant, 2♂, date and collector unknown (NMNH). *Pocahontas Co.*, Kaslow Prairie, ♂♂, ♀♀ 15 June 1966, K. L. Bean (ISU). *Story Co.*, Ames, ♀, 1941, collector unknown (NMNH).

KANSAS: *Johnson Co.*, Bonner Springs, ♂, 10 October 1973, W. S. Graig (UMO). *County Unknown*, Tall Oaks, ♂, 12 June 1964, H. S. Dybas (FMNH).

LOUISIANA: *Lafayette Co.*, Lafayette, on ground at night, ♂, 22 August 1996, L. A. Baptiste (UCD).

MINNESOTA: *Anoka Co.*, Coon Creek, ♂, 19 September 1933, A. C. Hodson (UMN). *Becker Co.*, Pickerel Lake, 2♂, ♀, 3 September 1975, A. Friskop (NDSU). *Houston Co.*, Mississippi River bluff, 2♀, 30 May 1941, Wing (UMN); Mississippi River bluff N of New Albin Iowa, ♂, ♀, 23 May 1954, C. E. Mickel (UMN); and 3 mi (4.8 km) NE Eitzen, along Winnebago Cr., ♂, ♀, 23 May 1954, collector unknown (UMN). *Martin Co.*, Fairmont, in cornfield, ♂, 3♀, juvs., 7 July 1942, 20 June 1944, G. B. Simpson (UMN). *Nobles Co.*, Worthington, 3♂, 5♀, 1 July 1941, C. E. Stower (UMN). *Wabasha Co.*, W of Lake Pepin, 2♂, ♀♀, 4 July 1907, collector unknown (TBMNH). *Washington Co.*, Scandia, Second Lake, ♂, 8 July 1958, L. V. Knutson (VMNH)

MISSOURI: *Bollinger Co.*, Glenallen, ♀, date unknown, A. Henderson (UMO). *Camden Co.*, Camdenton, 2♂, 15 May 1953, G. T. Riegel (EIL). *Clay Co.*, Coolie Lake, ♂, 30 May 1958, J. R. Heitzman (FSCA). *Pettis Co.*, 9 mi (14.4 km) S Sedalia, Friendly Prairie, ♂, 9 June 1978, collector unknown (UMO). *Stone Co.*, N of Kimberly City, Table Rock Lake, ♂, 25 May 1974, S. E. Thewke (UMO).

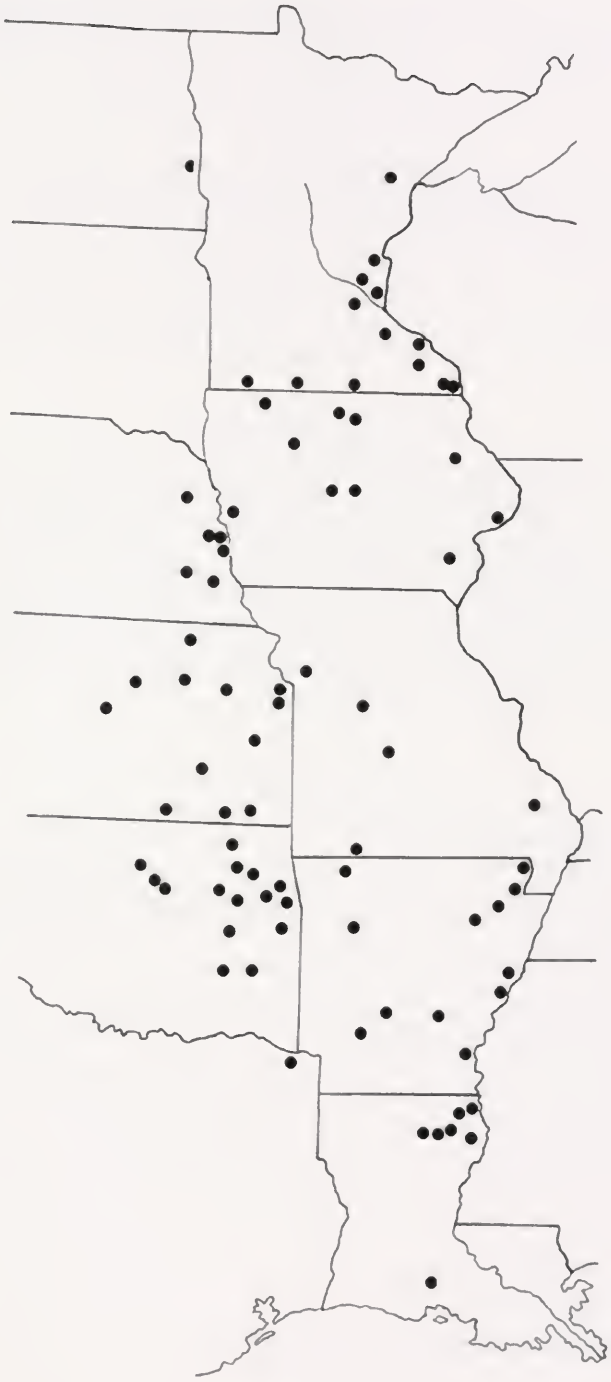

Fig. 1. Distribution of *Pleuroloma flavipes* west of the Mississippi River.

NEBRASKA: *Douglas Co.*, Waterloo (misspelled as "Wameloo"), ♀, 26 February 1949, collector unknown (NMNH). *Sarpy Co.*, Bellevue, Fontanelle Forest Nature Center, ♂, 22 June 1986, Dietz & Benedict (NCSM).

OKLAHOMA: *Cherokee Co.*, Greenleaf St. Pk., ♀♀, juvs., date unknown, J. Brooks (UCO). *Latimer Co.*, locality not specified, ♂, ♀, 9 June 1931, R. D. Bird (OMNH). *Mayes Co.*, Locust Grove, ♂, 2♀, 20 May 1972, D. C. Arnold (OKSU). *McIntosh Co.*, Eufala, by lake, ♂, June 1994, W. D. Sissom (WTAMU). *Noble Co.*, Perry, ♀, 6 June 1965, D. C. Arnold (OKSU) **Westernmost Oklahoma Record.** *Nowata Co.*, Lenapah, ♂, ♀, 19 May 1965, D. C. Arnold (OKSU). *Payne Co.*, Stillwater, on golf course greens, ♂♂, ♀♀, 26 June 1962, D. E. Howell (OKSU); and Ripley, Ghost Hollow, ♀, date unknown, McKenna (OKSU). *Pittsburgh Co.*, McAlester, ♂, 28 June 1972, J. Sallee (OKSU). *Rogers Co.*, Foyil, ♂, 3 June 1971, D. C. Arnold (OKSU). *Sequoyah Co.*, Gore, ♂, 20 April 1952, A. C. Cohen (SMUO). *Wagoner Co.*, 3 mi (4.8 km) S Porter, ♂, 25 May 1977, D. C. Arnold (OKSU).

TEXAS: *Bowie Co.*, ca. 9.5 mi (15.2 km) NNW DeKalb, along US Hwy. 259 at Beaver Dams Community, ♂, 2♀, 20 and 27 April 2002, S. B. Smith (NCSM). **New State Record.**

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POSSIBLE REPRODUCTION OF THE COMAL SPRINGS RIFFLE BEETLE, *HETERELMIS COMALENSIS* (COLEOPTERA: ELMIDAE), IN CAPTIVITY[1]

Joe N. Fries[2]

ABSTRACT: Endangered Comal Springs riffle beetles have been kept in captivity at the San Marcos National Fish Hatchery and Technology Center since 1996. In 2000, beetle larvae were found in an aquarium that previously had only adults. None of the larvae survived for more than 8 months. One adult beetle survived for 19 months.

KEY WORDS: *Heterelmis comalensis*, Coleoptera, Elmidae, Texas, reproduction.

The Comal Springs riffle beetle (*Heterelmis comalensis* Bosse, Tuff, and Brown) (Coleoptera: Elmidae) occurs in spring-runs of the Comal River (Comal Springs), New Braunfels, Comal County, Texas (Bosse *et al.* 1988), and a single specimen was found in the headwaters of the San Marcos River, Hays County, Texas, in 1992 (Barr 1993). The spring ecosystems of both rivers are dependent upon flow from the Edwards Aquifer which also provides high quality water to meet an ever-increasing human demand. *Heterelmis comalensis* was listed as endangered in 1998 by the U.S. Fish and Wildlife Service (1997), primarily because of threats to its habitat. Additionally, the U.S. Fish and Wildlife Service (1996) required the development of refugium populations for the listed species from the spring ecosystems of the San Marcos and Comal rivers.

Since July 1996, the San Marcos National Fish Hatchery and Technology Center (NFHTC), San Marcos, Texas, has been involved in refugium activities for *H. comalensis*. Beetles were collected from rocks in Comal Springs during 1996-1998 and brought to the NFHTC. They were identified as *Heterelmis* using Merritt and Cummins (1984) and were presumed to be *H. comalensis* since the only other similarly-sized elmids known from Comal Springs are *M. pusillus* (Arsuffi 1993; Barr 1993) and *Stenelmis* sp. (Bowles et al. 2000). Beetles were placed in flow-through (Edwards Aquifer water) aquaria with limestone rocks covered with algae from Comal Springs. Aquarium configuration was modified several times, changing flow pattern and rate, rock arrangement, and adding temperature-conditioned bio-filtered recirculated water. Although one beetle lived for 11 months, survival was poor and losses averaged about 24% per month.

In January 2000, 43 adult *H. comalensis* were collected at Comal Springs among leaf litter and rocks in the springs emerging from the edge of the spring-runs. Most of the beetles were aggregated on decaying leaves from anacua *(Ehretia anacua)*, an endemic tree, and had attached protozoans which commonly are found on riffle beetles (Brown 1987). The beetles were placed in an acid-washed aquarium containing a mixture of flow-through water and recircu-

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[2] U.S. Fish and Wildlife Service, San Marcos National Fish Hatchery and Technology Center, 500 East McCarty Lane, San Marcos, TX 78666, U.S.A. E-mail: joe_fries@fws.gov.

Mailed on April 9, 2004

lated water, anacua leaves that had been air-dried, and limestone rocks from a terrestrial source. The aquarium was fitted with a standpipe and small-mesh (about 0.5-mm) screening and was covered with tight-fitting plexiglass to exclude insects and other animals. In April 2000, five early instar larvae were found in this aquarium and removed to a covered, 600-ml plastic beaker for rearing to adulthood. The beaker was modified for flow-through of well water and contained anacua leaves and a limestone rock for substrate. All of these larvae died within 5 months.

In September 2000, 33 additional larvae were found, mostly on anacua leaves, in the aquarium with the adult beetles. One larva was confirmed as *Heterelmis* using Merritt and Cummins (1984) and was presumed to be *H. comalensis,* as were the remaining 32 larvae. The larvae were removed to the 600-ml flow-through beaker. By December 2000, only 18 of these larvae survived and by May 2001 all of the larvae had died. Survival of adult Comal Springs riffle beetles during this same 8-month period also was low (11%). However, three adult beetles lived in captivity for 17 months and one of these lived an additional 2 months. Brown (1973) noted that adults of *H. vulnerata* can live for several years and those of *M. pusillus* can live for at least 9 years in captivity. While it is possible that eggs or larvae were brought in from the wild and simply developed further in captivity, these life stages were never observed during collection. Thus, it is likely that either female beetles with fertilized eggs had been collected or fertilization and larval development took place in the aquarium. In either case, some level of early life stage development occurred in captivity. It is demonstrated here that adult specimens of *H. comalensis* can survive for at least 1 year, and possibly reproduce, in captivity.

Captive culture of the Comal Springs riffle beetle may become important for the short-term if spring-run habitat in the Comal River is degraded by loss of springflow or pollution. However, survival of *H. comalensis* can be assured only if springflow of high quality water is maintained.

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ADDENDUM—In February 2004, larvae (F2) produced from captive-bred adults (F1) were found, documenting completion of the Comal Springs riffle beetle's entire lifecycle in captivity.

A NEW SPECIES OF *PTEROPTRIX* (HYMENOPTERA: APHELINIDAE) FROM ARGENTINA, THE FIRST KNOWN APHELINID WITH THREE-SEGMENTED TARSI[1]

Jung-Wook Kim[2] and Serguei V. Triapitsyn[2]

ABSTRACT: A new species of aphelinid wasp, *Pteroptrix fidalgoi*, is described and illustrated from a single female collected in the Province of Misiones, Argentina. This is the first known representative of the family Aphelinidae with three tarsal segments. The reduction in number of tarsal segments in Chalcidoidea is briefly discussed.

KEY WORDS: *Pteroptrix fidalgoi*, Hymenoptera, Aphelinidae, Argertina, three-segmented tarsi.

Trichogrammatidae are defined primarily by having three-segmented tarsi, and secondarily by the antennal structure, usually S-shaped wing venation, a broadly jointed petiole, and a short and straight protibial spur. Among Chalcidoidea, three-segmented tarsi occur in Agaonidae and Eulophidae (Delvare and LaSalle 2000), and also in Mymaridae (Huber and Beardsley 2000). A new species described in this paper has three-segmented tarsi and a broad petiole similar to Trichogrammatidae. However, it clearly belongs to Aphelinidae based on antennal characteristics, structure of the mesosoma and wing venation, and the presence of a curved and bifid protibial spur.

This unusual specimen of *Pteroptrix* Westwood (Aphelinidae: Coccophaginae) was collected by Patricio Fidalgo in Loreto, Misiones, Argentina, which is the type locality of many Argentinean Hymenoptera collected by the late Alejandro A. Ogloblin. All previously known species of *Pteroptrix* have four tarsal segments. Other than having three-segmented tarsi, this specimen appears to be a normal *Pteroptrix*; it has no indications that it could be an aberrant form. The new species would key to *Pteroptrix* (=*Archenomus* Howard according to Hayat 1983) if we assume that it has four-segmented tarsi.

Generic placement of this species in Aphelinidae relies mainly on the antennal and tarsal segmentation, as well as on the presence or absence of a linea calva on the forewing (Hayat 1983, 1994). However, taxa with similar morphology, but with different segmentation of the antenna or tarsi, can be placed in separate genera without knowing their true affinities. For example, possible affinities of *Bardylis* Howard to *Coccophagoides* Girault and *Pteroptrix* to *Encarsia* Foerster have been suggested despite differences in the number of tarsal segments (see discussion of Hayat 1998). Furthermore, few studies have addressed the relationships of *Pteroptrix* and related genera (Prinsloo and Neser 1990, Viggiani and Garonna 1993). Without convincing characters for supporting *Pteroptrix*, the monophyly of this genus cannot be assumed. We provisionally place the new

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[2] Department of Entomology, University of California, Riverside, California 92521, U.S.A. E-mail of author J-W K: argids01@tamu.edu.

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species into *Pteroptrix*, assuming that the 3-segmented tarsi have no distinguishing phylogenetic value. We do not attempt to assess the delimitation of *Pteroptrix*, which would require a study of the large number of species groups and a rigorous phylogenetic analysis. Additionally, a single individual specimen makes it difficult to judge the phylogenetic significance of the new species. The supporting characters for its generic placement are as follows: one seta on the submarginal vein, costal cell longer than marginal vein, and mesotibial spur longer than mesobasitarsus (Table 1). While these are diagnostic features of *Pteroptrix* (Viggiani and Garonna 1993), unfortunately these characters evidently overlap with some other genera. As far as we know, there is no single character that supports the monophyly of *Pteroptrix* other than having all tarsi with a reduced number of segments (four-segmented). Only the combination of character states indicated in Table 1, including this single species with three-segmented tarsi, can be used to define *Pteroptrix*. Additionally, this specimen has a long and slender 'socketed peg-like structure' on the mandible similar to other *Pteroptrix* (Fig. 11, in Heraty and Schauff 1998).

The fauna of *Pteroptrix* in the Neotropical region is poorly known, with only three species recorded to date: *P. bicolor* (Howard) and *P. dimidiata* Westwood, both from Argentina, and *P. howardi* (Dozier) from Haiti and Puerto Rico (Noyes 1998).

Terms for morphological features used in the description follow those of Gibson (1997). Measurements are given in micrometers (μm) as length or, if applicable, as length/width. Explanations of measurements follow Hayat (1998). An abbreviation "F" is used: F = funicle segment.

Genus *Pteroptrix* Westwood, 1833

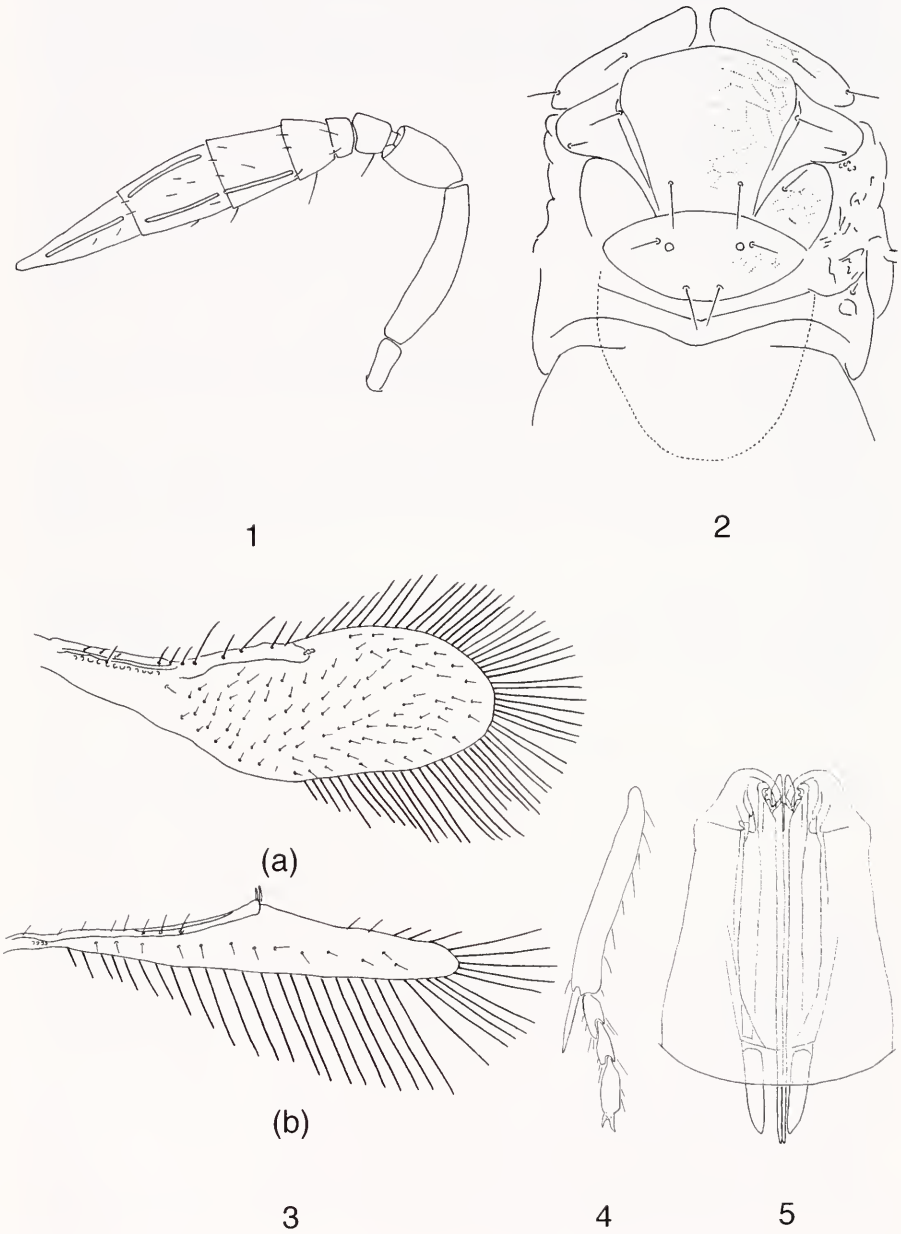
Pteroptrix Westwood, 1833: 344. Type species: *Pteroptrix dimidiatus* Westwood, 1833: 344, by monotypy.

Pteroptrix fidalgoi Kim & Triapitsyn, NEW SPECIES (Figs. 1-5)

Description. Female (holotype). Color. Body and appendages brown except following parts differently colored: face, vertex, and head above occipital suture orange; antenna dusky orange; side lobe and posterior and lateral parts of midlobe of mesoscutum orange; scutellum white; trochanters, protibia, apical third of mesotibia, apical half of metatibia, and tarsi orange. Wings hyaline except forewing blade slightly infuscated below venation, more so below marginal vein; venation brown.

Head. Head width 1.5 x of frontovertex width; eye length about 1.5 x as long as malar space; torulus below lower margin of eye; distance from torulus to eye margin 4 x diameter of torulus; a transverse sulcus on the posterior of the head. Mandible tetradentate, teeth very small; a long and slender, socketed, peg-like structure present.

Antenna (Fig. 1). 8-segmented, sparsely setose; flagellum spindle-shaped. Scape 5 x as long as broad; pedicel longer than combined lengths of F1 and F2; both F1 and F2 broader than long, F1 1.6 x longer than F2, F2 0.5 x as long as F3, F3 0.6 x as wide as F3, F3 appears to be part of clava rather than of funicle; length of two basal segments of clava as long as scape, basal segment of clava slightly longer than wide, two following segments notably longer than wide, distal segment of clava tapered at apex; funicle segments with 1 or 2 short longitudinal sensilla each; all three segments of clava with longitudinal sensilla each.



Figs. 1-5. Female of *Pteroptrix fidalgoi*, new species: (1) antenna; (2) mesosoma; (3) wings; (4) mesotibia and mesotarsus; (5) ovipositor.

Mesosoma (Fig. 2). Pronotum divided medially, each lobe with cellulate sculpture and 3 setae. Mesoscutum and scutellum with irregular cellulate reticulation. Mesoscutum much longer than scutellum; midlobe of mesoscutum with 2 pairs of setae, side lobe with 1 seta; axilla strongly projected forward into side lobe of mesoscutum, slightly longer than wide, with 1 seta. Distance from scutellar placoid sensillum to anterior seta less than its diameter; posterior pair of scutellar setae much closer to each other than are the anterior setae. Metanotum and propodeum short and smooth appearing.

Wings (Fig. 3). Forewing (Fig. 3a) 5.6 x as long as broad; submarginal vein with 1 seta; costal cell with 3 setae medially and 2 longer setae apically; marginal vein 0.8 x length of costal cell, with 6 strong setae on anterior margin. Chaetotaxy of blade irregular, with a small bare area apical to stigmal vein. Longest marginal cilia 0.8 x as long as greatest width of wing, marginal cilia on apical quarter of forewing more or less of same length. Hind wing (Fig. 3b) 7 x as long as broad; blade with a irregular row of microtrichia; longest marginal cilia about 1.8 x as long as greatest width of wing.

Legs. All tarsi 3-segmented. Mesotibial spur markedly longer than basitarsus (Fig. 4).

Metasoma. Ovipositor (Fig. 5) 1.7 x as long as mesotibia, about 4 x as long as third valvula; slightly exserted beyond apex of metasoma; external plate of ovipositor with 1 basal seta and 2 distal setae.

Measurements. Body (length, without head): 582. Head (width): 193. Antenna: scape: 84; pedicel: 44; F1: 18; F2: 11; F3: 22; clava: 157. Mesosoma (length): 215. Forewing (length/width): 455/82; longest marginal cilia: 109. Hind wing (length/width): 365/51; longest marginal cilia: 91. Legs (femur, tibia, tarsus): foreleg: 117, 91, 99; middle leg: 120, 146, 91; hind leg: 110, 153, 99. Metasoma: 368; ovipositor: 248.

Male. Unknown.

Type Material. Holotype female on slide: Argentina, Misiones, Loreto, 23.viii.2000, P. Fidalgo, YPT [yellow pan trap] in Ruinas Jesuiticas [deposited in the collection of Fundación e Instituto Miguel Lillo, San Miguel de Tucumán, Argentina (IMLA)].

Etymology. The new species is named after the collector, Dr. Patricio Fidalgo.

Distribution. Known only from the type locality in the Province of Misiones, Argentina.

Host. Unknown.

Comments. The new species is unique among *Pteroptrix* which otherwise have four tarsal segments. It has a tetradentate rather than tridentate mandible. *P. fidalgoi* new species is similar to the species from the *lauri* group as defined by Viggiani and Garonna (1993) based on mainly the shape of the antenna and the forewing, but that species group has the mesotibial spur shorter than the mesobasitarsus. The *incolus* group, suggested by Prinsloo and Neser (1990) for *Archenomus* and later incorporated in the *maritima* group of *Pteroptrix* by Viggiani and Garonna (1993), appears to be related to *P. fidalgoi* based on the presence of a transverse sulcus on the posterior of the head. However, the unique three-segmented tarsi prevent the placement of the new species in any of the presently recognized species groups (Viggiani and Garonna 1993). Currently, the monophyly of each of the five existing species groups of *Pteroptrix* is not well defined and we choose not to place this new species into a species group.

Table 1. Comparison of morphological characters in *P. fidalgoi* new species, other *Pteroptrix* species, and related genera.

Taxon	No. of tarsal segments	No. of antennal segments	Shape of flagellum	No. of setae on SMV	Relative length of CC to MV	Relative length of MTS to MT	T VII	MTT	Stigmal vein
P. fidalgoi	3-3-3	8	Spindle-shaped	1	CC>MV	MTS>MT	Typical	4	Non-expanded apex
Other *Pteroptrix*	4-4-4	7/8	Spindle-shaped/ cylindrical	1/2/4	CC>>MV	MTS≥MT	Typical	1, 3, or 2+1	Non-expanded apex
Bardylis	4-4-4	7	Cylindrical	1	CC>>MV	MTS<MT	Band-like	2+1	Non-expanded apex
Coccophagoides	5-5-5	8	Spindle-shaped/ cylindrical	>3	CC>>MV	MTS≥MT	Band-like	2+1	Expanded apex
*Encarsia**	5-5(4)-5	8	Cylindrical	2 (rarely 1/3/5)	CC≤MV	MTS<MT	Typical	2+1	Non-expanded apex

CC: costal cell; MT: mesobasitarsus; MTS: mesotibial spur; MTT: mandible teeth (teeth number of teeth number + truncation); MV: marginal vein; SMV: submarginal vein; T VII: gastral tergum VII (typical one, see Fig. 6 in Hayat (1998); band-like, see Fig. 8 in Hayat (1994), and Figs. 28 and 112 in Hayat (1983).

**Dirphys* Howard and *Encarsia* Hayat, related to *Encarsia*, are not included in the table. These two genera form a trichotomy with *Encarsia*, but they remain valid to preserve important diagnostic information (Polaszek and Hayat 1992).

DISCUSSION

The reduction of tarsal segments in Chalcidoidea is a phenomenon that is still poorly understood. In the Mymaridae, for instance, tarsomere number has been used in the past to subdivide the family into subfamilies and tribes; however, apparently closely related genera such as *Camptoptera* Foerster (tarsi five-segmented) and *Eufoersteria* Mathot (tarsi four-segmented, two apical tarsomeres likely fused) would end up in different subfamilies if only this character is considered. As Huber and Lin (1999, p. 38) wrote, "Reduction in tarsomere number from 5 to 4 has likely occurred several times in Mymaridae...Clearly, loss or perhaps fusion of segments, whether antennal or tarsal, occurs much more frequently than previously realized, necessitating a re-evaluation of generic limits in several groups. Unfortunately, in the past, too much reliance was placed on the number and constancy of appendage segments for defining genera, with the result that several genera, not only in the *Camptoptera* group, are too narrowly defined."

We fully agree with the above quote and believe that the recent discoveries of non-trichogrammatid Chalcidoidea with three-segmented tarsi, such as the genus *Trisecodes* Delvare and LaSalle (Eulophidae: Entedoninae) (Delvare and LaSalle 2000), as well as this new species of *Pteroptrix*, further support the necessity of reconsidering the practice of using appendage segmentation as the sole or main basis for definition of some groups.

In some groups of Chalcidoidea, reductions in the number of appendage segments may be associated with the adaptations for parasitization of smaller hosts. For instance, in species of the mymarid genus *Erythmelus* Enock, which are parasitoids of eggs of Tingidae, a reduction of funicle segments from six to five is rather common. This may be due either to the outright loss of a segment or to the fusion of any two neighboring segments (S. V. Triapitsyn, unpublished data). Furthermore, the funicle of one species of *Erythmelus* is four-segmented due to a further fusion of two segments following the initial loss of a funicle segment (Triapitsyn and Fidalgo 2001).

Parasitoids of armored scales (Diaspididae) sometimes have a reduced number of tarsal segments when compared with taxa from the same family that parasitize different, and often larger, hosts. For instance, two of the three known genera of Encyrtidae that have four-segmented tarsi, *Anthemus* Howard and *Arrhenophagus* Aurivillius (the other is *Tetracyclos* Kryger, probably parasitizing Pseudococcidae), belong to two different tribes; both are minute in size and both are parasitoids of Diaspididae.

As noted above, occasional reductions in the number of tarsal and especially funicle segments in Chalcidoidea may occur independently, and are not necessarily the result of a single event. There are three genera of Aphelinidae with a 4-4-4 tarsal formula: *Eretmocerus* Haldeman, *Bardylis*, and *Pteroptrix*. *Bardylis* and *Pteroptrix* are morphologically similar to *Coccophagoides* and *Encarsia* respectively, and both have been separated from similar genera based on the

tarsal segmentation. Hayat (1998) noted the striking similarity between *Pteroptrix* and *Encarsia*, especially the *citrina* species group of *Encarsia* (formerly *Aspidiotiphagus* Howard, all tarsi five-segmented, parasitic on Diaspididae). Additionally, the number of tarsal segments separates tetramerous *Bardylis* from pentamerous *Coccophagoides* despite their possible affinity and similarity (Hayat 1998). However, correlation of host size and segment reduction is not clear. The most widely used hosts of Aphelinidae are various Diaspididae and Aleyrodidae (Hayat 1998). These hosts are utilized by various aphelinid genera with either non-reduced or reduced tarsal and antennal segmentation. Without a careful study of the characters of the above genera, it is questionable whether the biology of parasitism on Diaspididae and a possible correlation with the reductions in some characters can be used to support the grouping. For example, the monophyly of the Diaspididae-parasitizing species of *Encarsia* was not supported by morphological and molecular analyses and they were scattered in three different places on the phylogenetic tree (Babcock *et al.* 2001).

Nevertheless, reduction of tarsal segmentation within *Encarsia* has been shown to be phylogenetically informative (Babcock *et al.* 2001). For example, the monophyly of the *luteola* group (parasitoids on Aleyrodidae) of *Encarsia*, with a four-segmented mesotarsus, was strongly supported (Babcock *et al.* 2001). The phylogenetically informative reduction in this species group is in direct contrast to the idea that four-segmented tarsi could have evolved multiple times and could not be informative in Aphelinidae. At the generic level, however, reduction of tarsal segments has not always proven to be informative within this family. Due to inconclusive and putative relationships among Aphelinidae based on different number of tarsal segments, reduction cannot be used by itself to justify designation of a new genus for this new species.

ACKNOWLEDGMENTS

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A NEW SPECIES OF *LEPTOGLOSSUS* (HETEROPTERA: COREIDAE: ANISOSCELINI) ASSOCIATED WITH THE AMAZONIAN PALM *MAURITIA FLEXUOSA* (ARECACEAE: LEPIDOCARYEAE) IN PERU[1]

Harry Brailovsky[2] and Guy Couturier[3]

ABSTRACT: A new species, *Leptoglossus hesperus* (Heteroptera: Coreidae), collected in the Amazonian palm *Mauritia flexuosa* (Arecaceae: Lepidocaryeae), is described from Peru and compared with *L. lonchoides* Allen. The hind leg and male genital capsule are illustrated.

KEY WORDS: *Leptoeglossus*, Heteroptera, Coreidae, *Mauritia flexrosa*, Arecaceae.

Previous to this paper only one species of *Leptoglossus*, (*L. lonchoides* Allen 1969) has been associated with palms (Couturier et al., 1993, Schaeffer and Panizzi 2000, and Howard et al., 2001).

Leptoglossus lonchoides was reported damaging fruits of *Bactris gasipaes* H. B. K. (Palmae), in Central Amazonia. The fruit suffered premature fruit fall that considerably reduced yields in Manaus, Brazil (Couturier et al. 1993).

In this contribution, we add a second species of *Leptoglossus* associated with the Amazonian palm *Mauritia flexuosa* L. f., in which the fruit is harvested by the rural population in the Peruvian Amazon to be consumed as fresh product (Padoch 1988). The presence of both adults and nymphs on the palm trees indicates that *L. hesperus*, completes its entire life cycle in this palm.

In addition to *L. hesperus* four other species of *Leptoglossus* are recorded from the Peruvian region: *L. cinctus* (H. S.), *L. flavosignatus* Blote, *L. neovexillatus* Allen, and *L. zonatus* (Dallas) (Allen 1969, and Brailovsky and Barrera 1998).

Acronyms used is this paper are: Muséum National d' Histoire Naturelle, Paris, France (MNHN), Universidad Agraria La Molina, Muséo de Entomología, Lima, Peru (UAMP), and Colección Entomológica, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM). All measurements are given in millimeters.

Leptoglossus hesperus, NEW SPECIES

Figures 2-3

Description. Male. Dorsal coloration. Head: dark orange with three broad black stripes, two lateral to midline, the other close to eyes; antennal segment I black with inner face dirty orange, segments II and III pale chestnut orange with

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[2] Department de Zoología, Instituto de Biología, UNAM, Apartado Postal No. 70153, México, 04510 D.F. México. E-mail: coreidae@servidor.unam.mx.

[3] ORSTOM, Institut francais de recherche scientifique pour de developpement en coopération, 213, rue La Fayette, F-75480 Paris Cedex 10, France.

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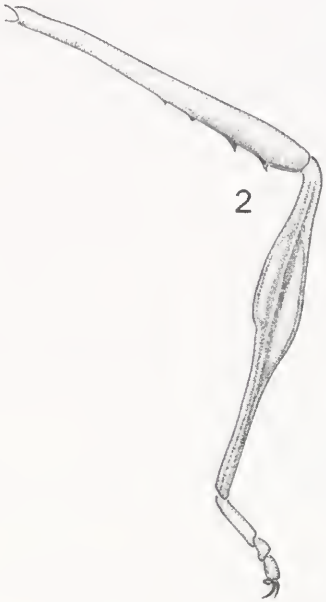
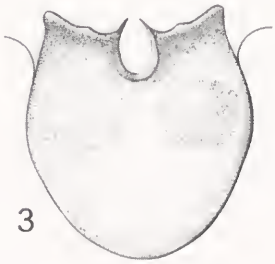
apical joint black, and IV pale chestnut brown with basal third dark chestnut orange. Pronotum: anterolateral, posterolateral, and posterior border dirty yellow; disc pale reddish brown, tinged with yellow; collar, anterior margin, lateral portion of calli, anterolateral margin near the border, and humeral angle black. Scutellum: pale reddish brown with apex yellow. Hemelytra: clavus and corium pale reddish brown with costal margin yellow; corium with light yellow irregular, transverse fascia; hemelytral membrane uniformly dark. Abdomen: connexivum pale chestnut orange with anterior third and upper margin yellow; dorsal abdominal segments black with posterior margin of segments III to VI yellow. **Ventral coloration.** Head dirty orange yellow with four discoidal spots, two close to postocular tubercle, and the other two near middle third and close to posterior margin; rostral segments I and II dirty yellow, and III and IV bright reddish orange; thorax and abdomen dirty orange yellow with numerous small black spots; prosternum, lateral margins of mesosternum, and metasternum black; anterior and posterior lobe of metathoracic peritreme yellow; fore and middle legs bright chestnut orange; hind leg with coxae, trochanters, femur and tarsi bright chestnut orange; hind tibiae bright chestnut orange with outer and inner dilation bright reddish brown; genital capsule dirty orange yellow; rim of abdominal spiracles dirty yellow.

Structure. Body medium sized. **Head:** tylus unarmed, rounded apically, extending anteriorly to the jugae, and slightly raised in lateral view; rostrum reaching anterior third of abdominal sternite VI; rostral segment III extending to at least posterior margin of metasternum. **Pronotum:** collar wide; each pronotal margin entire; humeral angles rounded to obtuse, and not exposed; calli slightly elevated, impunctate, without two medial tubercles; surface densely punctate; disc posteriorly with median longitudinal carina obsolete. **Legs. Hind tibiae:** outer dilation short, lanceolate, entire, without emarginations, occupying 39% of the length of hind tibiae, width of outer dilation wider than width of inner dilation; inner dilation lanceolate, entire, without emarginations, shorter than outer, occupying 37% of the length of hind tibiae; undilated portion of hind tibiae without spine-like teeth (Fig. 2). **Scutellum:** triangular, longer than wide, flat, without median longitudinal carina; apex subtruncated. **Genitalia. Genital capsule:** posteroventral edge with median notch, deep and rounded; dorsal prongs prominently acute, and projecting medially (Fig. 3).

Female. Coloration. Similar to male. Antennal segment I dirty orange, segments II and III bright chestnut orange with apical third black, and IV pale chestnut brown with basal joint black; rostral segments I to IV dirty yellow; connexival segments VIII and IX dirty yellow; dorsal abdominal segments VIII and IX black with posterior margin of VIII yellow; hind tibiae bright chestnut orange with outer and inner dilation bright reddish brown with whitish yellow irregular maculae near middle third; genital plates dirty orange yellow; rim of abdominal spiracles light brown to yellow. **Structure.** Rostrum reaching anterior margin of abdominal sternite IV; rostral segment III reaching middle third of metasternum. **Legs. Hind tibiae:** outer dilation short, lanceolate, entire, occupying 57% of the

length of hind tibiae, width of outer dilation wider than width of inner dilation; inner dilation lanceolate, entire, shorter than outer, occupying 35% of the length of hind tibiae; undilated portion of hind tibiae with two small spine-like teeth.





Figures 1-3. *Leptoglossus* spp. 1-2. Hind leg. 1. *L. lonchoides* Allen. 2. *L. hesperus* Brailovsky and Couturier. 3. Caudal view of the male genital capsule of *L. hesperus* Brailovsky and Couturier.

Measurements. (male, followed by female). Head length 2.35, 2.70, width across eyes 1.92, 2.30, interocular space 1.02, 1.35, interocellar space 0.47, 0.67, preocular distance 1.50, 1.67; length of antennal segments: I, 2.35, 2.75, II, 3.90, 4.20, III, 2.65, 3.00, IV, 4.35, 4.66. Pronotum: Length 2.55, 3.70, maximum width across calli 2.10, 2.65, maximum width across humeral angles 3.90, 5.20. Hind tibiae: Total length 7.15, 8.23, length outer dilation 2.85, 4.60, length inner dilation 2.65, 2.90, maximum width outer dilation 0.36, 0.61, maximum width inner dilation 0.21, 0.35. Scutellar length 1.65, 2.45, width 1.50, 2.30. Body length 15.50, 19.30.

Type material. Holotype: ♂, Peru: Departamento Loreto, Iquitos, km 8 carr. Iquitos-Nauta, 6-II-2001, J. Vazquez and C. Delgado (MNHN). Paratype: 1 male, same location as holotype (UNAM). 1 female, Peru: Departamento Loreto, Iquitos, Zungarococha, 25-IX-2001, J. Vazquez and C. Delgado (UAMP). 1 male, Peru: Departamento Loreto, Iquitos, km 17.5 carr. Iquitos-Nauta, 25-V-2001, J. Vazquez and C. Delgado (UAMP). 2 males, Peru: Departamento Loreto, Iquitos, Santa Clara "Simon Bolivar," 28-VIII-2001, J. Vazquez and C. Delgado (MNHN). 1 female, Peru: Departamento Loreto, Quisococha, 11-V-2001, J. Vazquez and C. Delgado (UNAM). All specimens were collected on the Amazonian palm *Mauritia flexuosa* (Arecaceae: Lepidocaryeae).

Biology. Males, females, and nymphs of *Leptoglossus hesperus* were collected on the inflorescences of the Amazonian palm *Mauritia flexuosa* (Arecaceae: Lepidocaryeae), growing in an ecosystem referred to as named "aguaje enano" or "dwarf aguaje," in the surrounding area of Iquitos, Department of Loreto, in Peru.

Mauritia flexuosa is a dioic palm that grows on periodically or permanently flooded areas. It is distributed throughout northern South America, east of the Andes (below 500 m), and is recorded from Brazil (from northern Amazonia to the state of Bahia), Colombia, Ecuador, the Guianas, Peru, Trinidad and Venezuela. The height of the adult plant reaches 25 m, the inflorescences are more than 2 m long, and each female inflorescence can carry 400 to 500 fruits (Henderson et al., 1995).

Discussion. This species is most similar to *L. lonchoides* Allen, in having the thorax and abdomen dirty orange yellow with numerous small black spots, the corium with yellow irregular transverse fascia, hind tibiae with the outer and inner dilation lanceolate, entire, without emarginations, and the posteroventral edge of male genital capsule with deep median notch, and prominent dorsal prongs (Fig. 3). In *L. hesperus* new species, the width of outer and inner dilations of the hind tibiae are smaller (Figs. 1-2), and the rostrum in males extends to the anterior third of abdominal sternite VI and on to the anterior margin of abdominal sternite IV in females. In *L. lonchoides*, the rostrum is shorter, usually reaching only the posterior margin of abdominal sternite III.

Etymology. From the Latin *"hesperus"* meaning west.

ACKNOWLEDGMENTS

We thank the team of the Instituto de Investigaciones de la Amazonia Peruana (IIAP) working in the "dwarf aguaje" region who made available specimens of the new species, particularly Joel Vazquez and C. Delgado, who collected the type series. Also special thanks are given to Ernesto Barrera (UNAM) for preparing the drawings.

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WINTER AGGREGATION OF *HARMONIA AXYRIDIS* (COLEOPTERA: COCCINELLIDAE) IN A CONCRETE OBSERVATION TOWER[1]

Paul W. Schaefer[2]

ABSTRACT: Aggregations of thousands of multicolored Asian lady beetles, *Harmonia axyridis*, have appeared each fall since 1993 in a 20.1 m high concrete observation tower at Mt. Gretna, Lebanon County, Pennsylvania. The tower is located in a clearing on a ridge in otherwise regenerated oak-maple-birch forests in Clarence Schock Memorial Park at Governor Dick (326 m elevation, 40° 14.78' N, 76° 27.35' W). Beetles aggregate in the ceiling/wall corners on four different levels in the tower's internal ladderways. Since the tower is open to the public for recreational purposes, one can visit the tower in late fall and witness these aggregations. During some winters, mortality appears very high, suggesting that the tower lacks adequate insulative properties for optimum survival.

KEY WORDS: *Harmonia axyridis*, Coleoptera, Coccinellidae, winter aggregation, lady beatle, overwintering mortality, fall flight behavior.

Since the multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) was first detected in North America (Louisiana) in 1988 (Chapin & Brou 1991), there has been considerable interest in this beneficial predator of aphids. Although it has had a positive impact against aphid pests [e.g. on pecan in the Southeast (Tedders & Schaefer 1994; De Quattro 1995) and apple orchards in West Virginia (Brown and Miller 1998)], it has also irritated many homeowners when adult beetles begin aggregating in the fall, alighting on and entering homes and other buildings seeking sites for overwintering (see Kidd *et al.* 1995 regarding the human impact). Nalepa *et al.* (1996) investigated aspects of *H. axyridis* biology (sex ratio, dimorphism, phenotype, parasitism) in winter aggregations and later aggregation behavior in response to artificial shelters (suggestive of bee hives) and the utilization of active apiary bee hives as aggregation sites (Nalepa *et al.* 2000). I provide a description of a large observation tower (See web address for illustration), similar to the silo illustrated in De Quattro (1995), located in south central Pennsylvania, that appears to meet criteria for successful *H. axyridis* aggregation, and that is readily accessible to the public.

METHODS

Tower Site. Located in Clarence Schock Memorial Park at Governor Dick, West Cornwall district near Mt. Gretna, Lebanon Co., Pennsylvania, a naturally regenerated forest, is a cylindrical, reinforced steel and concrete observation tower (20.1 m high and 4.6 m in diameter) built on the crest of a ridge (326 m elevation, 40° 14.78' N, 76° 27.35' W) to provide a panoramic view of the surrounding countryside. The tower is reached by a 30-minute walk and is used by recreational hikers who ascend the tower's internal ladderways to reach the observation deck on top for a view from above the surrounding forest canopy.

[1] Received March 2, 2001. Accepted May 6, 2001.

[2] Beneficial Insects Introduction Research Unit, USDA, ARS, 501 S. Chapel St., Newark, Delaware 19713, U.S.A. E-mail: pschaefer@biir.ars.usda.gov.

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The tower sits in a small clearing that was enlarged in 1996 but is otherwise surrounded by forests of hardwoods and a few conifers.

After first observing the tower in spring 1994, I made from one to three annual fall and then some follow-up spring inspections of the tower from 1994 to 2002. During many visits, I photographed the aggregations, collected some or all available beetles for unrelated studies, and on specific visits (Nov. 2000) took a GPS fix using a Model GPS III Plus (Garmin Corp., Olathe, Kansas, USA) and light intensity readings (March 1998) of the external surface and internal ladderways using a Minolta Auto Light Meter IV F, using spherical, flat and mini-receptor (Minolta Co, Ltd, Japan). I measured the relative light intensity in full sun away from the tower, on the outer surface, at the entrance level, and in the four upper levels, both ½ m directly inside of the slit window, and in the actual ceiling corners where the aggregations occurred.

On three consecutive inspections (1995 - 1997), I collected all exposed beetles aggregated on the south ladderway of the tower and isolated samples from each of the four levels (Figure 1). Beetles were brushed into a square plastic funnel, transferred to paper cartons, and returned to the laboratory. Individual containers from each level were weighed, weight of beetles alone was calculated, and beetles were then counted.

On many visits the progress of the aggregation formation was noted, photographed, appreciated, and then left for future visitors or visits.

RESULTS AND DISCUSSION

The tower was first found to contain aggregations of *H. axyridis* in the fall of 1993. A. G. "Al" Wheeler, Jr. (formerly at Penn. Dept. Agric., Harrisburg, now Clemson Univ.) first learned of the beetle aggregations from a Harrisburg co-worker and visited the site that same season. In mid-April 1994, Al and I visited the tower to find large quantities of dead beetles at all aggregation sites. We found only a few live beetles crawling about the outer tower surface. We concluded that either beetle survival had been very low or that all other survivors had already dispersed into nearby forests. We concluded that the intervening winter had killed large proportions of aggregated beetles. The tower was acceptable for aggregation but appeared to provide insufficient protection (e.g. low temperatures, desiccation) for optimal overwintering survival.

Based on the 1995 - 1997 beetle collections, mean numbers (based on 15,016 beetles collected), showed a slight but statistically insignificant decrease of beetles with tower height (Table 1). Thus beetles flew onto the tower irrespective of height and entered the slit-like windows (10 x 30 cm) at all levels equally and tended to avoid the tower entrance. This suggests that beetle flights occur uniformly at levels up to ca. 20 m in the vicinity of the tower. Mean calculated weight of an individual beetle in 1997 was 33.25 mg (n=5,762). Captured beetles were used for various research purposes, including our attempt to identify possible aggregation pheromones and potentially useful repellants (in collaboration with Jeffrey Aldrich, USDA, ARS, Beltsville, MD).

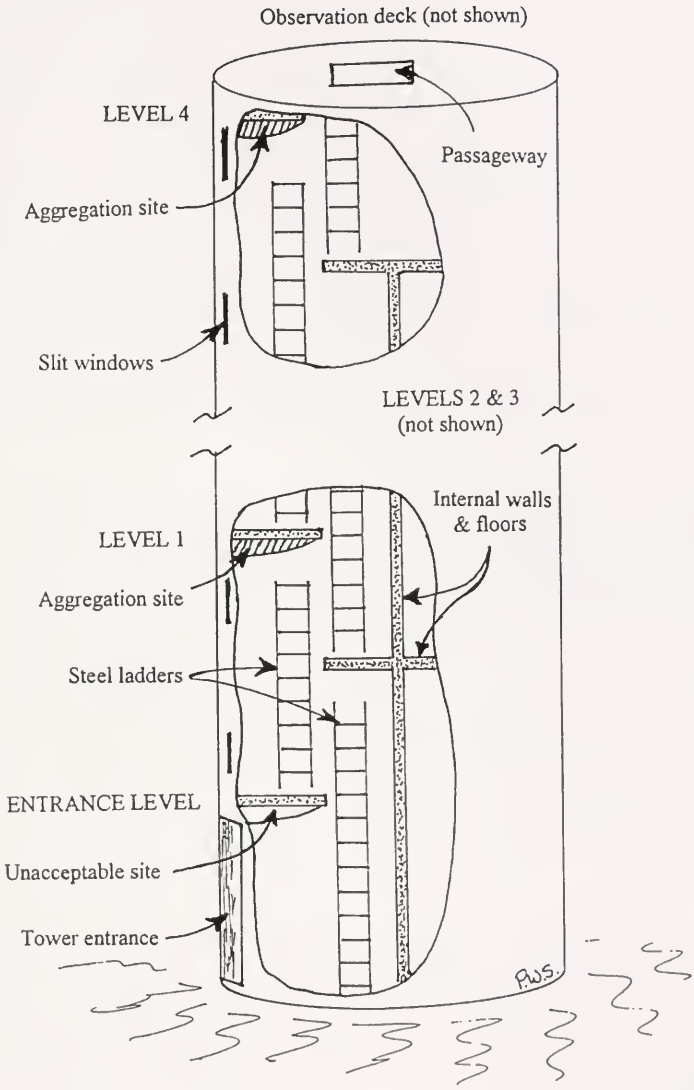

Figure 1: Observation tower at Clarence Schock Memorial Park at Governor Dick, Mt. Gretna, Pennsylvania, where *Harmonia axyridis* have aggregated annually since first discovery in 1993. The concrete tower is 20.1 m (66 ft) high and 4.47 m (15 ft) in diameter with internal beetle aggregation sites consisting primarily of 2.9 m of ceiling/wall interface at each of four levels. The west tower entrance (shown) faces 275° from magnetic north. This entrance level provides a similar area that is generally rejected by beetles. A corresponding enclosed ladderway, window slits, and entrance on the opposite or east side (not shown) is used by beetles to a lesser extent than the west side because of the orientation of the sun on mid- to late-afternoon sunny days in October and November when the beetles take flight.

Data on light intensity, particularly when considering that no or very few beetles aggregated at the naturally illuminated tower entrance, point to the importance of diminished light. At 3:30 p.m. on March 26, 1998, the full outside sunlight measurement was 36,000 lux (hereafter all measurements are converted to a percentage of this figure); reflectance on the outside concrete surface was 36%; while ½ m inside the entrance the light intensity was down to 4.2% and at the possible aggregation niche it was 2.0%. At upper levels 1 thru 3 the mean light intensity ½ m from the window slits was much lower (0.13%) and at the ceiling/wall interface (beetle aggregation sites) light intensity was only 28 lux or 0.08%. In contrast to these acceptable aggregation sites (Levels 1-4); the entrance level was devoid of beetles, suggesting that the difference between 740 lux and 28 lux made the difference, since the physical structure was similar with the exception of the brighter door-sized entrance (Figure 1). Severely diminished light intensity appears to act as a behavioral arrestant, and this may be one important factor in successful beetle aggregation.

Table 1. Mean *Harmonia axyridis* collected in the southwest side of the observation tower in Clarence Schock Memorial Park at Governor Dick, Mt. Gretna, Pennsylvania, during the winters of 1996 through 1998 and survival of beetles at upper and lower two levels pooled during November-February 2001. Levels refer to potential beetle aggregation sites, i.e. 2.9 m of ceiling/wall interface (See Figure 1).

					2001 Survival:	
Level	Height (m)	3 yr. total	Mean	SD	Total No.	% Alive
4	19.8	3,017	1,005.7a	301.3		
					796	57.4
3	15.8	3,016	1,005.3a	154.1		
2	11.7	4,056	1,352.1a	180.5		
					1,176	62.6
1	7.3	4,927	1,642.3a	467.6		
Entrance	2.2	0	0b	0		
Total/Mean		15,016	5,005.3	769.3	1,972	60.5

1. Based on the Student-Newman-Keuls test, means with the same letter are not significantly different ($P = < 0.05$).

In the fall of 1998, I discovered that all internal surfaces of the tower had been painted white. White paint had also been applied to the outside of the tower up to the 3.4 m level. This seemed to somewhat alter the general behavior of beetles in comparison to the years before painting, perhaps through differential surface texture, color, or contact stimuli. On November 1, 2000, I found many beetles slowly walking on concrete surfaces and only a few had aggregated in corners.

Some small clusters were present on the external surface of the tower. Another inspection 22 days later showed beetles rather loosely organized in clusters. Some of the small clusters remained on the external surface positioned at the concrete/white paint interface on the tower's southwest exposure. I also counted 231 *H. axyridis* positioned on the entrance level, just inside the entrance door (south side only) and I estimated at least a 5-fold increase on Level 1. I assume that colder temperatures soon thereafter forced all beetles into the darker, internal recesses of the tower ladderways but no visits confirmed this movement.

Based on collective observations at this tower and experiences at other sites (i.e. two old silos in Middletown, Delaware, and the Ironmasters House, Pine Grove Furnace State Park, near Gettysburg, Penn., on October 18, 1994) I propose the following behavioral sequence: *H. axyridis* beetles annually fly on warm, still, fall afternoons and then alight on the tower surface, crawl over the surface, and enter the slit windows to the internal ladderway 81 cm (32 inches) wide, and in diminished light aggregate at the ceiling-wall interface (Figure 1). At first the beetles cluster loosely, with many stragglers, and as colder days occur beetles progressively cluster together in tighter aggregations. In addition, some beetles packed tightly into the hollow ends of the steel ladder rungs, and in drain holes (from the floor above), and others accumulated on the tops of steel ladders and upright wooden guards opposite each ladder. In all locations, beetles remained nearly motionless or moved very sluggishly. Beetle survival was then dependent on the cumulative exposure to winds and sub-freezing temperatures.

Winter survival of the beetles appears to be very unpredictable. During the winter of 1994, the majority of beetles in these aggregations apparently died in *situ*. Probably the steel and concrete structure of the observation tower provided too little thermal protection for overwintering survival. Since I removed most beetles yearly beginning in the fall of 1995, I cannot comment further on survival in those winters, with the exception of the winter of 1997-1998 (an unusually mild winter). During that winter, when beetles had not been removed the previous fall, there was no evidence of mass mortality in March 1998. On February 15, 2001, after an unseasonably cold December, I collected beetles and determined that overall survival was 60.5% (Table 1). The following November (2002), beetles had aggregated as usual but the overall numbers diminished to approximately 1/10 that of the winters of 1995 and 1996 based on comparative photographs.

The observation tower continues to attract *H. axyridis*, but it is clear that it sometimes fails to provide sufficient insulation to maximize survival during unusually cold winters. One can only imagine that in the cracks and crevices of a natural rock outcropping (where I have observed naturally occurring aggregations in Hokkaido, Japan), aggregated beetles might experience warmer subsurface temperatures (considerably more constant and never so severely cold as ambient air temperatures), higher moisture levels, and perhaps also the insulating advantage of snow cover. Optimum winter survival of *H. axyridis* may occur

under these conditions. In conclusion, the Mt. Gretna observation tower has become a reliable site to observe and collect *H. axyridis* in late fall even though the survival of all aggregated beetles is very much dependent on the collective severity of ambient winter weather. The tower also makes a very convenient site for the general public to hike up the trails in late fall, enjoy the scenic view, and witness the annual aggregation of these invasive, yet remarkable lady beetles.

ACKNOWLEDGMENTS

I thank the trustees of the Clarence Schock Memorial Park at Governor Dick for maintaining the park and providing continued access to the general public. Many thanks to Susan Barth and Philip Taylor who provided technical help. Thanks also to Christine A. Nalepa (NC Dept. Agric., Raleigh), Wiliam H. Day (USDA, Newark, DE), and W. Louis Tedders, Jr. (Perry, GA) who provided helpful comments on earlier drafts and two anonymous reviewers who offered additional suggestions.

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Web Address: http://www.mbcomp.com/litzonlebanon/governor.htm

REVIEW OF THE MIDDLE AMERICAN LACE BUG GENUS *MACROTINGIS* (HETEROPTERA: TINGIDAE), WITH A KEY AND A NEW SPECIES FROM MEXICO[1]

Richard C. Froeschner[2]

ABSTRACT: The genus *Macrotingis* was described by Champion (1897:22) for two species. Later Drake added another species and a "variety" for one of Champion's species; that variety is herein elevated to full species status. The range of *Macrotingis*, previously known from Guatemala south into Panama, is extended a short distance northward into southern Mexico with the present description of the new species *M. schaffneri*. A key separates the five included taxa.

KEYWORDS: *Macrotingis*, Heteroptera, Tingidae, Middle America, Mexico.

Genus *Macrotingis* Champion
Figure 1

Macrotingis Champion 1897:22. Type species: *Macrotingis biseriata* Champion, designated by Drake and Poor 1936:387.

Diagnosis. This genus of Tingidae is readily recognized by the combination of its first antennal segment being much longer than the width of the head across both eyes coupled with the presence of a small, elevated, and inflated cyst on the median carina extending from the anterior slope of the pronotum to the anterior margin of the collar.

List of *Macrotingis* species

Macrotingis biseriata Champion 1897:22, **REVISED STATUS**
Macrotingis biseriata Champion 1897:22. Costa Rica. Honduras. Panama.
Macrotingis biseriata biseriata.- Drake 1928:4.
Macrotingis novicis Drake, **NEW STATUS**
Macrotingis biseriata novicis Drake 1928:4. Honduras.
Macrotingis schaffneri, **NEW SPECIES.** Mexico.
Macrotingis uniseriata Champion 1897:22. Guatemala.
Macrotingis zeteki Drake 1950:299. Panama.

Key to species of *Macrotingis*

1. Pronotal disc with lateral carinae extending forward over interhumeral convexity to calli. Occipital spines obliquely elevated, very long, length of one of them greater than interocular width. Length 4.1 mm.....*M. zeteki* Drake

[1] Received on September 29, 2001. Accepted on December 14, 2003.

[2] Department of Entomology, MRC-0105, United States National Museum of Natural History, Washington, D.C. 20013-7012. Dr. Froeschner died on May 2, 2002. Reprints may be requested from T.J. Henry, Systematic Entomology, Laboratory, ARS, USDA, P.O. Box 37012, National Museum of Natural History, MRC-0168 Smithsonian Institution, Washington, DC 20013-7012, U.S.A. E-mail: thenry@sel.barc.usda.gov.

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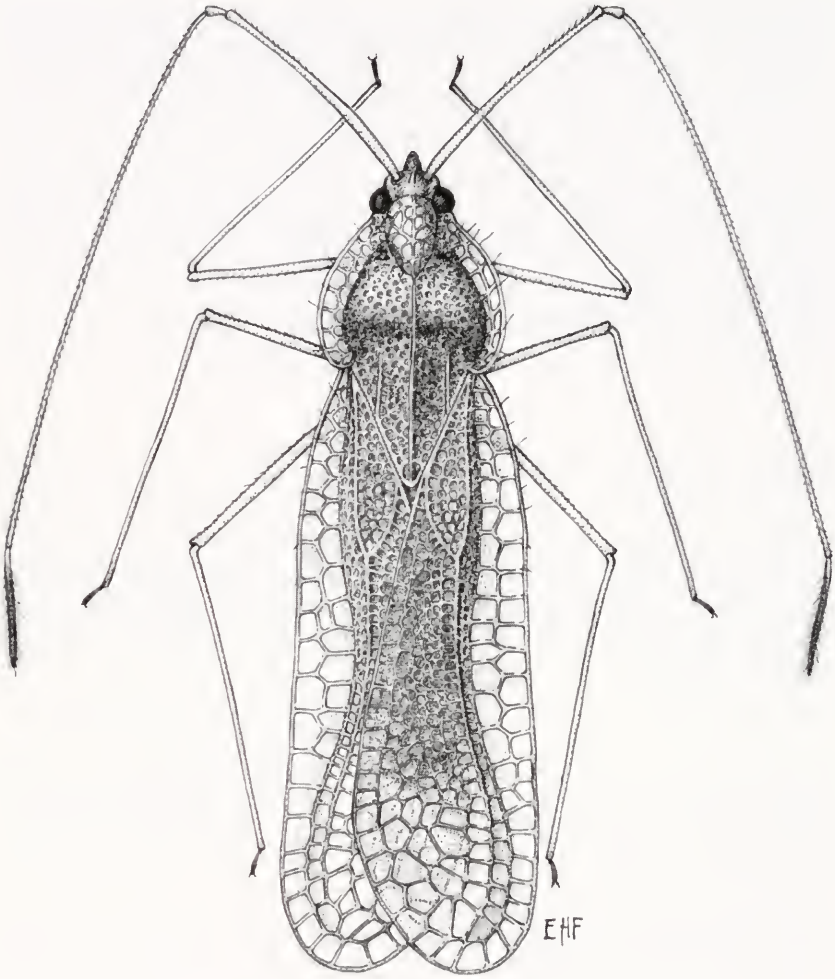

Fig. 1. *Macrotingis biseriata*, natural size 4.3 mm.

– Pronotal disc with lateral carinae, when present, restricted to area posterior to crest of interhumeral convexity. Occipital spines, when present, much shorter and decurved onto surface of head.....2

2. Lateral carinae of pronotal disc present posterior to interhumeral convexity 3

— Lateral carinae of pronotal discabsent.Length 4.7mm ....*M. schaffneri*, **NEW SPECIES**

3. Costal area with a single row of areolae. Length 4.7 mm ....*M. uniseriata* Champion

— Costal area with a partial to complete second row of areolae 4

4. Costal area with two rows of areolae reaching base of costal area. Length 4.2-4.3 mm .....*M. biseriata* Champion

— Costal area uniseriate basally. Length 4.6-4.9 mm .....*M. novicis* Drake

Macrotingis schaffneri, NEW SPECIES

Diagnosis. This species differs from all other members of the genus *Macrotingis* by lacking lateral carinae on pronotal disc.

Description. Male: Length 4.7 mm. Head with a single dorsal spine, the supraclypeal, which is very long, vertically recurved, its apex higher than crest of anterior pronotal cyst; dorsal surface convex, polished. Rostrum slightly passing midlength of mesosternum. Bucculae widened posteriorly, there slightly projecting under apex of prosternum; anteriorly projecting and meeting across clypeus.

Pronotum. Disc with numerous, close-set, distinct punctures; no discal lateral carinae; anterior cyst of median carina inflated, as high as median carina over interhumeral convexity, cyst slightly projecting above base of head, posteriorly terminated on anterior slope of interhumeral convexity, median carina elsewhere low, uniseriate. Paranotum slightly wider than an eye, weakly oblique, outer row of cells much larger than inner row.

Hemelytra. Elongate, costal margins almost parallel. Costal area uniseriate at base and at apical fourth, elsewhere with two very irregular rows of areolae. Discoidal area confined to basal third of hemelytron, with six areolae across widest part. Subcostal area regularly biseriate along slightly more than basal half of discoidal area, thence triseriate to well beyond discoidal area where it narrows to a uniseriate series. Hypocosta narrow, uniseriate.

Sternal laminae. Distinct; prosternal laminae straight, weakly converging posteriorly, separated by a space equal to space between anterior coxae; metasternal laminae strongly convexly curved, more widely separated than mesosternal laminae.

Peritreme. Not differentiated.

Abdomen. Impunctate.

Etymology. This species is dedicated to Dr. Joseph C. Schaffner, leader of the field parties that collected all except two specimens of the types series, including the holotype, and for his contributions to our knowledge of the Heteroptera through publications and field work.

Type specimens: Holotype ♂: Mexico, 2.1 mi. nw. Totolapan, July 11-17, 1981, Bogar, Schaffner, Friedlander. Deposited in Instituto de Biología, Universidad Nacional Autónoma de Mexico, Mexico, D. F. (UNAM). . **Paratypes:** MEXICO: 3 ♂, 7 ♀♀, Chiapas, 5 mi. north Nuevo Tenochtitlan, 3000', August 7, 1990, J. C. Schaffner (Texas A & M University, Collection Station [TAM]; 1 ♂, 1 ♀, Chiapas, 27 km. W. Cintalapa, August 30, 1991, R. W. Jones (TAM); 21 ♂♂, 19 ♀♀, same data as for holotype (TAM, UNAM, and [U.S.] National Museum of Natural History, Washington, DC [USNM]): 2 ♂♂, Oaxaca: 2.7 mi. nw. El Cameron, July 21-22, 1974, Clark, Murray, Ashe, Schaffner (TAM); 1.

Oaxaca, 27 mi. southwest Salina Cruz, July 14, 1987, Kovark, Schaffner (TAM); 2 ♀, Oaxaca, 10 mi. e. Totalapan, Elev. 4,000 ft., July 20, 1987, Kovarik, Schaffner (TAM); 2 ♂♂, 1♀ Oaxaca, 12.4 mi. w. Tehuantepec, August 4, 1980, Schaffner, Weaver, Friedlander (TAM); 6 ♂♂, 1♀, Oaxaca, 2 mi. n. Totolapan, July 17, 1973, Mastro & Schaffner (TAM, USNM); 1♂ Oaxaca, 10 mi. E. Totolapan, 4000 ft., VII-20-1987, P. Kovarik, and J. Schaffner (TAM).

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I thank Elsie Herbold Froeschner for the excellent figure of *Macrotingis biseriata*, the type species of the genus, and Joseph C. Schaffner, Texas A & M University, College Station for lending the types series of *M. schaffneri*. I also acknowledge the careful manuscript reviews by Thomas J. Henry, Systematic Entomology Laboratory, U.S. Department Agriculture, United States National Museum, Washington, D.C. and Paul J. Spangler, Department of Entomology, United States National Museum, Washington, D.C.

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A NEW NEARCTIC *PARACLOEODES* (EPHEMEROPTERA: BAETIDAE)[1]

W. P. McCafferty[2] and David R. Lenat[3]

ABSTRACT: *Paracloeodes fleeki*, new species, is described from larvae taken from sand substrates of medium sized streams in the southern outer Piedmont ecoregion of North Carolina. The new species differs from the closely related and parapatric *P. minutus* in having a medial lobe of the labial palp that is less rounded, being both distally non protuberant from its base and distomedially more angulate. Relatively larger gills are also diagnostic of the new species; however, to a large degree, the color pattern displayed by the new species is encompassed by the extensive pattern variability found in the ubiquitous and widespread *P. minutus*.

KEY WORDS: *Paracloeodes*, Ephemeroptera, Baetidae, mayflies, North Carolina.

The genus *Paracloeodes* Day was originally established by Day (1955) for what are now known as the widespread North and Central American species *P. minutus* (Daggy) (see McCafferty and Waltz 1990) and the Puerto Rican species *P. portoricensis* (Traver). No other species were known of this Western Hemisphere genus until one species was described from Cuba by Kluge (1991); four species were discovered from Argentina, Brazil, and Paraguay by Lugo-Ortiz and McCafferty (1996); and one other was described from Mexico by Randolph and McCafferty (2000). Because the latter species, *P. lugoi* Randolph and McCafferty, is known only from far southern Neotropical Mexico, *P. minutus* has remained the only species known to occur in the Nearctic region. *Paracloeodes* has been considered an austral genus of Neotropical origin (e.g., McCafferty 1998), and the best taxonomic treatment of the genus was given by Lugo-Ortiz and McCafferty (1996).

Certain samples of *Paracloeodes* taken in 1989 and 1993 from small streams in the Piedmont of North Carolina represent a second and more geographically restricted Nearctic species of *Paracloeodes*. The description of this new species is given herein. The species is named after Eric Fleek, a member of the North Carolina Division of Water Quality research team studying benthic macroinvertebrate fauna of North Carolina and contributing to our growing knowledge of aquatic insect biodiversity and water quality in the Southeast. All types and other material examined reside in the Purdue Entomological Research Collection, Purdue University, West Lafayette, Indiana.

Paracloeodes fleeki, NEW SPECIES

Larva. Mature body length: 3.2-3.4mm. Mature gill 4 length: 0.70-0.75mm. Mature caudal filaments length: 1.4-1.5mm. Head: Coloration light cream with light brown flecking. Interantennal keel present. Antennae not marked. Labrum subquadrate with branched setae along distal margin and dorsally with one to three long subdistal setae submedially. Planate mandible with weakly feathered

[1] Received on April 9, 2003; Accepted December 11, 2003.

[2] Department of Entomology, Purdue University, West Lafayette, IN 47907, U.S.A. E-mail: pat_mccafferty@entm.purdue.edu.

[3] North Carolina Division of Water Quality, Biological Assessment Unit, 4401 Reedy Creek Rd., Raleigh, NC 27607, U.S.A.

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prostheca (feathering often not apparent) and only shallow depression at base of mola. Angulate mandible with molar triangle nearly perpendicular to distal margin of mandible. Second segment of labial palpi (Fig. 1) with medial lobe nearly straight distally, not protuberant distally from base, and more angulate than rounded distomedially, and with row of hairlike setae on dorsal surface poorly developed. Thorax: Nota generally speckled with light brown. Pronotum usually with medial pair of short, longitudinal brown bars or spots. Tibiae of mid- and hindlegs with 9-11 marginal spines. Claws relatively slender, with basal rows of minute denticles. Hindwingpads absent. Abdomen: Dorsal and ventral patterning in different shades of brown somewhat variable. In well-marked individuals, tergum 1 with anteromedial longitudinal bar; tergum 2 darkest with medial and sublateral markings near anterior margin, and much of central area pigmented with brown but less so in exact center or medioposteriorly; tergum 3 somewhat pigmented with medial and submedial markings near anterior margin and diffuse light brown laterally; tergum 4 pale except for small lateral and submedial clouds (each submedial cloud often with smaller posterolateral adjacent cloud); tergum 5 light with small submedial clouds as in tergum 4 and with small medial light mark near anterior margin; tergum 6 well pigmented with dark submedial markings and brown over much of the surface except often for small medioposterior area; tergum 7 light with medial and submedial clouds; tergum 8 generally similar to 7 or unmarked; tergum 9 well pigmented with only small submedial and lateral areas at anterior margin not pigmented; tergum 10 with medial dot or narrow longitudinal bar near anterior margin. In lighter individuals, only tergum 2 with considerable diffuse pigmentation and light paired markings sometimes variously present on terga 3-7 and 9 (with terga 1,8 and 10 unmarked). In other individuals, tergum 1 with medial pigmented v-shaped area at anterior margin; tergum 2 with diffuse shading medially; tergum 3 with transverse marking anteriorly in middle two-thirds, and similar but less developed in tergum 4; terga 5-7 with small marks medially near anterior margin; tergum 8 unmarked; tergum 9 washed with light diffuse brown; and tergum 10 unmarked. Venter with distinct dark spot sublaterally on either side of sterna 2-7; some individuals with thin transverse pencil lines apparent at intersegmental margins of certain sterna; thicker transverse bars and/or lateral spots at pleural fold not present in known material.

Adult. Unknown.

Type material. HOLOTYPE: larva, NORTH CAROLINA, Guilford Co, South Buffalo Cr at SR 2821, VII-1993, D. Lenat and T. McPherson. PARATYPES: four larvae, including three slides, same data as holotype; one larva, NORTH CAROLINA, Gaston Co, unnamed tributary of Crowders Cr at SR 2416, IX-1989, D. Penrose and D. Lenat.

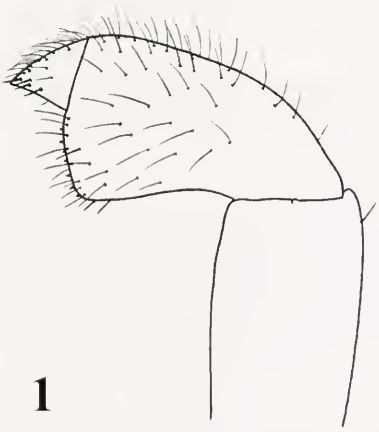
Additional material examined. *Paracloeodes fleeki:* NORTH CAROLINA, Gaston Co, unnamed tributary of Crowders Cr at SR 2416, IX-1989, D. Penrose and D. Lenat (larva); Guilford Co, Richland Cr at SR 1945, VII-1993, D. Lenat and D. McPherson (early instar larvae); same data as holotype (larva). *P. lugoi:* MEXICO, Guerrero, Río Balsas, between Iguala & Chilaparicingo off Hwy 95, 1800', XI-16-1968, RK Allen (larvae, slide-mounted). *P. minutus:* ARIZONA: Graham Co, Gila R at rd to San Jose, VII-07-1969 (adults); KANSAS, Douglas Co, Mud Cr, Sec 7 T125, Rt 20 E, KAW Valley Fish Farm, V-20-1980, P Liechti (larvae, slide-mounted); NEBRASKA: Buffalo Co, Platte R at Kearny, VIII-12-1982, AV Provonsha (larvae, slide-mounted); NORTH CAROLINA: Alamance Co, Alamance Cr, Haw R, VII-1998; Guilford Co, South Buffalo Cr, VII-1993; Mecklenberg Co, McAlpine Cr, Little Sugar Cr, VIII-1997 (all larvae + slide-mounted parts); OHIO, Clermont Co, E Frk Miami R, P&G-ESF 02082798LTA, VIII-27-1998, J Bowling (adults); QUEBEC, Ottawa R, nr Gatineau between W end Kettle Island & N shore, 75/40/27.9W 45/28/05.9N, IX-27-2002 (larva, slide-mounted); WYOMING: Sweetwater Co, Blacks Fork R at I-80, W Green River, VIII-02-1993, AV Provonsha (larvae, slide-mounted). Additional larval populations of *P. minutus* were examined from Indiana, Iowa, Nebraska, New York, Queratarо (Mexico), and Texas.

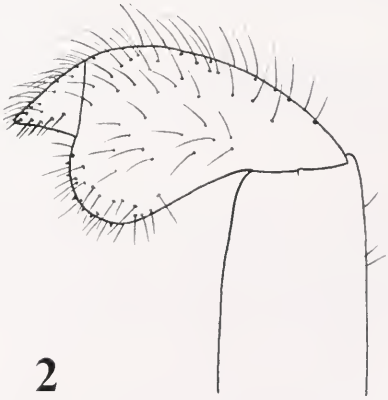
Discussion. *Paracloeodes fleeki* larvae are similar in several respects to those of *P. minutus*. For example, in addition to body size being similar, we did not find significant differences in the head capsule, antennae, labrum, mandibles, hypopharynx, maxillae, or legs, and thus these structures are not extensively treated in the formal description of *P. fleeki*, above. Also, whereas based on the material available of the new species, the ventral abdominal patterns are limited and relatively consistent, the examination of a large number of individuals of *P. min-*

utus revealed that those patterns were also associated with some individuals of *P. minutus*. In general, the dorsal abdominal patterns of the two species are variations on a similar theme of having pigmentation emphasized in terga 2, 3, 6, and 9, although in both species there are lighter individuals, and very early instars of *P. minutus* may show no markings. Nevertheless, we have not seen larvae of *P. fleeki* that exhibit lateral edge spots at the pleural fold of many of the abdominal segments, which are often evident in both a dorsal and ventral view of *P. minutus*, nor have we seen any *P. fleeki* larvae that have thick transverse bars at the intersegmental margins of sterna (especially sterna 6-8). Some individuals of both species, however, may demonstrate thin intersegmental lines associated with a few or most of the sterna.

The fact that larvae of *Pseudocentroptiloides* Jacob, some *Procloeon* Bengtsson such as *P. viridoculare* (Berner), and some other long-clawed baetids will demonstrate markings very similar to those described for *Paracloeodes* above suggests that habitat may have a strong influence on the similar and probably adaptive color patterns that are being expressed. All of the above taxa include very small larvae that are associated with sand-silt substrates in running water.

The most significant structural difference between *P. fleeki* and *P. minutus* involves the shape and development of the medial lobe of segment 2 of the labial palps. This mouthpart has proven useful in discriminating between all known species of *Paracloeodes* (see above). Figures 1 and 2 are provided so that a comparison can be made between the shapes of this structure in *P. fleeki* and *P. minutus*. In general, the lobe in *P. minutus* is relatively rounded or protruding (Fig. 2), and the lobe in *P. fleeki* is relatively angulate and non protruding. It should be noted that these shapes can be misinterpreted if only a dissecting microscope is used for examination. Therefore, slide mounts and compound microscopy are





Figs. 1 –2. *Paracloeodes* labial palp. 1. *P. fleeki*. 2. *P. minutus*.

highly recommended. It should also be noted that palps of early instar larvae are not definitive.

When comparing middle to late instar larvae, those of *P. fleeki* have larger gills than those of *P. minutus* (e.g., a 0.70mm or larger gill 4 vs. a 0.60mm or smaller gill 4). This was found consistently in all North Carolina material examined (see above). Although this is usually only a 15-20% difference in length, it is quite apparent when one has worked with both species. An important caveat is that smaller (earlier instar) individuals, including those of *P. minutus*, will often appear to have disproportionately longer gills. Thus, actual gill size differences in immature larvae are not easily interpreted or are non existent. Among larvae from North Carolina, the ratio of length to width of gill 7 was found always to be greater than 2.5 (e.g., 2.72) in *P. fleeki*, whereas it was always lower that 2.5 (e.g., 2.15) in *P. minutus*. However, we have seen larvae of *P. minutus* from Nebraska (see other material examined, above) with a very narrow-elongate gill 7 with a comparative ratio of 3.60. The narrowness of the gills associated with the latter can give a deceptive impression of long gills. Actual length measurements indicate that is not the case, and in this latter example from Nebraska, the actual length of gill 7 was only 0.50mm (compared to a typical 0.68mm gill 7 length for *P. fleeki*).

The new species was taken from sand substrates in three medium sized streams (8.0-13.0m wide) that are found in the southern outer Piedmont ecoregion of North Carolina. This area is located between the rocky stream system of the Slate Belt and the Foothills area of the Mountains. Two of the three streams had primarily sand substrates at the sites where the new species was collected; and one had pockets of sand substrate among predominantly mixed substrate. *Paracloeodes fleeki* does not appear to be limited by water quality because collecting sites registered only poor to fair water quality ratings.

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ABLEPTEMETES: A NEW GENUS OF TRICORYTHODINAE (EPHEMEROPTERA: LEPTOHYPHIDAE) FROM MEXICO AND CENTRAL AMERICA[1]

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

ABSTRACT: *Ableptemetes*, n. gen., is described for the Mexican and Central American species *A. dicinctus*, n. comb., and *A. melanobranchus*, n. comb., which were previously considered in either *Leptohyphes* or more recently *Tricorythopsis*. The new genus is known only from larvae and can be distinguished among North and Central American genera of the subfamily Tricorythodinae, by the presence of minute posteromarginal spines on abdominal terga 1-10 along with numerous other characteristics such as a double row of submarginal claw denticles. *Tricorythopsis* appears to be confined to South America. The recent keys to the subfamilies and revised genera of North and Central American Leptohyphidae as well as the larval characterization of the subfamily Tricorythodinae are slightly modified to accommodate the new genus and new morphological data associated with it.

KEY WORDS: *Ableptemetes*, Ephemeroptera, Leptohyhiidae, Tricorythodinae, Mexico, Central America.

Wiersema and McCafferty (2000) in their revision of the North and Central American genera of the mayfly family Leptohyphidae transferred the species originally described as *Leptohyphes dicinctus* Allen and Brusca and *L. melanobranchus* Allen and Brusca to the genus *Tricorythopsis* Traver. These species are known only as larvae (Allen and Brusca 1973). Their recombination had been based on the fact that they clearly did not belong to *Leptohyphes* Eaton, along with their apparent similarity with the first description of a larval exuviae associated with an adult *Tricorythopsis* from South America by Molineri (1999). This latter larval representative, although initially ascribed to *T. fictilis* Molineri, has proven to be the type of the genus, *T. artigas* Traver. Wiersema and McCafferty (2000) cautioned that the placement of the Allen and Brusca species in *Tricorythopsis* was contingent on verification from the discovery of their adults, or at least a study of mature larval specimens that may or may not confirm the descriptions of Allen and Brusca (1973) and provide additional descriptive data such as was deemed important in the revisionary work of Wiersema and McCafferty (2000).

Recently, a more comprehensive review of *Tricorythopsis* in South America has become available (Molineri 2001a). Also recently, a large series of mature larvae of *T. dicinctus* has been attained from Belize. The study of these larvae as well as the types of both species in question has revealed numerous characters that were not treated in the original descriptions and in some instances not even apparent in the poorly preserved type material. The newly available data make it obvious that the Allen and Brusca species in question should be removed from *Tricorythopsis* sensu stricto and placed in the newly described genus of the subfamily Tricorythodinae that follows.

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[1] Received on May 30, 2002. Accepted November 28, 2003.

[2] 4807 MFG, Inc., Consulting Scientists and Engineers, Spicewood Springs Rd., Building IV, Austin, TX 78759, U.S.A. E-mail: Nick.Wiersema@mfgenv.com.

[3] Department of Entomology, Purdue University, West Lafayette, IN 47907, U.S.A. E-mail: pat_mccafferty@entm.purdue.edu.

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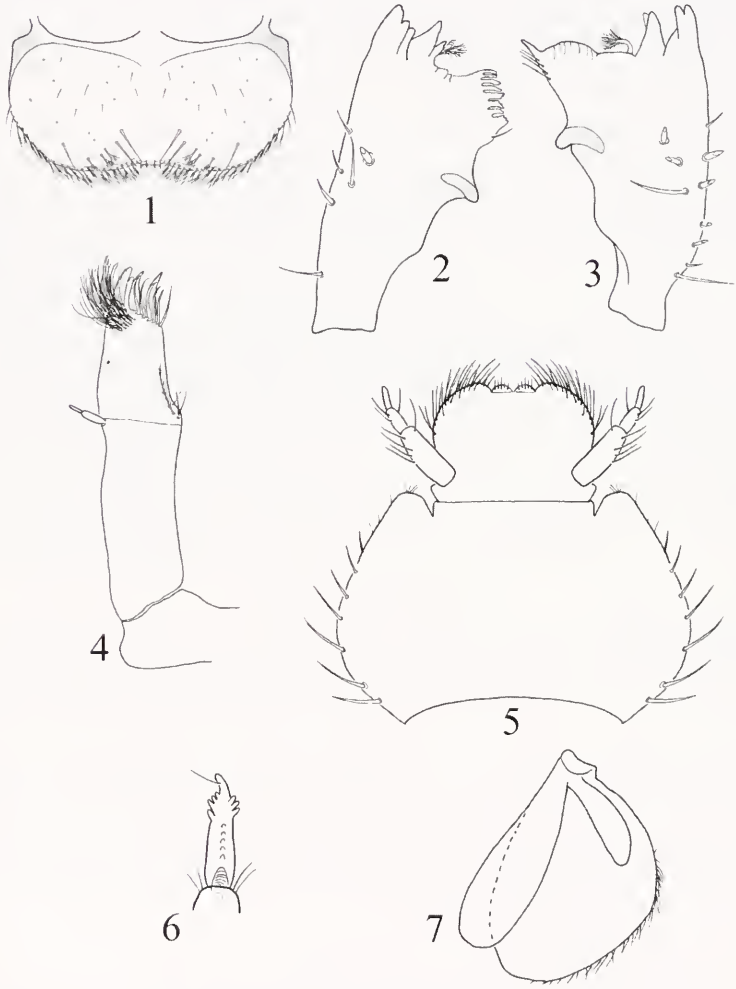
Ableptemetes, NEW GENUS

Larva. Body relatively elongate, known species ranging in mature length from 2.8 to 3.5 mm. Head (Fig. 1 Allen & Brusca 1973) with well-developed frontal shelf, genal projections and fronto-clypeal projection (all fringed with stout setae); vertex without tubercles. Compound eyes not sexually dimorphic. Labrum (Fig. 1) width nearly one and one-half times length. Mandibles (Figs. 2 & 3) with reduced molae. Galealaciniae (Fig. 4) with apical denticles pointed in same axis as that of galealaciniae (crown poorly developed). Hypopharynx with lingua slightly emarginate; superlinguae broadly rounded. Labium (Fig. 5) with short, defined glossae; submentum with lateral aspect rounded basally and constricted distally, with basal three-fourths of margin sparsely fringed with stout, medium-length setae, and distal one-fourth essentially bare. Thoracic nota without tubercles, fringed with setae. Hindwingpads absent in both sexes. Legs with anterior and posterior margins with both long and short, stout, bristlelike setae. Forefemora with short and broad, dorsally with transverse row



Figures 1-7. *Ableptemetes dicinctus*, n. comb., 1. Labrum. 2. Left mandible. 3. Right mandible. 4. Maxillae. 5. Labium. 6. Claw. 7. Gill two (ventral view).

of stout, bristlelike setae; hindfemora length subequal to that of hindtibiae and hindtarsi combined. Claws (Fig. 6) with basal denticles, and with two rows of submarginal, subapical denticles, sometimes reduced to one or two denticles on one side. Abdomen more or less triangular in cross-section, with peaked dorsum; terga 1-10 with long, fine, marginal setae laterally and posterolaterally and with short, apically truncate or rounded, posteromarginal spines; middle terga each with medioposterior protuberance fringed with stout setae. Gills present on abdominal segments 2-6; operculate gills (Fig. 7) large, subtriangulate with rounded borders, without submedial or subdistal, unsclerotized bands; ventral gill lamellae without fringes or flaps, length of inner lamellae approximately one-half that of out outer lamellae. Caudal filaments with whorls of setae at each segmental joining.

Adult. Unknown.

Type species. *Leptohyphes dicinctus* Allen and Brusca.

Species included. *Ableptemetes dicinctus* (Allen and Brusca), NEW COMBINATION; *Ableptemetes melanobranchus* (Allen and Brusca), NEW COMBINATION.

Etymology. From the Greek noun "ableptema" (mistake[n]) and the masculine suffix "etes" (one who [was]).

Distribution. Mexico and Central America.

DISCUSSION

The following combination of characteristics will serve to distinguish *Ableptemetes* larvae from known larvae of other defined genera of Leptohyphidae: lack of hindwingpads in both sexes; hindtarsi that are three-fourths to subequal in length to that of their respective tibiae; a mature body length of less than 3.6 mm.; abdominal terga 1-10 with minute posteromarginal spines; an abdomen that is triangulate in cross-section; operculate gills with an inner ventral lamellae approximately one-half of the length of the outer lamellae, and with both lamellae lacking fringes or flaps; and operculate gills that are subtriangulate and devoid of submedial or subdistal, unsclerotized bands.

Couplet 1 of the larval key to the North and Central American genera of Leptohyphidae (Wiersema an McCafferty 2000:356), and thus the larval characteristics associated with the subfamilies Tricorythodinae and Leptohyphinae in North and Central America, require modification to accommodate the new genus and new morphological data presented herein. The modified couplet 1 follows.

1 Posterior margin of abdominal terga 1-6 either without spines, or, in certain small larvae, with minute spines. Hindtarsi more than one-half length of hindtibiae. Hindwingpads absent ..... Tricorythodinae 2

1 Posterior margins of abdominal terga 1-6 or 2-6 with spines. Hindtarsi approximately one-half to much less than one-half length of hindtibiae. Hindwingpads present in males, present or absent in females ..... Leptohyphinae 7

In addition, in the first half of couplet 4 in the larval key, *Tricorythopsis* should be changed to *Ableptemetes*. In using couplet 1 of the adult key to genera (Wiersema and McCafferty 2000: 358), users should go directly to couplet 3, rather than couplet 2 as indicated, if the adult specimen keys to Tricorythodinae. Couplet 2 can be entirely deleted from the adult key.

It is important to reiterate that the key in Wiersema and McCafferty (2000), and as slightly modified herein, is intended for the North and Central American Leptohyphidae only. This was stated emphatically by Wiersema and McCafferty (2000), because of their prediction that numerous genera in South America were yet to be discovered and described. This prediction is now being borne out with recent discoveries of additional genera, for example, by Molineri (2001b, 2002).

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A NEW SPECIES OF THE GENUS *TOMOCERUS (TOMOCERINA)* FROM CHINA (COLLEMBOLA: TOMOCERIDAE) WITH A DISCUSSION OF THE SUBGENERA OF TOMOCERUS[1]

Yi-Tong Ma,[2] Jian-Xiu Chen,[3] and Kenneth Christiansen[4]

ABSTRACT: A new species *Tomocerus (Tomocerina) yiliensis*, from Xinjiang of northwest China is described. It is distinct from all other members of the subgenus because of the large number of setae on the trochanteral organ. The presence of more than one trochanteral organ seta forces a re-examination of the subgenera of *Tomocerus*, the subgenus *Tomocerina*, and the role of trochanteral organ setae in dividing subgenera of *Tomocerus*.

KEY WORDS: *Tomocerus* Collembola, Tomocerina, Tomocerinae, China, new species.

The genus *Tomocerus* was created by Nicolet (1842) and later given the type species *Macrotoma minor* Lubbock 1862 (opinion 239 ICZN, 1954:363). The genus was characterized by long, greatly subdivided antennae with the 3rd antennal segment more than 3 times as long as the fourth; an elongate toothed mucro, dental spines, 6 + 6 eyes and body scales. Meanwhile, Frauenfeld described a related genus *Tritomurus* in 1854, differing primarily in the absence of eyes. In 1896 Schäffer placed these genera in a subfamily of Entomobryidae – Tomocerinae – and in 1913 Börner raised them to family level. Both treatments have continued to the present day. In 1897 Schäffer created a new genus, *Lepidophorella* with a third antennal segment less than twice as long as the fourth. This and related taxa were eventually split off as a separate subfamily *Lepidophorellinae*, distinguished from the other Tomoceridae by its relatively much longer 4th antennal segment. The species with the shorter 4th antennal segment are now placed in the subfamily Tomocerinae. In addition most genera of Lepidophorellinae lack antennal annulations and have much shorter mucrones than do genera of the subfamily *Tomocerinae*. Except for a few obvious anthropochore species, the subfamily *Tomocerinae* is limited to the northern hemisphere, whereas the *Lepidophorellinae* are found only in the southern hemisphere. Others have described additional related genera or subgenera in the Lepidophorellinae: by Womersley *Neophorella* (1934) and *Millsia* (1942); by Salmon *Antennacyrtus* (1941), and *Novocerus* (1942); and by Ireson and Greenslade, *Lasofinus* (1990). In the Tomocerinae, Paclt described *Pogonognathellus* (1944) and Mills described *Tomolonus* (1949). Most subgenera of Tomocerinae were created by Yosii: *Monodontocerus* and *Tomocerina* (1955), *Aphaenomurus* and *Plutomurus* (1956) and *Lethemurus* (1970). Yosii (1967) considered most of these as separate genera. Other authors have varied from treating all as valid genera to considering all

[1] Received on March 18, 2002. Accepted December 11, 2003.

[2] Department of Biology, Nantong Teacher's College, Nantong 226000, People's Republic of China.

[3] Department of Biology, Nanjing University, Nanjing 210093, People's Republic of China.

[4] Department of Biology, Grinnell College, Grinnell, Iowa 50112, U.S.A. E-mail: christak@grinnell.edu.

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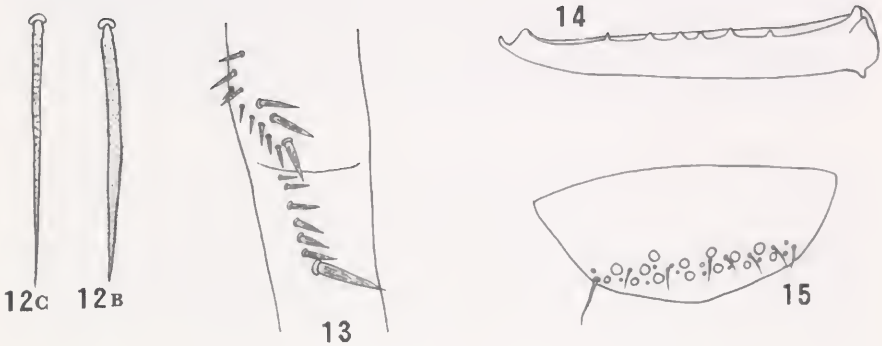
Figs. 1-15. *T. Tomocerina yiliensis* sp. nov. 1. habitus; 2. labrum; 3. dorsum of head; 4. dorsal chaetotaxy of Th. II - Abd. V; 5. trochanteral organ; 6. hind tibiotarsus, showing blunt setae; 7. hind foot complex; 8. tenaculum; 9. anterior face of ventral tube; 10. posterior face of ventral tube; 11. lateral flap of ventral tube; 12 A. manubrium (dorsal view), dotted line represents mid line; 12B. lateral seta of manubrium; 12C. dorsal seta of manubrium; 13. dental spines; 14. mucro; 15. upper anal flap chaetotaxy.



as subgenera of *Tomocerus* but all have considered these supraspecific taxa as members of the family Tomoceridae. Below we describe a new species of the subgenus *Tomocerina*.

Tomocerus (Tomocerina) yiliensis, NEW SPECIES (Figs. 1-15)

Maximum body length: 3.6 mm.

Color: Ground color pale yellow. Eye patches dark blue to black. Ant. III & IV with dark blue pigment. Pale blue pigment also present on tibiotarsi and anterior margin of Th. II (Fig. 1). Scales brownish, hyaline and heavily striated.

Head: Eyes 6+6, all subequal. Antennae 0.31-0.42 times as long as body and 1.8 – 2.6 times as long as head. Third segment 6 - 9 times as long as fourth. Labral setae 4/5,5,4, all smooth; each of distal 3 rows with clear basal papillae. Anterior margin of labrum with 4 recurved spinules (Fig. 2).

Chaetotaxy: Dorsum of head with 13-23 setae of different size near the antennal bases and 6 anterior interocular macrochaetae in a medial hexagon, 7 macrochaetae directly anterior to median furrow, 3 + 3 lateral median setae and posterior margin with a row of 36-75 small setae (Fig. 3). Macrochaetae and bothriotricha of thorax and abdomen as shown in Fig. 4. Upper anal flap with 14 large setae arranged in 2 irregular transverse rows (Fig. 15). Body macrochaeta with 0-3 basal microsetae.

Legs: Trochanteral organ with one somewhat larger and 8-22 smaller smooth setae on trochanter and one large seta on femur (Fig. 5). Two (rarely one) blunt setae on ventral side of tibiotarsus 3, finely ciliate setae, distributed as shown in Fig. 6. Unguis slender with a paired pseudonychia 0.28-0.52 times as long as inner edge of unguis; inner ungual teeth 6-7, rarely 4 or 5. Unguiculus lanceolate without inner teeth. Tenent hair spatulate, 0.64-0.96 times as long as inner edge of unguis (Fig. 7).

Tenaculum: rami with 4+4 teeth, corpus unscaled with 1 smooth seta (Fig. 8).

Ventral tube: scaled on all sides, anterior face with 27-50 striate setae of different sizes on each side (Fig. 9); posterior with 37-61 striate setae of different sizes (Fig. 10); lateral flap with 50-96 striate setae of different sizes (Fig. 11).

Furcula: Dens 1.32 – 2.6 times as long as manubrium and 4-5 times as long as mucro. Manubrium scaled dorso-laterally with a row of 8-10 large setae on each side, all weakly ciliate and strongly tapering near apex but not spinelike (Figs. 12A & B); dorsally with 2 setaceous stripes, each consisting of numerous acuminate, striate setae of different sizes (Fig. 12C), 14-24 of them very large. Dental spines dark brown, formula 10-12(13)/4-6, 1. Proximal spines arranged in 2 irregular rows; all simple with fine longitudinal striations (Fig. 13). Mucro elongate with numerous ciliate setae; outer dorsal lamella entire with 2-6 intermediate teeth; apical and anteapical teeth subequal (Fig. 14).

Types: Holotype female, China: Xinjiang, Yili, Narat Prairie, altitude 1500m-1600m, VIII-12-2000, Jian-xiu Chen, Songjie Wang & Fang Wang colls. Locality C9086; paratypes: 15 females,all on slides, same data as holotype. Deposited in the Department of Biology, Nanjing University.

Ecology: Found under stones and decayed wood in grassland.

Etymology: The new species is named after the locality of the types.

Discussion: The new species shares some characteristics with Japanese *T. Tomocerina aokii* Yosii (1972), such as the number of inner teeth on the unguiculus and intermediate teeth on the outer dorsal lamella of the mucro. However, it differs from *aokii* in tenaculum setae and in having more than one trochanteral organ seta. The latter characteristic differentiates *yiliensis* from all other described species of *Tomocerina*. Over time, a number of features have come to be considered as distinguishing characteristics of the different subgenera of *Tomocerus*. In the Tomocerinae, these include the number of basal mucronal teeth, the presence or absence of a small toothlet on one basal mucronal tooth, the presence or absence of large spine-like scales on the inner face of the base of the dentes, the presence of large lateral spines on the base of the dentes, the presence or absence of eyes, and the nature of the trochanteral organ. In this family this occurs on the base of the femur as well as the trochanter. It has been long accepted that there is a sharp distinction taxa having only a single such seta on femur and trochanter *(Tomocerus, Pogonognathellus, Monodontocerus, Tomocerina)*, those with more than one seta on the femur but only one on the trochanter *(Aphaenomurus* and *Tomolonus)* and those with more than one on both femur and trochanter *(Plutomurus* and *Lethemurus)*. Until the present study, *Tomocerina* was considered a member of the first group. The trochanteral organ setae on *T. yiliensis* are different in size and distribution from those of other multisetaceous Tomocerine trochanteral organs and their analogy with these remains in doubt. Assuming that these are trochanteral organ setae we re-examined Nearctic specimens assigned to species of *T. (Tomocerina)*. This showed that some populations of *T. (Tomocerina) lamelliferus* may have more than one trochanteral organ seta on their trochanter and that specimens from Colorado previously identified as *T. (Tomocerina) curtus* are in fact a species of *Tomolonus* lacking clear spine-like outer basal setae on the dens. In addition, we have recently examined specimens of *Tritomurus scutellatus*, and these appear to have one trochanteral organ seta on the trochanter. These discoveries make the distinction between *Tomocerina* and *Plutomurus* less clear cut; however, the number and size of the setae in the femoral trochanteral organ and the presence or absence of spine-like setae on the outer basal dentes still serve to distinguish the vast majority of *Plutomurus* and *Tomocerina* species. A reassessment of the criteria separating the supraspecific categories of Tomocerinae is clearly in order. This might result in fusing some of these subgeneric categories.

Most species of *Tomocerina* are very close to the genus *Tomocerus (s. s.)* except for the absence of a toothlet on the outer basal tooth of the mucro. *T. (Tomocerina) yiliensis* differs from members of the subgenus *Tomocerus (s. s.)*

in having more than one trochanteral organ seta on the trochanter as well as lacking the basal toothlet. *Tomocerina* is a small subgenus containing only 9 - 12 species, four of these were described or have been reported from China: *minutus* Tullberg 1876 from Shanxi and (as *varius*) from Yunnan, *calceus* and *purpurithorus* Liu et al. 1999 from Sichuan and *yiliensis* from Xinjiang.

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A NEW RECORD OF *TOMOCERUS BAICALENSIS* FROM CHINA WITH ITS REDESCRIPTION (COLLEMBOLA: TOMOCERIDAE)[1]

Yi-Tong Ma,[2,3] Jian-xiu Chen,[3] and Kenneth Christiansen[4]

ABSTRACT: The Russian species, *Tomocerus baicalensis*, is reported for the first time from China and it is redescribed on the basis of these specimens.

KEY WORDS: *Tomocerus baicalensis*, Collembola, Tomocerina, Tomereninae, China, new record.

The genus *Tomocerus (s.s.)* is distinguished from other Tomoceridae by a combination of six characteristics: (1) antennal segments III and IV annulate, (2) proximal part of dens lacking large spinelike outer setae and inner basal scale like appendages, (3) mucro with two basal teeth, (4) a small toothlet present on the outer basal tooth, (5) 6 + 6 eyes, and (6) a single seta on the trochanteral organ position on the trochanter and the proximal portion of the femur. There are fifty-five species of the genus *Tomocerus (s.s.)*, eighteen of them have been described or reported from China (Zhao et al. 1997): four from Sichuan (*emeicus* and *maximus* Liu et al 1999), *minor* Lubbock 1862 and *vulgaris* Tullberg 1871 (Liu et al. 1998); four from Tibet (*monticolus, obscurus, parvus* and *zayuensis* Huang and Yin 1981); three from Anhui (*similis* Chen and Ma 1997, *spinulus* Chen and Christiansen 1998, *cheni* Ma and Christiansen 1998); two from Fujian *caputiviolaceus* and *deogyuensis* Lee 1975 (Liu et al. 1998); one, *folsomi* Denis 1929, from Yunnan; one, *cuspidatus* Börner 1909, from Taiwan (Yosii 1940); one, *kinoshitai* Yosii 1954, from Hunan; one, *ocreatus* Denis 1948, from Zhejiang; and, one, *sibiricus* Reuter 1891, from Hebei (Huang and Liu 1995). A species new to China, *Tomocerus baicalensis* Martynova 1969, is reported from Xinjing, Northwest China. This species is redescribed on a basis of Chinese specimens.

Tomocerus (Tomocerus) baicalensis Martynova, 1969 (Figs. 1-16)

Body length: Chinese specimens maximum 3.9 mm.

Color: Ground color pale yellow. Eye patches dark blue. Frons and anterior margin of Th. II with greenish pigment. Ant. II-IV green or blue. Pale greenish pigment also present on Abd. III and IV, tibiotarsi and dens (Fig. 1).

Head: Eyes 6+6, subequal. Antennae 2.4 to 3.8 times as long as cephalic diagonal. Labral setae 4/5, 5, 4, all smooth; each of distal 3 rows on papillae. Anterior margin of labrum with 4 recurved spinules. Dorsal macrochaetae of head as follows: anterior area (A) 2/4; mid (M) 2/7; lateral (L) 2 (L1, L2), posterior (P) 4. Posterior margin of dorsal head with one row of 48-60 tiny setulae (Fig. 2).

Thorax: Macrochaetae and bothriotricha as shown in Fig. 3. Tibiotarsus with 2-5, 4-6, 4-6 blunt spiny setae respectively on ventral side of leg I-III (Figs. 5 and 6). Unguis rather slender; a pair of pseudonychia developed, 0.36-0.48 times as long as inner edge of unguis; inner teeth 5-6, 5-6 and 4-

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[2] Department of Biology, Nantong Teacher's College, Nantong 226000, China.

[3] Department Biology, Nanjing University, Nanjing 210093, P.R. China.

[4] Department Biology, Grinnel College, Grinnell, IA 50112, U.S.A. E-mail: christak@grinnell.edu.

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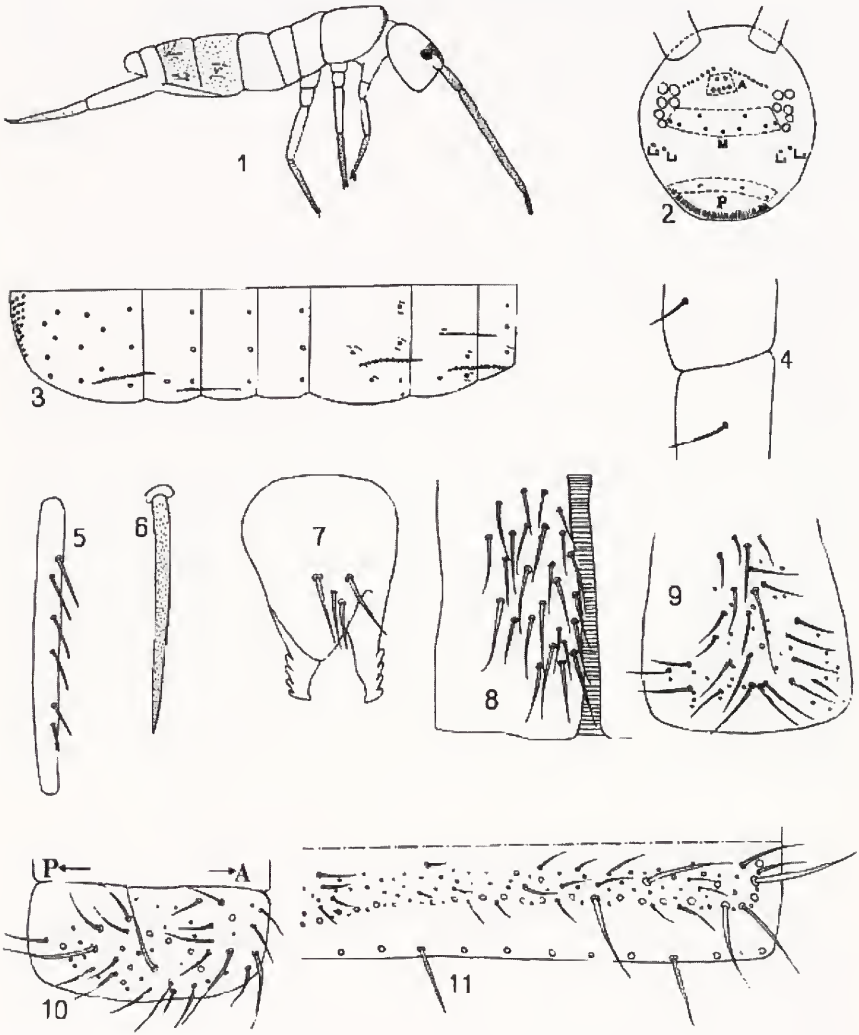
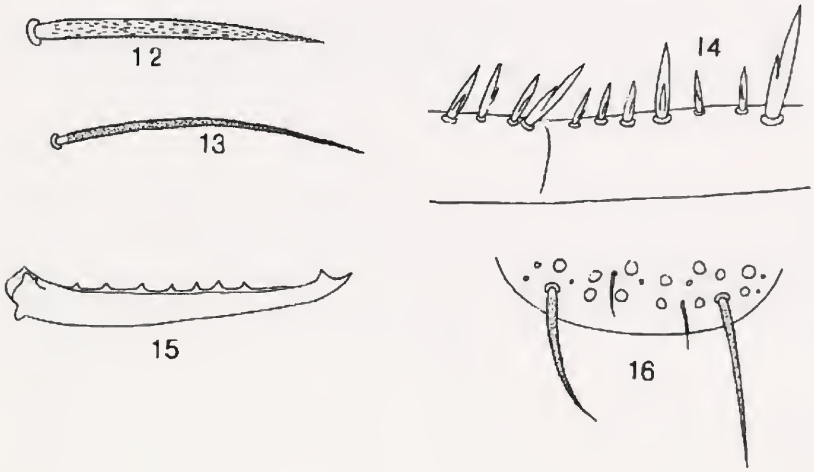


Figs. 1-16. *Tomocerus baicalensis* Martynova, 1969. 1. Habitus; 2. Dorsum of head, A= anterior microchaetae, M= median macrochaetae, L= lateral macrochaetae, P= posterior macrochaetae: 3. Chaetotaxy of body; 4. trochanteral organ; 5. hind tibiotarsus, showing blunt setae; 6. enlargement of blunt seta; 7. anterior face of tenaculum; 8. anterior face of ventral tube; 9. posterior face of ventral tube; 10. lateral flap of ventral tube; 11. dorsal face left side of manubrium: 12. enlargement of thick dorso-lateral large seta on manubrium; 13. enlargement of normal large seta on dorsal stripes; 14. dental spines; 15. mucro; 16. upper anal valve.



6 respectively on leg I-III. Unguiculus lanceolate without inner tooth. Tenent hair thick, 0.90-1.08 times as long as inner edge of unguis, apex spatulate.

Abdomen: Macrochaetae and bothriotricha on Abd. I-V as shown in Fig. 3. Tenaculum unscaled, with 4+4 teeth, 1-9 smooth setae on corpus. Ventral tube scaled; with 25-28 setae on each side of anterior face (Fig. 8), 46-65 on posterior face (Fig. 9), 45-75 on each lateral flap. Dentes 4.3 to 5 times as long as mucro and 1.4 to 1.78 times as long as manubrium (Table 1). Manubrium scaled, dorso-laterally with 1 row of 9-11 large setae on each side, all weakly ciliate and strongly tapered near apex (Fig. 12); dorsally with 2 setaceous stripes, each consisting of numerous acuminate, finely ciliate setae of different sizes, 20-26 of them large (Fig. 13). Dental spines as shown in table 1, dark chestnut brown, each with 1 lateral toothlet near base (Fig. 14). Mucro elongate with numerous ciliate setae; with 4-10 intermediate teeth; apical and anteapical teeth subequal (Fig. 15). Upper anal valve of Abd. VI with 14 large ciliate cylindrical setae arranged in 2 irregular transverse rows (Fig. 16). Scales brownish, hyaline and heavily striated. Trunk macrochaetae and bothriotricha surrounded by 0-3 setulae.

Table 1 Characteristics of some individual Chinese specimens of *Tomocerus baicalensis*.

Locality number	Ratio Antenna/ Cephlic diagonal	Dental spine formula	Setae on tenaculum	Body+ head mm	Manubrium length mm	Dentes length mm	Antenna length mm
C9077-1	?	3-4,1/3,1,2,1	1	2.1	0.4	0.6	?
C9077-2	3.83	5-6,1/5,1,2,1	9	3.9	0.6	1.0	2.5
C9077-6	3.70	4,1/2,1,2-3,1	1	2.3	0.3	0.6	1.5
C9077-9	2.80	4-5,1/3,1,2,1	1	2.4	0.3	0.5	1.2
C9077-12	?	4,1/3,1,2,1	4	2.6	0.5	0.7	?
C9077-16	2.40	4-4,1/3,1,2,1	?	2.4	0.3	0.5	1.1
C9077-2	3.20	5,1/2,1,2,1	2	2.8	0.5	0.7	1.6
C9077-3	?	6,1/3,1,2,1	1	2.1	0.4	0.5	1.1

Ecology: Under stones and in decayed wood in forest.

Chinese locality: China: Xinjiang: Tianshan Mountain: Tianchi Lake, altitude 1980m, VIII-2-2000, Collection number C9075, C9077, and C9078. Thirteen females, all on slides, collected by Chen Jian-xiu, Wang Songjie, and Wang Fang. Deposited in the Department of Biology, Nanjing University.

Remarks: This species was first described by Martynova (1969) on a basis of 3 specimens from the southern shores of Lake Baikal. It has not been recorded from Russia since that time. The Chinese specimens, also taken near the shores of a lake, agreed with Martynova's (1969) description and figures of this species. The species belongs to a group of largely East Asian species having the dental spines with multiple teeth. Both the Russian and Chinese populations of *baicalensis* differ from all other species of the group by having at most one secondary toothlet on each spine. There are a few differences between the two populations. These are primarily the body color and pattern and setae on the tenaculum. Martynova's specimens were considerably larger than ours 3.7 – 5.4 mm. compared to ours, which were 2.1 – 3.9 mm. and this probably explains a number of differences such as the tenacular setae number. Michael Potapov examined the types of *baicalensis* and could find no significant morphological differences between them and the drawings of the Chinese specimens we sent him. The difference in color and pattern may represent geographic variation.

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NOTES ON THE DISTRIBUTION OF *LEUCTRA CAROLINENSIS* AND *L. VARIABILIS* (PLECOPTERA: LEUCTRIDAE) IN MARYLAND, WITH AMENDED AND NEW STATE RECORDS[1]

Scott A. Grubbs[2]

ABSTRACT: The distributions of *Leuctra carolinensis* and *L. variabilis* in Maryland are clarified. The former is a late spring emerging species and known from the Appalachian Plateaus and Blue Ridge portions of the state while the latter species emerges during late autumn and recorded only from the Piedmont and Coastal Plain Physiographic Provinces. The status of *Yugus bulbosus* in Maryland is reevaluated and new state records are reported for five additional species of stoneflies: *Pteronarcys dorsata, Acroneuria frisoni, Agnetina capitata, Neoperla stewarti,* and *Isoperla dicala*. A total of 103 species are now known to occur in Maryland.

KEY WORDS: *Leuctra carolinensis, L. variabilis,* Plecoptera, Leuctridae, Maryland.

Grubbs (1997) updated the species list of stoneflies from Maryland by including 36 newly recorded taxa. These additions amended previous lists of Stark et al. (1986) as well as Duffield and Nelson (1990) to 95 species. Grubbs and Stark (2001) and Nelson et al. (2002) have subsequently added two species of *Perlesta* and *Alloperla usa* Ricker, respectively, to this list.

Nelson et al. (2002) questioned the record of *Leuctra variabilis* Hanson, which Grubbs (1997) included with late May collection data, correctly indicating that this taxon is an autumn-emergent species (Hanson, 1941). Nelson et al. (2002) provided ample evidence, via scanning electron microscopy, that material collected from the same or nearby localities was actually of the closely related species *L. carolinensis* Claassen. In addition, Nelson et al. (2002) provided the first verified records of *L. variabilis* from Maryland from bogs in the Piedmont and Coastal Plain Physiographic Provinces.

The primary intent of this note is to clarify the identity of the material reported as *L. variabilis* by Grubbs (1997). Secondarily, new state records are provided for five additional species and the distribution of *Yugus bulbosus* Frison in Maryland is clarified. All specimens listed below were collected by the author and are deposited in the personal collection of S. A. Grubbs at Western Kentucky University (WKU). Consequently, 103 species of stoneflies are now recorded from Maryland.

Family Leuctridae

Leuctra carolinensis Claassen

Distribution. FREDERICK County (Duffield and Nelson, 1990), GARRETT County.

Notes. All material reported by Grubbs (1997) from Garrett County and pre-

[1] Received on November 11, 2002. Accepted December 17, 2003.

[2] Department of Biology, and Center for Biodiversity Studies, Western Kentucky University, Bowling Green, KY 42101, U.S.A. E-mail: scott.grubbs@wku.edu.

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viously identified by the author as *L. variabilis* is *L. carolinensis*. Collection records of the latter species from numerous small spring-fed streams from the Appalachian Plateaus Physiographic Province in Maryland range from late May through early September and were first reported from Maryland from the Blue Ridge Physiographic Province by Duffield and Nelson (1990). At present, the only known Maryland localities of *L. variabilis* are from a few sites in Charles and Prince Georges counties.

Family Pteronarcyidae

Pteronarcys dorsata (Say)

Distribution. ALLEGANY County, Sideling Hill Creek, 1 female, 11 June 1997.

Family Perlidae

Acroneuria frisoni Stark & Brown

Distribution. ALLEGANY County, Sideling Hill Creek, 7 males, 16 females, 11-30 June 1997; same but 4 males, 2 females, 30 May 1998.

Agnetina capitata (Pictet)

Distribution. WASHINGTON County, Conococheague Creek, 1 male, 2 females, 14 July 1998.

Neoperla stewarti Stark & Baumann

Distribution. WASHINGTON County, near confluence of Potomac River and Tonoloway Creek, at light, 11 males, 16 females, 23 June 1997.

Family Perlodidae

Isoperla dicala Frison

Distribution. FREDERICK County, Big Hunting Creek, 1 male, 3 June 1997; WASHINGTON County, Licking Creek, 1 male, 1 female, 15 May 1999.

Yugus kirchneri Nelson

Distribution. GARRETT County.

Notes. Nelson (2001) demonstrated that *Y. bulbosus* is a complex of three closely related species. All specimens reported of *Y. bulbosus* (Frison) from Maryland by Grubbs (1997) were reexamined and are now considered to be *Y. kirchneri* Nelson. The remaining species, *Y. bulbosus*, *Y. kondratieffi* Nelson, and *Y. arinus* (Frison), are presently known only from the southern Appalachian Mountains.

ACKNOWLEDGMENTS

I thank Stan Szczytko (University of Wisconsin Stevens-Point) for confirming the identity of *Isoperla dicala*, and two anonymous reviewers for improving the quality of this manuscript.

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SCIENTIFIC NOTE

THE BEE GENUS *MYDROSOMA* IN COSTA RICA (HYMENOPTERA: COLLETIDAE)[1]

Charles D. Michener[2]

The dissoglottine genus *Mydrosoma,* consisting of rarely collected, moderate sized to large (10 to 17 mm body length) bees, is known from Mexico to Argentina, but in Central America it has been reported only from Panama (*M. brooksi* Michener, 1986). It is therefore of interest to report a male specimen of *M. brooksi* in the collection of InBio (Instituto Nacional de Biodiversidad) in Heredia, Costa Rica, borrowed for study by R. W. Brooks.

The data are as follows: Guanacaste Province: Estacion Pitilla, 9 km south of Santa Cecilia, 700 m elevation, March 1990 (P. Rios, C. Moraga & R. Blanco), no. 177060.

The specimen differs from Panamanian specimens of *M. brooksi* in that the midbasal projection of sternum 5 is an acute tubercle, not a short transverse lamella suggesting a tubercle. My first reaction was to think it represented a new species, but since its other characters including those of the hidden sterna and genitalia are as in *M. brooksi,* I think it is that species.

The structure of sternum 5 of the Costa Rican specimen requires a change in couplet 7 of the key to species (Michener, 1986, p. 199); the second alternative should read "S V with short, transverse, median basal lamella *or acute tubercle;* first flagellomere ..." (italics added).

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[1] Received and accepted August 19, 2002.

[2] Entomology Division, Natural History Museum and Entomology Program, Department of Ecology and Evolutionary Biology, University of Kansas, Lawrence, Kansas 66045, U.S.A. E-mail: michener@ku.edu.

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SCIENTIFIC NOTE

ACERPENNA SULFUROSUS, COMB. N. (EPHEMEROPTERA: BAETIDAE)[1]

N. A. Wiersema[2]

Day (1954) established the species *Baetis sulfurosus* Day for a large number of adult male mayflies collected within the region of Sulphur Creek in Sonoma County, California. To date, larvae have yet to be associated. Examination of the holotype and paratype material indicated that this species is more properly placed within the Nearctic genus *Acerpenna* Waltz & McCafferty [*Acerpenna sulfurosus* (Day), comb. n.], not *Baetis* Leach.

Among North American Baetidae fauna only the species of *Acerpenna* possess the following combination of features: forewings with double marginal intercalaries; relatively narrow hindwings, with an undulate costal border and often three longitudinal veins; a male subgenital plate roughly in the form of a conical process (difficult to see in older specimens); and elongate apical segment of the male forceps (Waltz and McCafferty 1987). *Acerpenna sulfurosus* is consistent in all features outlined above and is therefore transferred from *Baetis* to *Acerpenna*.

Although the reasoning for the above action is essential equivalent to that of McCafferty (1999), the adult type material of *A. sulfurosus* has been examined, allowing a more comprehensive comparison of this species and that of *Acerpenna pygmaea* (McDunnough).

I would like to thank W. Pulawski and B. Zuparko (California Academy of Science) for loan of type material.

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[1] Received on March 12, 2002. Accepted December 8, 2003.

[2] MFG, Inc. Consulting Scientists and Engineers, 4807 Spicewood Springs Rd., Austin, TX 78759, U.S.A. E-mail: Nick.Wiersema@mfgenv.com.

Mailed on April 9, 2004

SCIENTIFIC NOTE

A REPLACEMENT NAME FOR *STAGETUS CONVEXUS* WHITE (COLEOPTERA: ANOBIIDAE)[1]

Gianluca Nardi[2]

Stagetus convexus White, 1975: 181 from Mexico is a junior secondary homonym of *S. andalusiacus convexus* (Pic, 1921: 9) from Algeria (Pic, 1921:g Español, 1969), which was described as *Theca (Anomotheca) convexa*. No synonym of *Stagetus convexus* White is known so, according to the ICZN (1999 Art. 60.3), the following replacement name is proposed for it: ***Stagetus whitei*** NEW NAME.

Etymology. The replacement name is a patronym for Richard E. White.

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[1] Received on September 7, 2003. Accepted on February 3, 2004.

[2] Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale — Corpo Forestale dello Stato. Strada Mantova 29, I-46045 Marmirolo (MN), Italy. E-mail: l_nardi@hotmail.com.

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SCIENTIFIC NOTE

OTOCRYPTOPS GRACILIS BERKELEYENSIS VERHOEF, 1938, A SYNONYM OF *SCOLOPOCRYPTOPS GRACILIS* WOOD, 1862 (CHILOPODA: SCOLOPENDROMORPHA: SCOLOPOCRYPTOPIDAE)[1]

Rowland M. Shelley[2]

In my study of the North American scolopendromorph centipede fauna (Shelley 2002), I recognized six species in the genus *Scolopocryptops* Newport, 1844 (=*Otocryptops* Haase, 1887), four occurring east of the Central Plains and two west of the Rocky Mountains, primarily along the Pacific Coast. One of the latter, *S. gracilis* Wood, 1862, consists of three allopatric populations, the largest of which occupies an irregularly shaped area extending from northern California to an unknown distance in Baja California North with an eastward extension through the Mojave Desert into southwestern Utah and northwestern Arizona. I placed four species in synonymy under *S. gracilis* – *S. lanatipes* Wood, 1862; *S. californica* Humbert and Saussure, 1870; *Anethops occidentalis* Chamberlin, 1902; and *S. mundus* Chamberlin, 1911, the last two being new synonymies at that time. While recently reviewing a paper by K. W. Verhoeff (1938) on another matter, I discovered the description of *Otocryptops gracilis berkeleyensis* that I did not know existed. This account was based on a specimen from Berkeley, Alameda County, California, that was collected by A.E. Michelbacher in May of an unknown year and sent to Verhoeff, who thought it warranted taxonomic recognition. My conclusions about *S. gracilis* in 2002 were based upon examinations of some 700 individuals in 30 samples, of which 76 individuals and 33 samples were from counties bordering San Francisco Bay, and 17 individuals and 7 samples were from Berkeley itself. I found no evidence of clinal or geographic variation in *S. gracilis* and no reason to recognize subspecies or geographic races. I therefore formally place *O. g. berkeleyensis* in synonymy under *S. gracilis* **(syn. nov.)**.

ACKNOWLEDGMENT

I thank R. L. Hoffman for a prepublication review.

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[2] Research Lab., North Carolina State Museum of Natural Sciences, 4301 Reedy Creek Road, Raleigh, NC 27607, U.S.A. E-mail: rowland.shelley@ncmail.net.

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BOOK REVIEW

MITES OF GREENHOUSES, IDENTIFICATION, BIOLOGY AND CONTROL. Zhi-Qiang Zhang. 2003. CABI Publishing, CAB International, Wallingford, Oxon OX10 8DE, UK. 240 pp. Hardcover. ISBN 085199590X. US $80.00.

Mites are important pests in greenhouses around the world, yet the number of people trained in mite taxonomy is decreasing. Fewer and fewer entomology departments in the USA provide training on mite management. Thus, many pest managers will be given the task of managing mites in greenhouses without formal training in the study of mites (acarology). This book thus identifies a real need. According to the preface, this book is "based on a training manual prepared by the author for a 'Short Course on Mites of Greenhouses'.... primarily designed to help students, entomologists, pest control workers, and growers to identify mites that commonly occur on greenhouse crops, although the biology and control of major mite pests were also covered. The focus of the course on identification was warranted because any successful management of pests starts with the correct diagnosis of pest damage and identification of pest species..."

The book is divided into three parts: I. An introduction to greenhouses, crops and mites, mite classification, morphology and biology, methods for collecting, preserving and preparing mites. Part II includes identification, biology and control of pest mites, including spider mites, false spider mites, tarsonemids, eriophyoid mites, acarid mites, and others. Part III covers the identification, biology and application of beneficial mites in biological control, including chapters on phytoseiids, laelapids and other predatory mites. The book includes a glossary and an appendix with information about acarological journals, societies, courses, websites, and an index.

Chapter 2 provides an introduction to the major taxonomic groups of mites, but the line drawings and keys provided require that the student have cleared, slide-mounted specimens to examine under a compound microscope. Many pest managers and growers will be unable to use these keys because they lack the necessary chemicals to process specimens and compound or phase-contrast microscopes to see morphological traits. It is only in Chapter 3 that students are told how to collect, preserve, and prepare mites for microscopic study. The novice is not told that these keys only work on adults and that key traits may be difficult to discern if the specimens are incorrectly mounted. However, the keys themselves are useful and concise. Chapters 4-9 describe the morphology, biology, and damage caused by plant-feeding mite families. Each includes an illustrated key to the genera and species found in greenhouses. Without additional training, I doubt a novice could use the keys, although they are concise and useful for somewhat more experienced workers. Similarly, chapters 10-12 provide information on the morphology, biology and role each beneficial predatory species plays in the control of plant-feeding mites in greenhouses. However, anyone requiring details on how to release, when to release, or how to monitor the effects of such releases won't find this information. Monitoring methods and information on compatible pesticides (or how to determine which pesticides are compatible with natural enemies) are lacking.

This book contains a wealth of information particularly useful for entomologists and students with training in microscopy and monitoring methods. It provides pest managers and growers with a concise summary of useful information on mite biology and damage, as well as information on websites with color photos and additional information. It is not, however, an adequate source of information on the "nuts and bolts" of managing mites in greenhouses. The pest manager and grower will need additional training to identify pest mites and to deploy the available mite management tactics in greenhouses.

Marjorie A. Hoy, Department of Entomology and Nematology
University of Florida, Gainesville, FL 32611-0620, U.S.A.
E-mail: mahoy@ifas.ufl.edu

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BOOK REVIEW

A COLOR HANDBOOK OF BIOLOGICAL CONTROL IN PLANT PROTECTION. Beil Helyer, Kevin Brown, and Nigel D. Cattlin. 2003. Timber Press, Inc. 126 pp. Includes 418 color photos, taxonomic and subject indices, and references. $39.95 plus shipping and handling, hardcover.

As the authors indicate in the preface, books on the practical use of biological control are uncommon and often address the subject in a very general manner. Overall, this is one of the better handbooks covering the use of beneficial organisms in crop production systems. It could be used as a reference guide for consultants, scientists, producers and home gardeners. The color pictures are excellent and provide the most complete listing of a wide variety of beneficial organisms. The book is divided into four main sections: crop environments, pest profiles, beneficial arthropod profiles and entomopathogens. One key component of all successful integrated pest management programs is a good understanding of the plant-insect connection. Although the information contained in the crop environment section was informative and broadly addressed this connection, this area could have been addressed in more detail. A minor criticism of this section is that it would be more helpful if the subsections covered were similar. It appears that the authors were attempting to compare the various crop environments (arable, fruit production and protected systems); however, they often went in different directions. In addition, the section on practical tips for gardeners was informative but seemed out of place.

The overall arrangement of the book is very good and demonstrates the authors understanding of the need for a practical reference guide. The *pest profile section* is very well done including a color pest identification guide, description of pest characteristics, cropping systems affected, plant damage symptoms and common biological control agents for each pest group. The main section of this handbook, *beneficial arthropod and entomopathogen profiles*, is excellent and makes this a must for anyone interested in applied biological control. It is divided into four areas: species characteristics; life cycles; crop/pest associations; and influences on growing practices. The last section makes this handbook unique because it summarizes when you can make practical use of natural enemies in an integrated system.

In addition to a reference manual, I can see this manual being used for extension training programs for consultants, certified crop advisers, producers and master gardeners. It is reasonably priced and is a must for anyone interested in identification of natural enemies and the development of programs focusing on biological control.

Joanne Whalen
Extension IPM Specialist, Department of Entomology
University of Delaware, Townsend Hall
Newark, Delaware 119716-1303, U.S.A.
E-mail: jwhalen@udel.edu

BOOK REVIEW

INSECTS REVEALED: MONSTERS OR MARVELS? Jacques de Tonnancour. Translated from the French by Luke Sandford. Foreword by Sue Hubbell. 2002. Cornell University Press, Sage House. 512 E. State Street, Ithaca, NY 14850 United States. 166 pp. Hardcover US$35.00.

At times, scientists are asked why they study a subject with so much passion and determination. One possible answer for entomologists is revealed in the pages of he book *Insects Revealed: Monsters or Marvels?* This tome showcases the splendor of the insect world, particularly that of the most speciose of them all, coleopterans, and of the most popular, lepidopterans. Whether one considers these hexapodans attractive or not, de Tonnancour brings the glory of some of the showiest insects to life through spectacular photography. The prose, translated from French by Sandford, makes reading this work inviting and effortless while extending a gentle challenge to learn about the creepy creatures. Although there are some photos of mounted specimens that remove some of the charm of *in situ*-like imagery, most portrayed insects, whether butterflies or moths with winged rainbows of colors, scarab or lucanid beetles, the gruesome male warriors, bees of metallic colors, or orthopteroids with deceitful forms and colors, they all stand in a fantastic parade that captures the reader's interest. The book contains numerous stories about insects, in a style reminiscent of Jean-Henri Fabre, the great French naturalist of late 19th early 20th century. Some of the topics covered in the book include: insects and humans (Chapters 1 and 2); morphology (Chapter 5); ecology (Chapters 9-10), including an example of a "carnivorous" plant, *Nepenthes*, defenses, including mimicry (Chapter 12). The author also interweaves remarks on life histories, biological control, sexual selection, biogeography, conservation biology, etc. De Tonnancour beautifully embroiders a wide range of entomological topics with his images, yet some of the information could have been improved with ease by consulting major serials or journals that review entomology regularly (*e.g. Annual Review of Entomology, Annual Review of Ecology and Systematics, Trends in Ecology and Evolution*, and others). Also, the reader may have learned more if the author would have included references to review papers, an index, and an expanded glossary, for the benefit of those eager to learn more about these Lilliputians, as well as some photo – or electron micrographs – to add another layer of beauty. We enjoy and applaud the author's efforts of highlighting insects' appeal to the uninitiated through extraordinary imagery and simple prose. Judging from some of their colossal scientific names behind these generally small creatures, a reader could suspect that each species holds a large stand of equal importance in the world. However, the readers are kept engaged by the interesting narratives of the lives of these creatures throughout 160 pages of text. While there are a few obvious mistakes, perhaps due to occasional oversimplification, and a remarkable paucity of information on topics, such as: genetics and genetic manipulations of insects, speciation, systematics, applied entomology, physiology, and paleoentomology, to name a few, we savored this book with *gusto*. For this relatively inexpensive volume on this subject (by current standards for a well constructed, hard cover book, printed on glossy paper), we consider it a good value, an elegant addition to a book collection, and a delicious *hors d'oeuvre* inviting readers to devour more knowledge about the insect world.

Lester Humberto Guthrie
Montgomery College
Rockville, Maryland 20850, U.S.A.
E-mail: lestercito@hotmail.com

Jorge Alberto Santiago-Blay
National Museum of Natural History,
Paleobiology
Washington, District of Columbia 20560, U.S.A.
E-mail: santiago-blay@nmnh.si.edu

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We regret that we were unable to publish *Entomological News* during 2003. It is our intention to publish five issues of *Entomological News* with the volume number 114 and the year 2003 on each issue. Then we will begin volume number 115 with the year 2004 on each issue. We hope to quickly "catch up." Each paper will have the date of submission, acceptance, and publication printed on the first page of that paper.

We appreciate the loyal subscribers and authors who have supported us during this difficult period. Thank you.

Sincerely,

Susan Whitney King

Susan Whitney King
President,
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Mailed on April 9, 2004

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ENTOMOLOGICAL NEWS

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DIMINISHED FOOD RESOURCES ARE ASSOCIATED WITH DELAYED REPRODUCTION OR INCREASED POST-REPRODUCTIVE MORTALITY IN BROOD-BEARING TERRESTRIAL ISOPODS *ARMADILLIDIUM VULGARE* LATREILLE[1]

Scott L. Kight[2] and Anaiseh Hashemi[2]

ABSTRACT: Female terrestrial isopods (Crustacea: Oniscidea) carry eggs and early instars in a ventral brood pouch. We investigated reproductive expenditure of female *Armadillidium vulgare* Latreille under the condition of restricted food resources. Regardless of food availability, few cases of spontaneous termination of care were observed and most gravid females either successfully produced offspring or died while still bearing eggs. There were no differences in pre-hatching maternal mortality between food-restricted and non-restricted groups, but females exhibited significantly higher post-reproductive mortality when food availability was heavily reduced after oogenesis. This did not occur when food was restricted prior to oogenesis, but in this case females delayed the onset of reproduction. An association between mortality and past reproduction was further supported by high laboratory mortality, regardless of food availability, in non-gravid females field-captured late in the reproductive season. Maternal investment in *A. vulgare* thus appears to be energetically expensive. Despite the ability to terminate care, however, females continue to invest heavily in reproduction even when resources are scarce and the likelihood of mortality is high.

KEY WORDS: *Armadillum vulgare*, Isopoda, diminished food resources, delayed reproduction, post-reproductive mortality, brood-rearing.

The evolutionary significance of arthropod parental care has been reviewed elsewhere (Tallamy 1984; Tallamy and Wood 1986; Kaitala and Mappes 1992), but studies of the phenomenon are generally limited to the Insecta where it has independently evolved in several taxa. Subsocial behavior, however, also evolved in the Crustacea and can be readily observed in the terrestrial Isopoda (e.g. Linsenmair 1987). Unlike the majority of subsocial insects, which generally brood eggs deposited on external surfaces, a female terrestrial isopod bears eggs and early-instar young (manca) in a ventral marsupium (a fluid-filled pouch formed by oostegites on the ventral pereon). This places a number of unique constraints upon the reproductive success of female terrestrial isopods, including physical demands on locomotion (Kight and Ozga 2001) and spatial limits on fecundity (Tomescu et al. 1992; Dangerfield and Telford 1995).

Because reproductive success is constrained by egg-bearing, terrestrial isopods may have evolved behavioral or physiological plasticity in the face of changing environmental conditions. To optimize reproductive success, female isopods should alter the magnitude of parental investment depending on the availability of resources such as food and favorable habitats. For example, Rushton and Hassall (1983) observed that female *Armadillidium vulgare* Latreille

[1] Received on September 16, 2002. Accepted on December 11, 2003.

[2] Department of Biology and Molecular Biology, Montclair State University, Upper Montclair, NJ 07043, U.S.A. E-mail: kights@mail.montclair.edu.

reared on different food sources exhibited differences in fecundity. Isopod fecundity can also be negatively affected by competition among individuals for limited resources (Hassall and Dangerfield 1997).

The present study examines the reproductive biology of female *A. vulgare* under limited food resources. We first investigate the spontaneous termination of care and patterns of mortality in food-restricted females during the first reproductive episode of the season (reproduction is seasonal in temperate climates (Souty-Grosset et al. 1998). Gravid females may respond to food restriction in three possible ways: an increase of parental investment in the face of diminished resources, reduction (including termination) of investment, or no change in patterns of investment at all.

We next examine post-reproductive responses to food stress in females captured at the end of the reproductive season. Three alternative hypotheses may again be considered. If the act of brood bearing places burdens on maternal expenditure only in the short-term, post-reproductive, food-restricted females should have lower mortality than reproductive food-restricted females. Alternatively, if brood bearing reduces long-term residual reproductive potential, post-reproductive, food-restricted females are expected to suffer similar or even greater mortality than gravid food-restricted females. Finally, brood bearing may have no effect on mortality and post-reproductive females should not differ from reproductive females.

Finally, we test the hypothesis that females exposed to food stress prior to the first reproductive episode will respond differently than females stressed only after oogenesis. If limited food resources constrain oogenesis and the onset of reproduction, pre-reproductive females should reduce or delay investment. There are two additional alternatives: food-restricted, pre-reproductive females could increase investment (although this seems unlikely) or exhibit unaltered patterns of reproductive allocation.

METHODS I
FOOD RESTRICTION DURING THE BROODING PHASE

Armadillidium vulgare Latreille were hand-collected twice during the reproductive season of 2001 in Essex County, New Jersey, USA. The first sample was taken during early May, whereas the second sample was obtained in late August. Animals were collected from the same location in both cases and therefore our samples are presumed to be from a single population. Collected animals were returned to the laboratory and maintained at 21°C and a 15L:9D light/dark photocycle in ventilated plastic enclosures containing moist cellulose sponge and carrots administered *ad libitum*.

Upon evidence of egg-bearing (determined by visual inspection), females in the May sample were isolated in individual *Drosophila* culture vials and divided into three treatment groups by matched triads according to estimated body size. Control females were provided unlimited access to carrots throughout the exper-

iment. The second group was moderately food restricted by a feeding cycle in which carrots were provided for four consecutive days followed by removal of food for two days. The third group was heavily food restricted by a feeding cycle in which carrots were provided for two consecutive days followed by removal of food for four days. Each treatment group contained 30 females and was monitored for 17 days. During this period females were examined daily for either the continued presence of eggs, the occurrence of spontaneous termination of care, or the death of the subject.

Females from the August sample did not reproduce in the laboratory. Specimens were isolated into individual *Drosophila* culture vials and divided into two treatment groups by matched pairs according to estimated body size. Control females were provided unlimited access to carrots while the second group was heavily food restricted as described. Each treatment group contained 30 females examined daily for mortality over a period of 17 days.

RESULTS I
FOOD RESTRICTION DURING THE BROODING PHASE

Data were analyzed following Gravetter and Wallnau (1988) using *Statistix* v.2.0 statistical software with a = 0.05.

Few cases of spontaneous termination of care were observed, regardless of experimental treatment. Three control females, two moderately restricted and five heavily restricted females changed from an obvious gravid state to a non-gravid state over the course of the study ($N = 90$, $x^2 = 1.575$, $DF = 2$, $P = 0.4550$). In most cases the mechanism of termination was unknown, although we occasionally observed terminating females with eggs protruding from the marsupium and in some cases even feeding upon the eggs.

In the remaining reproductive females there were no differences among treatment groups in pre-hatching maternal mortality. Two control females, four moderately restricted and six heavily restricted females died without hatching young ($N = 80$, $x^2 = 2.820$, $DF = 2$, $P = 0.2441$). There was, however, significantly higher post-reproductive mortality in the heavily restricted treatment group (Fig. 1) during the observation period ($N = 68$, $x^2 = 15.67$, $DF = 2$, $P = 0.0004$). Fifteen heavily restricted females died shortly after the appearance of offspring, whereas this occurred in only 6 control and 7 moderately restricted females.

Mortality was also high in the presumably post-reproductive females captured in August. There were, however, no differences between the two late-season, treatment groups: 17 control females and 23 food-restricted females died during the study period ($N = 60$, $x^2 = 2.70$, $DF = 1$, $P = 0.1000$). While the late-season, food-restricted females did not differ from early-season reproductive food-restricted females in overall mortality ($N = 60$, $x^2 = 0.34$, $DF = 1$, $P = 0.5000$), overall mortality was significantly higher in late-season controls than in early-season reproductive controls ($N = 60$, $x^2 = 5.55$, $DF = 1$, $P = 0.0200$).

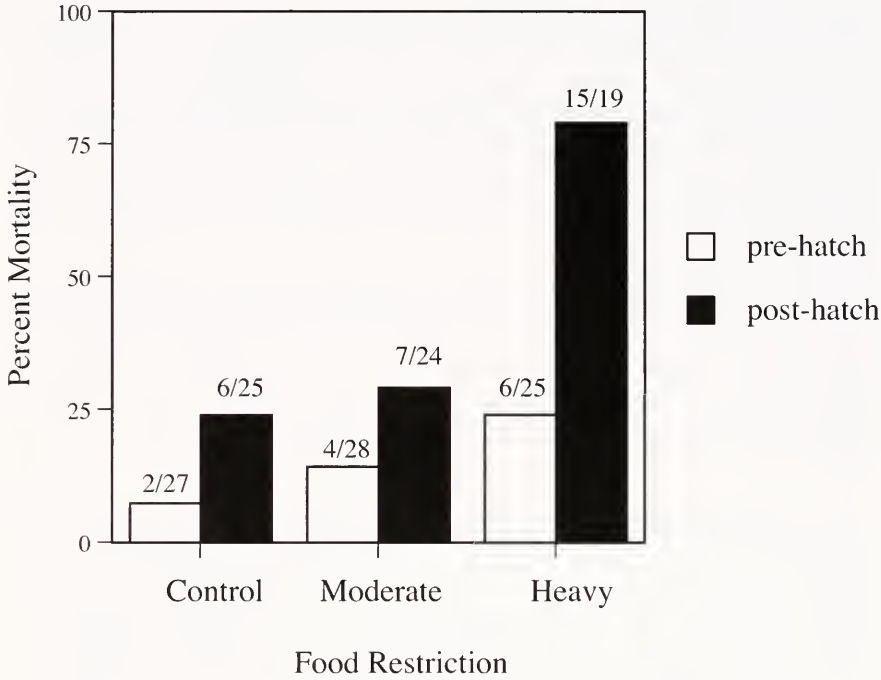

Figure 1. Percent pre-hatching (clear bars) and post-hatching (black bars) mortality in unrestricted (control) and moderately/heavily food-restricted reproductive females. Numbers over bars are frequency/total for each group.

METHODS II: PRE-REPRODUCTIVE FOOD RESTRICTION

The previous experiments were characterized by two patterns. First, heavy food restriction during reproduction was associated with high maternal mortality following the appearance of offspring. Second, females that presumably reproduced at least once suffered high mortality even when food was plentiful. It seems unrealistic, however, that food resources would suddenly disappear under natural conditions. Hence a more biologically meaningful experiment would involve food restriction prior to the onset of reproduction.

A. vulgare were again hand-collected in early May of 2002 in Essex County, New Jersey, USA. Pre-experimental treatment of animals was identical to that of the previous year with the following exceptions. First, only two experimental groups were constructed: control females with unlimited access to carrots throughout the experiment and heavily food-restricted females treated with a feeding cycle of two days access to food followed by four days without food. Second, food-restricted females were placed on this feeding cycle immediately after capture. Hence these females experienced diminished food resources prior to the first reproductive episode of the season.

We collected 106 females and divided them into the two treatment groups by matched pairs according to estimated body size. Upon evidence of egg bearing (determined by visual inspection), females were isolated into individual *Drosophila* culture vials. Females were examined daily for the continued presence of eggs, the occurrence of spontaneous termination of care, or the death of the subject. We also estimated fecundity as the number of young to emerge from the marsupium in successful females. Observations ended 43 days after the experiment began, when all females that reproduced had either successfully hatched young or died prior to hatching.

RESULTS II
PRE-REPRODUCTIVE FOOD RESTRICTION

There were no differences in the occurrence of oogenesis between treatment groups. Of the 53 control females, 28 became gravid, whereas 21 of 53 food-restricted females became gravid (N = 106, x 2 = 1.86, DF = 1, P = 0.1727). There were also no differences in pre-hatching or post-hatching maternal mortality. Seven control and three restricted females died without hatching young (N = 49, x 2 = 0.85, DF = 1, P = 0.3571) and nine control and seven restricted females died after the young hatched (N = 39, x 2 = 0.06, DF = 1, P = 0.8017). There were also no differences observed in fecundity, with control females producing an average of 20.19 hatched offspring (SE = 2.107) and restricted females producing an average of 20.28 (SE = 2.181) (T-test, N = 49, T = 0.03, P = 0.9773).

There was a statistical trend, however, for control females to initiate reproduction earlier than food-restricted females (Fig. 2). Control females became visibly gravid after an average of 9.79 days (SE = 1.713), while this occurred in food-restricted females after an average of 14.81 days (SE = 2.374) (T-test, N = 49, T = 1.76, P = 0.0846).

DISCUSSION

Perhaps the most interesting outcome of this study was that while females appeared capable of terminating post-embryonic maternal investment, they only did so with low frequency and without obvious pattern. In several insect taxa, spontaneous termination of care is an active reproductive strategy (Coleoptera: Silphidae, Scott and Gladstein 1993; Heteroptera: Cydnidae, Kight 1997; Heteroptera: Belostomatidae, Kight et al. 2000). In the present study, however, only a few cases of reversal from gravid to non-gravid condition were observed in all treatment groups, regardless of food availability. This might be expected if most females were nearing senescence. However, this seems unlikely because terrestrial isopods survive and reproduce across multiple years and samples most likely contained females from a range of ages and reproductive histories. We must therefore conclude that either active termination of care has not evolved as a reproductive strategy in *A. vulgare*, or that diminished food resources are insufficient

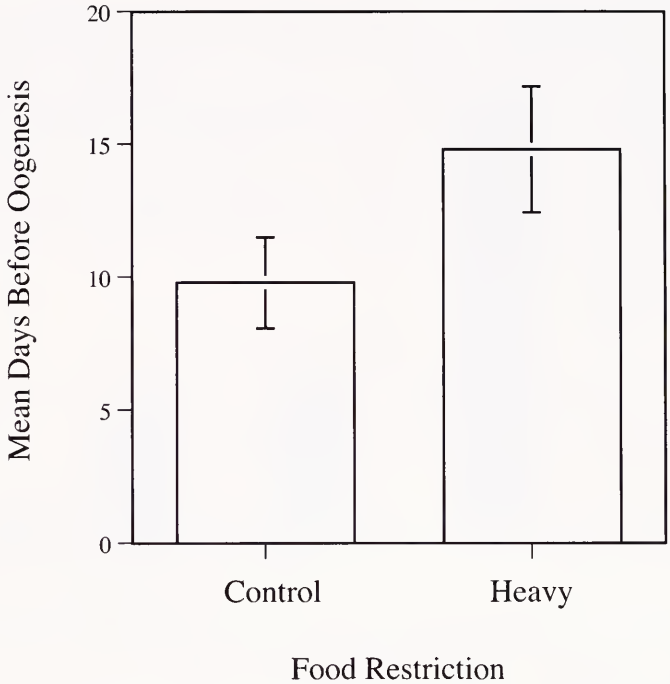

Figure 2. Average time (days) between capture and oogenesis in unrestricted (control) and heavily food-restricted reproductive females. Error bars represent standard error on the mean.

to elicit the response. The latter might be expected if food resources are rarely limited under natural conditions, but we have no data to address this hypothesis.

The most obvious effect of food restriction was seen in the relatively high post-reproductive mortality of females that were heavily food-restricted after oogenesis. Rather than terminate investment in the face of diminished resources, these females appeared to expend reserves that might otherwise have been used for post-reproductive maintenance and survival.

It is interesting that late-season females exhibited high mortality rates regardless of food availability. These females had presumably reproduced at least once prior to capture, and perhaps multiple times. Souty-Grosset et al. (1988) observed three parturial molts in some populations of *A. vulgare*. Late-season females may therefore have had low reserves for somatic maintenance and survival. This hypothesis is supported by the low overall mortality of early-season reproductive controls relative to late-season controls. It should be noted, however, that this difference is also consistent with age-related increases in mortality. These are not mutually exclusive hypotheses and could potentially have an additive effect on mortality.

In contrast, when food restriction was applied prior to oogenesis the overall mortality of food-restricted females diminished to a level not different from reproductive controls. This could be an adaptive outcome of the delay with which food-restricted females began reproduction. For example, females facing diminished resources may have physiologically adapted or behaviorally compensated prior to oogenesis, either by eating more food when it was available, producing smaller eggs, etc. Although our data do not address these hypotheses, we may reasonably rule out an adjustment in fecundity, which was not different between treatment groups at the time of offspring dispersal.

The tendency of food-restricted females to delay oogenesis, which we discovered only after the experiment ended, exposed an experimental design difficulty for the second year of the study. Because restricted females delayed reproduction, the portion of the observation period in which they were classified as post-reproductive was shorter than that of control females. This may have inflated the measure of post-reproductive mortality in control females. The alternative would have been to observe all females for some standard length of time after the hatching of young, but this could have inflated the measure of post-reproductive mortality in food-restricted females because they would have been older. Hence we must caution that our data provide a very conservative estimate of post-reproductive mortality in females that are food restricted prior to oogenesis.

We may reasonably conclude that brood bearing in female *A. vulgare* is energetically expensive. This expense appears to be met through increased post-reproductive mortality when food resources are limited after oogenesis or in delayed reproduction when food is scarce prior to oogenesis. Although active termination of care does not appear to be an important part of reproductive behavior in this species, reduced mortality suggests that delaying reproduction may be an effective strategy for maximizing reproductive success when food resources are limited.

ACKNOWLEDGEMENTS

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DESCRIPTION OF LARVA AND NEW HOST PLANTS FOR *ANTHONOMUS RUBRICOSUS* BOHEMAN (COLEOPTERA: CURCULIONIDAE) IN ARGENTINA[1]

Marta S. Loiácono,[2] Adriana E. Marvaldi,[3] and Analía A. Lanteri[2]

ABSTRACT: The main purposes of this paper are to describe the larva of *Anthonomus rubricosus* Boheman (Curculionidae: Anthonomini) and to provide new information on its host plants. The species is similar to *Anthonomus vestitus* Boheman, based on the presence of four epipharyngeal sensilla arranged in a single cluster and the labial palpus one-segmented. It differs by its smaller body size (about 2 mm), basal segment of maxillary palpus shorter than apical segment, and premental sclerite with posterior extension shorter than anteromedian extension. Teneral adults, larvae and a pupal exuvia of *A. rubricosus,* the latter along with a parasitoid (Pteromalidae), were found inside flowers of *Hibiscus rosasinensis* L. and fruits of *Pavonia* sp. (Malvaceae), in Misiones Province, Argentina.

KEYWORDS: *Anthonomus rubricosus,* Coleoptera, Curculionidae, larva, host plants, Argentina.

As a consequence of a survey of alternative host plants of *Anthonomus grandis* Boheman in Misiones Province, Argentina, we have found weevil larvae inside flowers, flower buds and fruits of two species of Malvaceae. Based on association with teneral adult specimens, some of these larvae were assigned to *Anthonomus rubricosus* Boheman, a species recorded as harmful to cotton in Argentina and Brazil (Bosq 1943, Silva *et al.* 1968, Lanteri *et al.* 2002). The main purposes of this paper are to describe the larva of *Anthonomus rubricosus* and to provide new information on its host plants.

METHODS

Field work to collect Malvaceae that would serve as alternate hosts of weevils harmful to cotton, was done in Misiones Province, Departments of Iguazú, Eldorado, San Ignacio and San Javier, along the Paraná and Uruguay rivers, during February 2001. Several samples of the following species were examined: *Malvastrum coromandelianum* (L.) Garcke, *Pavonia sepium* St. Hil., *Pavonia* sp., *Pseudabutilon* sp., *Sida rhombifolia* L., *Sida spinosa* L., *Hibiscus mutabilis* L., *H. rosasinensis* L., *H. schizopetalus* Hook.f., *H. syriacus* L. and *Hibiscus* sp. Samples of reproductive structures of these plants were dissected under a stereoscopic microscope to look for weevil specimens inside.

Techniques for preservation, dissection and illustration of the larva, follow May (1977, 1979, 1993). The terminology used in the description is according to Marvaldi (1999). Drawings were done with a camera lucida adapted to a compound microscope. Adult voucher specimens and larvae (slide mounted) are

[1] Received on August 28, 2002. Accepted on Februray 4, 2004.

[2] División Entomología, Museo de La Plata, Paseo del Bosque, 1900 La Plata, Argentina. E-mail: loiacono@museo.fcnym.unlp.edu.ar; alanteri@museo.fcnym.unlp.edu.ar.

[3] Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA-CRICYT), C. C. 507, 5500 Mendoza, Argentina. E-mail: marvaldi@lab.cricyt.edu.ar.

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deposited at the entomological collection of the Museo de La Plata (MLP). Teneral adults taken from reproductive structures of Malvaceae, along with larvae, were identified by comparison with adult specimens of *A. rubricosus* housed at the MLP collection.

RESULTS

Several weevil larvae were found inside reproductive structures of two species of Malvaceae from Misiones Province. Larvae about 5 mm long, collected inside fruits of *Malvastrum coromandelianum* and *Pseudabutilon* sp., in Eldorado and San Javier Departments, were assigned to Curculioninae in the broad sense (Alonso-Zarazaga & Lyal 1999) but in the absence of associated adults it was not possible to identify them further. They do not belong to *Anthonomus grandis*, neither can they be assigned to the tribe Anthonomini, since they have a frontal seta 2 present, six epipharingeal sensilla arranged in two clusters of three sensilla in each, and a terminal anus.

Small larvae (about 2.mm long) along with teneral adults, found inside flowers of *Hibiscus rosasinensis* L. and fruits of *Pavonia* sp, in Iguazú Department, were identified as *Anthonomus rubricosus* Boheman (Fig. 1).

A partially destroyed exuvia of one pupa was collected along with one female of Pteromalidae, Chalcidoidea, inside fruits of *Pavonia* sp., in Teyú Cuaré, San Ignacio Department, 15-02-2001. This exuvia apparently belongs to *A. rubricosus*, and we believe that the pupa was killed by the parasitoid.

Taxonomic information on *Anthonomus rubricosus* Boheman

Anthonomus rubricosus Boheman 1859 (= *A. campinas* Marshall 1938) is probably related to *A. vestitus* Boheman, distributed in Perú and Ecuador, and to other members of the genus assigned to the *squamosus* group of Dietz, such as *A. bisinuatus* Burke & Cross, from Colombia, and *A. testaceosquamosus* Linell, from southern Texas and northeastern Mexico (Burke & Cross 1966, Ahmad & Burke 1972). All these species have Malvaceae as hosts. *Anthonomus grandis* and other members of the *grandis* group also have several Malvaceae as hosts (Burke & Cate 1983, Burke *et al.* 1984; Jones & Burke 1997), but are probably less closely related to *A. rubricosus* (Clark pers. com.). A redescription of *A. rubricosus* based on adult characters is needed, but we consider that it would be better to do that in the context of a taxonomic revision of the genus *Anthonomus*.

Geographic range. Argentina, Bolivia and Brazil. Within Argentina, *A. rubricosus* is distributed throughout the provinces of Buenos Aires, Chaco, Corrientes, Entre Ríos, Misiones, Salta, Santiago del Estero and Tucumán.

Host plants. Weevils of the tribe Anthonomini are first grade oligophagous, regarding host selection. The hosts of each of the weevil species are confined to a single plant family and sometimes to one plant genus (Burke 1976). The knowledge of plant associations is very important to clarify the phylogenetic relationships within the tribe and to predict which species could be harmful for crops (Lanteri *et al.* 2002).

Fig. 1. Teneral adult of *Anthonomus rubricosus* inside a flower bud of *Hibiscus rosasinensis* (Malvaceae).

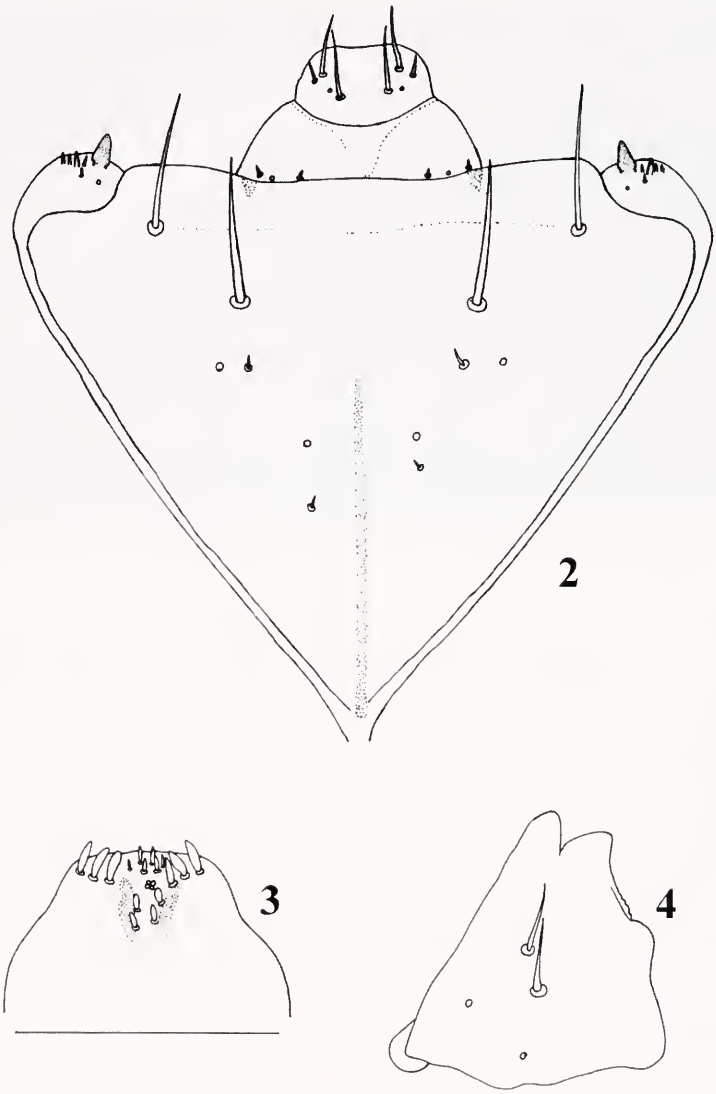
Previously, the known hosts for *A. rubricosus* in Argentina were *Sphaeralcea* sp. and *Gossypium hirsutum* L. (Lanteri *et al.* 2002). Herein we add *Pavonia* sp. and *Hibiscus rosasinensis* L. This weevil has caused severe damage to young cotton plants in Chaco, Argentina (Bosq 1943, Denier 1939), and São Paulo, Brazil (Silva et al. 1968).

Species related to *A. rubricosus* and their known host-plants are as follows: 1) *Anthonomus vestitus: Gossypium raimondii* Ulbr., *Gossypium hirsutum* L., *Cienfuegosia heterophylla* Garcke, *Hibiscus rosasinensis* L., *Althea rosea* (L.) Cav., and *Sida paniculata* L.; 2) *Anthonomus bisinuatus: Hibiscus* sp. and *Gossypium hirsutum* L.; 3) *Anthonomus testaceosquamosus: Hibiscus, Sida, Abutilon,* and *Pseudabutilon,* but this species does not attack cotton (Burke & Cross 1966, Ahmad & Burke 1972).

Material examined. ARGENTINA: Corrientes: 08-1934 (1 MLP); San Roque, 02-1920 (7 MLP); Colonia San Antonio, Dep. San Miguel, 2002, 10 ex. collected on pheromone trap close to cotton fields. Entre Ríos: Concordia, 02- 1996 (3 MLP). Misiones: Pindapoy, 10-1935 (1 MLP); Loreto, 04-1996 (7 MLP); Puerto Libertad, Dep. Iguazú, 12-02-2001, 1 teneral adult, in flowers of *Hibiscus rosasinensis* L.; Destacamento Ecolacustre Lago Uruguaí, 12-02-2001, 1 teneral adult along with larvae, in fruits of *Pavonia* sp. Chaco: Resistencia (1 MLP). Salta: Orán, 09-1939 (1 MLP).

Mature larva of *Anthonomus rubricosus*

Body length 1.5-2.0 mm. Head width 0.5 mm. Head capsule subcircular; stemmata (ocelli) pigmented before clearing with KOH, anterior stemma black, conspicuous, with convex cornea, posterior stemma hardly distinct, as small brown spot. Antenna (Fig. 2) with basal article bearing elongate-conical sensorium and six minute sensorial structures, one rounded and five elongate (one distinctly longer than others). Endocarina (Fig. 2) about 2/3 as long as frons. Frontal seta 1 and 3 very short, setae 4 and 5 long, subequal (Fig. 2). Dorsal epicranial seta 1 slightly longer than seta 2, setae 3 and



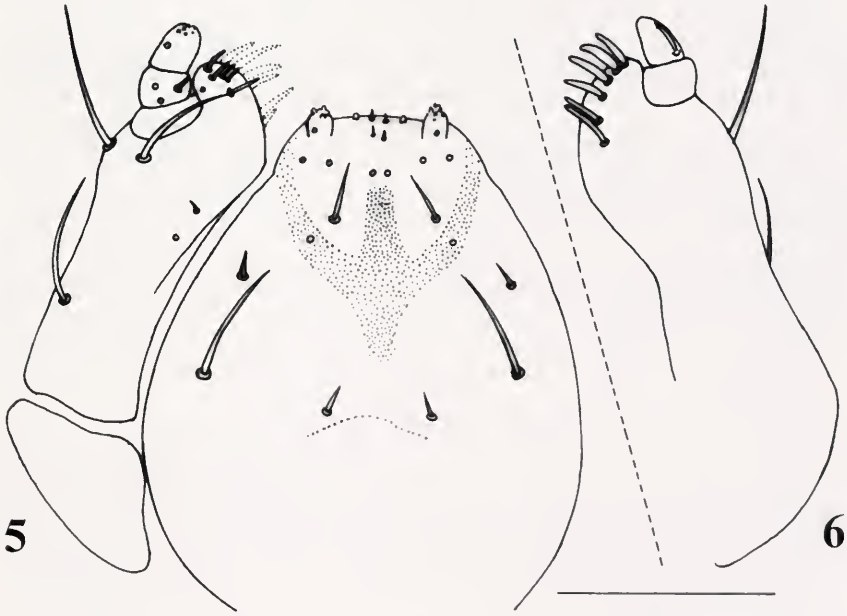
Figs. 2-4. Larva of *Anthonomus rubricosus*. 2) Clypeus, labrum and frontal area of head, dorsal; 3) epipharynx; 4) mandible. Scales = 0.1 mm.

5 longer than the others, seta 4 minute; dorsal epicranial seta 3 located closer to frontal line than seta 1. Lateral epicranial seta 1 about 1/2 as long as 2. Clypeal setae short, close to anterior margin of frons (Fig. 2). Labral setae 1 and 2 subequal in length, seta 3 short, less than 1/3 as long as seta 2 (Fig. 2). Epipharynx (Fig. 3) with three anterolateral setae on each side; four epipharyngeal sensilla (sensory pores) arranged in single median cluster; labral rods subparallel, slightly converging posteriorly, not reaching base of clypeus. Mandibular setae 1 and 2 subequal, longitudinally placed, well separated at base (Fig. 4). Maxilla (Figs. 5, 6) with six dorsal and five ventral malar setae; maxillary

palpus with basal segment shorter than apical. Labium (Fig. 5) with one-segmented palpus; premental sclerite with posterior extension shorter than anterior; postmental setae 1 and 3 short, subequal; seta 2 more than four times longer than others. Thoracic and abdominal spiracles with airtubes seven-annulated. Prothorax with two pleural setae. Meso- and metathorax with one epipleural and one pleural seta; postdorsal setae 1 and 3 longer than setae 2 and 4. Abdominal segment IX with pleural areas not projecting and with short sternal setae.

Materials examined. Argentina, Misiones, Dto. Iguazú, Destacamento Ecolacustre Lago Uruguaí, 12-02-2001, in fruits of *Pavonia* sp., 2 ex. Larvae were identified based on their association with adult specimens found on the same hosts and inside the same reproductive structures.

Comparative notes. Based on larval characters, *A. rubricosus* is close to *A. vestitus*. Both species have frontal setae 1 and 3 very short, four epipharyngeal sensilla arranged in a single cluster and the labial palpus one-segmented. In the key of Ahmad and Burke (1972), they key out together, except for their different sizes (the former species is about 2 mm and the latter, 4.1 - 5.5 mm). They also differ in the characters of the maxillary palpus and premental sclerite. In *A. rubricosus* the basal segment of the maxillary palpus is shorter than the apical segment, and the posterior extension of the premental sclerite is shorter than the anteromedian extension. In *A. vestitus*, the basal segment of the maxillary palpus is slightly longer than the apical segment, and the posterior extension of the premental sclerite is longer than the anteromedian extension.



Figs. 5-6. Larva of *Anthonomus rubricosus*. 5) Maxilla and labium, ventral; 6) maxilla, dorsal. Scales = 0.1 mm.

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We express special thanks to the graduate students Isabel Barrios, Flavio Moschione and Mariana Demaría for their contributions in the collection and identification of Malvaceae; to Cecilia Margaría for her help in the dissection of reproductive structures of plants in order to find weevils, and to specialists Horace Burke and Wayne Clark for their helpful comments and assistance with the bibliography. The financial support of the "Integrated pest management Project of the Cotton Boll Weevil in Argentina, Brazil and Paraguay" (CFC-ICAC) is acknowledged, as well as the support of CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas) from Argentina.

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A KEY TO THE GENUS *PHAEDON* (COLEOPTERA: CHRYSOMELIDAE: CHRYSOMELINAE) FROM CHINA AND THE DESCRIPTION OF A NEW SPECIES[1]

Si-qin Ge,[2] Xing-ke Yang,[2] and Jun-zhi Cui

Abstract: A key to all 16 Chinese species of *Phaedon* Latreille is provided with a description of *P. fulgida* sp. nov., from Guizhou, China. The new species is similar to *Phaedon cuprea* Wang, 1992 differing primarily in the presence of punctures on the pronotum and in aedeagus morphology. Type specimens are deposited in the Institute of Zoology, Chinese Academy Sciences, Beijing, China.

KEY WORDS: *Phaedon*, Coleoptera, Chrysomelidae, China, new species.

Phaedon was erected in 1829 by Latreille. Chapuis (1874) treated the three genera, *Alitene, Orthosticha, Emmertrus,* as synonyms of *Phaedon*. The genus *Phaedon* currently includes about 75 species worldwide, 33 of which occur in Asia, 3 species in Europe, 13 species in North America, 23 species in South America, 1 species in Africa and 2 species in Australia. The bulk of the species occur between 60°N and 50°S in temperate and sub-tropical regions. Species inhabit the farmlands of plains up to alpine meadows. For example, *P. alpina* Ge et Wang, occurs at 4,700m which is the highest altitude recorded for this genus.

Some species of *Phaedon* are of economic importance. For example, the lowland species, *P. brassicae* Baly mainly feeds on cabbage, radish, shepherd's-purse, carrot, shallot, lettuce and other similar crops. *P. armoraciae* Linnaeus mainly feed on *Armoracia*. The two species are important pests in China. *P. fulvicornis* Chen mainly feeds on *Rubus*. Furthermore, *P. alticola* Chen, a montane species, feeds on *Ranunculus tricuspis* and *Lanccea*.

The genus *Phaedon* was first studied in China during 1934 by the late Prof. Chen Sicien who redescribed two species, *P. armoraciae* Linnaeus and *P. brassicae* Baly in that year. Subsequently 12 new species were described by Chen (1936, 1974, 1984), Wang (1984, 1992a, 1992b, 1997) and Gressitt and Kimoto (1963). Most recently, Ge *et al.* (2002) described three new species. In this paper, we give a key for all the Chinese species and describe a new species from Guizhou, China.

Systematics

Genus *Phaedon* Latreille

Phaedon Latreille, 1829, *In* Cuvier, Regne Anim. ed. 2, 5: 151.

Alitene Gistl, 1857, Vacuna, 2: 530.

Orthosticha Motschulsky, 1860, Schrenck's Reisen Amurl., 2: 196. (Type species: *Plagiodera bonariense* Sahlberg.)

Emmetrus Motschulsky, 1860, Schrenck's Reisen Amurl., 2: 221. (Type species: *Chrysomela betulae* Fabricius.)

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[2] Institute of Zoology, Chinese Academy of Sciences, 25 Bei Sihuanxilu, Haidian, Beijing, 100080, China. E-mail: gesq@ioz.ac.cn.

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Diagnosis. Elongate, strongly convex. *Head:* small, deeply inserted into prothorax. Compound eyes elongate or sub-spherical. Anterior part of clypeus concave or convex. Apical segment of maxillary palpi slender, twice as long as penultimate segment. Antennae extending to base of elytra, segments 7-11 broadened apically. *Pronotum:* with coarse punctures; anterior margin broadly emarginate with projecting anterior angles. Base with or without a raised margin. *Scutellum:* triangular with rounded apex, impunctate. *Elytra:* broader than pronotum at base, slightly broadened after middle; with ten striae, not including incomplete basal scutellar row. Epipleuron plain, broadened basally, slightly narrowed posteriorly, inner edge without pubescence. *Underside:* Prosternal process slender, truncate apically, slightly broadened; procoxal cavities open; mesosternal process broadened, emarginate apically. *Legs:* outer-lateral margin of tibiae curved; third segment of tarsi entire or bilobed; claws simple.

Distribution. Worldwide, temperate and subtropical regions.

Key to the Chinese species of the Genus *Phaedon* Latreille

1. Basal margin of pronotum unmargined; epipleuron narrow; third segment of tarsi entire .... *P. fulvicornis* Chen, 1974
- Basal margin of pronotum margined; epipleuron broadened basally, slightly narrowed posteriorly; third segment of tarsi bilobed 2
2. Dorsum with markings 3
- Dorsum without markings 5
3. Mid-posterior area of elytra with dark markings ..... *P. gressitti* Daccordi, 1979
- Elytra without markings 4
4. Pronotum reddish-brown laterally and darker medially, dark area trapezoid, narrow apically, broadening posteriorly, covering 1/4 to 1/3 area of pronotum; elytral interstices impunctate .... *P. maculicollis* Chen, 1974
- Pronotum light reddish-brown laterally and dark medially, dark area trapezoid, narrow apically, broadening posteriorly, covering 1/3 to 1/2 area of pronotum; elytral interstices with fine punctures ..... *P. potentillae* Wang, 1992
5. Head and pronotum dark brown, elytra dark blue, purplish-blue or purplish-brown .... *P. alticola* Chen, 1974
- Head, pronotum and elytra unicolorous 6
6. Hindwing absent 7
- Hindwing present 12
7. Claw bearing segment of tarsus produced apically into a ventrally directed tooth-like spur (Fig. 4) 8
- Claw bearing segment of tarsus not produced apically into a ventrally directed tooth-like spur. 9
8. Scutellum sub-triangular and with fine punctures; elytral interstices with fine punctures .... *P. cuprea* Wang, 1992
- Scutellum ligulate and impuntate; elytral impunctate ..... *P. fulgida* Ge *et* Yang, *sp. nov.*
9. Epipleuron impunctate; interstriae of elytral interstices flat, impunctate, shagreened .... *P. alpina* Ge *et* Wang, 2002
- Epipleuron punctate 10
10. Third segment of antenna longer than second; epipleuron with coarse and sparse punctures .... *P. wumingshanensis* Ge *et* Wang, 2002

- Third antennal segment not longer than second 11
11. Body blue, two basal segments of antennae reddish-brown ..... *P. balangshanensis* Ge *et* Wang, 2002
- Body purple, antennae dark ..... *P. aptera* Chen *et* Wang, 1984
12. Elytral interstices impunctate 13
- Elytra punctate 14
13. Elytral interstices smooth ..... *P. chinensis* Gressitt *et* Kimoto, 1963
- Elytral interstices shagreened ..... *P. mellyi* Achard, 1922
14. Epipleuron impunctate; Body metallic reddish-brown ..... *P. fulvenscens* Weise, 1922
- Epipleuron punctate 15
15. Elytral interstice 9 and 10 of equal width ..... *P. armoraciae* Linnaeus, 1758
- Elytral interstice 10 wider than 9 ..... *P. brassicae* Baly, 1874

Phaedon fulgida Ge *et* Wang, NEW SPECIES

(Figs. 1-6)

Diagnosis. The new species is similar to *P. cuprea* Wang, 1992 differing from these primarily in punctation of the pronotum and aedeagus morphology. *P. cuprea* differs from the new species by having the following characteristics: clypeus with sparse punctures; vertex with dense and fine punctures; pronotum with coarse and dense punctures; scutellum sub-triangular and with fine punctures; diameter of punctures of elytral striae is the same as those of pronotum, interstriae with fine punctures.

Description. Length: 3.92-4.60mm (measured from the apex of the clypeus to the apex of the elytra), width: 2.72-3.12mm (measured at base of the elytra).

Form. Body sub-spherical, convex dorsally (Fig. 1).

Color. Metallic bronze; clypeus, last segment of maxillary palpus, two apical segments of labial palpi and claws mahogany brown.

Head. Frons slightly depressed, flattened along antennal sockets; clypeus with coarse punctures and pubescence; upper clypeus (lower frons) between antennal sockets with sub-triangular carina; frons with coarse punctures, and vertex with finely shagreened surface and very fine, sparse, confused punctures; eyes elliptical; average dorso-ventral eye length = 0.09mm; average interocular distance (at dorso-mesal margins) = 0.65mm.

Antennae. Slender, extending well beyond base of elytra, segments 7-11 with dense pubescence; segment (1-11) length (average of type series) in millimeters 0.23, 0.17, 0.21, 0.16, 0.14, 0.16, 0.16, 0.17, 0.19, 0.18, 0.22 (Fig. 2).

Pronotum (Fig. 3). Average length at middle = 1.03mm, average width at middle = 1.77mm; much narrower at base than elytra; rectangular; lateral margins evenly, gradually rounded, slightly narrower at antero-lateral angles, anterior margin widely emarginate with projecting antero-angles; postero-angles obtuse; anterior, lateral and posterior margins with raised bead; lateral margin with a shallow depression on central area; disc with sparse punctures, diameter of these same as those of clypeus; with finer punctures interspersed; lateral and antero-angles with coarse punctures; posterior margin with coarse and dense punctures; surface with shagrination.

Scutellum. Ligulate, smooth and impunctate, surface slight shagreened.

Elytra. Length = 2.56mm, width (at middle) = 3.38mm; convex; abbreviated scutellary stria plus 10 complete striae composed of deep, large punctures, larger than those of the clypeus; interstices surface smooth, impunctate, finely shagreened; humeral callus not prominent; apically interstices tapered and narrow; interstices equally spaced except 8th which is wider; epipleuron flat, broadened basally, slightly narrowed posteriorly.

Underside. Lateral margin of prosternal process with punctures and pubescence, apically truncate, slightly broadened, central area with a longitudinal ridge; procoxal cavities elongate, open; mesosternal process narrow, posterior margin emarginate, with sparse punctures and pubescense; meta-

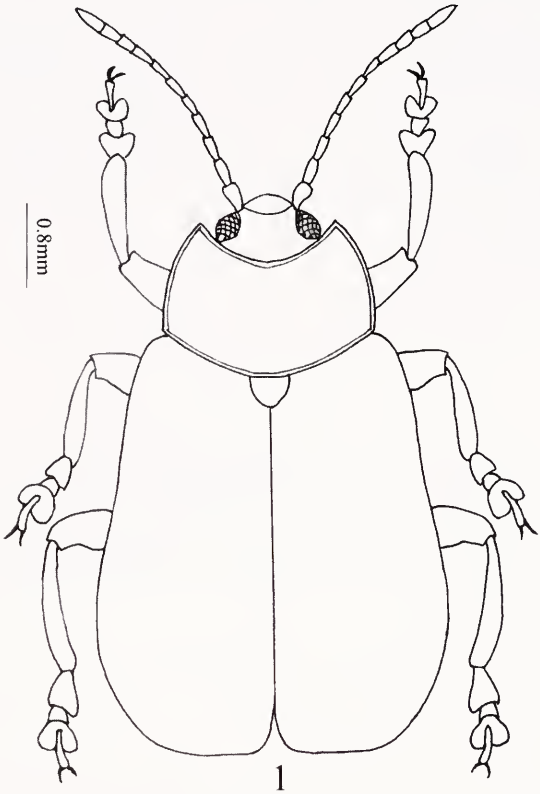


Fig. 1. Habitus of *Phaedon fulgida*, NEW SPECIES.

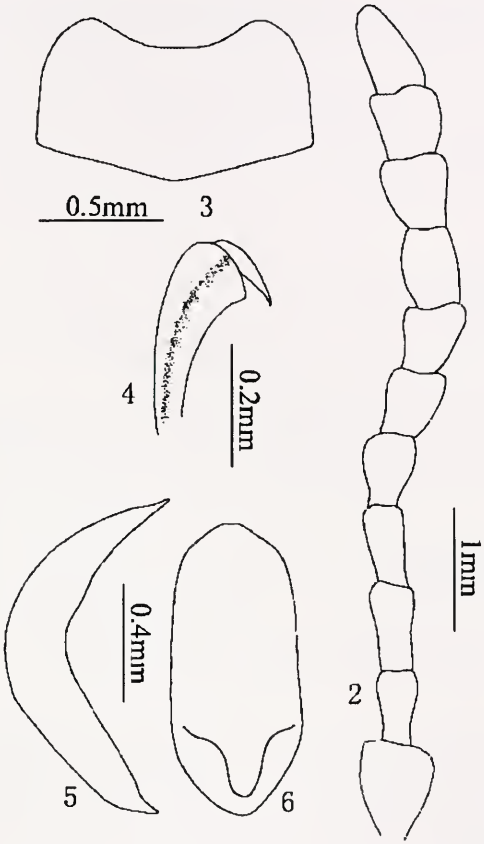
sternum with large coarse punctures, larger than those of the elytra, anterior margin emarginate; abdominal sternites with small shallow punctures and sparse pubescense.

Legs. With large punctures, diameter of these same as those of metasternum; with prominent pubescence, especially on lateral margin of tibiae and ventral surface of tarsi; femur rectangular, outer-lateral margin with shallow depression; tibiae slender, with dense pubescence especially at apex, outer-lateral margin curved, third segment of tarsi bilobed, claw bearing segment of tarsus produced apically into a ventrally directed tooth-like spur (Fig. 4); claws simple.

Aedeagus. In dorsal view broadened basally, tapered to apex, slightly pointed apically; in lateral view bent at right angles (Figs. 5-6).

Material studied. Holotype: male, China, Guizhou Province, Huixiangping County, Fanjing Shan (27.9°N, 108.6°E) 1780m, 1 August 2001, Coll. Hongbin Liang. Paratypes: 2 females, same data as holotype, except collected by Kangzhen Dong. All type specimens are deposited in the Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Etymology. From the Latin, *fulgida*, meaning shining.



Figs. 2-6 *Phaedon fulgida*, NEW SPECIES. Fig. 2. Antenna. Fig. 3. Pronotum. Fig. 4. Claw. Fig. 5. Aedeagus (lateral view). Fig. 6. Aedeagus (dorsal view).

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NOTES ON MEXICAN *PSILOPYGA* AND *OXYCNEMUS* (COLEOPTERA: NITIDULIDAE)[1]

José Luis Navarrete-Heredia[2]

ABSTRACT: Specific distributional data for *Psilopyga fasciata* in México is provided and new hosts records are included for *Oxycnemus rostrosus*, and *P. fasciata* from México, and *P. histrina*, and *P. nigripennis* from the United States.

KEY WORDS: *Psilopyga, Oxycnemus*, Coleoptera, Nitidulidae.

The genus *Psilopyga* LeConte, 1853: 286 has been used as a synonym of *Oxycnemus* by some authors starting with LeConte and Horn (1883) and followed more recently by Parsons (1943).

Sharp (1891: 364) stated that "the two genera are, however, very distinct," an assertion that was supported in a phylogenetic analysis of these genera and other close relatives (Leschen 1999). At present, six species are included in this genus, whereas nine are included in *Oxycnemus;* both genera are represented in México by one species each (Spornraft 1971; Leschen 1999).

The purpose of this paper is to provide specific distributional data for *Psilopyga fasciata* in México and record for the first time the fungal hosts for this species and *Oxycnemus rostrosus*.

Psilopyga fasciata Sharp, 1891: 364

Fig. 1

Psilopyga fasciata was described based on a single specimen collected by Truqui from México without specific locality (Holotype at British Museum, seen). It is easily recognized from the rest of North American species by the bicolored elytra: one-third to three-fifths of the base orange (as in the Holotype, cited by Sharp 1891), and the rest black. In his revision of the Nearctic Nitidulidae, Parsons (1943) recorded this species from Presscot, Arizona, USA, without specific host data, although the information available for other species, cited *Phallus impudicus* as the host for *Psilopyga histrina* (LeConte), and *P. nigripennis* (LeConte) (Parsons 1943) there are also new records for these species associated with *Mutinus elegans* (original data provided by R. Leschen from specimens collected in Arkansas. Specimens in his collection).

Material examined. México: Jalisco, Tenamaxtlan, Los Picachos-Tenamaxtlan, bosque mesófilo de monta□a, 1820m, ex *Laternea columnata*, 22.VII.2000, J. Cortés (1♂, 1♀; Colección Entomológica del Centro de Estudios en Zoología, CZUG). **United States:** Arizona, Maricopa Co., Hwy. 260 at Preacher Canyon (~6 mi E of Star Vly), 14.VIII.1992, from *Phallus impudicus* (Phallaceae) (coll. W.B. Warner) (1 ♀; Florida State Collection of Arthropods, FSCA).

Three of the four species (including *P. fasciata*) from the United States are

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[2] Entomología, Centro de Estudios en Zoología. CUCBA, Universidad de Guadalajara, Apdo. Postal 234, 45100 Zapopan, Jalisco, México. E-mails: snavarre@maiz.cucba.udg.mx and glenus@yahoo.com.mx.

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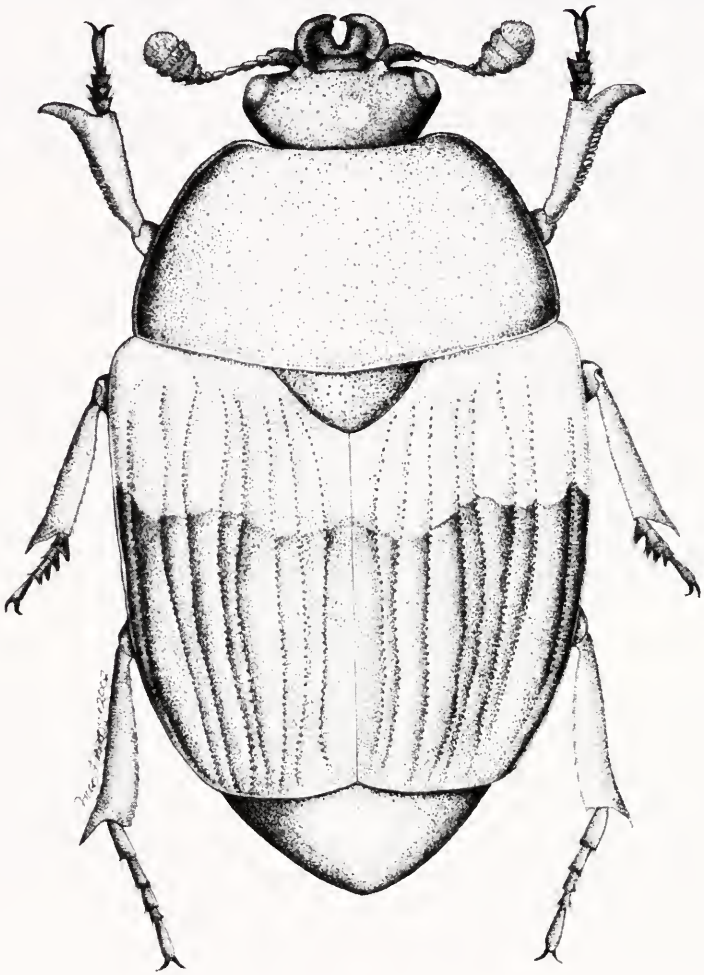

Fig. 1. Dorsal view of *Psilopyga fasciata* Sharp (male).

recorded from *Phallus impudicus* where this species is distributed primarily in temperate forest, but the single record from México includes a different host, *Clathrus columnatus* (Clathraceae) for this genus. Although the last record is from another host family, all of them belong to the Order Phallales.

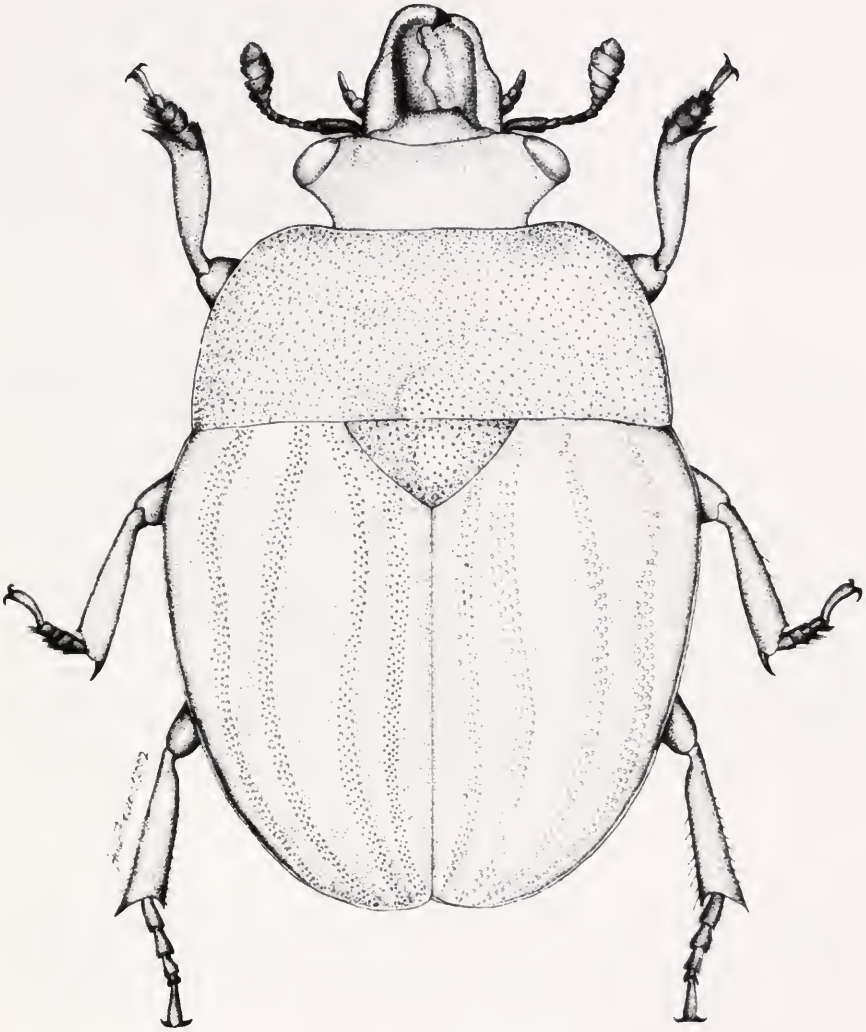

Fig. 2. Dorsal view of *Oxycnemus rostrosus* Reitter (male).

Oxycnemus rostrosus Reitter, 1873: 137

Fig. 2

Listed as *Oxycnemus rostratus* in Blackwelder (1945), this species is recorded from México (Veracruz), Guatemala, Nicaragua and Panamá. Known hosts for the species of this genus are: *Blumevania rhacodes*, *Dictyophora*, *Lysurus*

periphragmoides (Nouhra and Toledo 1994, cited also in Leschen 1999), and *Phallus impudicus* for *Oxycnemus lewisi* (Reitter) (Hayashi 1978).

Material examined: Veracruz, Catemaco, Dos Amates, 22.VIII.1992, *Dyctiophora indusiata* IV (Phallaceae), J. L. Navarrete-Heredia (1♂, 1♀; J.L. Navarrete-Heredia col., JLN); Veracruz, Cuauhtémoc, NTP-80 No. 5, 29.XII. 1991, J. R. Hernández (1♀; JLN). The fungal record agrees with those known for the genus. The single unusual finding for this species in carrion traps may be the result of chemical attraction instead of close association with carrion, due to their restricted association with Phallales (Leschen 1999).

DISCUSSION

Specimens of both species were collected during the day in the base of the fungi and inside the mature "mycoegg" (gelatinous egg structure, *sensu* Pegler and Gomez 1994), as is usual for these beetles. An interesting record of mycetophagids in the mycoeggs of *Linderiella rodrigueziana* (Clathraceae) from Costa Rica (Pegler and Gomez 1994) requires confirmation. Although the Mexican diversity of these genera is not high, México is the single country in the Western Hemisphere where both genera occur and represent the most southern *(Psilopyga)* and northern *(Oxycnemus)* distribution for these taxa. In México, *Psilopyga* species occur in montane areas and are associated with temperate mushrooms, but *Oxycnemus* is found primarily in localities with tropical influence and its species are associated with the single species of *Dyctiophora* which is tropical and subtropical in distribution *(D. indusiata)* (Guzmán *et al.* 1990). Due to their specific association with Phallales, additional collections of these cyllodines would provide important information on their biology and fungal host use.

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NEW CONOPIDAE FROM THE NEOTROPICAL REGION (DIPTERA)[1]

Sidney Camras[2]

ABSTRACT: A new subgenus *Aureoconops* of the genus *Physoconops* and six new species of Conopidae are described: *Physoconops (Aureoconops) aureolus* from Peru; *P. (Pachyconops) thompsoni* from the Bahamas; *P. (Kroeberoconops) argentinus* from Argentina: *Zodion chavalai* from Argentina; *Zodion bellum* from Mexico; and *Stylogaster parrilloi* from Costa Rica.

KEY WORDS: *Physoconopus, Aureoconopus, Zodion, Stylogaster,* Diptera, Conopidae, Neotropical.

The six new species of conopids described in this paper are quite distinct and easily recognized. Many other apparently new species are present in various collections received for identification, but more study and material are required to rule out variation of known species.

Conopidae are often collected individually as evident from these new species being known from single specimens, or in one case, from two specimens of the same sex.

Genus *Physoconops* Szilady
Subgenus *Aureoconops*, NEW SUBGENUS
(Fig. 1)

Type species *Physoconops aureolus* Camras

Vertex triangular, large and prominent, extending anteriorly over one third of the frons. Frons narrow, longer than wide. First flagellomere one fourth longer than pedicel. Abdominal pedicel long and narrow. Second tergite four times as long as wide. Gold pollinose areas extensive and distinct from dark areas.

Comments. This subgenus is unique in the large triangular shape of the vertex and the prominent gold pollinose coloration. The narrow frons associated with the long first flagellomere is also unusual. In my key to the subgenera of *Conops* (Camras 1955: 161) it comes closest to *Gyroconops* which has a wide frons and the vertex mainly rounded anteriorly.

Physoconops (Aureoconops) aureolus, NEW SPECIES
(Fig.1)

Head yellow and gold pollinose. Ocellar tubercle and Y-shaped pattern on frons black, as is the antenna, proboscis and occiput centrally. Black hair on dorsal part of vertex. Proboscis nearly two times as long as head. Antennal proportions 1: 2: 2¼. Scape four times as long as wide.

Thorax brownish black but mainly gold pollinose. Distinct wide gold pollinose pleural stripe joins gold of the mesonotum. A velvety black midstripe and divided black lateral stripe on the mesonotum.

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[2] Associate, Division of Insects, The Field Museum, 1400 S. Lake Shore Drive, Chicago, IL 60605-2496, USA.

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Legs brownish black, mainly gold pollinose. Apical part of tarsi and tips of claws black. Claws otherwise and pulvilli yellow.

Wing with brownish gray pattern between vein R+R1 and RS+R4+5 and vena spuria. Apical part of wing paler gray. Pattern darkest above and below vein R4+5. Halter yellow, rufous at club and base.

Abdomen mainly black, brownish black on second segment, yellow at junction of second and third segments. Gold pollinose apical margins on all segments and entirely so on apical segment. Pedicel long and narrow. Club of abdomen abnormally contracted. Genitalia brownish black.

Length: 12 mm.

Type Data. Holotype ♂. Peru: Madre de Dios: Manu, Rio Manu, 250 m., Pakitza, 12° 7'S, 70° 58'W, 9-23.ix.1988, Amnon Freidberg. Held on deposit at USNM for Peru (see Zumbado & Thompson, 1997:80 for details on this concept).

Remarks. This species keys to *P. costatus* (Fabricius, 1805) in my key (Camras, 1955: 186) but that species has a wide frons and belongs to the subgenus *Aconops*.

Physoconops (Pachyconops) thompsoni, NEW SPECIES

Head entirely black except for rufous at the antennal prominence of the frons, facial grooves and oral area, proboscis except for labellae, most of style, part of scape, and small areas on occiput; orbitals and facial grooves yellowish white pollinose. Antennal proportions 1:2:2. Scape three times as long as wide.

Thorax entirely black except for small rufous areas near postpronotum and on pleura. Coxae and legs rufous, but tarsi black except at base. Pulvilli and claws yellow; tips of claws black.

Wing and veins from costa to vein CuA + CuA1 bright rufous; sharply black in apical half of cell R4+5 and adjacent cell R2+3; black along vein CuA1 in discal cell; very pale rufous in posterior part of wing, but distinctly hyaline between vena spuria and vein M. Halter rufous, black at club and base.

Abdomen rufous on segments one to three except for narrow black margin at base of first and apex of third segments; apical margins yellow white pollinose at first to third segments and at sides of second segment. Remainder of abdomen and genitalia shining black.

Length: 14 mm.

Type Data. Holotype ♂. Bahamas: San Salvador Island, North Point. 4.vi. 1978, A.G. Scarbrough (USNM).

Remarks. This species keys to couplet 6 (Camras, 1955: 184), but has rufous on abdominal segments two and most of one and three. Named for F. Christian Thompson, who brought this specimen to my attention, in appreciation for his leadership and his fine work on Syrphidae especially those of the West Indies.

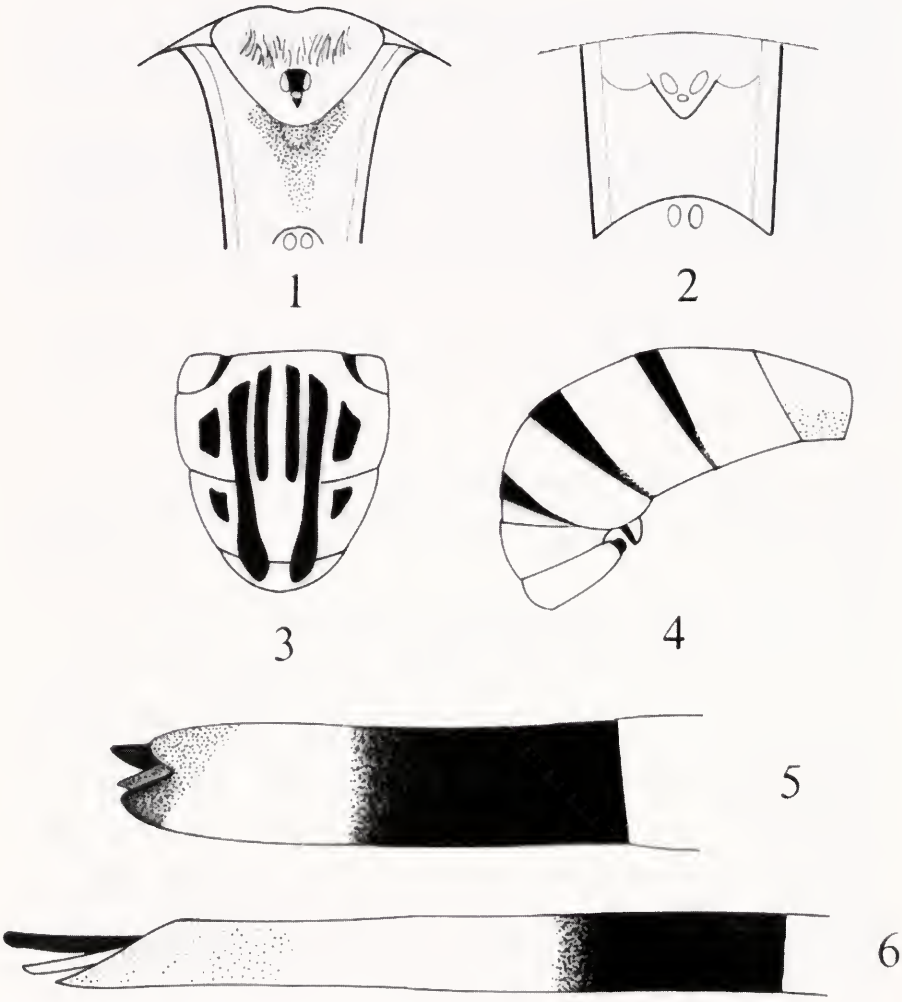
Physoconops (Kroeberoconops) argentinus, NEW SPECIES
(Fig. 2)

Head, antenna and proboscis black. Upper medial part of face yellow; ocelli and small areas on antennae rufous; face, grooves and orbitals gold pollinose in some views. Antennal proportions 1: 2½:1½. Scape 3½ times long as wide.

Thorax entirely black, faint yellow pollinose in some views. Legs black. Coxae gold pollinose. Rufous areas on knees, tarsi, and pulvilli. Claws entirely black.

Wing pattern from costa to vein CuA+CuA1 mainly rufous but paler in costal and cell R+Bm; blackish apically especially along vein R4+5 and along entire vein R1. Halter rufous, club black, gray at base.

Abdomen black, with a distinct rufous band at junction of second and third segments; second segment very shiny; gold pollinose posterior bands on segments three to five, entirely gold pollinose on



1, *Physoconops aureolus*, vertex and frons; 2, *Physoconops argentinus*, same; 3, *Zodion bellum*, mesonotum; 4, *Zodion chvalai*, abdomen; 5, *Stylogaster parrilloi*, ovipositor, apical segment; 6, *Stylogaster triannulata*, same.

sixth segment. Second segment five times as long as wide. Third segment shorter and becoming much wider apically resulting in a distinct wide abdominal club. Genitalia rufous and black.

Length: 11 mm.

Type Data. Holotype ♂. Argentina: Volcán, 2000 m., ii.1927 (USNM)

Remarks. This species keys to *P. hermanni* (Kröber, 1915) (Camras, 1955: 184) but has the facial grooves and legs black.

Zodion bellum, NEW SPECIES
(Fig. 3)

Head mainly yellow, vertex and frons rufous. Blackish area and gold pollinose triangle at side of vertex. Ocellar tubercle black. Face and gena gold pollinose. Brown area between face and gena. Grooves blackish. Occiput gray pollinose, gold pollinose between the usual two black lines from the vertex to neck. Antenna mainly black, first flagellomere dark rufous. Arista black. Antennal proportions 1:4:2½. Proboscis black, one and one half times head length.

Thorax and coxae blue gray pollinose with yellowish areas. Mesonotal black stripes very distinct, the submedials being a little narrower and shorter than the sublaterals and the laterals. The sublaterals extend onto the scutellum. Black areas on anepisternum. Eight scutellar bristles. Legs and claws black. Pulvilli yellow. Wing grayish hyaline, veins black. Calypter yellowish white. Halter yellow, brown at base.

Abdominal segments one to three blue gray pollinose, remainder of the abdomen gold pollinose. Second and third segments with large paired triangular black marks and narrow gold pollinose posterior margins. Very distinct narrow black stripes on fourth segment. V-shaped posterior margin of fifth segment appears blackish on anterior view. Genitalia shining black.

Length: 8 mm.

Type Data. Holotype ♂. Mexico: El Camaron, 20 mi. E, Oax. 21.vii.1956, D.D. Linsdale (Camras Collection).

Remarks. This species keys to *Z. pictum* Schiner, 1868 (Pearson and Camras, 1978: 205) which does not have the distinctive gold pollen on the apical abdominal segments. This specimen was studied by Pearson and he also thought it was new and near *Z. pictum*.

Zodion chvalai, NEW SPECIES
(Fig. 4)

Vertex reddish brown laterally extending onto the frons, yellow centrally. Ocellar triangle black. Frons bright orange yellow. Face, grooves, gena and lower occiput yellow pollinose. Upper occiput mainly black with usual pair of black lines from vertex to neck. Antenna yellow, black apically on first flagellomere and at base and apex of arista. Proportions 1:3:3. Gena two thirds of the eye height. Proboscis black, more than two times head length.

Thorax pale yellow and gray, gray and yellowish pollinose. Distinct sublateral black line extending onto the scutellum. Slender shorter black midline does not reach the scutellum. Metanotum gray pollinose, lower margin shining black. Coxae and legs yellow with yellow pollinose areas on coxae and tibiae. Apical segment of tarsi partly black. Pulvilli yellow; claw yellow, black apically. Wing faintly yellow hyaline, yellow in costal and subcostal cells and at base. Halter yellow.

Abdomen rufous with gold pollinose longitudinal markings. Distinct black posterior margins on segments two, three and four. Seventh segment, genitalia and theca shining rufous. Theca slender with black margin, as long as wide.

Length: 6.5 mm.

Type Data. Holotype ♀. Argentina: Cordoba, Capilla del Monte, coll. Prf. Hosseus (Chvála Collection).

Remarks. This species keys to couplet 19 (Pearson and Camras, 1975:206), but has the abdomen rufous with distinct black posterior margins on segments three, four and five. An entirely rufous abdomen in a female is unique in this genus.

Etymology. Named for Professor Milan Chvála, Charles University, Prague, in appreciation of his help and his fine work on Palearctic Conopidae.

Stylogaster parrilloi, NEW SPECIES
(Fig. 5)

Vertex triangular, dark yellow, reaching anterior one third of frons. Ocellar tubercle shining black. Frons velvety brownish black. Face and gena yellow with some brownish areas, silvery pollinose. Medial eye facets very large. Occiput pale, dark dorsally, white pollinose. Antenna dark yellow, first flagellomere rufous, black dorsally. Arista black, as long as pedicel. Antennal proportions 1:2:6. Proboscis black, yellow basally and on labella; second (middle) segment three times as long as head.

Thorax yellow and white. Most of mesonotum and pleural stripe back with greenish sheen. Postpronotum, posterior margin of mesonotum, margins of scutellum and upper margin of metanotum yellow. Pro- and mesocoxa and legs yellow. All tarsi black. Metafemur with three black bands, the apical band is narrowest. Metatibia black, yellow at base and preapical band which is almost entirely white haired, and occupies about one fourth of the tibia. Wing grayish hyaline, veins black. Halter yellow, brown at club and base.

Abdomen rufous, with yellow anterior bands which are white pollinose in some views. Fifth tergite black dorsally on anterior half. Hairs on sides of first tergite white. The narrow first segment of the ovipositor and almost proximal half of second segment rufous, the remainder black. Third segment black on proximal two fifths and narrowly at the apex including the medial process and most of the apical structures. Preapical band white and white haired occupying two fifths of the third segment.

Length: 14 mm. (Abdomen 4 mm, ovipositor 7 mm.).

Type Data. Holotype ♂. Costa Rica, Ala., 20 km S. Upala, 11-15.v.1990. F.D. Parker (Utah State University). Paratype: Same data as holotype, 11-20.iv.1991. Similar to the holotype but having black on the fourth tergite proximally at the center, and apically at the sides.

Remarks. In the key to the species of the *neglecta* group (Camras and Parrillo, 1985:123), this species keys to *S. triannulata* Camras and Parrillo, 1985 (Fig. 6). That species has a longer and more slender ovipositor, more than twice the length of the abdomen. The rufous at the base of the second segment is very short, and the white area on the third segment occupies about five-sixths. There is almost no black apically.

Etymology. Named after Philip P. Parrillo, Field Museum, Insect Division, Chicago, in appreciation of his opinions, advice, and assistance over many years.

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TWO ADDITIONAL STATE RECORDS OF F_1 MALE INTERSPECIFIC HYBRID *LIMENITIS (BASILARCHIA)* SPP. FORM "RUBIDUS" STRECKER (LEPIDOPTERA: NYMPHALIDAE)[1]

Austin P. Platt[2] and E. Thomas McClanahan[3]

ABSTRACT: State records of single male specimens of the interspecific hybrid form "rubidus" (Lepidoptera, Nymphalidae: *Limenitis (Basilarchia)* are reported from New Mexico and Kansas U.S.A. This form arises from rare mixed matings between *L. archippus* (Cr.) x *L. arthemis astyanax* (Fabr.), two closely related species which are involved in two quite differently colored mimicry complexes. The hybrids often occur when one or both of the parental species is or are rare. The New Mexican specimen involves the two southwestern desert subspecies of the parental butterflies. These two state records bring to 51 the known occurrences of these natural hybrids, all of which are males. This hybrid form has been reported from 20 states and the District of Columbia. Most of the hybrid records occur late in the flight season, except in Florida. Phenotypically and behaviorally this form represents a complete breakdown of the different mimetic resemblances present in its two parental species, thus placing this insect at a considerable selective disadvantage in natural populations.

KEY WORDS: Interspecific hybrid, *Limenitis (Basilarchia),* Lepidoptera, Nymphalidae.

This note reports two additional state records of F_1 interspecific hybrids between *Limenitis (Basilarchia) archippus* (Cr.), the viceroy, and the red-spotted purple, *L. arthemis astyanax* (Fabr.). These butterflies have been described as hybrid form "rubidus" Strecker 1878. Such taxonomic designations when applied to interspecific hybrids are not recognized as being valid by the International Commission of Zoological Nomenclature (ICZN) (Masters 1972). Earlier reviews of these rare and unusual insects have been reported by Mead 1872, Holdridge 1899, Platt et al. 1978, Ritland 1990, Covell 1989, 1994, Platt and Maudsley 1994, Boyd et al. 1999, and Schiefer 1999. This form occurs rarely, but with some regularity, and is broadly distributed across the United States. Between 1872 and 1998, "rubidus" hybrids have been reported from 20 states and the District of Columbia (Table 1). This hybrid insect apparently results from a very few interspecific matings occurring year after year in certain localized "hot spots." Such "hot spots" have been reported from north-central Florida, northeastern Georgia, southwestern Kentucky, eastern Nebraska, and east-central North Carolina (Platt et al. 1978, Platt and Greenfield 1974, Platt and Maudsley 1994, Ritland 1990, Covell 1994). Many of the records are from late in the flight season, and they occur when one or both of the parental species often are uncommon. All of the 51 known captured or observed naturally occurring specimens of these hybrids apparently have been males. There is some recent evidence that

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[2] Department of Biological Sciences, U. M. B. C., 1000 Hill Top Circle, Baltimore, Maryland 21250, U.S.A. Email: platt@umbc.edu.

[3] 605 East 69th Street, Kansas City, Missouri 64131, U.S.A.

Mailed on June 23, 2004

such interspecific hybrids are capable of backcrossing with parental females in nature (Platt et al. in review).

Table 1. Number of individuals, Locations (States), and Chronology (years) of 51 occurrences [captures, eclosions (e), and sightings (s) of hybrid form [*L. (B.)* "rubidus"] from before 1872 through 1998. (nd = no date).

Number of Individuals	Locations (States)	Chronology (Years)
1	Arizona	1979
1	Arkansas	1933
1	Delaware	1943
10 (8^{e}, 1^{s})	Florida	1974, 1986, 1987
1	Illinois	1960
5 (1^{e})	Georgia	1973, 1974, 1984, 1986
1	Kansas	1986
5	Kentucky	1948, 1978, 1980, 1993, 1998
2 (1nd)	Massachusetts	1896
1	Michigan	1974
4 (3^{s})	Mississippi	1995, 1998
2	Nebraska	1963
2	New Jersey	1880, 1910
1	New Mexico	1983
4 (2nd)	New York	1895, 1913
2	North Carolina	1970, 1972
2 (1nd)	Pennsylvania	Before 1872
1	Texas	1970
2	Virginia	1974, 1976
2	Wisconsin	1971, 1976
1(nd)	District of Columbia	—

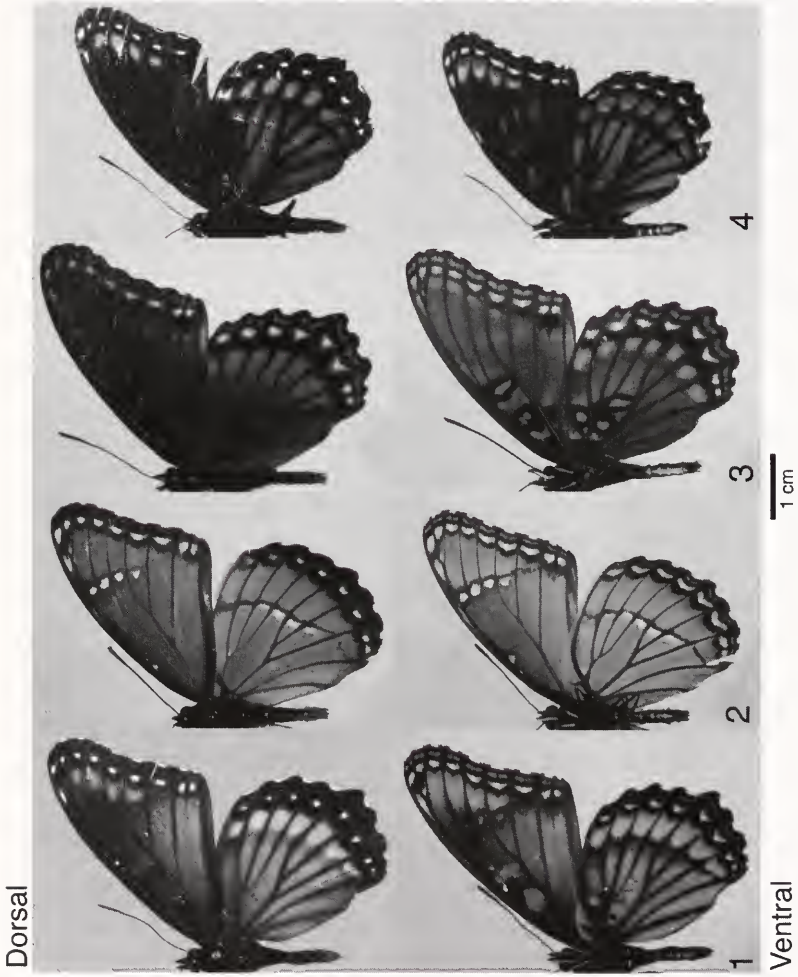
The first state record (Fig. 1) was collected in the Peloncillo Mountains, Guadalupe Canyon, Hildalgo County, New Mexico, on September 3, 1983, by S. J. Cary at an elevation of about 4700 ft. (1433 m). Mr. Cary informs A.P.P. that the collecting conditions were excellent, and that he observed over 40 species of butterflies on that day. Guadalupe Canyon passes through a short section of Arizona before turning southward and joining the Río Yaqui at Sonora, Mexico. He observed two red-spotted purples flying near where he collected the hybrid, but also notes that viceroys usually do not occur in Guadalupe Canyon at the site, although they may occur farther downstream in Mexico. In that region the two parent species are separated altitudinally, with *L. archippus* usually being found below 5000 ft. (1524 m), and *L. a. astyanax* occurring up to elevations of 8000 ft. (2438 m). He speculates that this interspecific pairing may have resulted from

an *L. archippus* straying too far upstream, thus encountering only the other species for potential mates (S.D. Cary pers. comm.).

The specimen was given to A. P. Platt by M. E. Toliver, and presently is in the Platt Collection at U.M.B.C. in Baltimore, Maryland. The collection locality indicates that this F_1 hybrid represents an interspecific cross involving the two southwestern (desert) subspecies of the parental butterflies, namely, *L. archippus obsoleta* (Edw.) x *L. arthemis arizonensis* (Edw.) (Figs. 2 and 3). The phenotype of this hybrid is of the "lighter" (more orange-brown, and hence, *archippus*-like) coloration of "rubidus," but it otherwise is typical of that of the wild hybrids for the more widely distributed eastern forms of the two parental species. Another earlier southwestern "rubidus" specimen (which also most likely represents a state record, as well) is noted from Arizona by Bailowitz and Brock 1991. The latter specimen was collected on October 13, 1979, by R. A. Bailowitz at St. David in Cochise County, in southeastern Arizona. St. David is located just southeast of Benson, Arizona, and is about 85 mi. (137 km) due west of the Peloncillo Mountains, not too far from Guadalupe Canyon.

The Kansas state record of hybrid "rubidus" (Fig. 4) was taken on August 31, 1996, by E. T. McClanahan while he was out collecting butterflies with his wife Judy, and his son Michael, in Lyon County, 12 miles west of Emporia. Michael first saw the dark *Limenitis* butterfly patrolling in a wooded area beside a gravel road where the McClanahans had stopped adjacent to some fields. The insect repeatedly returned to perch high up in a tall shrub on an embankment along the roadway. Attempting to induce flight, and perhaps bring the insect within reach, Michael tossed bits of gravel toward the butterfly, which flew out and downward, but it always managed to elude capture. E. T. M. finally climbed up the embankment and netted the insect on its perch about 10-12 ft. above the road. This butterfly is of the darker (more *L. arthemis astyanax*-like) phenotype.

Extensive laboratory hybridization of the two parental species of *Limenitis* done at U.M.B.C. by A.P.P. reveals that these interspecific crosses are fertile in both directions with regard to sex (Platt 1975, 1983, 1987). Likewise, wild interspecific pairings have been observed taking place in both directions as well (Klots 1959, Ritland 1990, and Covell 1994). When strains from the same geographic locality are used in the crosses, all of the F_1 hybrids are males, with but a single exception (Platt and Harrison 1994). Laboratory breeding of these butterflies demonstrates (contrary to what has been reported in the literature) that *L. archippus,* which prefers open fields and moist lowland meadow habitats, is oligophagous and restricted to the Salicaceae (willows and poplars) for its larval foodplants, whereas, *L. arthemis astyanax* is essentially polyphagous, feeding on a wide variety of both rosaceous and salicaceous foodplants. In New England and Maryland populations at least, the preferred foodplant of this mixed forest species is wild, or black cherry, *Prunus serotina* Ehrh. This rosaceous plant contains chemical (cyanin) deterrents which can be sensed by viceroy larvae (Flaim & Platt, pers. obs.), thus preventing them from feeding on such plants. However, the hybrid "rubidus" larvae will accept leaves from both plant families (Hanson



Figures 1-4. 1) Hybrid "rubidus" Stkr. (light morph)., male. Hildalgo County, New Mexico, September 3, 1983, S. J. Cary, Leg. M. C. Toliver. 2) *L. archippus obsoleta* (Edw.), male. Arizona, E. T. Owen Coll., USNM. 3) *L. arthemis arizonensis* (Edw.), male. Brewster County, Texas, May 14, 1977, Leg. M. Rickard. 4) Hybrid "rubidus" Stkr. (dark morph), male. Lyon County, Kansas, August 31, 1996, E. T. McClanahan. Figs. 1 and 4 represent state records for the hybrid form.

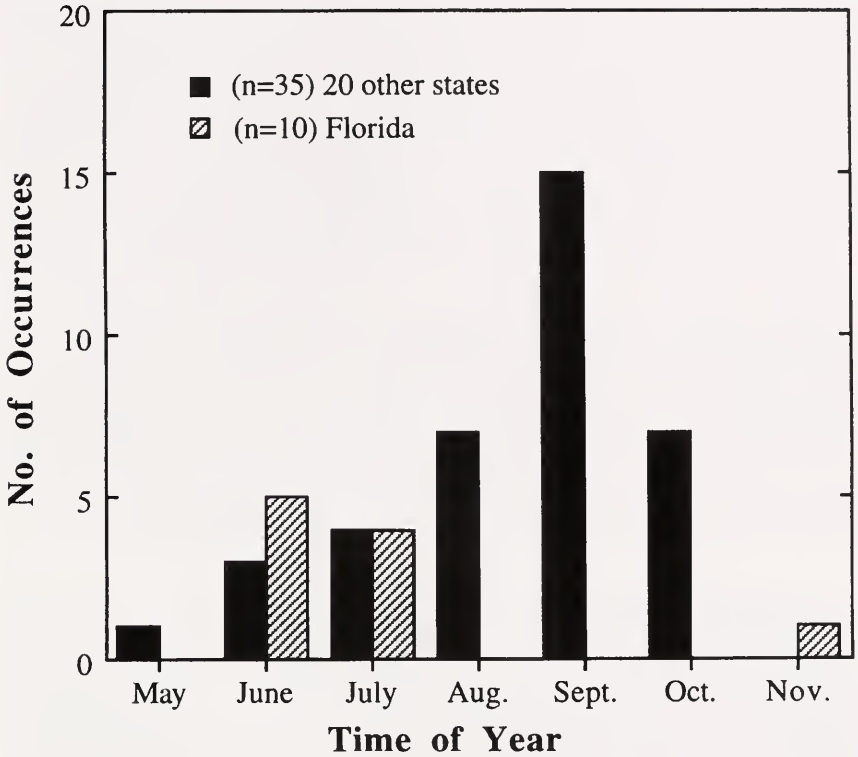


Figure 5. Monthly records of the occurrence of 45 captures, eclosions, and sightings of hybrid form *L. (B.)* "rubidus" Stkr. throughout the U.S. (solid bars) and in Florida (cross-hatched bars) between 1872 -1998.

1976, de Boer and Hanson 1984). Within single broods both the lighter and darker morphs of "rubidus" can occur as siblings (Platt and Greenfield 1971, Platt et al. 1978).

The two hybrid records reported here were both taken late in the flight season, agreeing with those previously reported (Fig. 5). The only exception to this generality is in Florida, where most of this hybridization seems to take place earlier in the flight season (Ritland 1990, Platt and Maudsley 1994). Thirty-five records from other than Florida have a mean collection emergence, or sighting date of September 2 ± 1.2 days. Ten Florida records (eight representing eclosions) occur earlier (mean date = July 11 ± 16.4 days), indicating late spring or summer crosses. For six other 19th century specimens the collection dates were not recorded. The northern June records (n=3), shown in Fig. 5, also most likely represent either late summer or early fall matings, since, all adult admirals eclosing this early in the season must have arisen from partly grown (third instar) larvae which have over-wintered in hibernacula.

Apparently, both ecological and premating isolating mechanisms which usually serve to keep the two species separated tend to break down in the late summer and fall portion of the year throughout most of the U. S. This in part may be related to the late season decreasing photoperiod, which induces many admiral butterfly larvae of both species to diapause in the third instar, thus contributing to a scarcity of adults, and consequently of potential mates (Platt and Greenfield 1974). However, Schiefer 1999 notes situations in Mississippi when hybrid "rubidus" were sighted, even though both species were exceptionally common.

The two parental butterflies mimic two different unpalatable models: *L. archippus* mimics *Danaus plexippus* (L.) (a Müllerian relationship), whereas, *L. arthemis astyanax* mimics *Battus philenor* (L.) (a Batesian relationship). Thus, the F_1 phenotype of hybrid "rubidus" represents a complete breakdown of both of these model-mimic relationships. As such, these interspecific hybrids must be at a considerable selective disadvantage, when compared to males of either of the parental species. Their visual and structural morphology and their behaviors likely are intermediate as well. Their female counterparts have not been reported in nature, so that the continuation of this form as a species is unlikely.

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Ms. C. Wilkens and Ms. A. Ellis, Department of Biological Sciences, U.M.B.C. assisted with the final preparation of the manuscript. The senior author greatly appreciates having received the New Mexican hybrid "rubidus" specimen from Dr. M. E. Toliver of Eureka College, Eureka, Illinois, and the information about its collection provided by Mr. S. J. Cary. Finally, we wish to thank Dr. B. P. Bradley and Dr. F. E. Hanson of the Department of Biological Sciences, UMBC, and Mr. S. J. Harrison of The Johns Hopkins Medical Institute in Baltimore, for critically evaluating the manuscript.

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Note added in proof: Additional records of *Limenitis* hybrid "rubidus" which have been reported since our manuscript was first submitted include two male specimens of the dark morph from central Missouri (Elder, 2000), one of which was collected in the early 1950s. Two other dark morphs (one very flight-worn) were reported from southern Louisiana (Ross and Marks, 2002). One of these also is an older record. Both of these accounts appear in the News of the Lepidopterists' Society 44 (2): 64-65 and 44(4):112-114, respectively. The two recently collected specimens are illustrated in color. The new Missouri specimen was collected on May 5, 2000, and the one from Louisiana was taken on July 29, 2000. Finally, Schiefer [2000, News of the Lepidopterists' Society 42(1):29] reported another dark form of this insect from Mississippi. These records are not included in this paper, but they add five specimens and two additional states to the distribution of this rather uncommon interspecific hybrid form.

CIRROSPILUS NEOTROPICUS SP. N. (HYMENOPTERA: EULOPHIDAE): AN INDIGENOUS BIOCONTROL AGENT OF THE CITRUS LEAFMINER, *PHYLLOCNISTIS CITRELLA* (LEPIDOPTERA: GRACILLARIIDAE) IN ARGENTINA[1]

Patricia A. Diez[2] and Patricio Fidalgo[2,3]

ABSTRACT: A complex of native parasitoids has been found to attack the citrus leafminer, *Phyllocnistis citrella* Stainton, since its introduction into Argentina. *Cirrospilus neotropicus* n. sp. is the most abundant indigenous parasitoid, with low but significant parasitism levels. *Cirrospilus neotropicus* n. sp. and the introduced exotic species, *Ageniaspis citricola* Logvinovskaya, are the main providers of biological control in the citrus orchards of northwestern Argentina. The new species, *C. neotropicus,* is described and the main morphological characters of both sexes are illustrated. Diagnostic characters are given which distinguish *C. neotropicus* from the Asiatic *C. ingenuus* Gahan, which has been mentioned in recent literature as similar to *C. neotropicus,* and from *C. floridensis* Evans, an eulophid recently described from Florida, USA.

KEY WORDS: *Cirrospilus neotropicus* n. sp., Hymenoptera, Eulophidae, biological control, Citrus Leafminer, *Phyllocnistis citrella,* Lepidoptera, Gracillariidae

After the introduction of the citrus leafminer (CLM) into Argentina in 1996, some six species of parasitoids were commonly recorded as attacking this pest: *Elachertus* sp., *Closterocerus* sp., *Cirrospilus* sp., *Sympiesis* sp., *Galeopsomyia fausta* La Salle and *Elasmus* sp. (Eulophidae) (Frías and Diez, 1997; La Salle and Peña, 1998; Schauff et al., 1998; Fernández et al., 1999a). One year later (1997), *Ageniaspis citricola* Logvinoskaya (Encyrtidae) was discovered in Tucumán province: a case of ecesis in biological control (Diez et al., 2000; Fernandez et al., 1999b). Nevertheless, in 1998 this parasitoid was introduced again into citrus orchards in Tucumán using stock obtained in Peru (Figueroa et al., 1999). The performance of the above mentioned parasitoids was evaluated by Diez et al. (2000) and Diez (2001) who observed that *A. citricola* is the most important biological control agent of the pest with a high level of parasitism (54%); followed by a single native parasitoid *Cirrospilus* sp. (19%). The other parasitoids are very uncommon and only occasionally are reared from the CLM. The species of *Cirrospilus* obtained from the CLM in Argentina has a wide distribution in the Neotropical region, from Mexico to Argentina, and was recorded in the literature, as "*Cirrospilus* sp. C", from Argentina, Brazil, Colombia, Honduras and Mexico (Schauff et al., 1998). Bautista *et al.* (1996) mentioned this species as "*C. cuadristriatus*" and Perales et al. (1996a, 1996b) as "*C. quadristriatus [=C. ingenuus]*" but Schauff et al. (1998) considered it to be an undescribed species and designated it as "*Cirrospilus* sp. C." The paper by

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[2] PROIMI-Biotecnología, Pje Caseros y Avda Belgrano, 4000, S. M. de Tucumán, Tucumán, Argentina. E-mail: pdiez2000@yahoo.com.

[3] CRILAR, Entre Ríos y Mendoza, 5301 Anillaco, La Rioja, Argentina. E-mail: pfidalgo@crilar-conicet.com.ar.

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Schauff et al. (1998) has facilitated enormously the identification of natural enemies of the CLM in all parts of the world where it is present. We describe this important indigenous CLM parasitoid as a new species in order to facilitate its recognition and permit its evaluation. The morphological terms used here follow Gibson (1997).

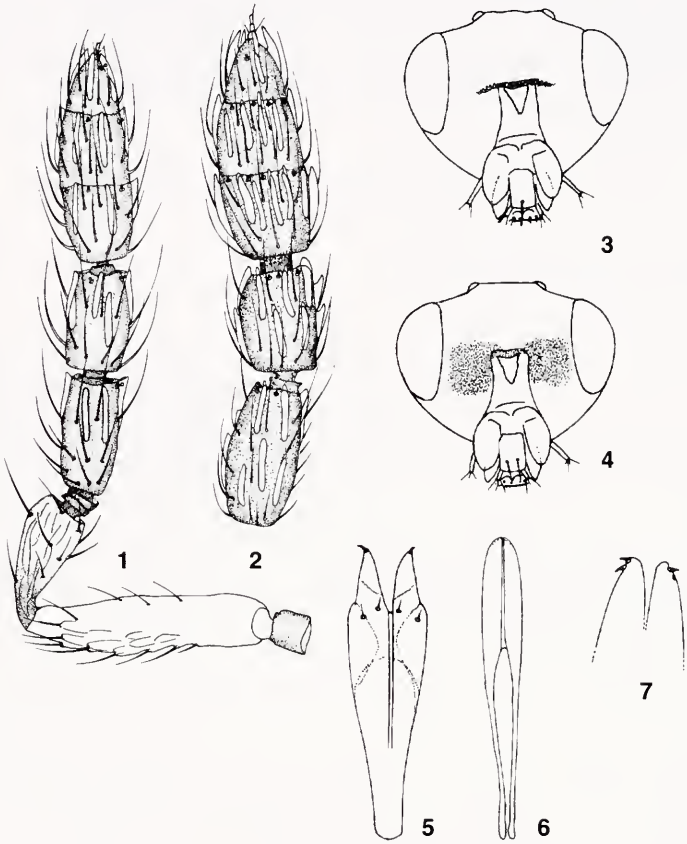
Cirrospilus neotropicus Diez and Fidalgo, NEW SPECIES
(Figs. 1-3, 5-6, 8, 10-12)

Cirrospilus sp. C, Schauff et al., 1998: 1011.
Bautista el al., 1996:73 as *C. Cuadristriatus*.
Perales et al., 1996a: 93 - 1996b: 349-350, as *C. quadristriatus*.

Description. Female holotype: **Coloration** (Figs. 2, 3, 11). Body yellow with the following areas dark brown: radicle and antennal flagellum (basal half of pedicel dark but lighter than flagellum), apex of mandible, transverse line above occipital foramen (Fig. 3), small spot on neck of pronotum, small spot around mesothoracic spiracle, notauli, transcutal articulation, small spot laterally on metanotum, dorsal setae of prothorax and mesothorax, posterior margin of propleuron, small spot on upper mesepimeron, basal half of petiole, two lateral spots on first tergite of gaster, a transverse band located at the posterior margin of tergite 2nd and anterior margin of 3rd, another similar band in 3rd-4th tergites, 4th-5th tergites and 5th-6th tergites (last band curving backwards laterally), and third valvulae (Fig. 11). Wings hyaline except venation and setae dark brown, parastigma with a hyaline break. **Structure.** Body length: 1.68 mm; all parts of body with shallow more or less hexagonal reticulation. **Head:** antenna attached at level of lower margin of eye, radicle short (about as long as wide), scape 4x as long as wide in lateral or dorsal view, first funicular segment about as long as pedicel and a little longer than the second, clava with a terminal spine; all funicular segments and clava with longitudinal sensilla, some of them, particularly on the apical segments, with their apices projecting freely above surface (Fig. 2); mushroom-shaped capitate peg sensilla present apically between longitudinal sensilla on all funicular segments and on first and second segments of clava, a single one sensillum on the last segment of clava (Fig. 2); maxillary and labial palpi one segmented, labium with one seta (Fig. 3); mandible with 2 external large and 4 internal small teeth; malar sulcus present (lineal); compound eyes with hairs between facets. **Mesosoma:** prosternum closed by cervicalia; prepectus subtriangular in shape; anterior third of notauli converging posteriorly, but becoming almost parallel in the posterior two thirds; placoid sensilla of scutellum small and round, located about halfway between anterior and posterior pairs of setae; propodeum with a prominent medial carina and plicae along anterior and posterior margins (also with small carinae laterally), callus with 9-10 setae; endophragma apically notched, its end at the level of posterior margin of propodeum. Hind coxae vague on outer side. **Fore wing:** length 2.2x its maximum width; submarginal vein 0.8x length of marginal vein; stigmal vein 0.2x length of marginal vein, stigma extending beyond base of uncus (~ 2 uncus-lengths), uncus distinctly recurved (Fig. 8); postmarginal vein 0.8x length of stigmal vein (Fig. 8); parastigma with paired sensilla in the hyaline break, costal cell with more setae on the distal upper margin than in the ventral surface, marginal fringe short, less than 0.1x maximum width of fore wing. **Metasoma:** petiole small, 0.3x as long as broad, smooth and conical in shape, ovipositor length 1.7x length of hind tibia.

Male. Body length: 0.7-1.25 mm. Similar to female in structure and coloration (Fig. 1, 3, 10), except antennal flagellum with fewer longitudinal sensilla, whose apices do not project freely above the surface (Fig. 1), and in 45 of specimens there is a dark brown central spot on the scutellum and the axilla (Fig. 12). Genitalia as in figures 5 and 6; aedeagus length 1.1x length of genital capsule; apex of digitus sharp-pointed and with one digital spine (Fig. 5).

Morphological variation. Males vary primarily in the degree of coloration of the mesosoma: 6.2% of the specimens lack the central spot on the scutellum and one specimen has three spots on the propodeum. Both females and males some-

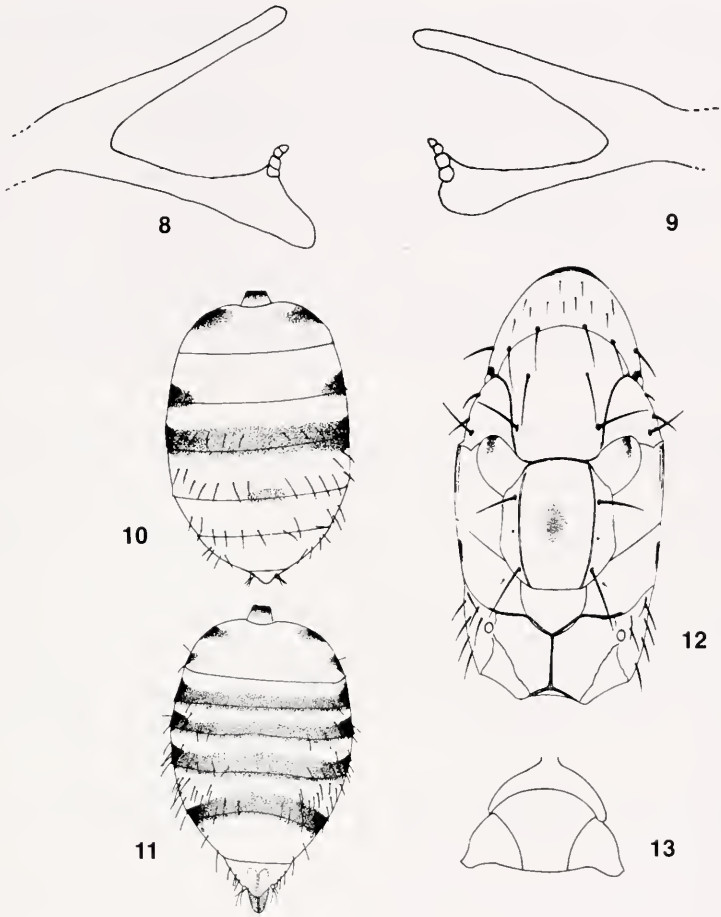


Figs. 1-7. *Cirrospilus neotropicus* **n. sp.** (1, 2, 3, 5, and 6), *Cirrospilus ingennus* Gahan (4, 7). **1** antenna ♂; **2** flagellum ♀; **3** head in posterior view; **4** head in posterior view; **5** aedeagus; **6** genital capsule; **7** digitus.

times have the anterior, median and posterior carinae of the propodeum light brown rather than dark brown. Females and males also vary in the number of setae on the midlobe of the mesoscutum.

Type material of *C. neotropicus* n. sp. is deposited in the Collections of: **IMLA** Instituto Miguel Lillo, Tucumán, Argentina: ♀ Holotype and 15 ♀ and 12 ♂ Paratypes; **MCNLP** Museo de Ciencias Naturales de La Plata, Argentina: 1 ♀ and 1 ♂ Paratypes; **USNM** United States National Museum, Washington, DC: 1 ♀ and 1 ♂ Paratypes; **FSCA** Florida State Collections of Arthropods, Gainesville, Florida, USA: 1 ♀ and 1 ♂ Paratypes; **BMNH** British Museum of Natural History, London: 1 ♀ and 1 ♂ Paratypes.

Specimens studied. All specimens were reared from *Phyllocnistis citrella* on citrus. Holotype female, **Argentina:** TUCUMÁN: Horco Molle, 1-I-2000, P. Diez and E. Frías coll.; Paratypes:



Figs. 8-13. *Cirrospilus neotropicus* **n. sp.** (8, 10 - 12), *Cirrospilus ingenuus* Gahan (9, 13). **8** postmarginal and stigmal veins; **9** postmarginal and stigmal veins; **10** gaster mm; **11** gaster ff; **12** thorax ff; **13** anterior half of thorax showing notauli.

TUCUMÁN: Horco Molle, 1-II-2000, P. Diez and E. Frías coll. (1 ♂). CATAMARCA: Villa Capayán (ca. Concepción), 4-II-2000, O. Luque col. (5 ♀ y 6 ♂); Colonia del Valle, 4-II-2000, O. Luque col. (8 ♀ y 3 ♂); 26-II-2003, O. Luque col. (7 ♀ y 7 ♂).

Distribution. Neotropical, from Mexico to Argentina (Schauff et al., 1998): México, Honduras, Colombia, Brasil, Argentina, and Bolivia (new record). In Argentina it is present in the provinces of Salta (Los Tucanes, Ruta Nacional 34, km. 1,286), JUJUY (Finca Lucero, ca. Ledesma; Yuto), TUCUMÁN (Horco Molle, S. M. de Tucumán, Tafí Viejo), CHACO (Makallé), SANTA FE (Villa Ocampo) and CATAMARCA (Colonia del Valle, Villa Capayán).

Etymology. This species is named for the Neotropical region where *C. neotropicus* n. sp is widely present.

Remarks. According to Schauff et al. (1998) "this species is very similar in coloration to *C. ingenuus* Gahan, but is distinct on morphological characters." *C. ingenuus* is native to Asia and was introduced in Florida (USA) where it is apparently established (La Salle et al., 1999). Recently Evans (1999) described *C. floridensis* reared from CLM in Florida so there are at present three known species of *Cirrospilus* attacking CLM in the New World. After studying five specimens (3 ♀ and 2 ♂) of *C. ingenuus* from USA (Florida, Homestead, 26-vii-2000, P. Diez col., Ex *P. citrella* on citrus) and based on the Gahan (1932) description and on Evans' description of *C. floridensis,* we observed the following differences in these species which we present in the following key:

1 Notauli converging distinctly posteriorly as they reach hind margin of mesoscutum (Fig. 13); propodeum very coarsely sculptured, (as the hind coxae on the outer side), with a delicate median carina but without lateral folds; stigma not extending much beyond base of uncus; uncus only slightly recurved; postmarginal vein 1.2x longer than the stigmal vein; male genitalia with the apex of the digitus rounded and with two digital spines (Fig. 7); dark spot (sunglasses-shaped spot) around occipital foramen (Fig. 4) ..... *Cirrospilus ingenuus* Gahan

• Notauli converging posteriorly in it first third, but becoming almost parallel as they reach hind margin of mesoscutum (Fig. 12); propodeum with a prominent median carina (smooth on anterior half and with minute carinae on the posterior half), hind coxae with shallow sculpture; stigma extending beyond base of uncus (~ 2 uncus-lengths), uncus distinctly recurved; postmarginal vein always shorter than stigmal vein; male genitalia with the apex of digitus sharp and with one digital spine (unknown in *C. floridensis*) (Fig. 5); dark spot around occipital foramen absent, only a line dorsal (Fig. 3). 2

2 Female: first tergite of gaster with two dark spots on each lateral margin. Male: gaster with two dark transverse bands medially on dorsum. Both mesoscutum with a dark band along anterior and posterior margin ..... *Cirrospilus floridensis* Evans

• Female: first tergite of gaster with one dark spot on each lateral margin (Fig. 10). Male: gaster with one dark tranverse band medially on dorsum (Fig. 10); both: mesoscutum without dark bands ..... *Cirrospilus neotropicus* Diez and Fidalgo

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PERISTENUS DIGONEUTIS (HYMENOPTERA: BRACONIDAE), A PARASITE OF *LYGUS LINEOLARIS* (HEMIPTERA: MIRIDAE) IN NORTHEASTERN UNITED STATES ALFALFA, AND THE NEED FOR RESEARCH ON OTHER CROPS[1]

W. H. Day,[2] A. T. Eaton,[3] R. F. Romig,[4] K. J. Tilmon,[5] M. Mayer,[6] and T. Dorsey[6]

ABSTRACT: The tarnished plant bug (TPB), *Lygus lineolaris* (Palisot), damages a wide variety of important crops in North America. *Peristenus digoneutis* Loan, a European parasite established to provide biological control of this plant bug, has reduced TPB numbers in alfalfa for ten years. Damage to apple fruit in New Hampshire during the same time period has been reduced by 63%, and it appears that biological control is responsible for this decrease. Moderate to high parasitism rates by *P. digoneutis* have also been observed in strawberries, vetch, red clover, and weeds. *P. digoneutis* is dispersing on its own, and has been found in 62 counties in eight states, and in Canada. Additional research is needed on the parasitism of *L. lineolaris* on apples and other crops, and on movement of the parasite into new areas.

KEY WORDS: *Peristenus digoneutis*, Hymenoptera, Braconidae, *Lygus lineolaris*, Hemiptera, Miridae, alfalfa.

Lygus lineolaris (Palisot), the tarnished plant bug (TPB) (Hemiptera: Miridae), is a moderate to serious pest of a wide variety of crops—fruits (Bobb 1970, Guest 1999, Mailloux and Bostanian 1988, Weires et al. 1985), vegetables (Boivin et al. 1991, Guest 1999, Hagle 1978), crops grown for seed (Gupta et al. 1980, Scott et al. 1966, Wise and Lamb 1998), tree seedlings (Schowalter and Stein 1987), and cotton (Scott et al. 1985). Large numbers of TPB often are produced in forage crops (alfalfa and red clover), but usually they are thought to only damage these crops when they are grown for seed. However, when alfalfa or clover is harvested for hay, large numbers of adult TPB may fly into high-value crops, where they may cause serious yield and quality losses. For example, apples are damaged when TPB adults puncture the small fruit, which later become distorted at the feeding site as the fruit grows. Many affected apples will be so blemished or misshapen that they cannot be sold, or bring very low prices. Peaches, strawberries, raspberries and blackberries are similarly distorted, and fruit yield / quantity is also reduced.

Early research (Day 1987) showed that parasitism of the TPB, a native species, in alfalfa by native parasites was very low. Consequently, parasites of the European tarnished plant bug *(L. rugulipennis)* were collected by the USDA

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[2] USDA-BIRL, 501 S. Chapel Street, Newark, DE 19713. E-mail: wday@biir.ars.usda.gov.

[3] Plant Biology Department, University of New Hampshire, Durham, NH 03824.

[4] West Chester State University. Present address: 13 Linda Lane, Fleetwood, PA 19522.

[5] Entomology Department, Cornell University, Ithaca, NY 14853.

[6] New Jersey Dept. of Agriculture, Trenton, NJ 08625.

Mailed on June 23, 2004

European Biological Control Lab, and these were released by WHD at two locations in NJ and one in DE. The plan was to establish one or more parasites in alfalfa, because this is a common crop in the northeast U.S. (10 million acres), so it could serve as a reservoir for the parasite. Alfalfa is especially suitable because it is not frequently sprayed with insecticides (due to the successful biological control of the alfalfa weevil, blotch leafminer, and pea aphid initiated by the USDA). Establishment of an effective parasite could reduce TPB damage indirectly (via reduction in the number of TPB adults leaving alfalfa for susceptible crops) or directly (by reducing TPB numbers in fruit and vegetable crops).

Peristenus digoneutis Loan, a small parasite (Hymenoptera: Braconidae) of TPB nymphs, was established in northwestern New Jersey by the first author in 1984 (Day et al. 1990). It has two generations per year, which attack the two principal generations of the TPB, and was soon killing 50 percent of nymphs. By 1993 this parasite had been detected in nine counties, in parts of four states (Fig. 1, 1993 line). And, in our long-term alfalfa monitoring fields in northwestern New Jersey, the parasite had reduced TPB numbers by 65% (Day 1996).

Peristenus digoneutis has continued to disperse in all directions but south, where it is likely limited by summer temperatures (Day et al. 2000). *P. digoneutis* has now been detected in 62 counties in 8 states, and in Canada (Fig. 1). The objective of this paper is to present data on TPB damage to apples during a 20-year period, which it is hoped will stimulate research on other crops damaged by the TPB, at locations where the parasite is present.

METHODS

Tarnished plant bug nymphs were collected in alfalfa fields, using a sweep net, near Blairstown, New Jersey (lat. 41°00' N, long. 75°00' W, elevation 160-290 m). Three fields were sampled weekly with a sweep net from early May through July, when this mirid is most abundant, and biweekly from August to October. The data in Figure 2 show the average numbers of TPB nymphs each year: each number is an average of the maximum (peak) number sampled during the first and second generations (which usually occur in late June and late July); each number per generation is an average of three fields. Data are presented for 19 years. Additional details on the sampling methods are in Day (1996).

Each year, apples were examined at harvest, in 15-28 commercial orchards (avg. 23) across New Hampshire. An average of 11,500 apples (500 per orchard) were checked for defects per year, and the percentage damaged by the TPB was recorded. The average injury over all orchards each year, for 20 years, is presented in Figure 3. The pre- and post-biocontrol means for both TPB numbers and apple damage were compared by an analysis of variance, using years as replicates. The percentage damaged apples data were normalized using the arcsine transformation (Snedecor 1956) before the data were analyzed.

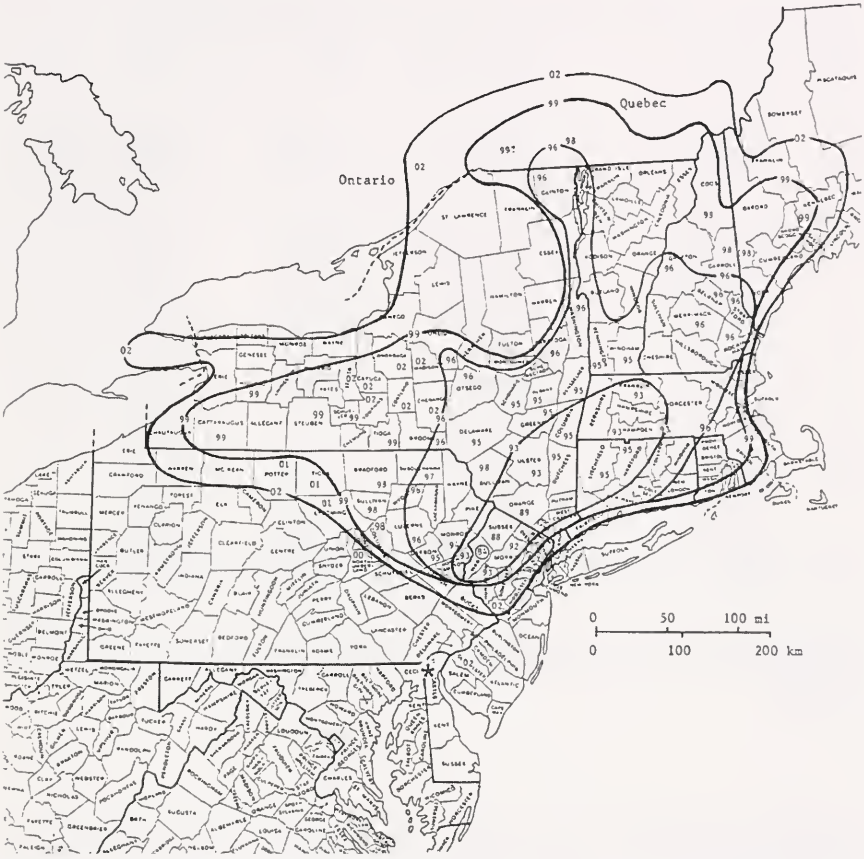

Figure 1. The known distribution of *Peristenus digoneutis* in the northeastern United States and southeastern Canada as of March 2003. March 2003. This map is from Day et al. 2000, updated by an additional 13 county records obtained in 2000-2002 (locations and dates are in Table 1). The Canadian records are from Broadbent et al. 1999. The numbers in the counties indicate where and when the first recovery was made. In most cases, this was the first attempt to detect this species, so it had arrived earlier. The heavy lines depict the probable dispersion of the parasite by 1993, 1996, 1999, and 2002.

RESULTS AND DISCUSSION

Previous research (Day 1996) documented the large increase in parasitism of TPB nymphs caused by *P. digoneutis* from 1985 through 1992, and the rapid decrease in TPB numbers from 1990-1993. Figure 2 shows that the TPB has remained at low levels during the six years (1994-1999) since then. The overall result is a population reduction of 65%, for eight consecutive years.

Table 1. New country detection records* for *P. digoneutis*, 2000-2002

State	County	Nearest town	Date	Author
NJ	Mercer	Pennington	7/29/02	Day
	Gloucester	Aura	7/18/02	Mayer & Dorsey
NY	Cayuga	Scipio Center	6/26/02	Romig
	Chenango	Norwich	6/24/02	Romig
	Cortland	Marathon	6/27/02	Romig
	Madison	Nelson	6/25/02	Romig
	Onondaga	Pompey	6/25/02	Romig
	Seneca	Fayette	6/26/02	Romig
	Tompkins	Lansing	6/26/02	Romig
PA	Northumberland	Elysburg	7/27/00	Romig
	Lycoming	Calvert	7/23/01	Romig
	Potter	Brookland	7/31/01	Romig
	Tioga	Wellsboro	8/01/01	Romig

* Females were reared from field-collected nymphs. Females are positive evidence of an established parasite population (females can only be produced by mated female parents, so both sexes were present).

During the same time period, damage to apples by the TPB decreased by a similar amount (63%) for 10 years (Fig. 3). Although no concurrent TPB counts had been made in these orchards, the striking similarity between Figs. 2 and 3 suggests that a general decrease in TPB numbers occurred. The parasite was numerous enough to be detected the first year it was looked for (1996, Fig. 1; Day et al. 2000), so it must have been present in New Hampshire for several years. In addition, the high parasitism rates observed in alfalfa (Day 1996), and in weeds and cover crops (Tilmon 2001, RFR unpubl.), indicate that TPB numbers should be reduced over large areas—so fewer TPB adults should be available to fly into apple orchards to feed on (and injure) the young apples.

Field samples in the northeastern states by the authors have found *P. digoneutis* parasitizing significant numbers (30% or more) of TPB nymphs in alfalfa, vetch, strawberries, and weeds (chickweed, fleabane) (Tilmon 2001, and WHD unpubl.). Parasitism levels are now high enough in several crops and weeds that research on the value of biological control can be conducted in many northeastern locations. Such studies are needed on strawberries, apples, peaches, raspberries, beans, and other crops. If anyone is interested in starting cooperative or independent research, contact the first author.

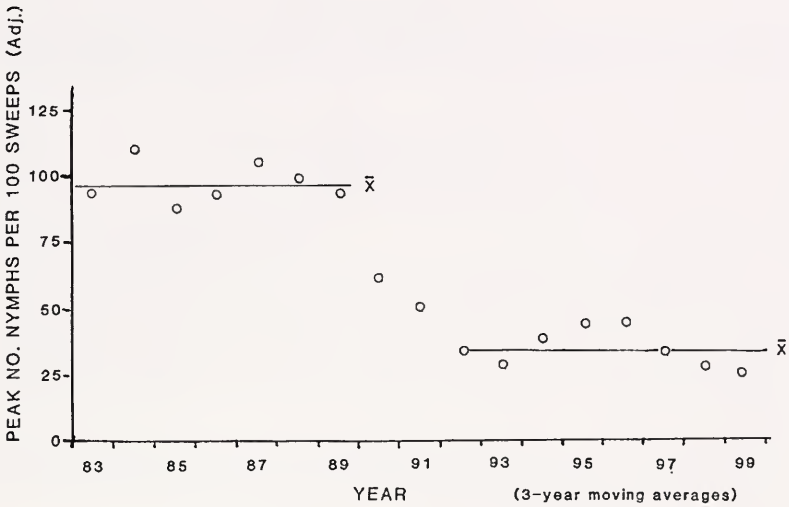

Figure 2. The abundance of tarnished plant bug nymphs in alfalfa, in northwest New Jersey, 1983-1999. The two averages ("before biocontrol" and "after biocontrol") are statistically different (F = 267; df = 7,1; P < 0.001).

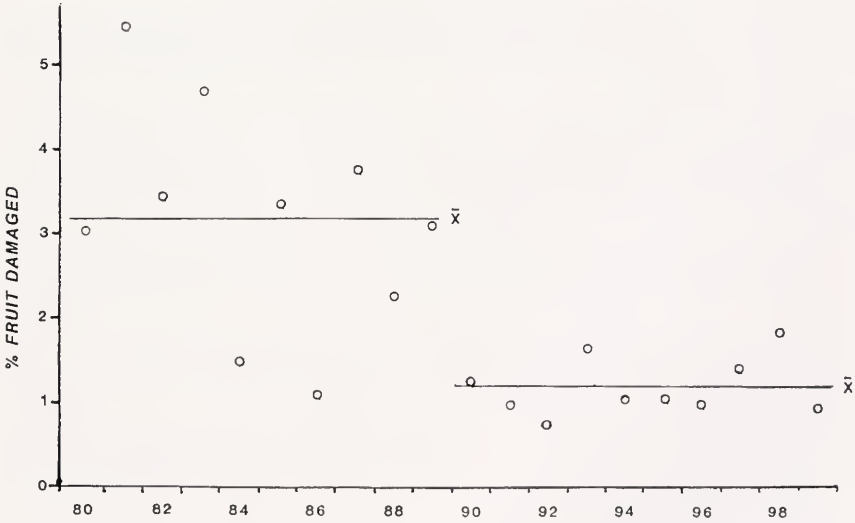

Figure 3. The incidence of tarnished plant bug injury to apples in New Hampshire, 1980-1999. The "before" and "after" averages are statistically different (F = 26.7; df = 9,1; P < 0.001).

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DITCHING AT SEA: PREDATOR AVOIDANCE BY THE ATLANTIC MARINE SHORELINE TIGER BEETLE, *CICINDELA MARGINATA* F. (COLEOPTERA: CARABIDAE)[1]

Foster Forbes Purrington[2]

ABSTRACT: The stenotopic marine shoreline tiger beetle, *Cicindela marginata* responds to threat, presumably chiefly from shore birds, in its Atlantic tidal mud flats habitat by flying out over salt water and deliberately ditching. After a brief hesitation it flies off the water and returns to shore.

KEY WORDS: *Cicindela marginata*, Coleoptera, Carabidae, predator avoidance.

Along the shoreline mouth of estuarine Mattapoisett River (Mattapoisett, Plymouth County, Massachusetts), I observed a population of *Cicindela marginata* F. (Coleoptera: Carabidae: Cicindelinae) on tidal mud flats colonized by smooth cordgrass, *Spartina alterniflora* Loisel; ribbed mussel, *Geukensia demissa* (Dillwyn); and the mud fiddler crab, *Uca pugnax* (Smith). When threatened by my approach, these tiger beetles typically flew seaward a distance of circa 5 meters, landed briefly on the saltwater surface and then flew back to shore, often into dense cordgrass where they remained motionless for several minutes. My observations, on July 25, 2003, extended for circa two hours in bright sun and light winds, during which time I saw 20 or so such deliberate ditching flights.

DISCUSSION

While Cicindelinae include many stenotopic species inhabiting shorelines more-or-less exclusively, there are almost no reports of water escape strategies to avoid predation. Larochelle and Lariviere (2001) state (without attribution) that *C. gabbii* (G.H. Horn) is "often seen floating backwards (sic) upon the ocean water near its shore habitat," seeming to imply a deliberate predator avoidance ditching flight such as I report herein for *C. marginata*. However, they do not specify a return *flight* to shore by *C. gabbii*. Detailed population studies of southern California stenotopic marine shoreline tiger beetles by Nagano (1982) included *C. gabbii* but he made no mention of sea ditching escape behavior, nor did he in his later article on California Channel Islands cicindelines (Nagano 1985). Cazier (1954), in discussing that species, also does not mention this behavior.

Ditching behavior by *C. marginata* is not mentioned in three recent local natural histories of eastern cicindelines (Glaser 1984, Knisley and Schultz 1997, Leonard and Bell 1999), and Gould (1834) notes only that adults retreat "to the high grass" when threatened, or when the tide comes in. In fact, in ten pages

[1] Received on December 23, 2003. Accepted on February 17, 2004.

[2] Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, 300 Aronoff Laboratory, 318 W. 12th Avenue, Columbus, Ohio 43210. E-mail: purrington.1@osu.edu.

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devoted to predator avoidance and escape strategies, Knisley and Schultz (1997) do not mention any strategy that involves water. Davis' (1903) report on Rhode Island tiger beetles does not include this species.

Pearson and Vogler (2001) devote a chapter to predator avoidance by tiger beetles but make no mention of water escape strategies. In their Appendix B (p. 276), however, they cite Cummin's (1992) report of an elaborate water escape behavior by a tropical Megacephalini species, *Oxycheila polita* Bates in Costa Rica, adding (without attribution) that of 46 known congeners many other *Oxycheila* species use this strategy, although Cummins (1992) does not mention this. *Oxycheila polita* forages along rocky edges of fast-flowing streams. When approached, it jumps or flies into turbulent water and is transported submerged up to "several hundred feet" whereupon it flies up and out of the water (Cummins 1992).

A less complex water escape strategy is reported for *C. marginata* by Johnson (1972) in his anecdotal Gulf Coast travelogue, collecting them in the Florida Keys with some difficulty because they often avoided him by flying out over salt water, but he does not mention ditching. In another southeastern tiger beetle collecting travelogue, Lawton (1970) notes that of an abundant *C. marginata* population in the Florida Keys, every shoreline escape flight was made "well out over the water for some distance" rather than upbeach or inland. This same tactic is reported for *C. hamati monti* Vaurie, that flies out over open water of freshwater pools on South Padre Island, Texas, to avoid predation (Ideker 1977). I have seen *C. repanda* Dejean do this along sandy beaches of Lake Erie, east of Cleveland, Ohio. Given the very close proximity of shorelines to populations of many tiger beetle species, it would not be surprising if adults routinely made use of water overflights to evade collection by humans and shore birds.

Amphibious behavior by tiger beetle adults has been reported in other contexts. Larochelle and Lariviere (2001) mention that *C. nevadica knausii* Leng and *C. willistoni echo* Casey enter shallow water (2.5 cm. deep) on foot, presumably to hunt for prey. *Cheiloxia binotata* Castelnau flies in large swarms low over Peruvian rivers at dusk and throughout the night, regularly skating on the water surface in pursuit of prey (Pearson 1984). Nocturnal ocean foraging by a tiger beetle was reported by Roth and Brown (1980). They cited J. R. Hendrickson's (personal communication) report of *C. sinaloae schrammeli* Cazier landing at night on the Gulf of California six miles out to feed on arrowworms (Chaetognatha), some species of which are luminescent, which may be relevant to their accessibility to a nocturnal predator. This precinctive subspecies is known only from marine shorelines in Mexico at the head of the Gulf in Sonora and Baja California (Cazier 1954).

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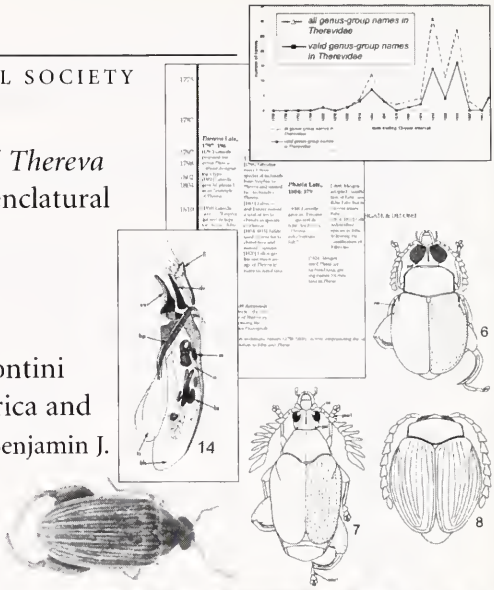

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SCIENTIFIC NOTE

FIRST NEARCTIC RECORDS OF *TEMPISQUITONEURA* (DIPTERA: CHIRONOMIDAE: ORTHOCLADIINAE) From Arizona, USA[1]

Gary T. Lester,[2] Brian J. Krestian,[2] and John H. Epler[3]

Aquatic macroinvertebrates are increasingly being used as biological indicators of water and habitat quality in many water quality programs throughout North America (Barbour *et al.* 1999). The Western Environmental Monitoring and Assessment Program (WEMAP) is a four-year study of water quality of rivers and streams across 12 western states being conducted by the United States Environmental Protection Agency (USEPA). Included in this study is the collection and taxonomic analysis of aquatic, benthic macroinvertebrates. While processing benthic invertebrate samples for this project, taxonomists (BJK and GTL) at the environmental consulting firm EcoAnalysts, Inc., encountered larval Chironomidae that were not represented in any literature for North America. Specimens were sent to the third author (JHE) for examination, whereupon the larvae were determined to be *Tempisquitoneura merrillorum* Epler. There are too few collections of *T. merrillorum* as of yet to determine any water quality associations for this species.

Tempisquitoneura merrillorum was described from specimens collected in Costa Rica (Epler and de la Rosa 1995). Larvae were reported to be strictly symphoretic on *Corydalus* sp. larvae, attaching themselves to either the abdominal gills or thorax of the host. Pupae were found in constructed silken cases attached laterally to the thorax. Larvae and pupae collected in Arizona were found attached to *Corydalus* sp. larvae in a manner identical to those reported from Costa Rica.

The occurrences of *T. merrillorum* in Arizona represent the first Nearctic records of the genus. Figure 1 shows the geographic location of sample locations. Specimens reported herein are deposited in the collection at the EcoAnalysts, Inc. Macroinvertebrate Laboratory in Moscow, Idaho (EI), and the Florida State Collection of Arthropods at Florida A&M University in Tallahassee (FAMU). Collection data and specimen disposition are as follows:

ARIZONA: 10 larvae, Gila County, Tonto Creek, Lat. 34.28333, Long. 111.07086, V-22-2001, A. Francis (2 larvae FAMU, 8 larvae EI); One larva, Greenlee County, Blue River, Lat. 33.24044, Long. 109.1915, VI-19-2001, P. Matson (EI).

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[1] Received on February 13, 2003. Accepted on March 13, 2004.

[2] EcoAnalysts, Inc., 105 East Second Street, Suite #1, Moscow, ID 83843, U.S.A.
E-mail: eco@ecoanalysts.com.

[3] 461 Tiger Hammock Road, Crawfordville, FL 32327, U.S.A.

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EcoAnalysts, Inc. also encountered several larvae and one pupa with a pharate male in Arizona in 2002. Data for this collection is unavailable for publication due to confidentiality concerns of the client. The pupa and two larvae are deposited at FAMU with a coded sample location.

Physical habitat and water quality data for the two localities are presented in Table 1.

Table 1. Water quality parameters (grab samples) at *T. merrillorum* locations. These are one-time grab samples collected at the same time as the benthic invertebrate sample at each site. No means or variation are associated with the values.

Chemical Variable (mg/l)	**Tonto Creek**	**Blue River**
pH	8.65	9.12
Conductivity	296.8	426.8
Alkalinity	2909.27	3054.62
Turbidity	11.3	0.298
Total Suspended Solids	38.7	2.2
Dissolved Organic Carbon	1.86	1.99
Dissolved Inorganic Carbon	35.84	35.54
Total Phosphorus	55	40
Calcium	41.715	39.328
Magnesium	11.081	12.947
Sodium	2.831	31.394
Potassium	0.79	2.335
NH_4	0.016	0.005
SO_4	13.38	17.82
NO_3	0.02	0
Chlorine	2.94	36.86
Total Nitrogen	2.94	36.86
Zinc	0.006	0.005
Silicon Dioxide	7.701	34.06

DISCUSSION

Epler and de la Rosa (1995) discuss taxonomic similarities and differences among *Thienemanniella*, *Corynoneura*, and *Tempisquitoneura* larvae and pupae in detail. Whole (unmounted) *Tempisquitoneura* larvae are generally similar in appearance to the closely related *Thienemanniella* and the genus is usually found attached to its corydalid host. Consequently, to date they may have been simply overlooked in benthic samples or misidentified as *Thienemanniella* sp. The pupa

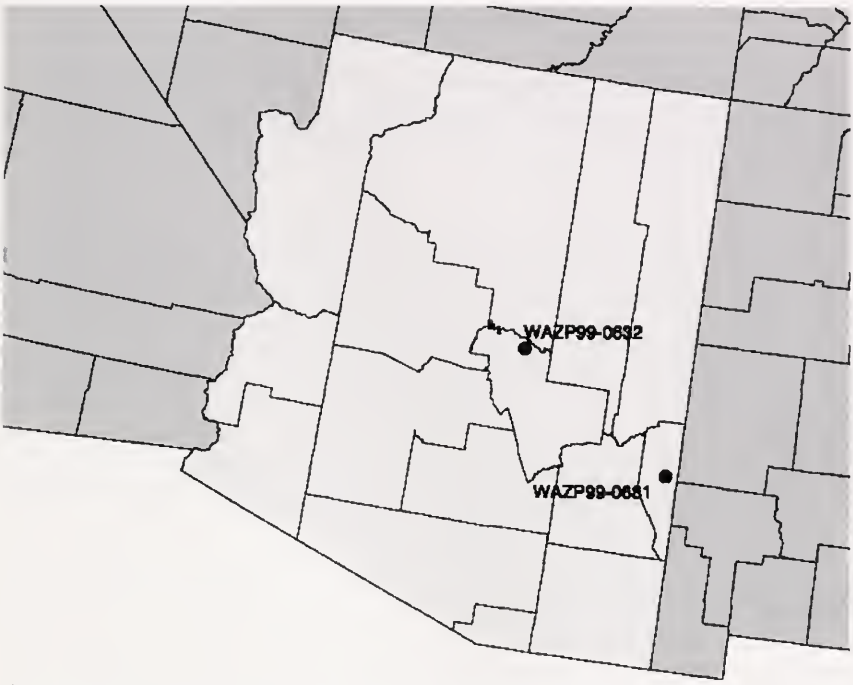

Figure 1. Locations of *Tempisquitoneura merrillorum* Epler in Arizona, southwestern U.S.A. site WAZP99-0632 is located in Tonto Creek whereas site WAZP99-0681 is located in the Blue River.

of *Tempisquitoneura* is probably separable from the other two genera by the incomplete setal fringe of the anal lobes, which is restricted to the apical half (Epler and de la Rosa 1995, Figure 3D), in addition to other characters listed in the original description.

ACKNOWLEDGEMENTS

We thank Phil Larsen, Dave Peck and Barb Rosenbaum (USEPA) for permission to publish data and for habitat and water quality data collected at the site. This paper is published as EcoAnalysts, Inc. Publication No. 2004-1.

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BOOK REVIEW

NATURAL ENEMIES. AN INTRODUCTION TO BIOLOGICAL CONTROL. Ann Hajek. 2004. Cambridge University Press, Cambridge, CB2 2RU United Kingdom. Hardback, US$110.00 (ISBN 0 521 65295 2). Paperback, US $50.00 (ISBN 0 521 65385 1).

Natural Enemies is intended as a college textbook for those who are at an intermediate level of readiness (*e.g.* at least one college biology course) to learn about biological control. The book is arranged in a traditional, rational, and well-organized fashion. Hajek introduces the subject and its current historical backdrop (Chapters 1-2) and then provides useful discussions of three non-mutually exclusive strategies of biological control: classical, augmentative (inoculative and inundative), as well as conservation (Chapters 3-5). Throughout the book, she emphasizes the need for sound knowledge of the systems, a goal seldom achievable, so that rational integrated pest management decisions can be taken. Thereafter, Hajek includes excellent chapters on biological control of pestiferous animals (Chapters 6-12), weeds (Chapters 13-15), and plant pathogens (Chapters 16-17). The book concludes with very timely discussions on safety (Chapter 18), and present uses of biological control (Chapter 19). Most illustrations are excellent; some of them are gorgeous scanning electron micrographs. *Natural Enemies* closes with a useful glossary, a substantial list of references, and an index.

Hajek highlights numerous important topics, such as: 1) dire need for sound taxonomic work, including characterizing the ecology and genetics of target organisms and the natural enemies using diverse approaches, 2) whether a "balance of nature" is ever attained in biological control, 3) biological control strategies depend on the targeted pest, 4) difficulties rearing numerous organisms involved in biological control, 5) factors that increase the probability of survival of natural enemies, 6) importance of market considerations, 7) situations where biological control may not necessarily be the best way to proceed, 8) public perception of the field as environmentally friendly (in contrast with genetic engineering perceived by some as not so environmentally friendly), and many others. While none of these themes are new to biological control, she often brings fresher examples from a wide array of taxonomic groups as well as strong ecological insights to support her assertions.

Natural Enemies is a good summary of the intersection between entomology, plant pathology, microbiology, ecology, host-pest-environment interactions, and others, as they apply to the biological control of insect pests, weeds, and pathogens. The book contains knowledge useful in the development of biological control practices that are compatible with integrative pest management. In spite of *Natural Enemies'* emphasis on cases of biological control in the Holarctic region, particularly the U.S.A., the book offers a fair balance of topics and serves as an excellent introduction to the subject. My personal preference would have been to: 1) incorporate the citations in the text, although I acknowledge some readers find that practice distracting, 2) add chapters on the identification of organisms (e.g. plants to the level of division, insects to the ordinal level) with major references to lower taxonomic levels and/or for different geographical regions, experimental design, and statistical analyses, and 3) include more cases involving point/counterpoint arguments, such as issues involving conflict of interests/values. Finally, end of chapter questions and/or activities, a practice common in introductory biology/ecology textbooks, would have made this text more viable for classroom use.

Biological control is a complex scientific endeavor and at times "many decisions ... seem more like art than science." *Natural Enemies* stresses the complexities of the natural world, repeatedly warns us about the meticulousness that must be exercised in their study and safe practice, and still manages to keep the subject attractive and readable.

Jorge A. Santiago-Blay, Department of Paleobiology, MRC-121
National Museum of Natural History, Smithsonian Institution
P. O. Box 37012, Washington, District of Columbia 20013-7012 U.S.A.
E-mail: santiago-blay@nmnh.si.edu

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SOCIETY MEETING OF OCTOBER 23, 2002

Population genetics of *Parnassius* butterflies in the Northern Rockies, Canada

Nusha Keyghobadi

The Academy of Natural Sciences, Philadelphia, Pennsylvania, U.S.A.
(now at Okanagan University College, British Columbia, Canada)

Habitat fragmentation is currently considered one of the most serious problems for nature conservation. From a genetic perspective, the increased isolation of populations that results from habitat fragmentation is predicted to have two major effects on genetic variation, with genetic differentiation among populations predicted to increase and genetic diversity within populations predicted to decrease. Dr. Nusha Keyghobadi examined the genetic consequences of habitat fragmentation on populations of the alpine butterfly *Parnassius smintheus*. This butterfly tends to occupy alpine meadows above tree line where its hostplant, *Sedum lanceolatum*, occurs. In the last century, increasing tree cover and the increase in elevation of the tree line has been observed in North America and is attributed to climate change and forest management practices. Increasing forest cover at high altitudes leads to fragmentation of the meadow habitats favored by this butterfly.

Dr. Keyghobadi examined whether (1) the amount of genetic differentiation among populations and (2) levels of genetic diversity within populations, were affected by the degree of isolation of these populations, particularly by intervening forests. Her study was conducted in a series of alpine meadows distributed along ridges in the front ranges of the Canadian Rocky Mountains. Genetic variation was assessed using microsatellite DNA loci. The degree of genetic differentiation among pairs of populations was significantly correlated with the geographic distance separating those populations. Furthermore, the amount of forested habitat separating populations was a better predictor of genetic differentiation than was the amount of meadow habitat, suggesting that forested areas are significant barriers to genetic exchange among populations. Also, levels of genetic diversity were significantly lower in more isolated populations. Overall, Dr. Keyghobadi's results suggest that further fragmentation of meadow habitats will have significant impacts on genetic variation in this species.

In other entomological notes, Jack Gingrich noted the appearance of *Ochleratatus* (= *Aedes) japonicus*, an introduced species, at four sites in Delaware. Jon Gelhaus noted the re-discovery of the crane fly *Leptotarsus rivertonensis* in New Jersey after nearly a century; it had been described from specimens collected in Riverton, New Jersey, in 1903, and was found in 2002 at a scout camp in Salem County, New Jersey. Hal White noted that the niece of Philip Calvert contacted the Society through seeing the Society's webpage on the Calvert Award. Philip Calvert (1871-1961) was a noted worldwide authority of Odonata, and long-term member of the Society, including serving 23 years as editor of *Entomological News*.

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

Mailed on June 23, 2004

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THREE NEW SPECIES AND ONE NEW SUBSPECIES OF COLPURINI (HETEROPTERA: COREIDAE) FROM THE PACIFIC ISLANDS[1]

Harry Brailovsky[2] and Ernesto Barrera[2]

ABSTRACT: Three new species *Kerzhnerhygia nubila* from Irian Jaya (Dutch New Guinea), *Sciophyrella cerama* from Ceram Island, *Sciophyrella submacroptera* from Papua New Guinea, and one new subspecies *Brachylybas novoguinensis furcatus* from Irian Jaya, are described. Adult dorsal habitus of some species are illustrated, and drawings of pronotum, male genital capsule, and female genital plates are included.

KEY WORDS: Heteroptera, Coreidae, Colpurini, new species, Pacific Islands.

The Colpurini fauna of the Pacific Islands is poorly known due to its complex geography and the lack of intensive appropriate field research. What is presently known, nevertheless, indicates such a fauna as being outstanding in richness and interesting, with an unusually high rate of endemic elements (Brailovsky 2000, Brailovsky and Barrera 2003).

The paper is a further contribution to the knowledge of this tribe and provides the descriptions of three new species and one new subspecies.

Brachylybas novoguinensis furcatus, NEW SUBSPECIES
(Figs. 2-3, 16)

Description.-Male (holotype). Dorsal coloration. Head black, with postocular tubercle yellow and apex of tylus bright chestnut orange; antennal segments I to III bright chestnut orange, IV segment yellow with basal third bright chestnut orange; pronotum with anterior and anterolateral margins dark yellow; anterior lobe of pronotal disk dark brown with medial longitudinal furrow between calli black; posterior lobe of pronotal disk dark yellow with punctures reddish brown; clavus and corium reddish brown with claval vein, claval comissure, corial veins, apical margin, and costal margin dark yellow; hemelytral membrane dark brown to black with veins dark yellow; connexival segments reddish brown with anterior and posterior border yellow; dorsal abdominal segments dark to bright brownish orange. **Ventral coloration.** Head black; rostral segments dark yellow; thorax and abdominal sterna dark yellow with punctures reddish brown; prosternum, mesosternum, metasternum, coxae, fore and middle femora, tarsi, and genital capsule bright chestnut orange; trochanters yellow; hind femur and tibiae chestnut orange with one or two irregular yellow rings, one subbasal, and one near middle third. **Structure.** Rostrum reaching middle third of abdominal sternite V; humeral angles subtruncate, not exposed (Fig. 2). Genital capsule: Posteroventral edge with long, broad, bifid tube, directed outward and upward; each arm relatively elongate (Fig. 3).

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

Measurements. Male (female). Head length: 1.60 mm (1.58 mm); width across eyes: 1.76 mm (1.72 mm); interocular space: 1.16 mm (1.04 mm); antennal segments lengths: I, 1.80 mm (1.76 mm); II, 2.80 mm (2.84 mm); III, 2.08 mm (2.04 mm); IV, 1.40 mm (1.36 mm). Pronotal length: 1.96 mm

[1] Received on July 4, 2003. Accepted on January 6, 2004.

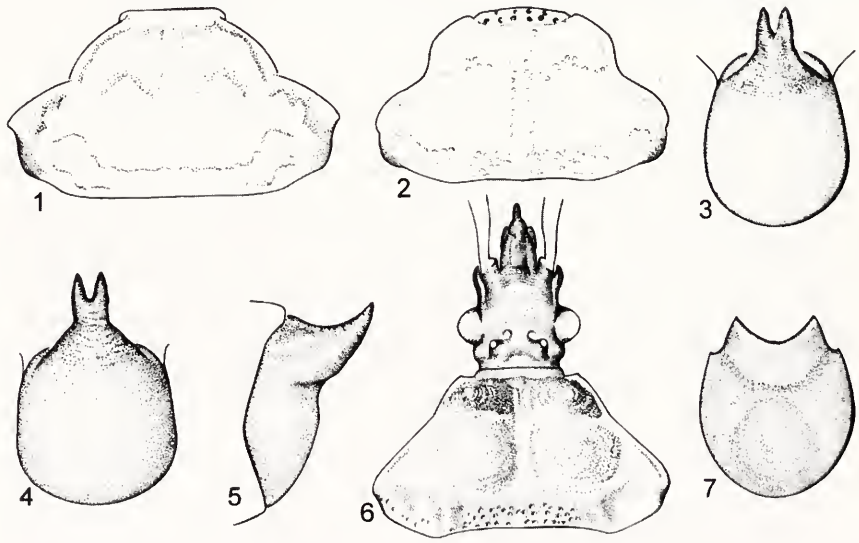
[2] Departamento de Zoología, Instituto de Biología, UNAM, Apartado Postal No. 70153, México 04510 D.F. México. Email: coreidae@servidor.unam.mx.

(2.04 mm); maximum width of anterior lobe: 2.12 mm (2.12 mm); maximum width of posterior lobe: 3.08 mm (3.08 mm): Scutellar length: 1.32 mm (1.32 mm); width: 1.38 mm (1.34 mm). Total body length: 9.08 mm (9.16 mm).

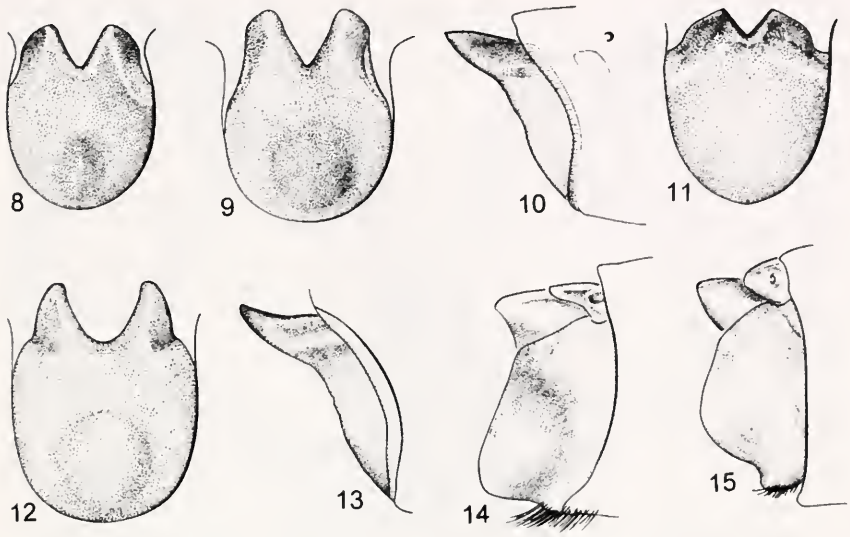
Type Material. Holotype: male, Irian Jaya (Dutch New Guinea), Jayawijaya Province, Angguruk-Tanggeam, 1500-1800 m, 28-29-IX-1991, A. Riedel. Deposited in Zoologische Staatssammlung, Munchen, Germany. **Paratypes:** 2 males, 2 females, same data as holotype. Deposited in Zoologische Staatssammlung, Munchen, Germany, and Colección Nacional de Insectos (CNIN), Instituto de Biología, UNAM, México; 1 male, Irian Jaya, Lordberg, 11-XII-1912, S. G. Burgers (Kais Augustafl Exp.). Deposited in Zoologisches Museum, Humboldt Universitat, Berlin, Germany.

Discussion. *Brachylybas novoguinensis furcatus* new subespecies, occurs in Irian Jaya and stands close to the nominal species *B. novoguinensis novoguinensis* Brailovsky & Martinez (1994) described from Papua New Guinea. In *B. n. furcatus* the humeral angles are subtruncate and not exposed (Fig. 2), the rostrum reaches the middle third of abdominal sternite V, and the posteroventral edge of the male genital capsule has a long, broad, and bifid tube, each arm being relatively elongate (Fig. 3). In *B. n. novoguinensis* the humeral angles are laminate, exposed, and subacute (Fig. 1), the rostrum reaches the anterior third of abdominal sternite V, and the tube of the male genital capsule has the arms shorter (Figs 4-5).

Etymology.-From the Latin *furcatus,* for forked, referring to the branched genital capsule.



Figures 1-2. Pronotum. 1. *Brachylybas novoguinensis novoguinensis* Brailovsky and Martinez. 2. *Brachylybas novoguinensis furcatus* NEW SUBSPECIES. Figures 3-5. Male genital capsule, caudal view (3-4), lateral view (5). 3. *Brachylybas novoguinensis furcatus* NEW SUBSPECIES. 4-5. *Brachylybas novoguinensis novoguinensis* Brailovsky and Martinez. Figures 6-7. *Kerzhnerhygia nubila* NEW SPECIES. 6. Head and pronotum. 7. Male genital capsule, caudal view.



Figures 8-15. *Sciophyrella* spp. 8-13. Male genital capsule, caudal view (8-9, 11-12), lateral view (10, 13). 8. *S. submacroptera* NEW SPECIES. 9-10. *S. cerama* NEW SPECIES. 11. *S. parva* Brailovsky and Barrera. 12-13. *S. morobe* Brailovsky and Barrera. 14-15. Female genital plates, lateral view. 14. *S. morobe* Brailovsky and Barrera. 15. *S. cerama* NEW SPECIES.

Kerzhnerhygia nubila, NEW SPECIES
(Figs. 6-7)

Description. Male (holotype). Dorsal coloration. Chestnut orange brown, with antennal segment IV (except the basal joint), anterolateral margins of pronotal disc, and apex of scutellum pale yellow; hemelytral membrane pale brown with veins darker; connexival segments bright reddish orange with posterior margin yellow; dorsal abdominal segments bright orange. **Ventral coloration.** Head bright reddish brown; rostral segments I and II dark yellow with chestnut brown reflections, and III and IV dark yellow; thorax bright reddish brown with acetabulae, upper margin of propleura, and irregular marks on mesopleura and metapleura yellow; coxae chestnut orange; trochanters and tarsi chestnut orange with yellow reflections; femora and tibiae chestnut orange with two yellow rings, one subbasal, the other near middle third; abdominal sterna and genital capsule pale chestnut orange with punctures darker; anterior lobe of metathoracic peritreme creamy yellow to pale chestnut orange, and posterior lobe pale chestnut orange; pleural abdominal segments orange with posterior margin yellow. **Structure.** Head longer than width across eyes; antenniferous tubercle armed, strongly projecting forward and inward, with the apex acutely rounded; antennal segment II the longest, III and IV subequal, and I longer than III and IV; buccula with weakly middle projection; rostrum reaching anterior margin of abdominal sternite VII; calli prominently raised, separated along midline by short longitudinal furrow; legs unarmed (Fig. 6). Genital capsule: Posteroventral edge U-shaped, with lateral arms broad, strongly produced (Fig. 7).

Female. Coloration. Similar to male (holotype). Connexival segments VIII and IX, dorsal abdominal segments VIII and IX, and genital plates bright orange with outer margin of paratergite VIII and IX yellow.

Measurements.-Male (female). Head length: 1.74 mm (1.62 mm); width across eyes: 1.40 mm (1.40 mm); interocular space: 0.90 mm (0.88 mm); interocellar space: 0.42 mm (0.44 mm); preocu-

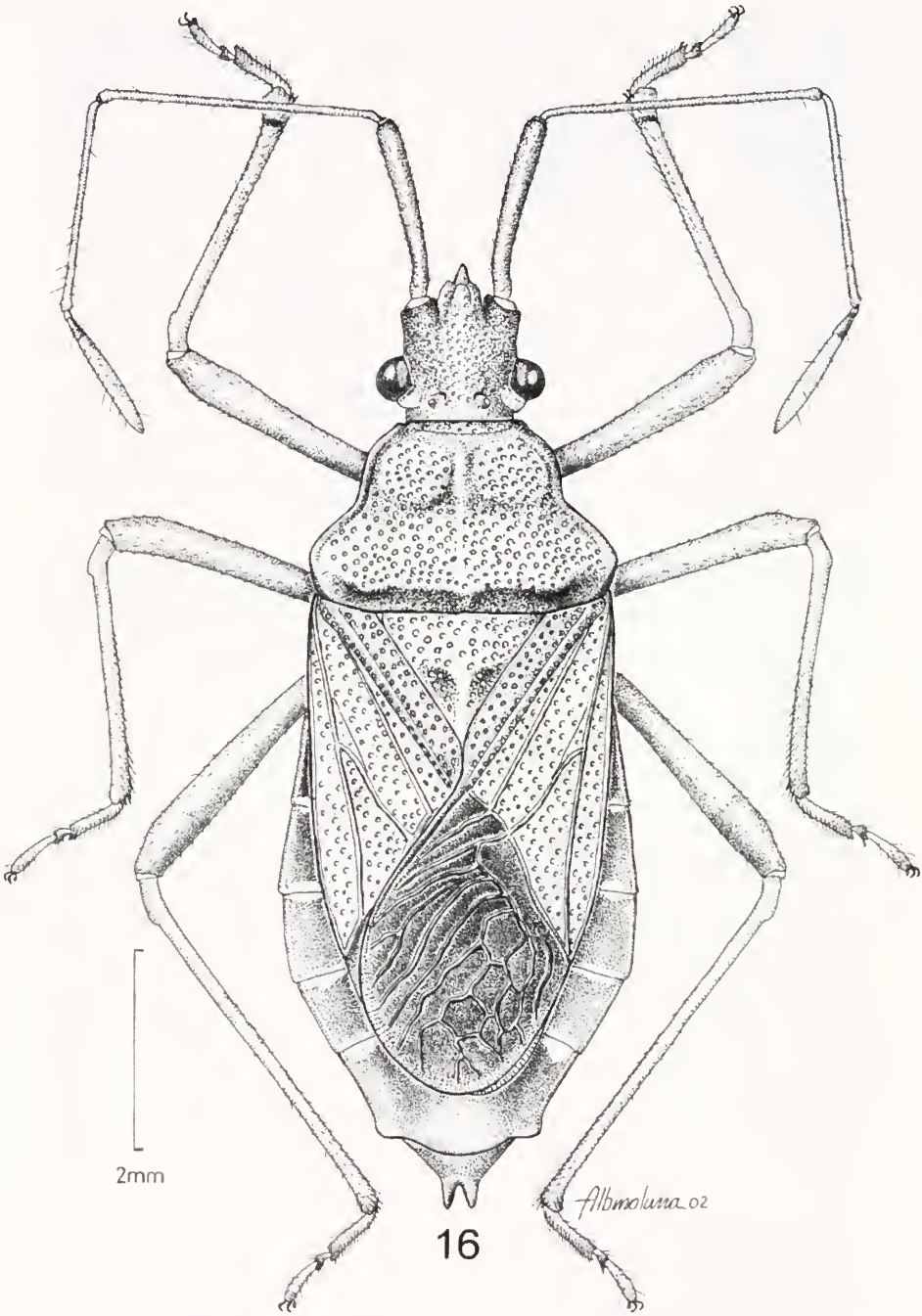


Figure 16. *Brachylybas novoguinensis furcatus* NEW SUBSPECIES, dorsal view. Male.

lar distance: 1.18 mm (1.18 mm); antennal segments lengths: I, 1.48 mm (1.48 mm); II, 2.64 mm (2.44 mm); III, 1.18 mm (1.22 mm); IV, 1.18 mm (1.22 mm). Pronotal length: 1.84 mm (1.80 mm); maximum width of anterior lobe: 1.92 mm (1.86 mm); maximum width of posterior lobe: 3.16 mm (3.32 mm): Scutellar length: 1.56 mm (1.60 mm); width: 1.48 mm (1.52 mm). Total body length: 9.80 mm (9.58 mm).

Type material.-Holotype: male, Dutch New Guinea, ger 29 km unterh d. Maanderberges a. Sepik, 11-16-VII-1913, S. G. Burgers (Kais Augustafl Exp.). Deposited in Zoologisches Museum, Humboldt Universitat, Berlin, Germany. **Paratypes:** 1 male, 1 female, same data as male holotype. Deposited in Zoologisches Museum, Humboldt Universitat, Berlin, Germany, and Colección Nacional de Insectos (CNIN), Instituto de Biología, UNAM, México; 1 female, Dutch New Guinea, Maanderberg, 10-16-VIII-1913, S. G. Burgers (Kais Augustafl Exp.). Deposited in Zoologisches Museum, Humboldt Universitat, Berlin, Germany.

Discussion.-Brailovsky (1993) described the genus *Kerzhnerhygia* and included two species *K. armata* and *K. robusta*. *Kerzhnerhygia nubila,* new species, is similar to *K. robusta* in having the femora unarmed, and is easily recognized by the head longer than wide (across the eyes), antennal segments III and IV subequal, and rostrum reaching anterior margin of abdominal sternite VII. In *K. robusta* the head is wider than long, antennal segment IV is shorter than III, and rostrum reaching anterior third of abdominal sternite III. In *K. armata* each femur are armed with two rows of long spines, the rostrum reaching the anterior third of abdominal sternite V or VI, the head is as long as wide, with antennal segment IV shorter than III, and the projection of the antenniferous tubercle clearly diverging anteriorly, not converging like in *K. nubila.*

Etymology. From the Latin *nubilus,* referring to the relatively undistinguished nature of the species.

Sciophyrella cerama, NEW SPECIES
(Figs. 9-10, 15)

Description.-Male (holotype). Dorsal coloration. Head bright dark orange brown, with pale yellow longitudinal band running from antenniferous tubercle to neck, comprising the space between eye and ocelli, and dorsal view of postocular tubercle; tylus pale bright chestnut orange; antennal segments I to III ochre yellow (IV mutilated); anterior lobe of pronotal disk bright dark orange brown with ochre yellow irregular mark at collar and calli; posterior lobe of pronotal disk bright pale chestnut orange with punctures reddish brown, external edge of humeral angles and irregular stripe at middle third yellow; scutellum, clavus, and corium pale chestnut orange with punctures reddish brown; hemelytral membrane ambarine with veins dark brown; connexivum dark orange with posterior border yellow; dorsal abdominal segments dark orange. **Ventral coloration.** Head bright dark orange brown with the area close to eyes yellow; rostral segments yellow with dark orange reflections; thorax ochre yellow with punctures reddish brown; anterior lobe of metathoracic peritreme creamy yellow, and posterior lobe dark orange; coxae dark orange brown; trochanters dark yellow; femora chestnut orange; tibiae chestnut orange with two yellow rings, one subbasal, the other near middle third; tarsi chestnut orange with yellow reflections; abdominal sterna and genital capsule ochre yellow with punctures reddish brown; pleural margin of abdominal sterna bright orange with posterior border yellow. **Structure.** Head longer than wide across the eyes, or as long as wide; tylus unarmed, apically globose or weakly bifid; antenniferous tubercle unarmed; genae with obtuse, nearly indistinct teeth; postocular tubercle protuberant, globose; ocelli weakly raised; rostrum reaching posterior border of abdominal sternite IV or anterior margin of V; pronotum bilobed; frontal and humeral angles rounded, not exposed; calli slightly convex; fore femur ventrally armed with small denticles; middle and hind femora unarmed or with few denticles; tibiae sulcated; scutellum longer than wide; hemelytra macropterous, reaching the apex of last abdominal segments; apical margin of endocori-

um impunctate. Genital capsule: Posteroventral edge with deep U-shaped notch, enclosed by two conspicuously robust and elongate arms; space between arms wider than 0.45 mm (Figs. 9-10).

Female.-Coloration. Similar to male (holotype). Connexival segments VIII and IX dark orange with posterior border yellow; dorsal abdominal segments VIII and IX dark orange; genital plates ochre yellow with punctures reddish brown. Structure. Genitalia: Gonocoxae I enlarged dorsoventrally, in caudal view closed, in lateral view uniformly convex, not protruding, ventrally projected in a short and blunt lobe (Fig. 15).

Measurements.-Male (female). Head length: 1.68 mm (1.76 mm); width across eyes: 1.64 mm (1.76 mm); interocular space: 0.92 mm (0.96 mm); interocellar space: 0.46 mm (0.48 mm); preocular distance: 1.02 mm (1.08 mm); antennal segments lengths: I, 1.82 mm (1.82 mm); II, 2.62 mm (2.64 mm); III, 1.84 mm (1.87 mm); IV, mutilated. Pronotal length: 2.30 mm (2.44 mm); maximum width of anterior lobe: 2.04 mm (2.32 mm); maximum width of posterior lobe: 3.56 mm (4.00 mm): Scutellar length: 1.88 mm (2.04 mm); width: 1.64 mm (1.88 mm). Total body length: 10.70 mm (11.76 mm).

Type material.-Holotype: male, Ceram Island, 1913, E. Stresemann. Deposited in The Natural History Museum, London. **Paratypes:** 3 males, 2 females, same data as male holotype. Deposited in The Natural History Museum, London, and Colección Nacional de Insectos (CNIN), Instituto de Biología, UNAM, México.

Discussion.-Close to *S. morobe* Brailovsky & Barrera (1996) described from Papua New Guinea and Dutch New Guinea, with scutellum clearly longer than wide, antennal segment III longer than I, frontal angles rounded and not exposed, tylus apically globose to weakly bifid, postocular tubercle protuberant, antenniferous tubercle unarmed, and apical margin of endocorium impunctate. Both species are distinguished by the shape of the male and female genitalia. In *S. cerama,* recorded from the Island of Ceram, the lateral arms of the male genital capsule are remarkably broad and elongate (Fig. 9-10), the gonocoxae I are enlarged dorsoventrally and in lateral view uniformly convex (Fig. 15). In *S. morobe* the lateral arms are elongate and relatively broad (Figs. 12-13), and the gonocoxae I with upper third almost straight, and inner third directed outward, and conspicuously protuberant (Fig. 14).

Etymology.-The name is derived from the type locality.

Sciophyrella submacroptera, NEW SPECIES
(Fig. 8)

Description.-Male (holotype). Dorsal coloration. Head pale chestnut orange with yellow longitudinal band running from antenniferous tubercle to the neck, comprising the space between eye and ocelli, and dorsal view of postocular tubercle; antennal segments I to III ochre yellow, IV ochre yellow with basal third and apex dark orange brown; pronotum, including the punctures pale chestnut orange with lateral margins of collar, anterolateral borders, external edge of humeral angles, and an irregular spotting at calli and at middle lobe of pronotal disc yellow; clavus and corium pale chestnut orange; hemelytral membrane pale ambarine, with veins dark brown; connexivum dark orange brown with posterior border yellow; dorsal abdominal segments dark orange. **Ventral coloration.** Including the genital capsule pale chestnut orange on an ochre yellow background; rostral segments I, III, and IV ochre yellow, II dark orange brown; anterior lobe of metathoracic peritreme creamy yellow, posterior lobe dark yellow; coxae dark chestnut brown; trochanters ochre yellow with outer margin dark brown; femora and tibiae dark chestnut orange with two yellow rings one subbasal, the other near middle third (rings of fore femur difficult to see); tarsi dark chestnut orange with yellow reflections. **Structure.** Head wider than long or as long as wide; tylus unarmed, apically globose or weakly bifid; antenniferous tubercle and genae unarmed; postocular tubercle protuberant, globose; ocelli weakly raised; rostrum reaching middle third of abdominal sternite IV; pronotum bilobed; frontal

angles round to slightly produced; humeral angles rounded, not exposed; calli convex; femora unarmed or ventrally with few denticles; tibiae sulcate; scutellum longer than wide or as long as wide; hemelytra submacropterus, reaching posterior border of abdominal segment VI or anterior border of VII; apical margin of endocorium impunctate. Genital capsule: Posteroventral edge with deep U-shaped notch, enclosed by two short and stout arms; space between arms shorter than 0.40 mm (Fig. 8).

Female. Coloration. Similar to male holotype. Connexival segments VIII and IX dark orange brown with posterior border yellow; dorsal abdominal segments VIII and IX dark orange; genital plates pale chestnut orange on an ochre yellow background. Structure. Genitalia: Gonocoxae 1 enlarged dorsoventrally, in caudal view closed, in lateral view uniformly convex, not protruding, and ventrally projected in a short and blunt lobe.

Measurements. Male (female). Head length: 1.52 mm (1.48 mm); width across eyes: 1.56 mm (1.48 mm); interocular space: 0.84 mm (0.80 mm); interocellar space: 0.44 mm (0.42 mm); preocular distance: 0.92 mm (0.94 mm); antennal segments lengths: I, 1.40 mm (1.36 mm); II, 1.96 mm (1.80 mm); III, 1.36 mm (1.24 mm); IV, 1.36 mm (1.24 mm). Pronotal length: 1.92 mm (1.76 mm); maximum width of anterior lobe: 1.74 mm (1.84 mm); maximum width of posterior lobe: 2.76 mm (2.64 mm): Scutellar length: 1.32 mm (1.40 mm); width: 1.32 mm (1.20 mm). Total body length: 8.82 mm (9.18 mm).

Type material. Holotype: male, Papua New Guinea, Kokoda, 1200', IV-1933, L. E. Cheesman. Deposited in The Natural History Museum, London. **Paratypes:** 1 male, 1 female, same data as male holotype. Deposited in The Natural History Museum, London, and Colección Nacional de Insectos (CNIN), Instituto de Biología, UNAM, México; 2 females, Papua New Guinea, Kokoda, 1200', VI-1933, L. E. Cheesman. Deposited in The Natural History Museum, London.

Discussion. *Sciophyrella submacroptera* is the only species in the genus with submacropterous condition on the hemelytra. All the previously known species are macropterous (Brailovsky & Barrera 1996). Like *S. parva* Brailovsky & Barrera (1996) the space between the arms of the male genital capsule is less than 0.40 mm, and the maximum length of the body is less than 9.40 mm in both sexes. In *S. parva* the posteroventral edge of the male genital capsule has a small V-shaped notch with lateral arms conspicuously shorter (Fig. 11). In *S. submacroptera,* the lateral arms of the male genital capsule are longer with the notch deep and U-shaped (Fig. 8). The female genital plates of both species are similar.

Etymology.-Named for its submacropterous condition.

ACKNOWLEDGMENTS

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CORRIGENDA

On a recently published paper [Kight and Hashemi, *Entomological News* 114(2): 61-68], several Greek characters were misprinted. On page 63, where it reads "Data were analyzed... with a = 0.05." it should have read "Data were analyzed... with α= 0.05." On pages 63 and 65, several sentences include an "X^2 " or an "X 2". In all cases, it should have been printed as χ^2.

A NEW SPECIES OF BUSHCRICKET (ORTHOPTERA: TETTIGONIIDAE) OF THE PALAEARCTIC GENUS *ISOPHYA* (PHANEROPTERINAE) FROM TURKEY[1]

Hasan Sevgili[2]

ABSTRACT: The new bushcricket species *Isophya rizeensis* is described from montane forest and subalpine zones of Mt. Kaçkar, Turkey. Its relation with other related members of the genus is discussed on the basis of morphological and bioacoustical traits. Data on the song and stridulatory organs of the new species are also presented.

Key Words: Orthoptera, Tettigoniidae, Phaneropterinae, *Isophya*, Turkey, calling song.

The genus *Isophya* Brunner von Wattenwyl (Orthoptera, Tettigoniidae) is, by far, one of the large genus of the subfamily Phaneropterinae, containing about 90 species (Otte et al., 2004). Like the closely related largest genus *Poecilimon* Fischer, *Isophya* species occur mainly in Southeastern Europe, Anatolia and Caucasica (e.g. Ramme, 1951; Bei-Bienko, 1954; Karabag, 1958; Harz, 1969; Heller *et al.*, 1998), many of them having very restricted ranges within this area. Turkey was already known for a remarkably high number of *Isophya* species and the majority is endemic to Anatolia (Çyplak *et al.*, 2002; Sevgili and Heller, 2003). All are short winged, usually green or blackish colored, living in forests (e.g. *I. redtenbacheri*), forest edges (e.g. *I. paveli*), shrubby (e.g. *I. hakkarica*) and maquis vegetation (e.g. *I. rodsjankoi*) or steppe vegetation (e.g. *I. nervosa*) from sea level to above the timberline.

The differential diagnosis of species within *Isophya* is based on small differences in some morphological structures, such as the pronotum, tegmina, male cerci, the female subgenital plate, ovipositor and some morphometric characters (e.g. Ramme, 1951; Bei-Bienko, 1954; Karabag, 1962; Sevgili and Heller, 2003). Therefore, the acoustic signals used for mate finding and attracting behavior of males and females can be very useful diagnostic characters as songs of closely related species may often differ in one or more parameters (e.g. Zhantiev and Korsunovskaya, 1986; Heller, 1988, 1990; Ragge and Reynolds, 1998; Stumpner and Meyer, 2001; Orci *et al.*, 2001). Documentation of the acoustic and mating behaviors of the numerous *Isophya* species is still largely incomplete. Calling songs of *Isophya* species have mostly been recorded for European (Zhantiev and Dubrovin, 1977; Heller, 1988; Ingrisch, 1991; Orci *et al.*, 2001) and Anatolian species (9 species) (Heller, 1988, 1990). In this paper, we describe a new species, *Isophya rizeensis*, known from Çamlyhemsin (Rize Prov.) in the East Black Sea Region (Dogu Karadeniz Bölgesi) of Turkey. In addition, we present the description of the male calling song of the new species. This study is part of a larger project on the systematics and calling songs of the genus *Isophya* in Turkey.

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[2] Hacettepe University, Faculty of Science, Department of Biology, 06532, Beytepe, Ankara, Turkey. E-mail: hsevgili@hacettepe.edu.tr.

Mailed on July 28, 2004

METHODS

Bush crickets. All specimens were collected from the East Black Sea Region of Turkey. Some were preserved in alcohol, but living specimens were examined for coloration. The type material, including holotype, examined in this study are deposited in HUZOM (Hacettepe University, Zoology Museum, Ankara, Turkey). Morphological terminology follows Ramme (1951), Bei-Bienko (1954), Harz (1969) and Sevgili and Heller (2003). Figures were drawn and measurements were taken using a camera lucida attached to a stereo microscope. Measurements were defined as follows: total length, the distance between the frons and apex of abdomen (excluding ovipositor); length of pronotum (pronotal disc), the median length of the disc from anterior to posterior margin; length of tegmina, the distance between the rear margin of the pronotum to tegmen tip as viewed laterally; length of hind femur, the greatest dimension of this structure as seen in lateral view (excluding trochanter); length of ovipositor, the distance from the apex of the ovipositor to the apex of the subgenital plate. Measurements are given in mm. Stridulatory files were studied with a light microscope and a Scanning Electron Microscope (SEM). For electron microscopy, the left forewing was removed and transferred to absolute ethanol for at least 18 hours, cleaned using an ultrasonic cleaner, then air-dried and mounted on a microscope stub.

Song nomenclature. Calling song, song produced by an isolated male. Syllable, the sound produced by one complete up (opening) and down (closing) stroke of the wing. Impulse, a simple, undivided, transient train of sound waves. Syllable period (reciprocal value: syllable repetition rate), time period from the beginning of one syllable to the beginning of the next.

Calling song. The male calling songs were recorded in the laboratory using a Sony WM-GX688 Walkman and a stereo microphone (50 Hz to 18000 Hz) (distance to microphone about 10 cm). The calling songs of 12 males were recorded at temperatures between 23°C and 29°C. The males and females were kept acoustically isolated from the male being recorded. After digitising the songs on a PC, oscillograms (after filtering) and its analysis were made using a PC and the programs Spectra Plus, Turbolab and CoolEdit.

SYSTEMATICS

Tettigonioidea: Tettigoniidae: Phaneropterinae: Barbitistini

Isophya Brunner von Wattenwyl, 1878

Isophya rizeensis, NEW SPECIES

(Figs. 1-6, 8-20, 22)

Type locality. TR. Rize Prov.- Çamlyhemsin, Meydan köyü alty, 40°54' N 40°56' E, 900 m, 23 July 2002 (Leg. H. Sevgili).

Description. Male (holotype): Fastigium of vertex (Fig. 1) produced anteriorly, lateral margins parallel or slightly converging anteriorly, narrow, about 1/3x antennal scape, with dorsal groove.

Disc of pronotum (Fig. 2) constricted in middle of length, metazona slightly wider than prozona and with raised margins in prozona and metazona; anterior and posterior margins almost straight; in

profile (Fig. 3), dorsal surface of pronotum distinctly concave, ventral edge of paranota slightly convex and passing acutely into hind margin of pronotum. Tegmina (Figs. 2-3) 1.2x as long as pronotum; maximum width of disc of left tegmen almost as wide as hind margin of pronotum; Cu_2 ¾x as long as hind margin of pronotum, not thicker than 3rd antennal segment; tegmina with dense rugose venation; mirror almost quadrangular; costal area large with venation. Stridulatory file (Figs. 14-17) with 77-95 teeth (n= 6) not quite reaching posterior margin of tegmen, spacing largest in mid part of file; in ventral view slightly fusiform and arcuate, distal and proximal part of file gradually narrowed; length of file taken as shortest distance between proximal and distal most tooth about 2.85 mm. Hind femur about 4.25x longer than pronotum, without ventral spines.

Epiproct (Fig. 4) transverse, almost twice as wide as long, slightly concave at hind margin. Cercus (Figs. 4-6a, b) long, very distinctly incurved in apical part; incurved part long, forming about right angle with longitudinal axis of cercus, slightly tapering towards apex; apex pointed, ending in a distinct and black denticle on apex located somewhat dorsally. Subgenital plate (Figs. 4, 8) large and relatively long, extending beyond middle of cerci while cerci in normal position; slightly narrowed apically with distinct trapezoidal or rounded notch.

Coloration: Highly variable in colouration as in *I. redtenbacheri* (Bei-Bienko, 1954). Males belong to two basic colour morphs; almost black specimens were collected in lowlands (600-1000 m altitudes), light brown or yellowish-green specimens in subalpine zones of Kaçkar mountains (Kaçkar Da∂y). In both morphs, main colour of tegmina of male blackish or claret red in subcoastal and radial areas including veins. Abdomen usually two light longitudinal bands dorsally; ventral surface of abdomen yellow or red in some specimens. Apex of cercus usually black.

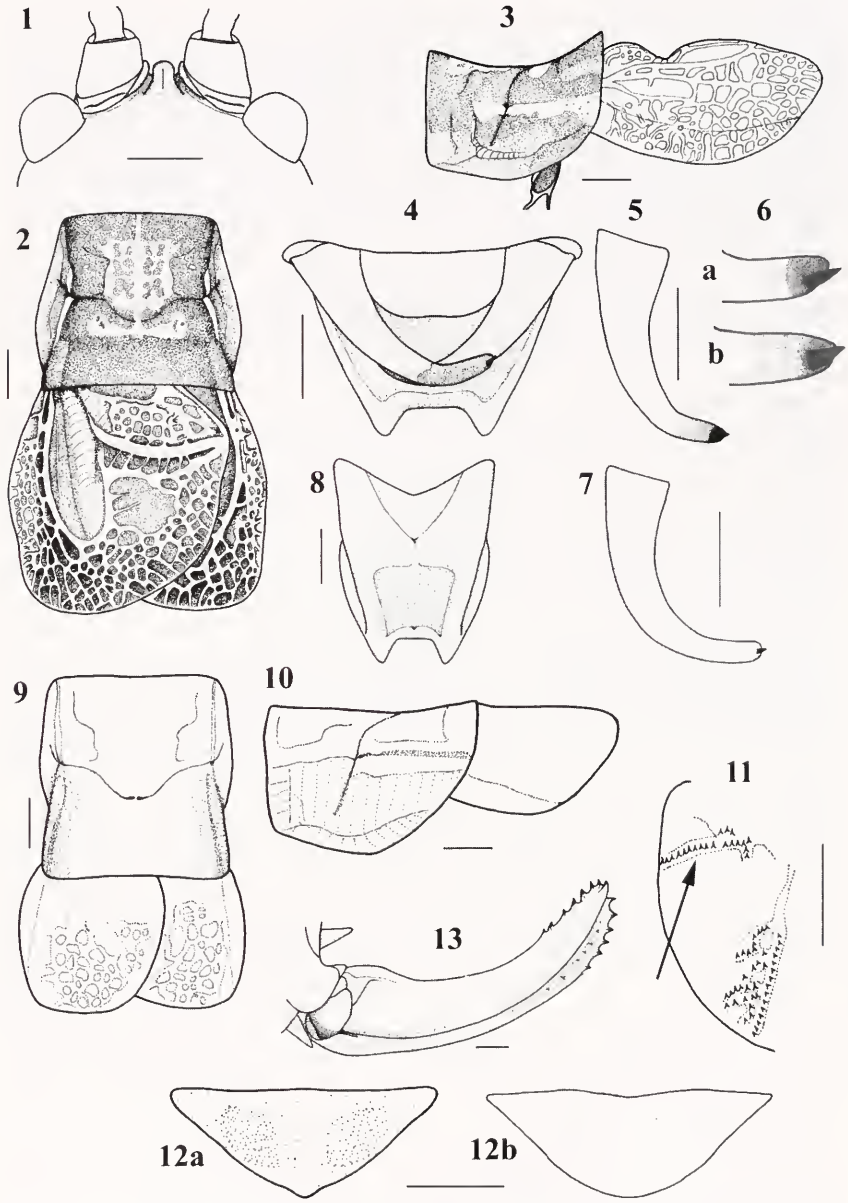
Female: Fastigium of vertex as in male, but slightly robust at apex. Disc of pronotum (Fig. 9) cylindrical, slightly constricted in mesozona, prozona and metazona of equal width; in profile (Fig. 10), dorsal surface of pronotum slightly concave, metazona slightly raised; ventral edge of paranota convex. Tegmina (Figs. 9-10) about 0.7x as long as pronotum, with dense rugose venation; stridulatory area of right tegmen as Fig. 11.

Cercus short and conical, slightly longer than epiproct. Subgenital plate (Fig. 12a, b) wider than long, posteriorly rounded or usually with a short median process at hind margin. Ovipositor (Fig. 13) long and distinctly upcurved, about 2.2x as long as pronotum; upper margin with 6-8, lower margin with 7-10 denticles at apical part. Gonangulum slightly swollen anterio-dorsally, hind margin slightly convex; dorsal part narrower than ventral part; lamella folded with gonangulum forming deep groove. Coloration similar to male, but green specimens are dominant.

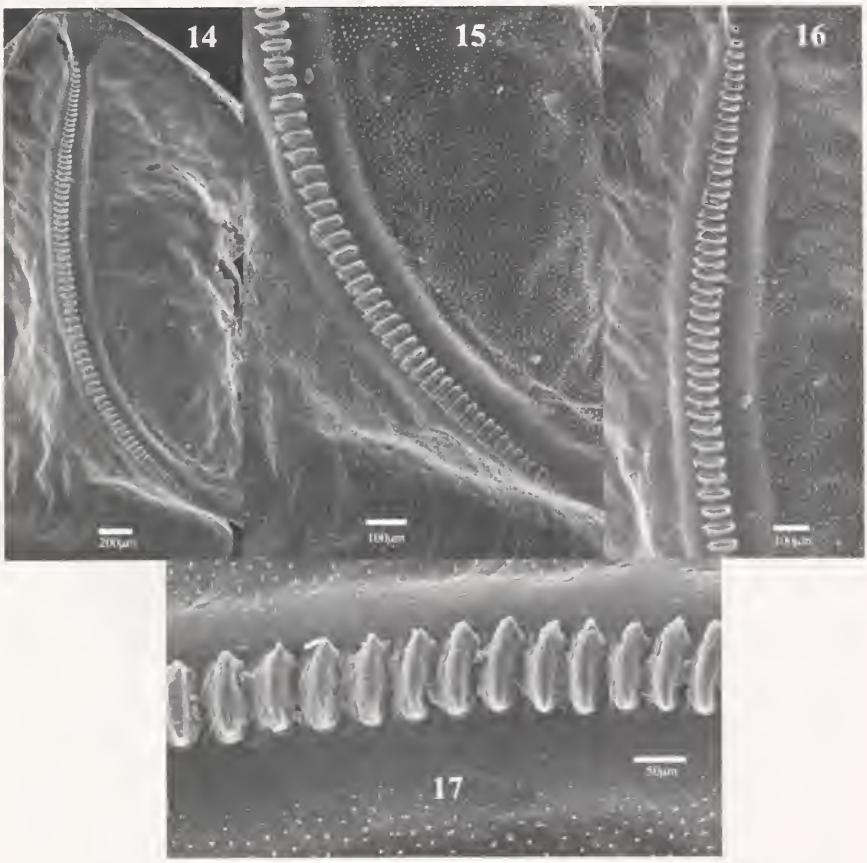
Song: (12 males recorded) The male calling song produced throughout the day but mainly at night. The song consists of two syllables (Figs. 18-20), recorded at 23-29°C. This calling song can be heard mainly in July and August, audible at a distance of 8-10 m. The song can be formulated as (A.....B) or sometimes (A.....B+tick or isolated impulse), repeated at very variable intervals (mostly 6-10 s, n= 18). "After-tick" are also usually present. The average duration of the song ranges between 453 ± 12 ms (at 24°C) and 395 ± 7 ms (at 28-29°C). The average gaps between two syllables is about 261 ± 12 ms (at 24°C) and 199 ± 4 ms (at 29°C). The average number of impulses of (A) first decrescendo type syllable ranges from 29 to 31. The second syllable (B) is crescendo type and consists of 45-56 impulses. The first syllable period (A.....) lasts about 334 ± 10 ms (at 24°C) and 277 ± 3 (at 28-29°C). The duration of this syllable (A) is approximately 73 ms. The mean duration of second syllable (B) longer than first, evaluated range from 118 ± 7 ms (at 24°C) and 120 ± 6 ms (at 28-29°C).

Measurements (male, n= 40; female, n= 25; (mean ± SD)): Length of body: male 17.7-25 (21.6 ± 0.25), female 19-23.8 (21.7 ± 0.3); pronotum: male 3.1-4.2 (3.7 ± 0.04), female 3.8-4.8 (4.4 ± 0.05); tegmina: male 3.9-5 (4.6 ± 0.03), female 2.4-3.5 (2.9 ± 0.1); hind femur: male 14.4-17 (15.9 ± 0.1), female 16-19.2 (17.5 ± 0.2); ovipositor: 9-12 (10.5 ± 0.1).

Material examined (52 males, including holotype, 25 females): Turkey: Holotype-male: TR. **Rize-** Çamlyhemsin, Meydan köyü alty 40°54' N 40°56' E, 900 m, 23 July 2002 (Leg. H. Sevgili). Paratypes: same locality, 1 male;- Çamlyhemsin, Palovit deresi ayrymy, 40°56' N 40°58' E, 600 m, July 23, 2002, 6 males, 2 females (4 males, 1 female in alcohol);- Çamlyhemsin, Zilkale köyü, Yüksek otluklarda, 40°54' N 40°56' E, 885 m, July 24, 2002, 2 males, 1 female (1 male in alcohol);- Çamlyhemsin, Elevit, Subalpin zon, 40°51' N 41°00' E, 1890 m, July 24, 2002, 8 males, 2 females (4 males in alcohol) (Leg. H. Sevgili); Rize- Meydan köyü, 1100 m, July 18, 1991, 10 males, 2 females;



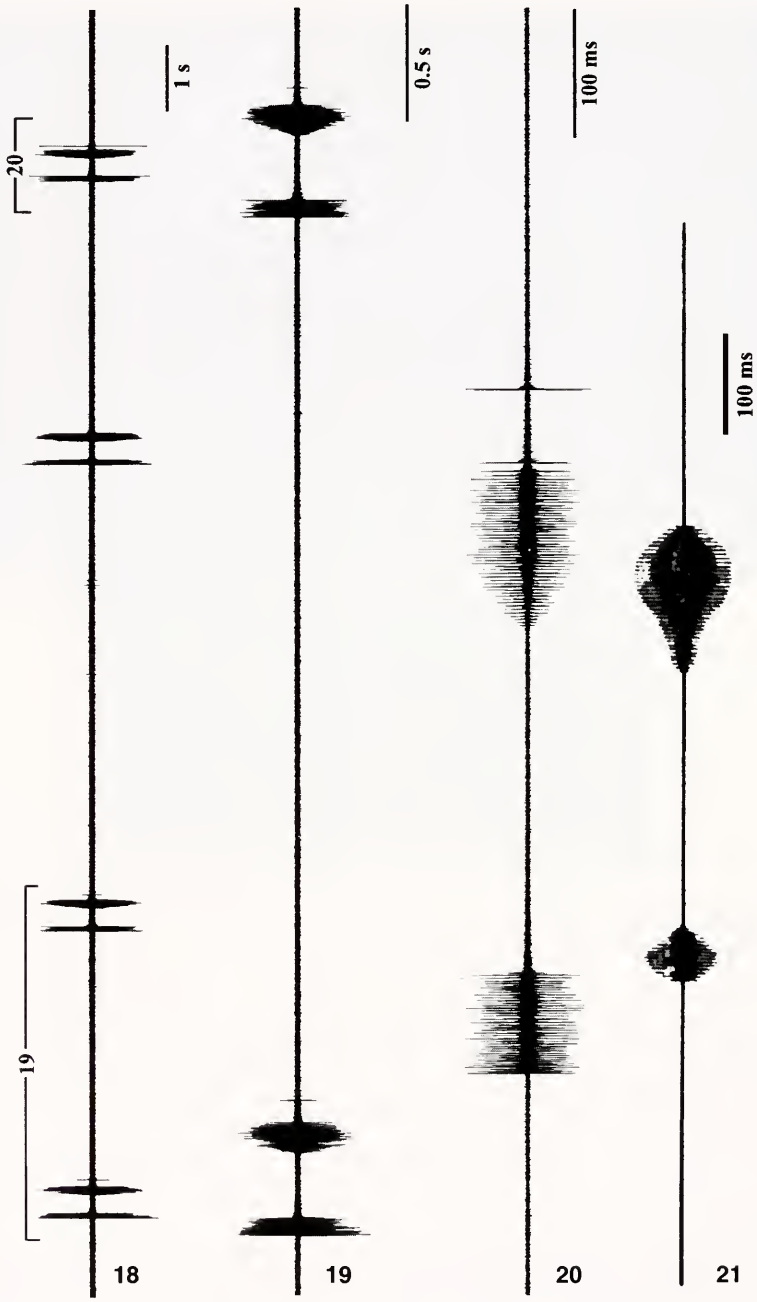
Figs. 1-13. Morphological features of *Isophya rizeensis* n. sp. (Figs. 1-6, 8-13) and *I. redtenbacheri* (Fig. 7); 1, male fastigium of vertex, dorsal view; 2, male pronotum and tegmina, dorsal view; 3, ditto, lateral view; 4, male epiproct, cerci and subgenital plate, dorsal view; 5, male left cercus; 6a, b, male apical parts of the cerci; 7, male left cercus of *I. redtenbacheri;* 8, male subgenital plate, ventral view; 9, female pronotum and tegmina, dorsal view; 10, ditto, lateral view; 11, female stridulatory area of right tegmen; 12a, b, female subgenital plates; 13, ovipositor. Scales 1 mm.



Figs. 14-17. *Isophya rizeensis* n. sp. Electron micrographs of male left tegmina. 14, stridulatory file, ventral view, distal end to the left; 15, idem, proximal part of file; 16, idem, distal part of file; 17, idem, mid part of file.

Rize- Çat düzü, July 13, 1991, 1 female;- Çamlyhemsin, Çat-Elevit yolu, July 9, 1990, 1 male;- Çamlyhemsin, Çat köyü, Elevit deresi, July 16, 1991, 1 male;- Çamlyhemsin, July 20, 1989, 1 female;- Çamlyhemsin, Çat, July 20, 1989, 3 males, 4 females;- Çamlyhemsin, Vanksi yaylasy, 2150 m, July 11, 1991, 4 males, 2 females;- Çamlyhemsin, Elevit yaylasy, 2400 m, July 17, 1991, 1 male (Leg. A. Demirsoy);- Çamlyhemsin, Çat-Elevit yolu, July 9, 1990, 4 males, 1 female;- Çamlyhemsin, Çat düzü, July 9, 1989, 2 females (Leg. S. S. Çaglar);- Çamlyhemsin, Çat düzü, July 9, 1990, 5 males, 2 females;- Çamlyhemsin, Çat köyü, Vanksi yaylasy, July 9, 1990, 4 males, 2 females (Leg. S. S. Çaglar and A. Demirsoy);- Kale- Hemsin yolu, July 10, 1991, 1 male, 1 female (Leg. A. Demirsoy) **(HUZOM)**.

Discussion: This new species is well characterised in the male by the stridulatory file and abdominal terminalia and in the female by the ovipositor. These characters distinguish it clearly from all other described species of the genus *Isophya*. *I. rizeensis, I. redtenbacheri* and *I. gracilis* are closely related species of the *amplipennis* Group (*I. amplipennis, I. redtenbacheri, I. rizeensis* sp. n., *I.*



Figs. 18-21. Oscillograms at different speeds of the male calling songs of *Isophya rizeesis* n. sp. (Figs. 18-20, at 24°C) and *I. gracilis* (Fig. 21). 18, four calling songs: 19, two calling songs at higher resolution; 20, one calling song at higher resolution; 21, one calling song of I. gracilis (reprinted from Zhantiev and Dubrovin, 1977, with the kind permission of R. Zhantiev).

speciosa, I. rodsjankoi, I. savignyi, I. splendida, I. uludaghensis, I. reticulata, I. sureyai, I. gracilis, I. pylnovi, I. kalishevskii, I. caspica, I. hemiptera) exhibiting similarities in the structure of the narrow fastigium, the concave pronotum and tegmina having a dense rugose venation. *I. rizeensis* differs from *I. redtenbacheri* in the larger body in both sexes, the shorter incurvate part of cerci of male (Figs. 4-5, 7) and distinctly longer ovipositor (in *I. redtenbacheri,* 7-8.5 mm according to Bei-Bienko, 1954). It also differs from *I. gracilis,* by the thinner and longer cerci, bigger apical denticle of cerci in male and distinctly longer ovipositor (in *I. gracilis,* 7-7.5 mm according to Bei-Bienko, 1954). On the other hand, the structure of the pronotum and tegmina of the new species is rather similar to that of *I. amplipennis, I. reticulata* and *I. speciosa* in both sexes. *I. rizeensis* differs from these species by the stridulatory file of left tegmen, cerci and subgenital plate in the male and gonangulum and lamella in the female. The stridulatory file of the new species (with 77-95 teeth) resembles that of *I. reticulata,* which shows 100-122 teeth (n= 5). In contrary to fusiform file of *I. rizeensis,* the files of *I. amplipennis* (with 80-90 teeth) and *I. speciosa* (with 150-180 teeth) become gradually widened towards the distal part (see Heller, 1988).

The calling song of *I. rizeensis* (Figs. 18-20) resembles that of *I. rodsjankoi* (unpublished data) and *I. gracilis* (Fig. 21, see Zhantiev and Dubrovin, 1977), but some of the song parameters of *I. gracilis* differ from that of *I. rizeensis.* The duration of first syllable in *I. rizeensis* is longer than that in *I. gracilis. I. rizeensis* and *I. gracilis,* on the other hand, are basically similar to the durations of second syllable, the gap between two syllables and syllable period, but the amplitude modulation of the song is clearly different (for details see Zhantiev and Dubrovin, 1977). The new species is clearly defined by its song, differing in several characters from *I. rodsjankoi.* The duration of the calling song of *I. rizeensis* is shorter than that in I. rodsjankoi. Besides, the number of impulses of second syllable in *I. rizeensis* appears to be higher than in *I. rodsjankoi.* On the other hand, while the song of *I. rizeensis* consists of two syllables, *I. redtenbacheri*'s song consists of only one crescendo type syllable (unpublished data).

Distribution and habitats: The range of this species covers a small area of the East Black Sea Region of Turkey (Fig. 22): from the northern slopes of Kaçkar mountains (between 600-2500 m altitudes) to the lowlands of Çamlyhemsin town in Rize province, a region of abundant rainfall. The distribution area of this species is situated in the Colchic sector of Euxinian province of Euro-Siberian phytogeographical region. Its vegetation consists of the formations of mesophytic forests, alpine meadows and scrubs. According to our observations, this species occurs in forest communities including ferns, glades and shrubs in lowlands, subalpine scrubs and meadows in highlands. The new species occurred syntopically with some other bushcrickets, such as *Poecilimon schmidti, P. similis, Phonochorion* spp., *Pholidoptera griseoaptera* in lowlands and *Psorodonotus specularis* and *Phonochorion* in subalpine and alpine zones. Its nymphs are mainly found in the beginning of June and adults are found in July and August.

Etymology: Rize Province has many high mountains in the East Black Sea Region of Turkey containing numerous endemic faunal and floral elements.

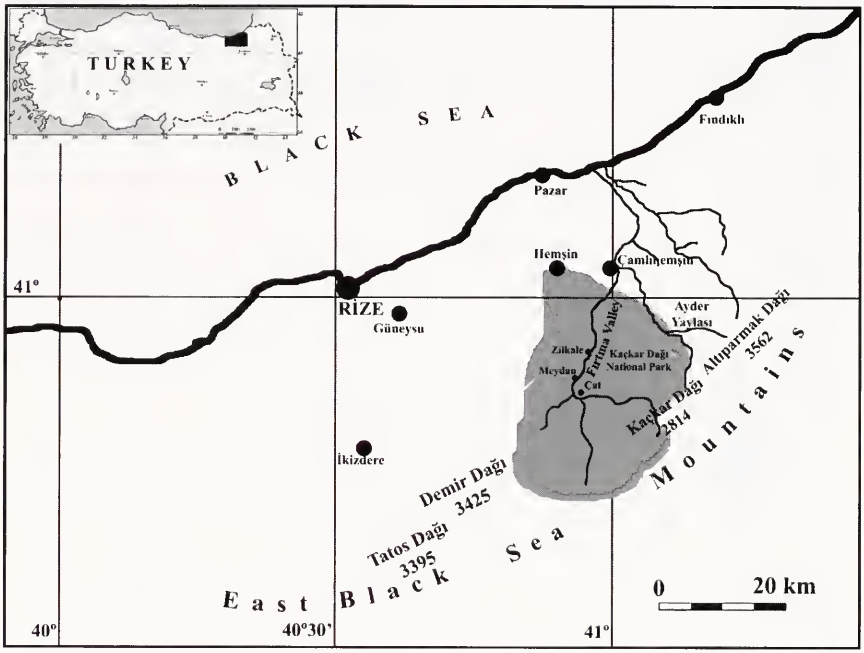


Fig. 22. Map of Rize Province, East Black Sea Region of Turkey. The stippled area indicates the distribution of *Isophya rizeensis* n. sp.

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BIOLOGICAL NOTES ON MEXICAN (COLEOPTERA: LUCANIDAE) *LUCANUS (PSEUDOLUCANUS) MAZAMA* (LECONTE)[1]

Pedro Reyes-Castillo,[2] Imelda Martínez M.,[3] and María Luisa Castillo[2]

ABSTRACT: *Lucanus (Pseudolucanus) mazama* (LeConte 1861) lives in Mexican *Quercus* (oak) forests in decaying logs, where both adults and larvae are commonly found. The species is distributed in mixed pine-oak forests of the Sierra Madre Occidental, in areas of the Mexican states of Chihuahua and Sonora. The male reproductive apparatus is composed by 2 testicles, each with 12 testicular follicles, and 2 vas deferentia, 2 accessory glands, an ejaculatory bulb, and an ejaculatory duct. In females, the reproductive apparatus consists of 2 ovaries, each with 12 ovarioles, and 2 lateral oviducts, the common oviduct, bursa copulatrix, spermatheca with its gland, and vagina.

KEY WORDS: *Lucanus (Pseudolucanus) mazama*, Coleoptera, Lucanidae, México.

The Lucanidae family is a relatively small group of Scarabaeoidea, distributed widely around the world. Six Mexican species have been recorded (Maes 1992), representing about 0.5 percent of species known worldwide. Most of these species are endemic and known only on the basis of one or two adult specimens, since they are often difficult to collect. *Lucanus (Pseudolucanus) mazama* (LeConte 1861) is a Mexican stag beetle species that is large and relatively abundant. Although it was described from the United States, where it is found in Arizona, Colorado, New Mexico, and Utah (Maes 1992), it was recorded by Parry (1875) in northern Mexico, in the states of Chihuahua (Bates 1889, Villada 1901) and Sonora (Benesh 1944).

Stag beetle reproductive systems have been studied in few species, most of them European. Bordas (1900) described the reproductive apparatus of males of *Dorcus parallelipipedus* (Linné 1735) and *Lucanus cervus* (Linné 1758); the latter was illustrated by Franciscolo (1997), as was the typical scheme of the female Dorcinae. The only North American species known in this regard is the male *L. capreolus* (Linné 1763), described by Williams (1945). In a comparative study of the number of ovarioles (per ovary) in Scarabaeoidea, Ritcher and Baker (1974) observe that this number varies among different subfamilies of Lucanidae, from 6-6 in Aesalinae and Platycerinae, to 12-12 in Sinodendroninae and Lucaninae. Holloway (1960, 1998) studied numerous morphological structures of Lucanidae adults, and, considering the complete cuticular structures of the male and female genitalia, concluded that they "exhibit characters of high taxonomic and phylogenetic value."

Precise information had previously been lacking on the distribution of Mexican *L. mazama,* its habits, larval development, and male and female reproductive anatomy. These subjects are dealt with in the present paper.

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[2] Instituto de Ecologia, A.C., Departamento de Biología de Suelos, km.2.5 Carretera antigua a Coatepec #351, Congregación El Haya, 91070 Xalapa, Veracruz, México. E-mails: reyespe@ecologia.edu.mx, maluisac@ecologia.edu.mx, respectively.

[3] Departamento de Ecología y Comportamiento Animal. Apartado Postal No. 63. 91000 Xalapa, Veracruz, México. E-mail: imelda@ecologia.edu.mx.

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METHODS

This study examined 20 Mexican *L. mazama* adults from the collections of the Instituto de Ecología, A.C. (IE), Xalapa, Mexico, and the Museum national d'Histoire naturelle (MNHN) Paris, France.

Sixteen third-instar larvae of *L. mazama* were collected on July 13, 1996, 2 km to the south of Yepachic (Chihuahua), in a large oak *(Quercus)* stump, in a mixed pine-oak forest, at an altitude of 1,660 m. The larvae were maintained alive in a terrarium at a relative humidity of 80 percent and a temperature of 23.3°C ± 3.1, supplied with abundant wood and decaying detritus of oak and *Bursera simaruba,* until pupation occurred and the imagos emerged.

A male that emerged November 29, 1996, was dissected June 16, 1997, and a female that emerged November 3, 1996, was dissected November 21, 1996, to examine their reproductive apparatus, which were maintained in Ringer saline solution, fixed in AFATD (ethyl alcohol 96°–formaldehyde–trichloroacetic acid–dimethylsulfoxide), and stained in toto with Feulgen-green light. Some organs were included in Celoidina®-Parafina Histosec®, and histological sections of 7μm were stained using the technique of PAS-Heidenhain hematoxylin (Martínez 1999). Cuticular structures were macerated with potassium hydroxide and stained with chlorazol black (Carayon 1969).

The rest of the adults, two males and three females, were kept as separate male-female pairs, in two terraria with decaying wood, at a relative humidity of 80 percent and a temperature of 25.8°C ±1.8, from February 1997 until their deaths in May 1998. From among these insects, a male, which had emerged November 27, 1996, was selected for dissection after it had copulated, an event that occurred on May 15, 1998.

The anatomical terms used here to describe reproductive apparatus are those proposed by Snodgrass (1933) and Tuxen (1970).

Material Examined. Mexico: coll. E. Borel/ 2 males (MNHN-Paris); /Höge/ex coll. Bolieau/ 1 female (MNHN-Paris); /Höge/ 1 male (MNHN-Paris); Chihuahua: /Santa Clara/Höge/Ex Musaeo H. W. Bates 1892/ 1 male, 1 female (MNHN-Paris); /Santa Clara/Höge/ex coll. Bolieau/ 1 male (MNHN-Paris); Chihuahua: 2 km south of Yepachic, 13-VII-1996, P. Reyes and D. W. Edmonds, coll./ altitude 1,660 m, mixed pine-oak forest, in a decaying oak log/ 2 males, 3 females, 5 third-instar larvae (IE-Mex); 2 km south of Yepachic, 12-VII-1996, P. Reyes and D. W. Edmonds, coll. /altitude 1,660 m, mixed pine-oak forest, in a rotting oak log/ 1male pupa, 1 female pupa, and 3 males and 4 females that emerged in the laboratory during October and November, 1996 (IE-Mex); Sonora: /Yécora/15-VII-1966/P. Reyes and W. D. Edmonds, coll./altitude 1,400 m, by light, between 21:00 and 23:30 hours/ 1 male (IE-Mex); /Puerto de La Cruz, 10 km east of Yécora/17-VII-1996/P. Reyes, coll./altitude 1,770 m, in a rotting oak log/1 adult remains, 1 third-instar larva (IE-Mex).

RESULTS

Distribution and habits. On the dates indicated above, adult males and females and larvae were collected from decaying oak (*Quercus* spp.) stumps and logs that are found in mixed pine-oak forests between the altitudes of 1,400 and 1,770 m in the Sierra Madre Occidental, in the states of Chihuahua and Sonora. One male adult was attracted by light in July. On being collected, adults showed thanatosis and the larvae stridulated.

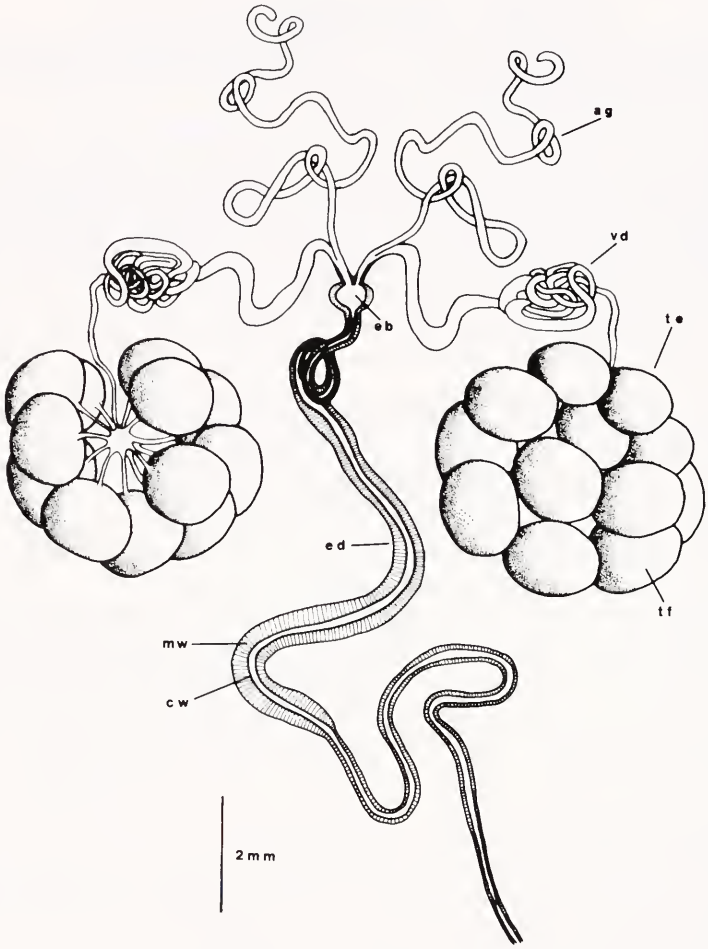

Fig. 1. Scheme of male *Pseudolucanus mazama* reproductive apparatus (ag, accessory gland; cw, cuticular wall of the ejaculatory duct; eb, ejaculatory bulb; ed, ejaculatory duct; mw, external muscular wall of the ejaculatory duct; te, testis; tf, testicular follicle; vd, vas deferens).

Of a total 16 third-instar larvae maintained live in the laboratory (at a relative humidity of 80 percent and temperature of 23.3°C ± 3.11), 7 died, while 9 developed to the pupa stage; of the latter, 7 reached the adult stage (3 males and 4 females). The larvae remained buried the entire time, active in the wood and decaying detritus that served them as both food and substrate. Pupation occurred in the detritus, apparently without construction of a cocoon. In 5 larvae, the prepupa-pupa period lasted from 5 to 8 days. In 7 larvae, the period from pupa to

adult lasted between 31 and 35 days. Adults showed surprising longevity in the laboratory (maintained at a relative humidity of 80 percent and temperature of 25.8°C ± 1.8), up to 18 months, during which time they showed little activity and almost no feeding. In early May 1998, one pair appeared to be preparing to mate and the female fed on dead wood. The adults spent most of their time buried between the terrarium floor and the bottom of the decaying log.

Male reproductive system. The male reproductive system consists of 2 testes, each with 12 testicular follicles, and 2 vas deferentia, 2 accessory glands, an ejaculatory bulb, and an ejaculatory duct (Fig. 1).

The reproductive structures of a young male that had emerged six and a half months prior to study and which was dissected on June 16, 1997, were surrounded by abundant fat-body and tracheoles. In contrast, the male dissected 18 months after emergence, on May 15, 1998, did not show similar fat-body material, but did show abundant tracheoles, and its testicular follicles were smaller than those of the younger male.

Testicular follicles of both younger and older males were free, without a covering membrane, and spherical, though slightly flattened in the dorsoventral direction. In histological observation, the follicles are radial. In the young male, the testes were immature, showing only primary and secondary spermatocyte cysts, and not fully developed spermatozoa. In the 18-month-old male that had copulated shortly before dissection, the histological structure of the testicular follicles showed degenerating cysts without a trace of spermatozoa (Fig. 2). Most likely, spermatogenesis had not occurred, and copulation had not been functional.

A relatively long vas efferens emerges from each testicular follicle. All the vas efferentia flow into the vas deferens of their respective testicle. The vas deferentia show three different regions: a straight region on leaving the follicles, a volu-

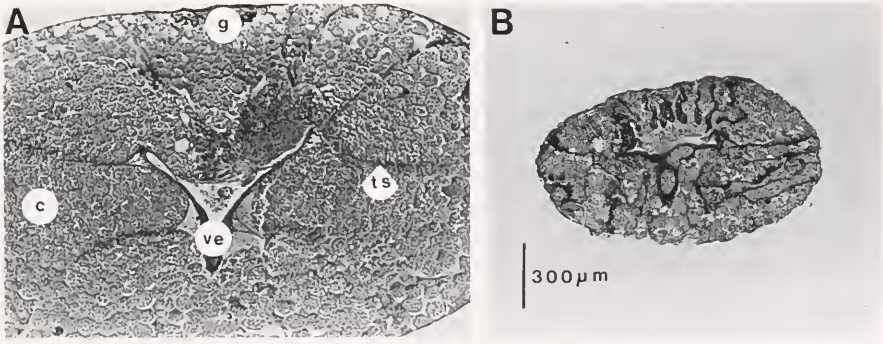

Fig. 2. Microphotographs of histological sections of *Pseudolucanus mazama* testicular ollicles: (A) in a recently emerged male, (B) in a male one year after emergence (c, cysts; g, germarium; ts, testicular septa; ve, vas efferens). The same scale is used in both photographs.

minous region in which they curl around themselves, and an enlarged region that narrows near emergence in the ejaculatory bulb.

The accessory glands are tubiform, relatively long, and rolled around themselves. They both discharge, parallel to the vas deferentia, in the anterior part of the ejaculatory bulb.

The ejaculatory bulb is very small and thick, almost spherical. It is formed of a relatively thick cuticular intima, surrounded by a muscular cloak that is not very thick. The 2 vas deferentia and 2 accessory glands open into the anterior region of the ejaculatory bulb. The ejaculatory duct emerges from the ejaculatory bulb's posterior region.

The ejaculatory duct is very long and has two distinct regions of about the same length. The anterior part, emerging from the ejaculatory bulb, has a cuticular intima covering the duct and a thick muscular wall toward the exterior. The posterior section narrows; while the interior diameter of the duct remains the same as in the anterior region, the duct's muscular wall here is much thinner. This posterior section gives into the aedeagus, which has a permanently everted internal sac with a long terminal flagellum.

Female reproductive system. The female reproductive system is formed of two ovaries, each with 12 ovarioles, and two lateral oviducts, a common oviduct, the bursa copulatrix, spermatheca with its gland, and vagina (Fig. 3).

The entire reproductive apparatus is surrounded with abundant fatty material and numerous tracheoles, to such a degree that during dissection it was difficult to distinguish the different structures. These structures became clearer after being stained in toto with Feulgen-green light, or after maceration and staining of the cuticular structures with chlorazol black.

The female studied had recently emerged and was immature. Each telotrophic ovariole presented a germarium, a vitellarium without oocytes, and a long pedicel (Fig. 4). The pedicels of the ovarioles of each ovary ended in a calix. In each ovary, the ovarioles and calix were enveloped in a membrane. Each ovary's calix continued until it met the corresponding lateral oviduct. Both lateral oviducts terminated in the common oviduct, which was relatively long and surrounded by abundant muscular tissue, and which terminated in the vagina.

The spermatheca was a large, sclerotized structure, formed by the spermathecal capsule, a duct, and a gland. The spermathecal capsule was heavily sclerotized and surrounded by abundant glandular tissue. The cuticular spermathecal duct was surrounded by a thick coat of muscular tissue that emerged from the base of the capsule. The duct's posterior region was thicker and had a folded wall, joining the anterior part of the vagina between the common oviduct and the bursa copulatrix. The spermathecal gland was cuticular and surrounded by glandular tissue that was not very thick; the gland's duct was short, ending in the base of the spermathecal capsule.

The bursa copulatrix had a highly folded cuticular intima, surrounded by a muscular wall. Before terminating in the anterior part of the vagina, the posteri-

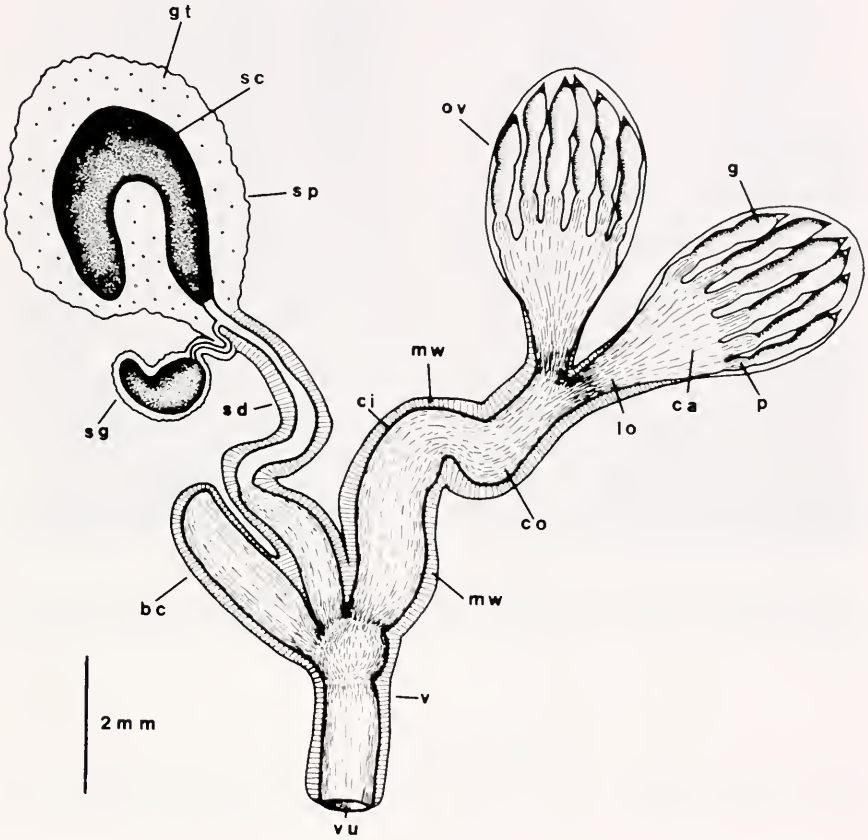

Fig. 3. Scheme of female *Pseudolucanus mazama* reproductive apparatus (bc, bursa copulatrix; ca, calix; ci, cuticular intima seen through the muscular wall; co, common oviduct; g, germarium; gt, glandular tissue covering the spermathecal capsule; lo, lateral oviduct; mw, muscular wall; ov, ovary; p, pedicel; sc, spermathecal capsule; sg, spermathecal gland; sp, spermatheca; sd, spermathecal duct; v, vagina; vu, vulva).

or section of the bursa copulatrix leaned against the base of the spermathecal duct. At this point, these two structures were enveloped by the same coat of muscular tissue.

The vagina's cuticular intima was highly folded and surrounded by a thick coat of muscular tissue. The vagina comprised two different regions. The anterior section was bulky. The common oviduct joined this section toward its beginning, while the bursa copulatrix and the spermatheca joined this section lateral-

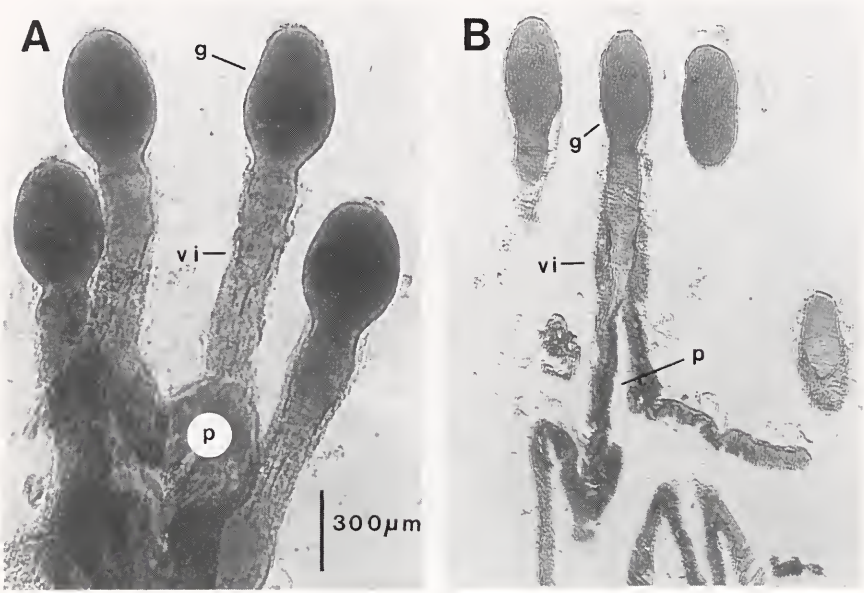

Fig. 4. Microphotographs of *Pseudolucanus mazama* ovarioles: (A) in toto, (B) in a histological section (g, germarium; vi, vitellarium; p, pedicel). The same scale is used in both photographs.

ly. The posterior part of the vagina was straight, terminating in a vulva that opened to the exterior.

DISCUSSION

Lucanus mazama belongs to a genus with wide holarctic and oriental distribution. The genus's 63 species include 5 known in North America; of these, *L. mazama* alone reaches the north of Mexico (Maes 1992). *L. mazama* distribution in Mexico occurs in woods of boreal origin, a mix of pine and oak, in the Sierra Madre Occidental. The species maintains holarctic affinities, being adapted to colder weather, and in the Mexican zone of transition shows a nearctic dispersal pattern (*sensu* Halffter 1976).

In Mexico, *L. mazama* lives in rotting stumps and logs, with a preference for oak (*Quercus* spp.). Both adults and larvae are commonly found in these habitats. The adults are sometimes attracted to light. These characteristics are shared by two related North American species, *L. capreolus* and *L. placidus* (Say 1825) (Ritcher 1966, Mathieu 1969), though the larvae of these two latter species appear more polyphagous. The surprising longevity found in nonfeeding *L. mazama* adults—18 months in the laboratory—contrasts with the longevity of *L.*

capreolus, which has been observed to live in the laboratory for just 3 months with a diet of sugared water provided through a piece of cotton (Mathieu 1969).

The present study provides the first complete description of *L. mazama* reproductive apparatus, both male and female.

In the male, the reproductive anatomy resembles that of *L. capreolus,* studied by Williams (1945), with equal numbers of testicular follicles (12-12), and also that of *L. cervus,* which has 10-10 testicular follicles, and of *Dorcus parallelipipedus,* which has from 10-10 to 12-12 testicular follicles, as studied by Bordas (1900). These two authors described seminal vesicles in these species, but in *L. mazama* we observed no dilation of the vas deferentia that would respond to such seminal vesicles. Lack of seminal vesicles is a common characteristic of other Scarabaeoidea species, notably those of the dung beetle subfamilies (Pluot-Sigwalt and Martínez 1998). The aedeagus of *L. mazama* agrees with that of other Lucaninae (Holloway 1960) in having a permanently everted internal sac and basal piece that does not surround the median lobe. The permanently everted internal sac in *L. mazama* terminates in a long flagellum.

We have no detailed description of female reproductive anatomy in Lucanidae species, except the general scheme of Dorcinae put forward by Franciscolo (1997). This scheme is generally consistent with our observations on *L. mazama,* which shows 12-12 ovarioles, the same number found by Ritcher and Baker (1974) in a female of this species from Arizona, in *Sinodendron rugosum* Mannerheim 1843, and in other Scarabaeoidea (Rutelinae and Cetoniinae).

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IMMATURE STAGES OF *SINOPLA PERPUNCTATUS* (HETEROPTERA: ACANTHOSOMATIDAE) FROM ARGENTINA[1]

P. Martínez,[2] P. M. Dellapé,[2] M. del C. Coscarón,[2] and H. Giganti[3]

ABSTRACT: The five instars of the acanthosomatid *Sinopla perpunctatus* are described and illustrated. Descriptions include morphological and morphometric characters of specimens from Neuquen (Argentina) collected on *Nothofagus* sp. (Fagaceae).

KEY WORDS: *Sinopla perpunctatus*, Heteroptera, Acanthosomatidae, immature stages, Argentina.

The family Acanthosomatidae, a member of the superfamily Pentatomoidea, contains about 180 species in 45 genera (Kumar, 1974; Rolston and Kumar, 1974). Its geographic range is mostly in the Southern Hemisphere, but it does extend north into Europe, Asia, and North America. The genus *Sinopla* Signoret 1863 belongs to the Blaudisinae, a subfamily that occurs in South America, South Africa, and Australia, with one genus recorded from Madagascar. *Sinopla perpunctatus* is restricted to the southern portion of the Western Hemisphere (Chile and Argentina). Little is known about the biology of most austral species (Schuh and Slater, 1995). Recently, Carter and Hoebeke (2003) described in detail the seasonal history and duration of the immature stages of *Elasmostethus atricornis* Van Duzee, which is distributed in the Palaeartic, Oriental, and Australian Regions extending to the Neartic. Maternal care of eggs and young nymphs has been mentioned only for Neartic and Paleartic species. (Bequaert, 1935). In this contribution, we describe the five nymphal instars of *Sinopla perpunctatus* Signoret.

METHODS

We studied a total of 21 specimens from Neuquen (Argentina), collected on *Nothofagus* sp. (Fagaceae), a genus distributed in the southernmost regions of the Western Hemisphere (34°S to Tierra del Fuego). The material was preserved in 75 percent ethanol. Terminology used for morphology follows that of Miller (1971) and Decoursey and Esselbaugh (1962). Measurements are given in millimeters. Illustrations were made with a drawing tube on a Wild M-stereomicroscope. Scanning electron micrographs were made from specimens mounted on stubs, sputter-coated with a gold palladium alloy, and studied with a JEOL T-100 SEM. The studied material is deposited in the Museo de Ciencias Naturales de La Plata (Argentina).

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[2] Departamento Científico de Entomología, Facultad de Ciencias Naturales y Museo, Paseo del Bosque, 1900 La Plata, Argentina. E-mails of MCC: coscaron@netverk.com.ar, mchinches@yahoo.com.

[3] Facultad de Cs. Agrarias, Universidad Nacional del Comahue, C. C. 85 - 8303 Cinco Saltos, Rio Negro, Argentina.

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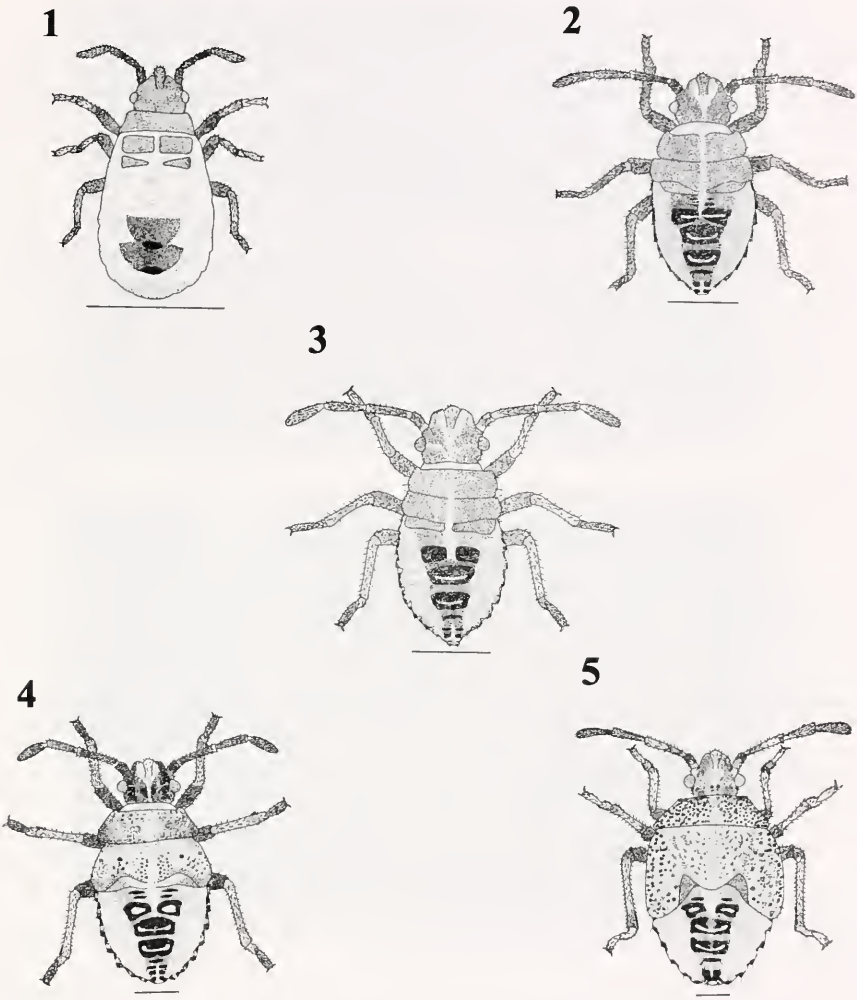
DESCRIPTIONS

First instar (Fig. 1). Total length 2.00 (n= 1). Length of head 0.47, width 0.48. Head dark brown dorsally, reddish posteriorly, brown ventrally; setae short, spareed. Clypeus and jugae dark brown. Clypeus broadly surpassing jugae. Eyes prominent, rounded; red, whitish posteriorly. Width of eye 0.48, interocular space 0.32. Rostrum brown, surpassing mesocoxae. Rostral length 0.88, ratio of segment lengths approximately 1: 1.66: 1.55: 1.66. Antennae brown, yellowish at the base and apex of the articulations; setose, abundant distally. Antennal length 0.684, ratio of segment lengths approximately 1, 1.56: 1.14: 2.14. Pronotum dark brown with median sulcus pale; length 0.22, width 0.53; rectangular. Meso and metanotum dark brown. Pale brown ventrally. Legs pale; setae short, abundant on tarsi and tibiae. Abdominal length 1.05, width 0.92. Abdomen pale brown, dorsally tinged with red and two large red spots medially; plates as in Figure 1. Pale brown ventrally, tinged with red; last segments with a brown spot medially.

Second instar (Fig. 2). Total length 3.50 (n= 1). Length of head 0.92, width 1.03. Head brown dorsally, pale brown medially and ventrally; setae short, spareed. Clypeus and jugae pale brown. Eyes prominent, rounded; red, whitish posteriorly. Width of eye 0.15, interocular space 0.73. Rostrum pale brown, segment I laterally and segment IV darker; surpassing metacoxae. Rostral length 2.18, ratio of segment lengths of ca. 1:1.42:1.34:1.27. Antennae brown, yellowish at articulations; setose, more abundant distally. Antenna 1.95 long, ratio of segment lengths ca. 1: 2.34: 2.07: 2.40. Pronotum brown, with median sulcus pale; length 0.40, width 1.28; rectangular, with posterior borders rounded; setae sparced. Wing pad length 0.52. Wing pad and area between brown. Sternum pale brown. Legs brown; setae short, abundant on tarsi and tibiae. Abdominal length 1.67, width 1.52. Abdomen dorsally pale brown, tinged with red and red spots; dorsal plates as in Figure 2; pale brown ventrally, external fringe reddish; setae median, sparced.

Third instar (Fig. 3). Total length 3.70-4.11 (mean = 3.91) (n= 10). Length of head 0.83-1.00 (mean = 0.92), width 1.07-1.13 (mean = 1.09). Head brown dorsally (in some specimens dark brown), pale brown medially, forming v-shaped mark; pale brown ventrally; with sparced and short setae. Jugae pale brown, darker laterally. Clypeus pale brown (in some specimens dark brown). Labrum dark brown. Eyes prominent, rounded; red, whitish posteriorly. Width of eye 0.17-0.18 (mean = 0.18), interocular space 0.73-0.77 (mean = 0.75). Rostrum pale brown (in some specimens dark brown), segment I laterally and distally and segment IV darker; reaching the metacoxae. Rostral length 1.90-2.07 (mean = 2.00), ratio of segment lengths ca. 1: 1.32: 1.38: 1.20. Antennae brown (in some specimens dark brown), creamy at articulations; segment IV fusiform; setose, distally abundant. Antennal length 1.62-2.07 (mean = 1.90), ratio of segment lengths ca. 1: 2.86: 2.32: 2.41.Pronotum brown (in some specimens dark brown) with median sulcus pale; length 0.40-0.47 (mean = 0.44), width 1.28-1.65 (mean = 1.42); rectangular, with their posterior borders rounded; humeral angles projected laterally (Fig. 3); setae median, spareed. Wing pad length 0.42-0.60 (mean = 0.53); brown (in some specimens dark brown); setae median, spareed. Sternum pale brown, tinged with red ventrally. Legs pale brown to dark brown; setae short and median, abundant on tarsi and tibiae. Abdominal length 1.75-2.23 (mean = 2.00), width 1.17-2.53 (mean = 1.92). Abdomen globose; dorsally pale brown, tinged with red and red spots; dorsal plates as in Figure 3. Pale brown ventrally, fringe lateral reddish; spiracles present on segments 2 to 8 laterally; setae median, spareed.

Fourth instar (Fig. 4). Total length 4.11-5.44 (mean = 4.89) (n= 8). Length of head 1.00-1.33 (mean = 1.18), width 1.33-1.60 (mean = 1.49). Head brown dorsally; laterally, with a dark spot behind the eyes; pale brown ventrally; setae short, spareed. Clypeus pale brown, tinged with red, whitish distally. Juga pale brown tinged with red, dark brown laterally. Labrum dark brown. Eyes red; rounded, prominent. Width of eye 0.20-0.30 (mean = 0.26), interocular space 0.92-1.05 (mean = 0.97). Rostrum pale brown, darker at apex; reaching the metacoxae. Rostral length 2.28-3.23 (mean = 2.71), ratio of segment lengths ca. 1: 1.51: 1.40: 1.21. Antennae dark brown, yellowish at the articulations; setose, distally abundant. Antennal length 2.42-3.05 (mean = 2.71), ratio of segment lengths ca. 1: 3.00: 2.37: 2.67. Pronotum dark brown, median sulcus pale; length 0.63-0.92 (mean = 0.74), width 1.07-2.53 (mean = 2.16); punctuate; anterolateral angles projected laterally; setae short, sparced. Meso- and metatergum dark brown, median sulcus pale; punctate; setae short, spareed. Wing pad length 0.92-1.23 (mean = 1.08); dark brown; punctuate; setae median, spareed. Ventrally pale brown, tinged with red; prosternum with two red spots antero-laterally. Legs pale brown, femora and tarsi darker; setae short and median, longer on tibiae; abundant on tarsi and tibiae. Mid tarsi and pulvilli and parempodia as seen in Figures 6-7 respectively. Abdominal length 1.68-2.53 (mean = 2.21), width 2.27-3.03 (mean = 2.57). Abdomen red, tinged with pale brown dorsally; medially with dark



Figs. 1-5: 1, First instar. 2, Second instar. 3, Third instar. 4, Fourth instar. 5, Fifth instar. Scale line: 1 mm.

plates arranged as in the Figure 4; pale brown ventrally, margin narrowly reddish, with brown spots on the distal segments; setae median, sparced.

Fifth instar (Fig. 5). Total length 6.96 (n= 1). Length of head 1.29, width 2.00. Head brown, tinged with red in the vertex; redline ocelli present; outer posterior margin of eyes dark brown; pale brown ventrally, with two reddish bands laterally; setae short and median, sparced. Jugae laterally dark brown and mesially reddish; ventrally with a dark fringe. Clypeus reddish, distally whitish. Labrum dark brown; setae short. Eyes prominent, rounded; red, posteriorly whitish. Width of eye 0.18, interocular space 0.47. Rostrum pale brown; segment I basally tinged with red; reaching the metacoxae. Rostral length 3.45, ratio of segment lengths ca. 1: 1.56: 1.36: 1.12. Antennae pale brown, segments I and II tinged with pale red; setae sparced on segments I and II, abundant and thinner on segments III and IV. Antenna 3.67 long, ratio of segment lengths ca. 1: 3.50: 2.66: 2.50. Pronotum

Figs. 6-7. Scanning electron micrographs. Fourth instar: 6. Tarsi x 150; 7. Pretarsi (pulvillus, parempodia, and claws). x 350.

pale brown, tinged with red; median sulcus pale; length 1.00, width 3.48; punctate; setae short and median, sparced. Meso- and metatergum pale brown, median sulcus pale; punctate; setae median. Area between wing pad pale brown, tinged with red; punctate. Ventrally pale brown, tinged with red; prosternum with two red spots antero-laterally. Wing pad length 2.87; pale brown, reddish laterally, mesially dark brown; punctate; setae short and median, sparced. Legs pale; pretarsus dark brown distally; setae short and median, sparced, abundant on tarsi and tibiae. Abdominal length 2.85, width 4.43. Abdomen pale brown, dorsally tinged with red and whitish areas; dorsal and lateral plates dark. Ventrally pale brown, with narrow reddish margin, surrounded by whitish spots; spiracle 2 to 8 lateral; setae long, sparced.

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GYNANDROMORPHISM IN POLLINATING FIG WASPS (HYMENOPTERA: AGAONIDAE)[1]

R. A. S. Pereira,[2] A. P. Prado,[3] and F. Kjellberg[4]

ABSTRACT: Gynandromorph specimens of pollinating fig wasps (Hymenoptera: Agaonidae) are reported for the first time. Gynandromorph individuals of *Pegoscapus tonduzi* (pollinator of *Ficus citrifolia* - Moraceae) and *Blastophaga psenes* (pollinator of *F. carica*) were found in galls from which insects had not emerged. *P. tonduzi* gynandromorph specimens showed female and male tissues distributed in a mosaic over all parts of the body, but with the genitalia predominantly masculine, while in *B. psenes* the individuals had a female front part and a male hind part. The presence of gynanadromorphs at low frequencies in two species suggests that they may also occur in other fig wasp species, but their occurrence is not noticed because of their low frequency and because it is necessary to crack open the closed galls to find these insects.

KEY WORDS: Agaonidae, pollinating fig wasps, Hymenoptera, gynandromorphism.

Gynandromorphism is described as the simultaneous presence within the same organism of genotypically and phenotypically male and female tissues (Laugé 1985). Gynandromorph forms have been described in several orders of arthropods (Martini et al. 1999). In Hymenoptera, this phenomenon is described within some families, such as, Anthophoridae (Urban 1999), Apidae (Gordh and Gulmahamad 1975), Chalcididae (Haltead 1988), Diprionidae (Martini *et al.* 1999), Formicidae (Jones and Phillips Jr. 1985), Halictidae (Nilsson 1987), Scelionidae (Huggert 1977) and others cited by Nilsson (1987).

The origin of this phenomenon is not completely known, but it is generally attributed to developmental anomalies. Nilsson (1987) discusses some possible causes of gynandromorphism in haplodiploid insects such as hymenopterans: 1) eggs that contain two nuclei and the fertilization of only one of these may produce a gynandromorph; 2) polyspermy, by which one sperm may fertilize the egg while a nucleus from a supernumerary sperm may give rise to haploid cells in the embryo and thus a gynandromorph; 3) accidental meiosis giving rise to haploid cells in a diploid embryo; 4) the opposite event giving rise to diploid cells from haploid ones and 5) accidental loss of sex-determining loci.

Feminization mediated by *Wolbachia* in genetically male individuals, although not known in Hymenoptera (Cook and Butcher 1999), deserves more studies. Feminization due to *Wolbachia* infection is known in Isopoda (Rigaud and Juchault 1993) and was recently reported in Lepidoptera (Hiroki et al. 2002, Kageyama *et al.* 2002). In Isopoda, *Wolbachia*-mediated feminization leads to the production of gynandromorph phenotypes (Rigaud and Juchault 1993). In Diptera, *Wolbachia* infections may be distributed throughout somatic tissues (Dobson

[1] Received on December 20, 2002. Accepted on January 26, 2004.

[2] FFCLRP-USP. Departamento de Biologia, CEP 14040-901, Ribeirão Preto/SP, Brazil. E-mail: raspereira@yahoo.com.br.

[3] Unicamp. Depto. de Parasitologia, CP 6109, CEP 13083-970, Campinas/SP, Brazil. E-mail: apprado@unicamp.br.

[4] CEFE-CNRS (Centre d'Ecologie Fonctionnelle et Evolutive), Montpellier, France. E-mail: kjellberg@cefe.cnrs_mop.fr.

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et al. 1999); thus, in haplodiploid organisms like Hymenoptera, feminization associated with infection of somatic tissues could produce a gynandromorph.

The genus *Ficus* (Moraceae) is pollinated by tiny species-specific pollinating wasps belonging to the family Agaonidae (Ramírez 1970, Wiebes 1979, Herre *et al.* 1996). Agaonids show a strong sexual dimorphism, with winged females and wingless pale brown males (Figure 1 A-B). Sex-determination is haplodiploid, males developing from unfertilized eggs and females from fertilized ones (Cook 1993).

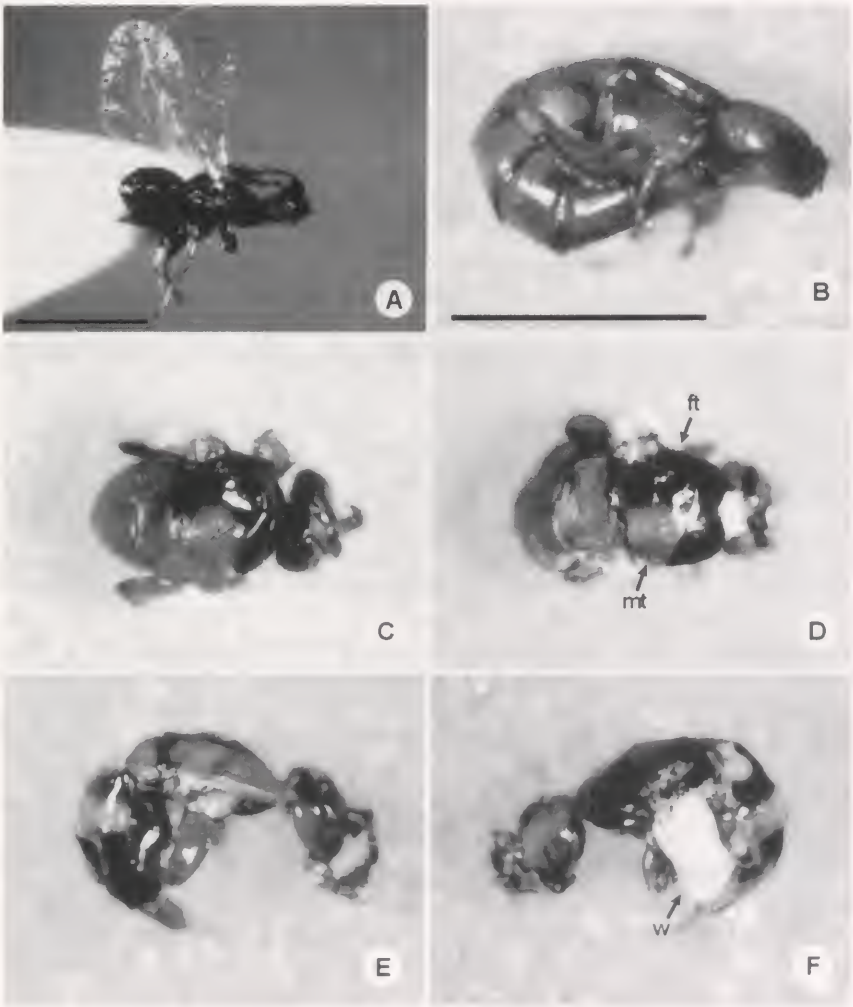

Figure 1. *Pegoscapus tonduzi* pollinator of *Ficus citrifolia*. Normal female and male: A-B. Gynandromorph individuals: C – specimen 1 (dorsal), D – specimen 2 (dorsal), E-F – specimen 3 (laterals). ft = female tissue, mt = male tissue, w = wing. B-F at the same scale. Scales = 1mm.

Among non-pollinating fig wasps, gynandromorphism was described in the genus *Psenobolus* (Ichneumonoidea, Braconidae) (Ramírez and Marsh 1996) and the gynandromorph specimen helped to associate female and male forms classified before as different species due to the accentuated sexual dimorphism. However, this phenomenon is not described in the literature for fig wasp species belonging to the superfamily Chalcidoidea that includes pollinating fig wasps.

Six gynandromorph specimens of the pollinating species, *Pegoscapus tonduzi,* were found in crops of two trees of *Ficus citrifolia* sampled during August 2001 in the surroundings of the Campinas State University campus, Brazil (22° 54'S, 47° 03'W). Twenty-five syconia of each tree were sampled near the wasp emergence phase before any wasps had left the fruit. Each syconium was placed individually in a plastic flask, and all the wasps were allowed to emerge before being frozen. The gynandromorph individuals were found in galls from which insects had not emerged, suggesting these insects had some viability problems. Gynandromorph specimens showed female and male tissues distributed in a mosaic over all parts of the body, but with genitalia predominantly masculine (Figure 1 C-F). The external morphology presented female or male traits according to the predominance of female or male tissues respectively, including the development of wings in these thorax parts with female tissues (Figure 1 F).

This phenomenon seems to be rare, since only six gynandromorph individuals were observed in approximately 600 syconia or 14,000 males assessed during the five-year study. Another interesting point is that all the gynandromorph individuals were found in two samples at the same period of the year, suggesting perhaps an environmental factor, such as low temperatures, could cause developmental interferences in these insects. Gynandromorphism was also observed, though in a slightly different form in *Blastophaga psenes,* the wasp pollinating *F. carica.* In 1984, four gynandromorphic individuals were observed in a sample of 127 syconia containing 3,312 males. They were all in non-exited galls, suggesting again a lack of viability. In *B. psenes,* the individuals had a female front part and a male hind part. Three were found on one tree within the same crop that matured in May (two in the same syconium), while the fourth was observed on another tree in a crop that matured in July. No gynandromorphic male was observed in other years of sampling.

The presence of gynanadromorphs at low frequencies in two species suggests that they may occur in other fig wasp species, but their occurrences is not noticed because of their low frequency and because it is necessary to crack open the closed galls to find these insects. More studies will be necessary to elucidate the factors that lead to the development of gynandromorph fig wasp individuals.

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A NEW SPECIES OF *ATRICHOPOGON* KIEFFER FROM NORTHERN ARGENTINA (DIPTERA: CERATOPOGONIDAE)[1]

Pablo I. Marino[2] and Gustavo R. Spinelli[2]

ABSTRACT: *Atrichopogon carpinteroi,* n. sp. from the Argentinian province of Formosa is described and illustrated from male and female specimens collected with a light trap. The species, easily recognized by the contrasting coloration between the thorax and abdomen, lacks secondary sexual dimorphism. It is compared with the congeners, *A. utricularis* Macfie and *A. homofacies* Spinelli.

KEY WORDS: *Atrichopogon,* new species, Diptera, Ceratopogonidae, northern Argentina

Atrichopogon Kieffer, a worldwide genus, is one of the most speciose in the family Ceratopogonidae, only surpassed in the Neotropics by *Culicoides* Latreille and *Forcipomyia* Meigen. Borkent and Spinelli (2000), in their catalog of the New World ceratopogonids south of the United States of America, listed 75 species for the region, and there has been only one species subsequently described, *Atrichopogon mexicanus* Huerta (2001). Of these species, the following eleven are known to occur in Argentina: *A. albinensis* Ingram and Macfie, *A. balseiroi* Spinelli, *A. casali* Cavalieri and Chiossone, *A. delpontei* Cavalieri and Chiossone, *A. domizii* Spinelli, *A. homofacies* Spinelli, *A. mendozae* Ingram and Macfie, *A. obfuscatus* Ingram and Macfie, *A. obnubilus* Ingram and Macfie, *A. seudoobfuscatus* Spinelli and *A. talarum* Spinelli (Spinelli, 1998).

The feeding habits of the female adults are poorly known. Some suck haemolymph from blister beetles (Wirth, 1956a, b), while others are pollinivorous or appear to be autogenous. Larvae are aquatic or semiaquatic and are found on the surface of mud, wet wood, or stones, feeding on diatoms and other algae (de Meillon and Wirth, 1991).

Species of *Atrichopogon* form a fairly uniform group as far as their adult morphology is concerned (Debenham, 1973), and very similar species can be recognized as adults only by the male genitalic characters. However, pigmentation patterns appear to be very important in the recognition of many species in Costa Rica (Borkent, pers. comm.).

Through the courtesy of Jorge Williams from the Museo de La Plata, Argentina, we obtained specimens of a very distinctive species of *Atrichopogon* collected with a light trap in the Argentinian province of Formosa, which is here described as a new species.

METHODS

Specimens were slide mounted in Canada balsam and examined, measured

[1] Received on January 6, 2004. Accepted on February 3, 2004.

[2] División Entomología, Museo de la Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina. E-mails: pabloaguara@yahoo.com.ar and spinelli@museo.fcnym.unlp.edu.ar, respectively.

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and drawn using a binocular compound microscope with attached camera lucida. Types of the new species are deposited in the collection of the Division of Entomology, Museo de la Plata, Argentina (MLPA).

Terms for structures follow those used in the Manual of Nearctic Diptera (McAlpine et al., 1981), and for special terms applying to *Atrichopogon* see Wirth (1994). Terms for wing veins follow the system of the Manual of Nearctic Diptera, with modifications proposed by Szadziewski (1996).

Atrichopogon carpinteroi, NEW SPECIES
(Figs. 1-9)

Diagnosis. A medium-size species of *Atrichopogon* with no secondary sexual dimorphism; eight proximal flagellomeres whitish, distal five dark brown; thorax with scutum, scutellum, postscutellum, paratergite, propleuron and anepisternum dark brown, rest of pleura and legs pale yellowish; abdomen pale yellowish, segment 8-10 of female slightly darker; spermatheca large, ovoid with short neck, lightly sclerotized; parameres apparently missing; aedeagus triangular, tapering to cap-like apex, basal arch very low.

Description of male. Head. Vertex, frons dark brown; clypeus brown; proboscis pale. Ommatidia with interfacet spicules, narrowly abutting medially. Antenna (Fig. 1) with flagellomeres 1-8 whitish, bottle-shaped, flagellomeres 9-13 elongated, dark brown, proportions as shown in Fig. 1, flagellomere 13 with basally constricted nipple; flagellomeres with sensillae chaetica and trichodea, without plume setae (Fig. 2); AR 1.20. Maxillary palpus (Fig. 3) pale, darkish at apex; third segment slender, with shallow sensory pit near midlength; segments 4, 5 closely appressed; segment 5 conical-shaped; PR 3.00. Proboscis short, length 0.240 mm; P/H ratio 1.07.

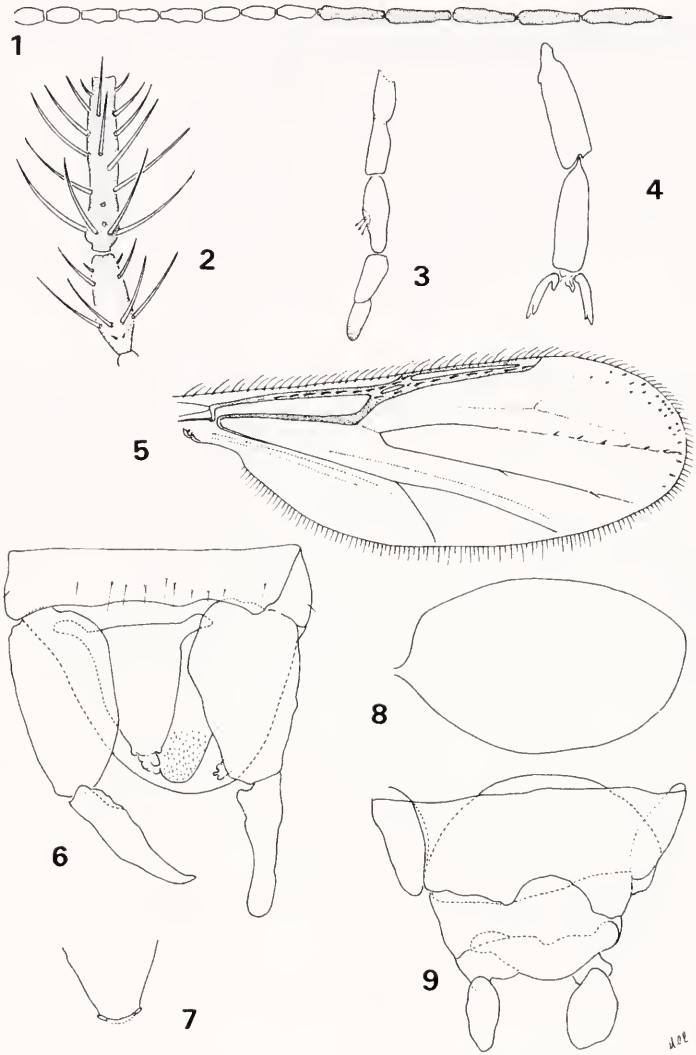
Thorax. Scutum, scutellum, postscutellum, paratergite, propleuron, anepisternum dark brown; rest of pleura pale yellowish; scutum with all setae in dark pits; with lateral suture. Paratergite with one stout seta. Legs uniformly yellowish; hindtibial spur short, hindtibial comb with 7 spines; prothoracic TR 2.91, mesothoracic TR 3.08, metathoracic TR 2.28; claws (Fig. 4) curved, moderately stout, bifid at tip; empodia present. Wing (Fig. 5) plain, without pattern of pigmented membrane; with few macrotrichiae in cell r3, one or two in cell m1; first radial cell reduced, second radial cell well formed, long, narrow; cubital fork proximal to level of costal apex; wing length 0.98 mm; breadth 0.36 mm; CR 0.69. Halter whitish.

Abdomen. Tergites uniformly pale yellowish. Sternites more or less similarly rectangularly shaped. Genitalia (Fig. 6): Segment 9 with tergite moderately elongate, extending to level of apex of gonocoxite; sternite 9 narrow, with single row of setae. Gonocoxite pale yellowish, moderately stout, 1.6 times longer than greatest breadth; gonostylus 0.75 as long as gonocoxite, slender, nearly straight, tip pointed. Parameres apparently missing. Aedeagus triangular, stout, lightly sclerotized, tapering to cap-like tip (Fig. 7); basal arms short, recurved; basal arch very low, extending to 1/10 of total length. Cercus small, lobe-like, not projecting beyond apex of tergite 9.

Female. As for male, only with genital differences; AR 1.27 (1.26-1.28, n = 2); PR 2.95 (2.90-3.00, n = 2); proboscis length 0.30 mm; P/H ratio 1.33 (1.25-1.41, n = 2); wing length 1.14 (1.13-1.14, n = 2) mm; breadth 0.44 (0.43-0.46, n = 2) mm; CR 0.70 (0.69-0.71, n = 2); prothoracic TR 2.96 (2.92-3.00, n = 2), mesothoracic TR 3.21 (3.17-3.25, n = 2), metathoracic TR 2.43 (2.35-2.50, n = 2). Tergites 1-7 pale yellowish, 8-10 slightly darker. Spermatheca large, ovoid with short neck, lightly sclerotized, measuring 0.240 by 0.152 mm (Fig. 8). Sternite 8 without elongate, curved setae. Segments 8-10 as shown in Fig. 9. Cercus pale.

Distribution. *Atrichopogon carpinteroi* n. sp. is known only from the type locality.

Material Examined. Holotype male, allotype female, Argentina, Formosa prov., Estancia La Marcela, 35 km E El Colorado, 27/28-VII-2003, J. Williams, light trap (MLPA); paratype female, same data.



Figs. 1-9. *Atrichopogon carpinteroi,* n. sp. 1-7. male; 8-9. female. 1. flagellum; 2. flagellomeres 8-9; 3. palpus; 4. tarsal claws; 5. wing; 6. genitalia; 7. tip of aedeagus; 8. spermatheca; 9. abdominal segments 8-10. Scale bars = 0.05 mm.

Taxonomic Discussion. Males and females were associated by their similar pigmentation pattern and were collected at the same locality and date. The female of this new species resembles the female of *A. utricularis* Macfie from Costa Rica by virtue of the large, ovoid, lightly sclerotized spermatheca with narrow duct and by the few macrotrichia at the wing tip, but differs by having bifid

tarsal claws (simple in *utricularis*) and by several differences in pigmentation patterns, e.g., proximal eight flagellomeres pale (flagellum nearly entirely dark brown in *utricularis*), abdomen pale yellowish (very dark brown in *utricularis*) and legs pale yellowish (yellowish brown in *utricularis*).

Atrichopogon homofacies Spinelli from Argentina and *A. carpinteroi* both lack secondary sexual differences. However, the abdomen of *A. homofacies* is pale brown, so that the pigmentation of thorax and abdomen does not contrast, the flagellum is entirely dark brown and only the last three flagellomeres of male flagellum are elongated. In addition, *A. homofacies* differs in the following genital characters: Y-shaped female genital sclerotization; parameres present, fused, and with a blunt tip; aedeagus Y-shaped with higher basal arch and deeply pigmented, stout, pilose gonostylus.

Etymology. The species is named after Diego L. Carpintero from the Museo de La Plata, in recognition of his excellent work recognizing ceratopogonids in alcohol preserved light traps samples.

ACKNOWLEDGMENTS

We would like to acknowledge Jorge Williams for his valuable help collecting insects using light traps in several places of Argentina.

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CONFIRMATION OF *PROSTOIA COMPLETA* AND *SHIPSA ROTUNDA* (PLECOPTERA: NEMOURIDAE) IN MISSISSIPPI, U.S.A.[1]

Bill P. Stark[2] and Matthew B. Hicks[3]

ABSTRACT: *Prostoia completa* (Walker), previously reported from Mississippi but without specific locality data, is confirmed from several sites recently discovered by personnel of the Mississippi Department of Environmental Quality, Biological Services Section, in the northern part of the state, and *Shipsa rotunda* (Claassen) is reported in the state for the first time. An updated checklist of 55 species now reported from the state is given.

KEY WORDS: *Prostoia completa, Shipsa rotunda,* Plecoptera, Nemouridae, Mississippi, U.S.A.

Stark (1980) recorded only three nemourids from Mississippi with *Amphinemura nigritta* (Provancher) the only relatively common species. *Prostoia completa* (Walker) was included on the basis of a Ricker (1952) record which did not give a specific locality, and *A. delosa* (Ricker) on the basis of a single female specimen in the Bryant Mather collection. Subsequently, collections of *A. nigritta* have been made from a few sites but no new records of other nemourid species were available until a recent winter sampling program by the Mississippi Department of Environmental Quality (MDEQ) produced nymphs determined as *Prostoia* from several localities. The purpose of this study was to confirm the presence of *P. completa* in the state by collecting adult specimens at the MDEQ sites. While collecting these specimens we were surprised to find an additional nemourid species, *Shipsa rotunda* (Claassen), at one site. Specimens are deposited in the B. P. Stark collection (BPS), Mississippi College, Clinton, Mississippi, or in the Mississippi Department of Environmental Quality, Biological Services Section (MDEQ), Pearl, Mississippi, as indicated in the species accounts.

Prostoia completa (Walker)

Nemoura completa Walker, 1852. Holotype ♂, Nova Scotia, British Museum of Natural History.

Stark (2001) lists this species from 22 states and Canadian provinces in the general region from Nova Scotia to Minnesota, south to Oklahoma and Mississippi, and east to the Carolinas. Specific records exist for Alabama (James 1972; Stark and Harris 1986) and Arkansas (Poulton and Stewart 1991), but the species has not yet been reported in Tennessee although B. C. Kondratieff has records from several counties (Kondratieff pers. com.). Ricker's (1952) specimen, a male (C. Favret, pers. com.), is listed in the Illinois Natural History Survey data base from Potts Camp [Marshall County], Mississippi, collected February 17, 1941.

[1] Received on March 26, 2003. Accepted on February 9, 2004.

[2] Dept. of Biology, Box 4045, Mississippi College, Clinton, MS 39058, U.S.A. E-mail: stark@mc.edu.

[3] The Nature Conservancy of Mississippi, 6400 Lakeover Road, Jackson, MS 39213, U.S.A. E-mail: mhicks@tnc.org.

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We presume this specimen was collected from Oaklimeter Creek, which flows through Potts Camp, although we collected only *Taeniopteryx* specimens at this site.

Material Examined. Mississippi: Alcorn County, Bearman Creek, CR 771 near Lone Pine, 28 February 2002, 4 nymphs (MDEQ). Alcorn Co., Hatchie River, CR 755 near Lone Pine, 28 February 2002, 3 nymphs (MDEQ). Lee County, Twenty Mile Creek, 21 February 2001, 1 nymph (MDEQ). Marshall County, Big Spring Creek, Potts Camp Road, 15 February 2003, B. Stark, M. Hicks, 5 ♂, 5 ♀, 12 nymphs (BPS). Same site, 16 January 2001, 13 nymphs (MDEQ). Marshall County, Little Spring Creek, Wilkins Church Road, 15 February 2003, B. Stark, M. Hicks, 1 nymph (BPS).

Shipsa rotunda (Claassen)

Nemoura rotunda Claassen, 1923. Holotype ♂, Waldeboro, Maine, Cornell University.

Stark (2001) lists this species from 18 states and Canadian provinces in the general region from New Brunswick to Alaska, south to Arkansas and South Carolina. The species is reported from Arkansas by Poulton and Stewart (1991) and Alabama (James 1972; Stark and Harris 1986), but not Tennessee. The record given below is from a creek somewhat smaller than the typical habitat for this species.

Material Examined. Mississippi: Marshall County, Big Spring Creek, Potts Camp Road, 15 February 2003, B. Stark, M. Hicks, 1 ♂, 2 ♀, 2 nymphs (BPS).

Systematic List of Mississippi Plecoptera

SYSTELLOGNATHA

Family Chloroperlidae

Alloperla natchez Surdick & Stark
Haploperla brevis (Banks)
Haploperla chukcho (Surdick & Stark)

Family Perlidae

Acroneuria abnormis (Newman)
Acroneuria arenosa (Pictet)
Acroneuria carolinensis (Banks)
Acroneuria evoluta Frison
Agnetina annulipes (Hagen)
Attaneuria ruralis (Hagen)
Eccoptura xanthenes (Newman)
Neoperla carlsoni Stark & Baumann
Neoperla clymene (Newman)
Neoperla coxi Stark
Neoperla occipitalis (Pictet)
Neoperla robisoni Poulton & Stewart
Neoperla stewarti Stark & Baumann
Paragnetina fumosa (Banks)
Paragnetina kansensis (Banks)

Perlesta lagoi Stark
Perlesta placida (Hagen)
Perlesta shubuta Stark
Perlinella drymo (Newman)
Perlinella ephyre (Newman)
Perlinella zwicki Kondratieff, Kirchner & Stewart

Family Perlodidae
Clioperla clio (Newman)
Diploperla duplicata (Banks)
Helopicus bogaloosa Stark & Ray
Isogenoides varians (Walsh)
Isoperla bilineata (Say)
Isoperla coushatta Szczytko & Stewart
Isoperla dicala Frison

Family Pteronarcyidae
Pteronarcys dorsata (Say)

EUHOLOGNATHA

Family Capniidae
Allocapnia aurora Ricker
Allocapnia granulata (Claassen)
Allocapnia mystica Frison
Allocapnia polemistis Ross & Ricker
Allocapnia recta (Claassen)
Allocapnia rickeri Frison
Allocapnia starki Kondratieff & Kirchner
Allocapnia virginiana Frison
Nemocapnia carolina Banks

Family Leuctridae
Leuctra cottaquilla James
Leuctra ferruginea (Walker)
Leuctra rickeri James
Leuctra tenella Provancher

Family Nemouridae
Amphinemura delosa (Ricker)
Amphinemura nigritta (Provancher)
Prostoia completa (Walker)
Shipsa rotunda (Claassen)

Family Taeniopterygidae
Strophopteryx fasciata (Burmeister)

Taeniopteryx burksi Ricker & Ross
Taeniopteryx lita Frison
Taeniopteryx lonicera Ricker & Ross
Taeniopteryx maura (Pictet)
Taeniopteryx parvula Banks

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FIVE NEW SPECIES OF *NEOTRICHIA* (TRICHOPTERA: HYDROPTILIDAE: NEOTRICHIINI) FROM SOUTHERN MEXICO AND NORTHERN BELIZE[1]

Andrew C. Keth[2]

ABSTRACT: Five new species of microcaddisflies of the genus *Neotrichia*, *Neotrichia amplector*, from southern Mexico, and *Neotrichia amplio*, *Neotrichia garra*, *Neotrichia mathisi*, and *Neotrichia pulgara*, from northern Belize are described and illustrated. New figures of *Neotrichia ersitis*, *Neotrichia okopa*, *Neotrichia aequispina*, *Neotrichia rasmusseni*, and *Neotrichia maria* are included for comparison.

KEY WORDS: *Neotrichia*, Trichoptera, Hydroptilidae, Neotrichiini, southern Mexico, northern Belize, new species.

The genus *Neotrichia* (Trichoptera: Hydroptilidae) is one of the most speciose groups of microcaddisflies (Flint *et al.* 1999). *Neotrichia* species have been collected over the whole of North America, from as far north as Saskatchewan and Maine, southeast to Florida, and west to Oregon and California (Wiggins 1998). The distribution includes Mexico, Central and South America, and representative species can be found in Cuba and nearly all the islands of the Caribbean (Harris 1990; Flint *et al.* 1999). Of the 121 nominal species of *Neotrichia*, 101 occur only in the Neotropics (Harris 1991; Frazer and Harris 1991; Morse 1993; Morse 1997; Flint *et al.* 1999; Keth 2002).

An ongoing study of *Neotrichia* systematics has led to the discovery of several new species. In this paper I describe one new *Neotrichia* species from southern Mexico and four new species from northern Belize. Descriptive terminology follows that of Marshall (1979) and Keth (2002). Type material will be deposited at The National Museum of Natural History, Smithsonian Institution (NMNH), Washington, D.C., USA and at The Frost Entomological Museum, The Pennsylvania State University (PSU), University Park, Pennsylvania, USA.

Neotrichia amplector Keth, NEW SPECIES

(Fig. 1)

Diagnosis. *Neotrichia amplector* is most similar to *N. ersitis* Denning (Fig. 2), both having short triangular inferior appendages with robust serrations along the mesal margins. Both *N. amplector* and *N. ersitis* also have ornate sclerotized ridges at the apex of the subgenital plate. *Neotrichia amplector* differs from *N. ersitis* having ventromesal folds of segment IX that embrace the subgenital plate and a lack of sclerotized, apical hooks on the apex of the phallus.

[1] Received on April 21, 2003. Accepted on December 8, 2003.

[2] Department of Biology, Clarion University, Clarion, PA 16214, U.S.A. E-mail: aketh@clarion.edu.

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Male. Length 1.9 mm. 18 antennal segments. Brown in alcohol. Abdominal segments VII and VIII annular. Segment IX arising from within segments VII and VIII, anterior margin tapered to long, finger-like projection; posterior margin blunt, sclerotized in lateral view; in ventral view producing bands that wrap around base of subgenital plate to form rounded, overlapping flaps each with a single, stout seta visible between inferior appendages. Segment X fused with dorsolateral margins of segment IX, long, slender, tapered to acute apex in lateral view; in dorsal view deeply emarginate with lateral margins sclerotized. Genitalia as in Fig. 1. Subgenital plate thick, broadening slightly to apex having sclerotized, beak-like apicoventral projection in lateral view; in ventral view broad, uniform to blunt apex with long, paired apicolateral setae produced from sclerotized, ridges along apical margins. Inferior appendage short, basally rounded, rapidly constricted at 2/3 length, dorsally serrate 2/3 length to apex in lateral view; in ventral view triangular, prominently serrate along mesal margin midlength to acute apex. Bracteoles slender, somewhat spatulate in lateral view; in ventral view uniform, curved slightly to rectangular apex. Phallus long, narrow with preapical constriction giving rise to slender, round paramere; apex long, broadening slightly over entire length to membranous tip; ejaculatory duct uniform, protruding slightly prior to phallus tip.

Female. Unknown.

Larva. Unknown.

Type Material. Holotype. Mexico: Tabasco. Teapa, Grutas de Colona, Rio Puyacatengo. March 7, 1988. Barba and Barrera. 1 male (NMNH).

Etymology. Latin: of embrace, referring to the ventromesal folds of segment IX that embrace the subgenital plate.

Distribution. *Neotrichia amplector* is know only from the type locality in southern Mexico.

Neotrichia amplio Keth, NEW SPECIES
(Fig. 3)

Diagnosis. Although it is unlikely that *Neotrichia amplio* will be mistaken for *N. okopa* Ross (Fig. 4), they are somewhat similar in their triangular inferior appendages and subgenital plates lacking projections. *Neotrichia amplio* differs from *N. okopa* having many long, prominent setae on the inferior appendages, minute setae covering the surface of the subgenital plate, and sclerotized, apical ribbons on the apex of the phallus. *Neotrichia amplio* is also larger and more robust than most other *Neotrichia* species.

Male. Length 2.2 mm. 18 antennal segments. Brown in alcohol. Segments VII and VIII annular. Segment IX arising from within segment VIII, anterior tapered, angular; posterior margin blunt, sclerotized. Segment X long, basally broad, tapered and dorsally setose to slender apex that is bifid at extreme tip in lateral view; in dorsal view long, broad, uniform to bilobed apex with each lobe flared slightly at extreme tip. Genitalia as in Fig. 3. Subgenital plate uniform to blunt apex with dorsal surface covered with short, stout setae in lateral view; in ventral view slender, margins rounded to lobate apex producing long, paired, apicolateral setae; tiny, finger-like projection mesad base of each apical seta. Inferior appendage broad, curved, tapered to acute apex in lateral view; in ventral view long, broad, tapered over entire length to rounded apex, margins and surface with multiple, prominent setae; fused mesally by ornate, sclerotized ridge from base to midlength. Bracteoles short, basally slender, broadening to spatulate apex in lateral view; in ventral view stout, nearly uniform to apex, slightly divergent. Phallus long, constriction prior to apex giving rise to flat, ribbon-like paramere covered over entire length with fine, stout setae; apex long, tapered to slightly flared tip producing pair of sclerotized knife-like blades along lateral surface; superior blade long, tapered, inferior blade ½ length of superior blade, tapered only slightly to acute apex; ejaculatory duct uniform to phallus tip, protruding.

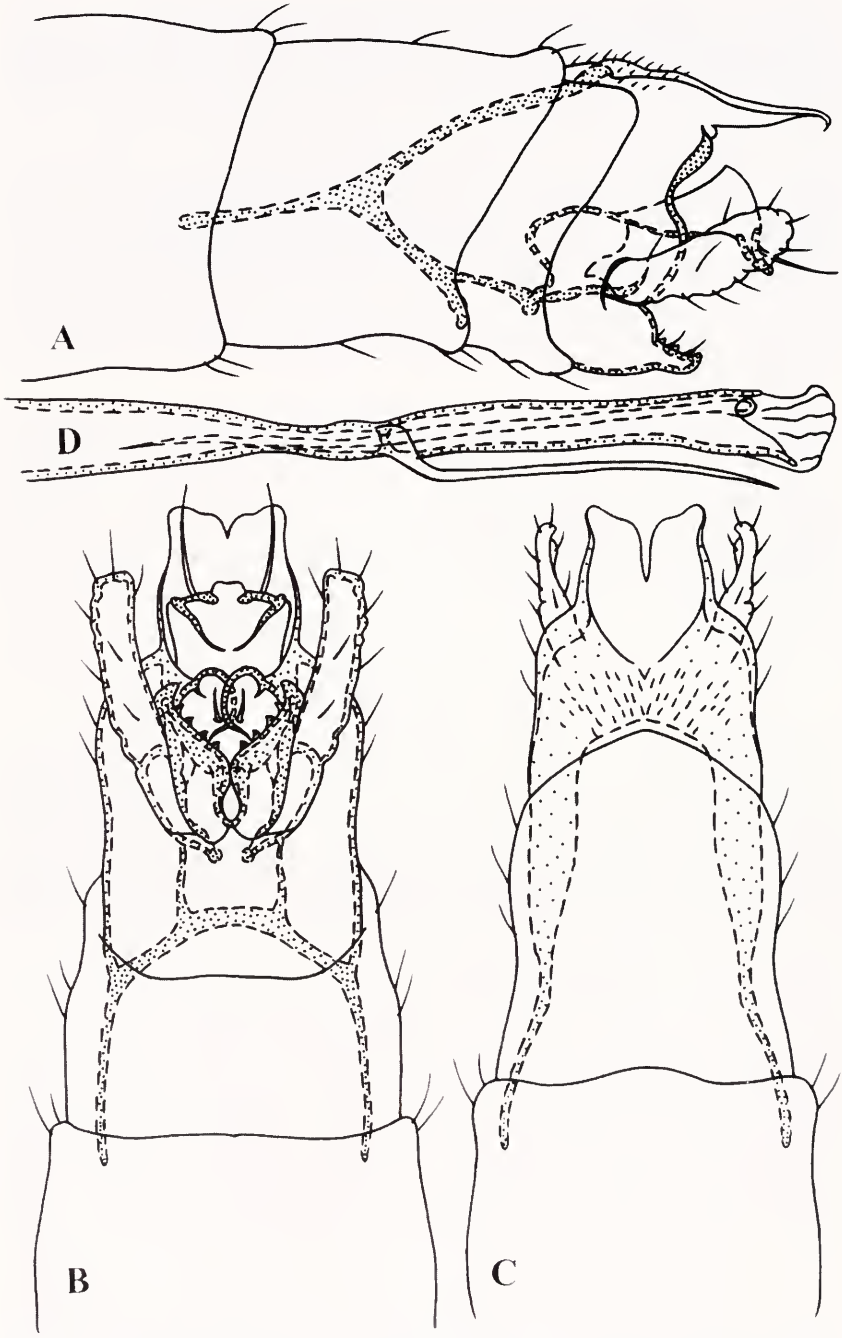

Figure 1. *Neotrichia amplector*; male genitalia. a. lateral b. ventral c. dorsal d. phallus.

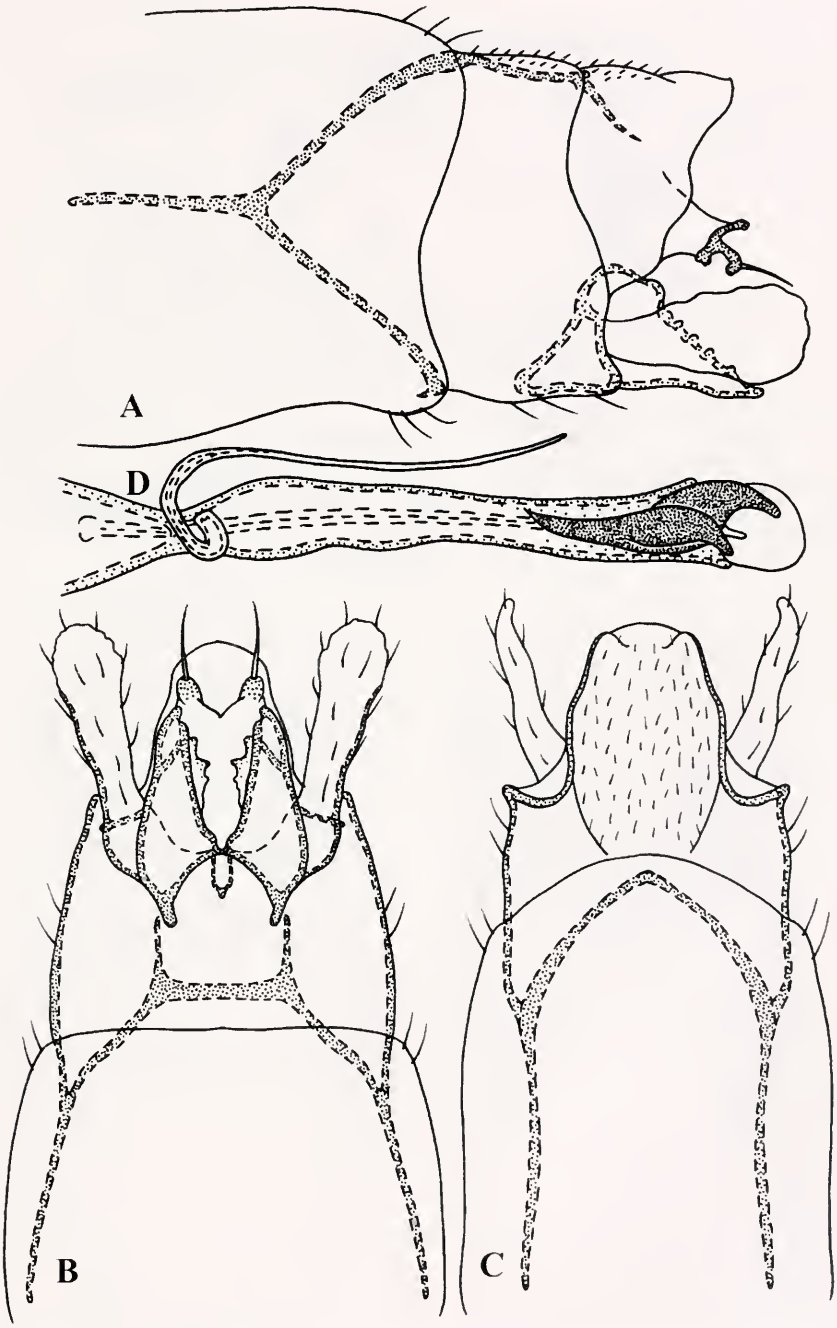

Figure 2. *Neotrichia ersitis,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

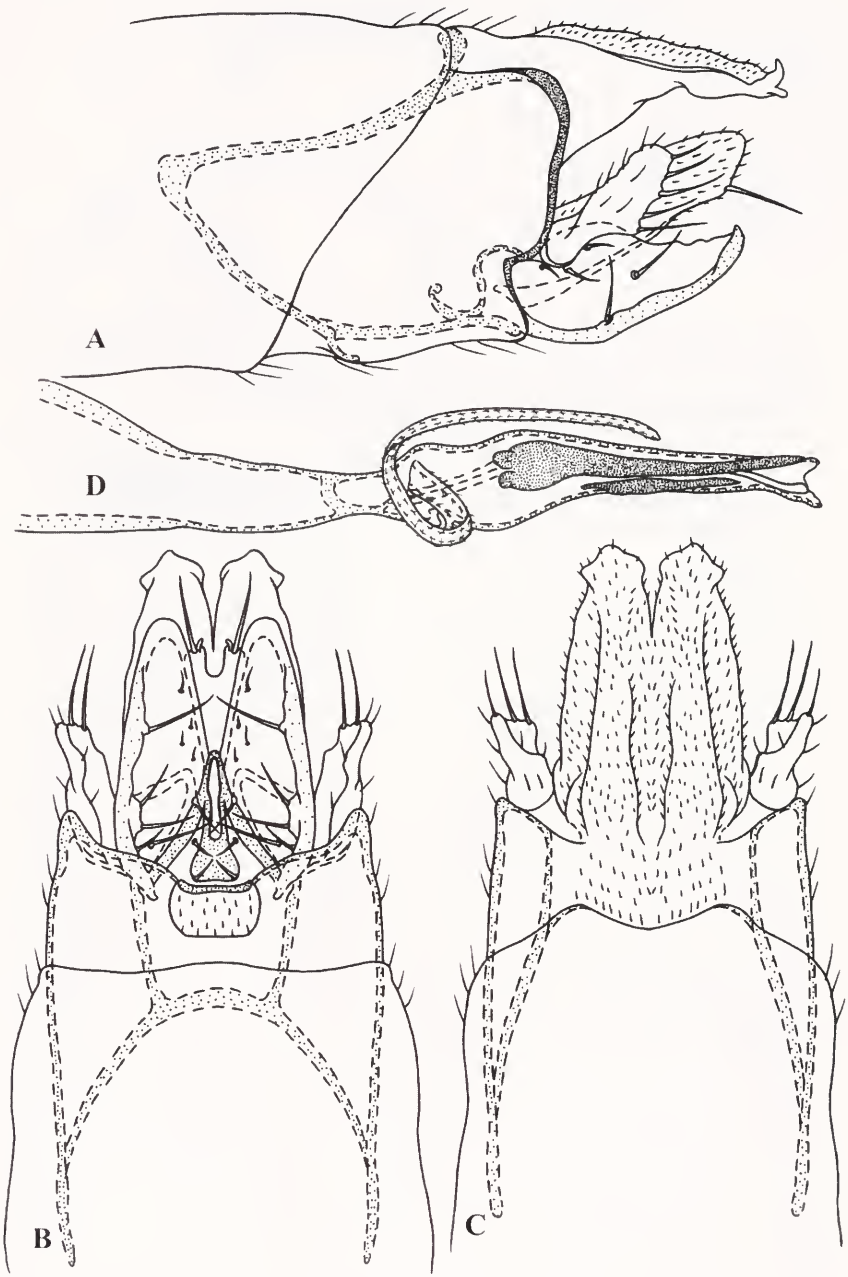

Figure 3. *Neotrichia amplio,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

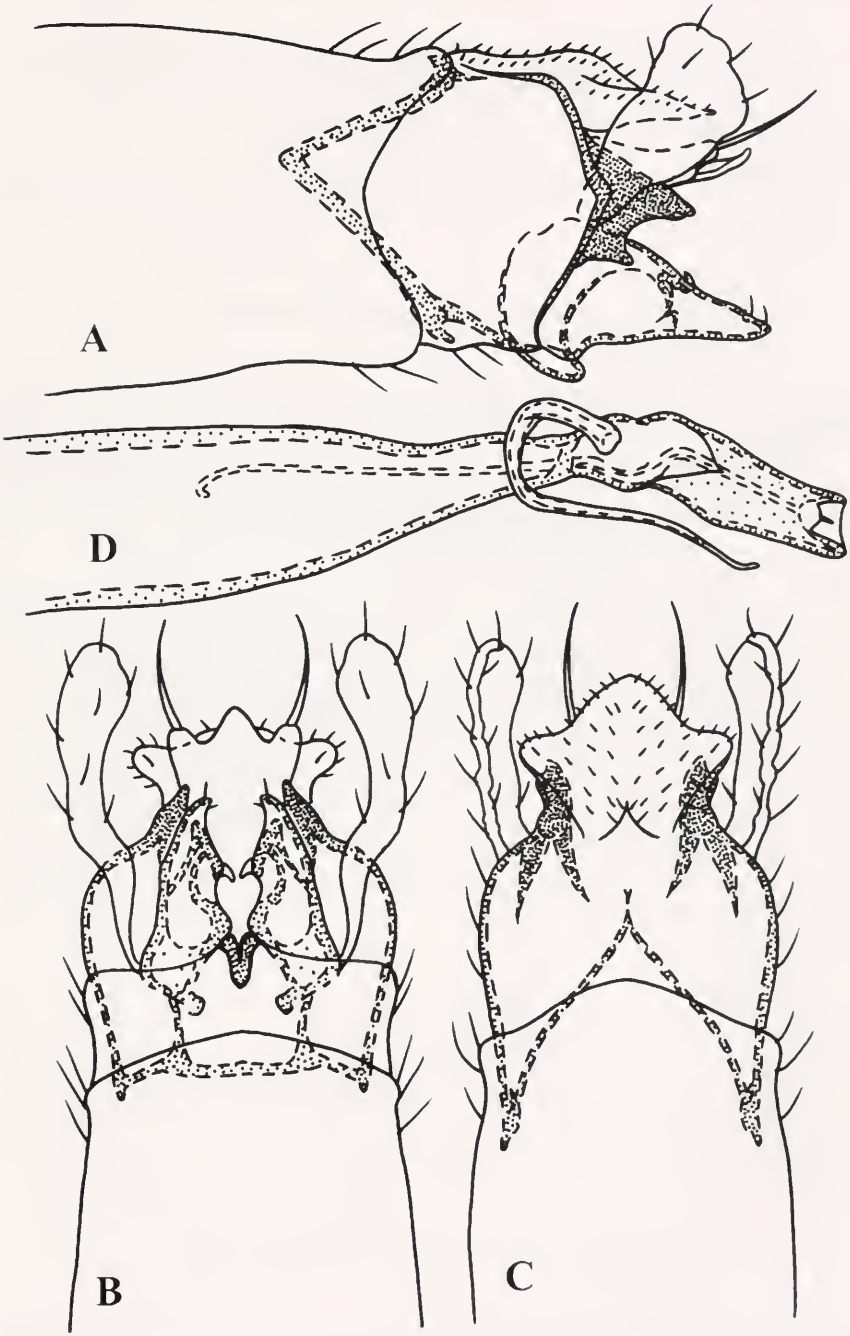

Figure 4. *Neotrichia okopa*, male genitalia. a. lateral b. ventral c. dorsal d. phallus.

Female. Unknown.

Larva. Unknown.

Type Material. Holotype. Belize: Orange Walk District. New River Lagoon, dock area at Lamanai Ruins. January 9, 1998. L. J. Davenport. 1 Male (NMNH).

Etymology. Spanish: of ample or full, referring to the robust stature of this species.

Distribution. *Neotrichia amplio* is know only from the type locality in northern Belize.

Neotrichia garra Keth, NEW SPECIES
(Fig. 5)

Diagnosis. Although it is unlikely that *Neotrichia garra* will be mistaken for *N. aequispina* Angrisano (Fig. 6), they are somewhat similar in their slender, tapered inferior appendages and the heavily sclerotized apicolateral extensions of segment IX. *N. garra* differs in the bilobed, translucent apex of segement X, the beak-like ventral projection of the apicolateral extension of segment IX, and in the tapered dorsal flap prior to the phallus tip.

Male. Length 1.9 mm. Head missing. Golden-brown in alcohol. Abdominal segments VII and VIII annular. Segment IX arising from within segments VII and VIII, anterior margin narrow, finger-like; posterior margin sclerotized, fused dorsally with segment X, producing rectangular apicolateral extension with prominent ventral beak in lateral view; in ventral view extension visible as sclerotized knob projecting mesad of inferior appendage. Segment X tapered to acute apex with translucent, flap-like extension curved dorsad in lateral view; in dorsal view constricted and laterally sclerotized to apex, deep emargination bridged by bilobed, translucent blade projecting posteriorly. Genitalia as in Fig. 5. Subgenital plate broadening slightly to blunt apex in lateral view; in ventral view broad to emarginate apex producing paired, apicolateral setae. Inferior appendage slender and tapered to acute apex, curved dorsad in lateral view; in ventral view basally broad, tapering to acute apex, divergent, with setae along mesal and apical margins. Bracteoles slender, spatulate in lateral view; in ventral view uniform, narrowed slightly at apex. Phallus long, narrow with slight preapical constriction giving rise to broad, flat paramere projected posteriorly and covered with minute setae; apex uniform with tapered, sclerotized flap produced along dorsal margin prior to tip; ejaculatory duct uniform to phallus tip, non-protruding.

Female. Unknown.

Larva. Unknown.

Type Material. Holotype. Belize: Orange Walk District. New River Lagoon, dock area at Lamanai Ruins. January 9, 1998. L. J. Davenport. 1 male (NMNH).

Etymology. Spanish: of claw, referring to the claw-like combination of the inferior appendage and apicolateral extension of segment IX in lateral view.

Distribution. *Neotrichia garra* is known only from the type locality in northern Belize.

Neotrichia mathisi Keth, NEW SPECIES
(Fig. 7)

Diagnosis. *Neotrichia mathis* is most similar to *N. rasmusseni* Harris and Keth (Fig. 8), both having reduced, knob-like inferior appendages and constricted api-

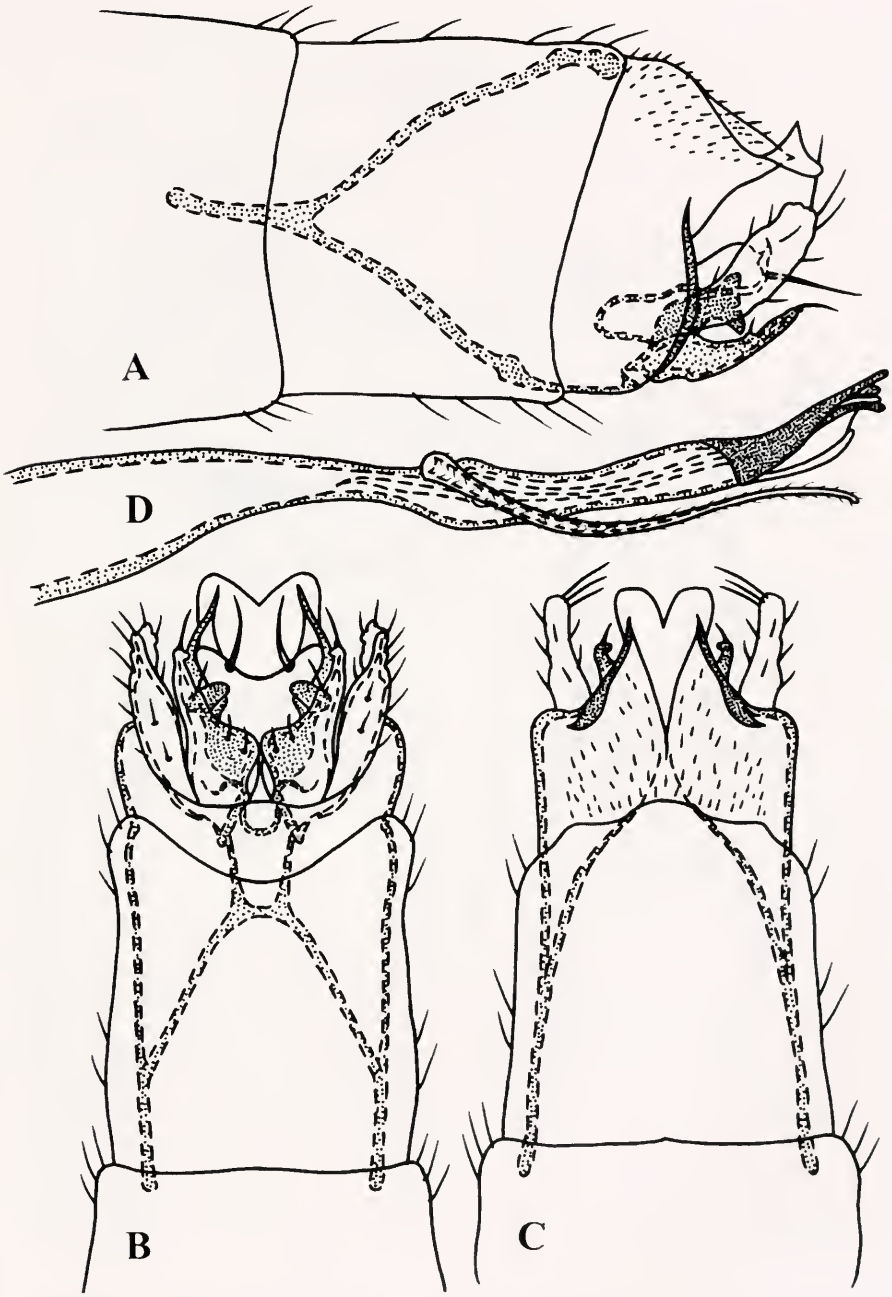

Figure 5. *Neotrichia garra,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

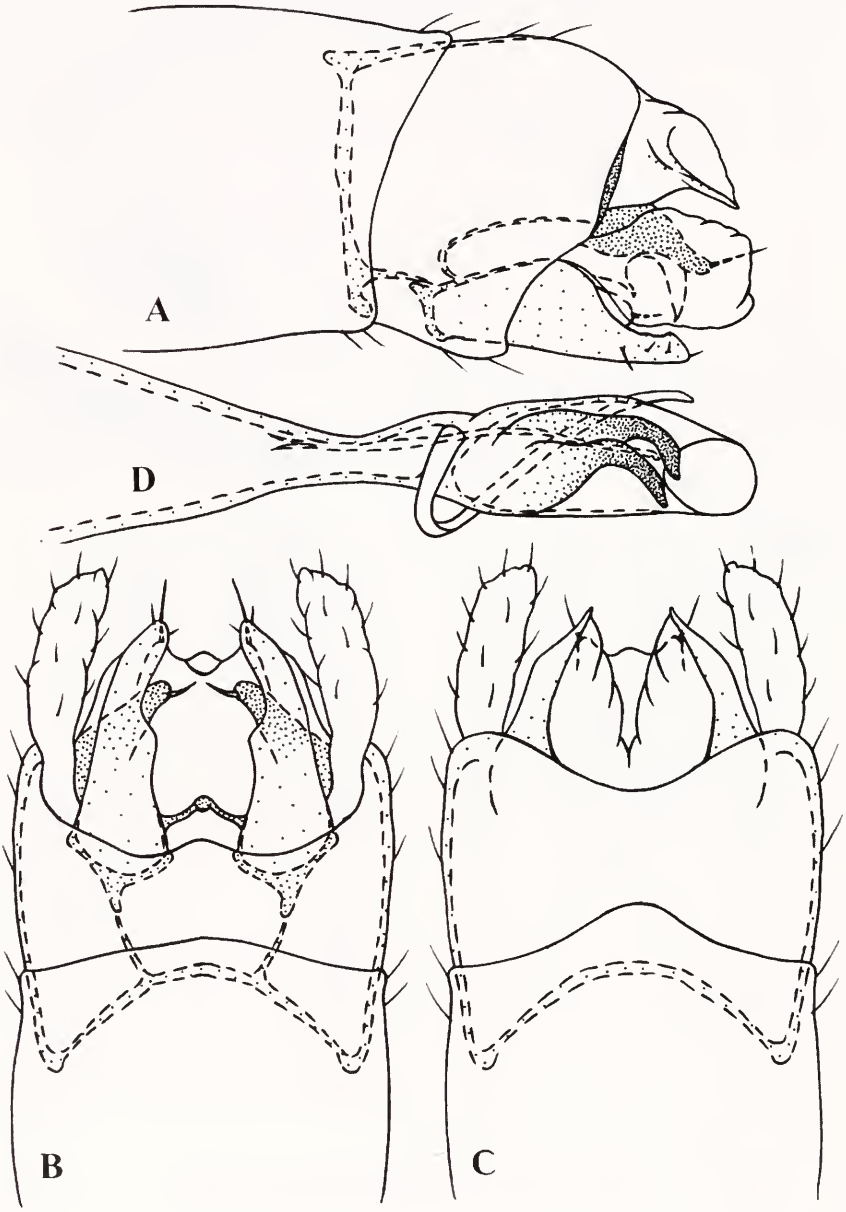

Figure 6. *Neotrichia aequispina,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

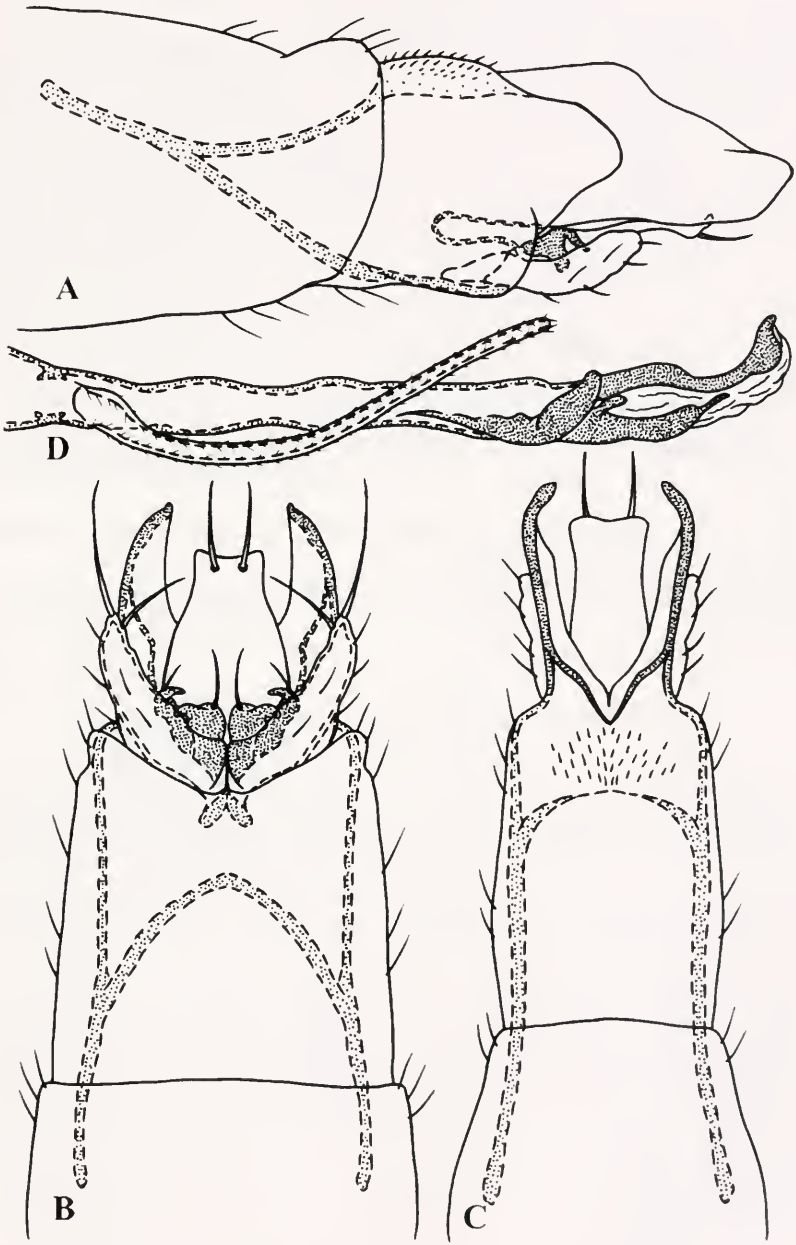

Figure 7. *Neotrichia mathisi,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

cal extensions of segment X. *Neotrichia mathisi* differs from *N. rasmusseni* in the incised apex of segment X, broad subgenital plate lacking an incision, and in the close ventromesal association of the bracteoles.

Male. Length 1.8-2.0 mm. 18 antennal segments. Brown in alcohol. Segments VII and VIII annular. Segment IX arising from within segments VII and VIII, anterior margin long, finger-like; posterior margin rounded, extending posteriorly in lateral view. Segment X fused dorsally with segment IX, long, robust, tapered to blunt apex in lateral view; in dorsal view deeply incised producing pair of long horns, curved mesad at apex with sclerous margins over entire length. Genitalia as in Fig. 7. Subgenital plate long and slender to apex flared slightly dorsad in lateral view; in ventral view broad with margins tapered to squared apex producing paired, apicolateral setae. Inferior appendage greatly reduced, sclerous, pincer-like in lateral view; in ventral view short, cushion-like with long, apicomesal seta and apicolateral finger curving mesad and producing single, apicolateral seta. Bracteoles short, nearly uniform to rounded apex in lateral view; in ventral view fused mesally at base, partially covering inferior appendages basally, divergent with two long, prominent setae at apex. Phallus long, constriction prior to apex giving rise to flat, ribbon-like paramere covered over entire length with fine, stout setae; apex long, uniform with multiple, scerotized, finger-like projections encompassing membranous tip; ejaculatory duct uniform to phallus tip, non-protruding.

Female. Unknown.

Larva. Unknown.

Material Examined. Holotype. Belize: Orange Walk District. New River Lagoon, dock area at Lamanai Ruins. January 9, 1998. L. J. Davenport, 1 male. (NMNH) Paratypes: 6 males. (3 NMNH; 3 PSU)

Etymology. Named in memory of Michael Mathis in recognition of his contributions to Trichoptera systematics.

Distribution. *Neotrichia mathisi* is know only from the type locality in northern Belize.

Neotrichia pulgara Keth, NEW SPECIES
(Fig. 9)

Diagnosis. *Neotrichia pulgara* is most similar to *N. maria* Bueno-Soria and Hamilton (Fig. 10), both having heavily sclerotized apical horns projecting from segment X. *Neotrichia pulgara* differs from *N. maria* primarily in the straight, rod-like aspect of the horns of segment X and in the long, slender phallus apex with dorsally membranous, scoop-like tip. The apical horns of *Neotrichia maria* are tapered and curved markedly mesad and the phallus apex is nearly ½ the length of that seen in *N. pulgara.*

Male. Length 1.9 mm. Antennae broken. Brown in alcohol. Segments VII and VIII annular. Segment IX arising from within segments VII and VIII, anterior margin long, finger-like; posterior margin reduced, blunt, with apicolateral extension giving rise to bracteole. Segment X fused dorsally with segment IX, long, gently curving to sclerous, thumb-like apex in lateral view; in dorsal view produced as paired, sclerotized rods with blunt, rounded apices. Genitalia as in Fig. 9. Subgenital plate long, tapering slightly to acute apex in lateral view; in ventral view broad basally, margins ventrally folded and serrate, apex highly constricted, narrowly emarginate, with paired apical setae. Inferior appendage long, narrow, having dorsal hump near midlength with 2 prominent setae projecting dorsally, tapered to acute apex in lateral view; in ventral view basally broad, rapidly constricted 2/3 length, slender 2/3 length to thumb-like apex, shorter than, but similar in appearance to, dorsoapical rods. Bracteoles short, slender, projecting somewhat dorsad in lateral view; in ventral view slender, uniform. Phallus long, slender, preapical constriction giving rise to broad, flat paramere projecting posteriorly and covered with minute setae; apex extremely long and uniform, tip dorsally

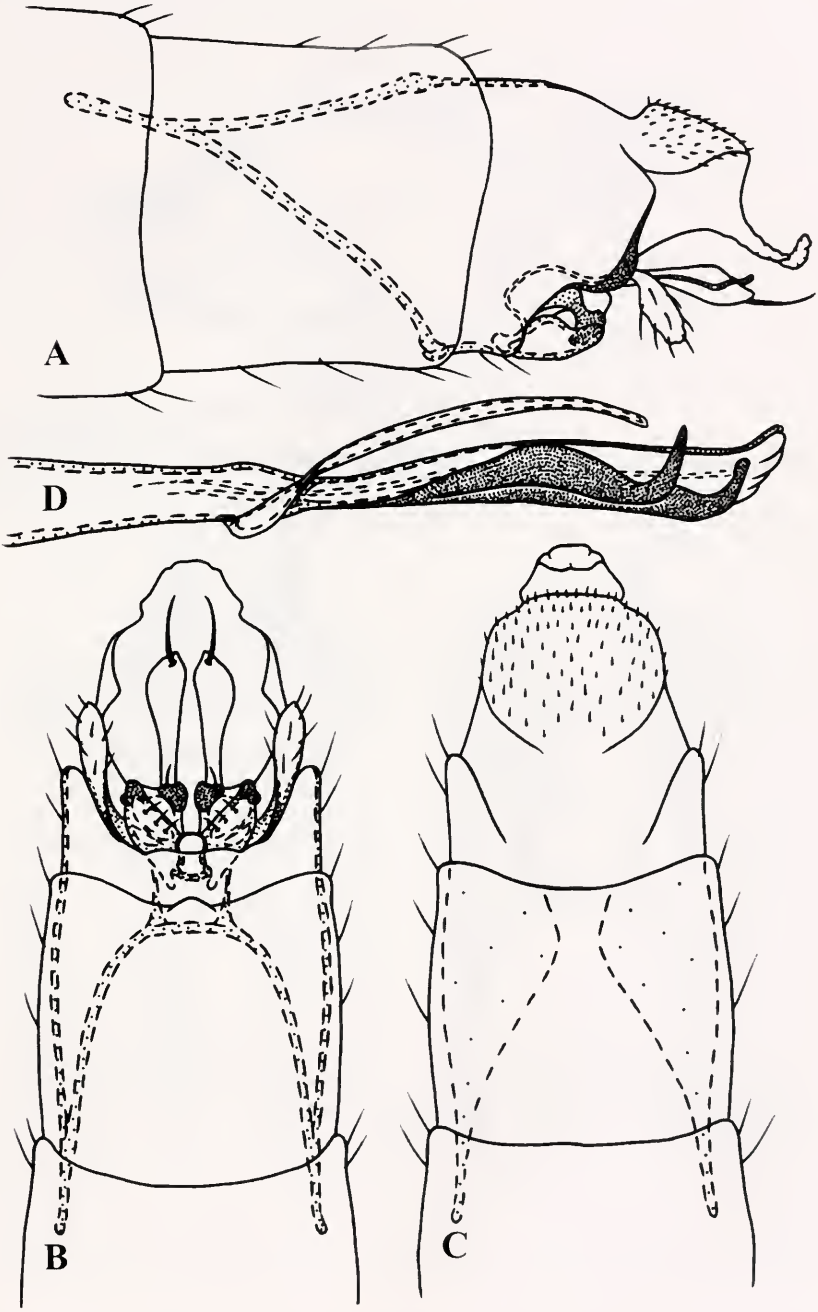

Figure 8. *Neotrichia rasmusseni,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

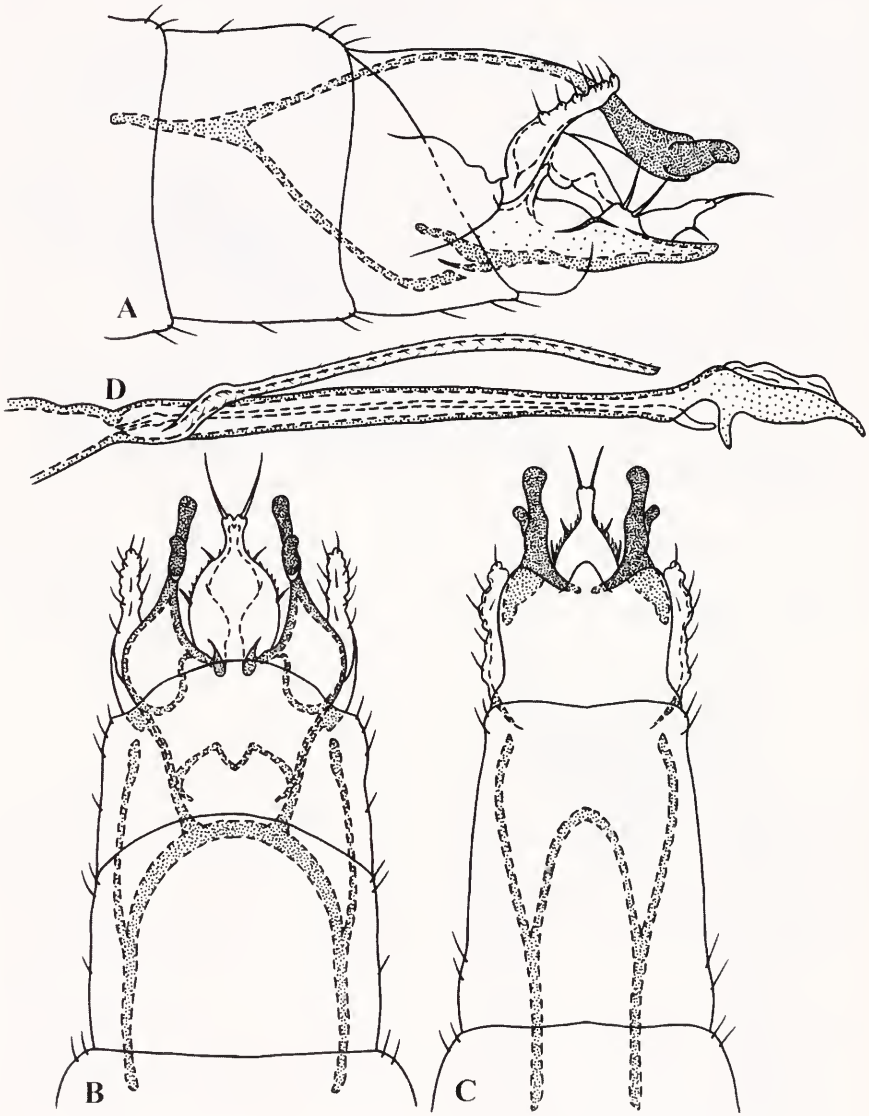

Figure 9. *Neotrichia pulgara,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

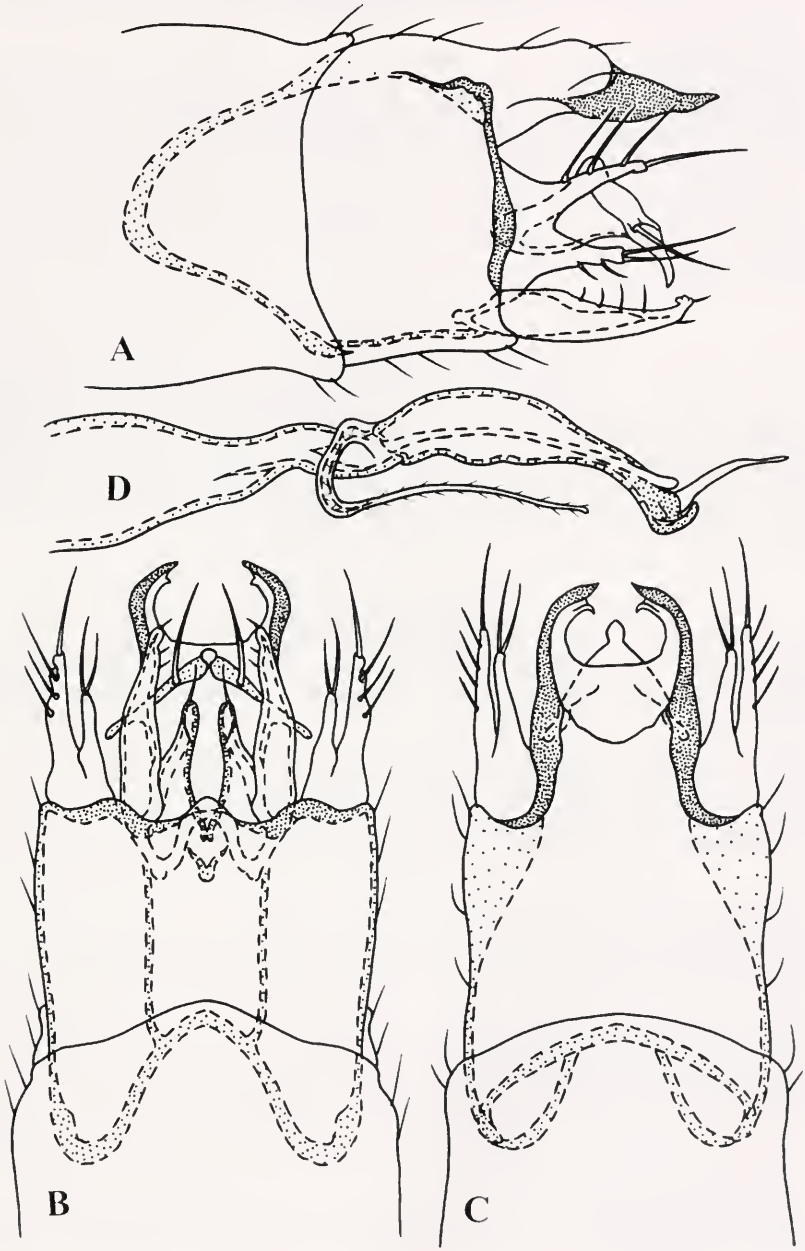

Figure 10. *Neotrichia maria,* male genitalia. a. lateral b. ventral c. dorsal d. phallus.

membranous and broadening slightly with lightly sclerous margins and finger-like processes projecting ventrally at tip base and posteriorly at extreme tip; ejaculatory duct uniform, protruding ventrad prior to phallus tip.

Female. Unknown.

Larva. Unknown.

Type Material. Holotype. Belize: Orange Walk District. New River Lagoon, dock area at Lamanai Ruins. January 9, 1998. L .J. Davenport. 1 male (NMNH).

Etymology. Spanish: of thumb, referring to the sclerotized thumb-like inferior appendages and apical extensions of segment X.

Distribution. *Neotrichia pulgara* is known only from the type locality in northern Belize.

ACKNOWLEDGEMENTS

The Pennsylvania Agricultural Experiment Station at The Pennsylvania State University supported this work. I thank Bruce McPheron for that support and I thank Steve Harris at Clarion University for the use of his lab and for critical review of the manuscript. I recognize Larry Davenport at Sanford University, Birmingham, AL, for collecting most of the material and the California Academy of Sciences, Andrew Rasmussen at Florida A&M University, the Illinois Natural History Survey, and Oliver Flint, Jr. at the National Museum of Natural History (Smithsonian) for loans of material for study.

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BOOK REVIEW

INSECTS OF THE TEXAS LOST PINES. (W. L. Moody Jr., Natural History Series, No. 33). Stephen Welton Taber and Scott B. Fleenor. 2003. ISBN 1-58544-235-6. Cloth US $50.00, 1-58544-236-4. Paperback US $24.95, 296 pp. 209 B+W photos, 1 map. Texas A & M University Press. College Station, TX 77843, U.S.A. www.tamu.edu/upress.

The Lost Pines of Texas are diverse vegetation islands that support isolated colonies of loblolly pine (*Pinus taeda)* at their western-most range limit as well as a mix of Post-Oak Savanna and Tall-Grass Prairie. These communities are confined largely to Bastrop and Fayette Counties in Central Texas, isolated from more contiguous Piney Woods of East Texas. Given this specific scope of this book, the authors and publisher (whose previous works include the more widely appealing *Fire Ants* and *The World of the Harvester Ants*) are to be congratulated for going the distance to publish this book. Still, while the intent is laudable, the execution is somewhat lacking.

One major fault is the absence of color photographs [other than the obvious "art photo" of the cover, a spread specimen of a zebra longwing butterfly *(Heliconius charithonia),* a species that the authors report as sighting on only a single occasion (pp. 25), against the bark of a loblolly pine]. If the intent was a guide to identification for naturalists and visitors to the region, then color would have been an obvious selling point. The excessive use of black and white photographs, many of them of specimens (though in many cases too small to be useful) argues that the authors' intent was to publish a scientific work. Unfortunately, their intent falls short, leaving this book without an obvious audience.

The book is prefaced well with a short "Introduction" and a look at "The Lost Pines as a Setting for Animal Life," and then treats some 280 taxa in 13 chapters (including "Spiders, Scorpions and Other Arachnids," as well as those other well-known insects, the "'Molluscs and Earthworms"). Two appendices ["Endemic Texas Insects Occurring in the Lost Pines" (9 species) and "Exotic Animals Occurring in the Lost Pines" (6 insect and 2 earthworms species)] and a useful bibliography and index complete the text. While the first two chapters provide much useful background information on the region, they fail to document the methods employed by the authors (how long, where, or when their studies were conducted) or the scope of their survey. The reader is left with no basis on which to judge their remarks in the subsequent species treatments. In fact, given the number of interpretive speculations and other problems with the text, this reviewer wonders who, if anyone, subjected this book to, as the authors state, "the fire of peer review that is expected of scientific work" (pp. 10).

The choice of taxa covered is remarkably uneven—regardless of group—even given the authors' stated reasoning to include those "that have seldom or never been illustrated before" (pp. 10). For example, in the "Butterflies and Moths," the authors treat 25 butterfly species under 19 headings (with B/W photos of 17 species), with a note that 8 additional species, found in an "unpublished 1968 document" (pp. 18) in the files of the Texas Parks & Wildlife Department, occur in the Lost Pines. Most species shown in the book are large, common in Texas and "charismatic" taxa that have been profusely illustrated (in color) in many other books. The authors virtually ignore 25% of the butterflies by including only one of the 14 species of pierids and none of the skippers known to occur here (www. esb.utexas.edu/philjs/Stengl/lists/butterflies.html) long before this book was published. Only eight out of the almost 1000 species of moths are treated (www.esb.utexas.edu/ philjs/Stengl/lists/moths.html).

Additional criticisms, common enough to be indicative of the poor quality of the book, are the lack of apparent order to either the sequence of chapters or the sequence in the taxa covered within chapters (for example, *Anax junius* is found on pp. 184 while *A. longipes* is found on pp. 195), scientific names of some plants are omitted (*e.g.* Hercules-club on pp. 22) and common name sources are not cited..

Phil Schappert, Stengl "Lost Pines" Biological Station / Integrative Biology,
University of Texas at Austin, Austin, TX 78712-0253, U.S.A. E-mail: philjs@mail.utexas.edu.

Mailed on July 28, 2004

BOOK REVIEW

A JOYFUL NOISE, POEMS FOR TWO VOICES. Paul Fleischman. Illustrated by Eric Beddows. 1988. Harper Trophy Publishing. 44 pp. Paperback. ISBN 0064460932. US$5.99.

The spectrum of adjectives used to describe our human sentiment towards insects spans from glorious to ghastly. As our numerous co-inhabitants of Earth, insects' role in the ecosystem is varied and valued, marveled at, and painstakingly studied. But while biologists dance with joy over the evolutionary genius of Batesian mimicry, others scream with horror at the sight of the common cockroach. Paul Fleischman however, simply enjoys them. Through his Newberry Award-winning book, *A Joyful Noise, Poems for Two Voices,* he invites the teacher and student of entomology, as well as the entomonaive, to find simplicity in an ordinarily complex field. He urges the indifferent to appreciate, the innocent to ask questions, and the fearful to take a closer look. Written to be read aloud simultaneously by two readers, this book is a fun, interactive, and educational experience for just about anyone.

A Joyful Noise, Poems for Two Voices is composed of fourteen poems about insects ranging from the irksome crickets (Gryllidae) to the more popular lepidopterans, which include the butterflies, moths, and skippers. Fleischman, who writes each poem from the insect's perspective, allows readers to more easily appreciate and relate to the plight of insects. He describes the ephemeral lifespan of mayflies, for which their order, Ephemeroptera, is named. He also marvels at the eusociality of honeybees (Apidae), the bioluminescence of fireflies (Lampyridae), and the seemingly physics-defying mode of locomotion characteristic of water striders (Gerridae). Finally, Fleishman depicts the behavior of more pesky insects. The booklice share their simple enjoyment of Shakespeare and Horace, and cicadas explain that their swarming is a celebration of the world above after spending years underground. Throughout each of these intriguing and often humorous depictions, Fleishman manages to incorporate a few more commonplace facts, for example, the time of year that grasshoppers spawn or the competition between digger wasps and beetles.

The illustrations, by Eric Beddows, are another unique feature of *A Joyful Noise*. They exhibit some degree of true anatomical detail, but are anthropomorphized just enough to make the little bugs endearing. One that stands out in particular is an illustration of the queen bee in "Honeybees." Beddows depicts her delicate membranous wings (for which the honeybee's order, Hymenoptera, is named) but also adds eye lids and lashes to give her an appearance that is feminine and distinctly human. He also has her lying on a chaise lounge as if she were a queen resting in her drawing room. Additionally, on the inside cover, there are what appear to be scientific drawings of stick bugs (Phasmatodea). These particular bugs, however, are intellectuals avidly reading their books. The queen bee and stick bug make for just two of many memorable illustrations.

While all of Fleischman's poems are written to be read aloud jointly by two people, select lines are meant to be read in sequence, and others are meant to be read in synchrony. This presents readers with an opportunity to share this wonderfully interactive experience and is suitable for all combinations of experts and beginners. It also reminds us of the soothing, rhythmic sound of chirping insects that marks a blazing summer afternoon, or that lulls us to sleep at night. Overall, this informative, humorous and stimulating collection of poems instills a new appreciation for insects in readers of every age and background.

Bethany Sadlowski, Arlington, Virginia 22202 U.S.A. E-mail: b_sadlowski@yahoo.com
Julia Louie, University of Maryland, College Park, MD 20742 U.S.A. E-mail: julouie@niaid.nih.gov.

[1] Received on January 10, 2002; Accepted on June 18, 2002.

[2] Department of Entomology, University of California, Riverside, California 92521, U.S.A. E-mail of author J-W K: argids01@tamu.edu.

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Cicada – Why Have You Stayed Away So Long

Benjamin C. Garber© [1]

Big red eyes, gossamer wings,
I sure do Love the way you sing
It's your time, to sing your song
A million friends can sing along

Chorus
Cicada, what are you made of
Why have you stayed away so long
Oh Cicada, we'll see ya later
But, please don't stay away so long

Seventeen years underground
Sucking sap and make no sound
Crawl on out, peal that shell
"This bug needs a Hug," you start to yell.
Chorus

Now I have seen the recipes
Stewed and fried and fricasseed
But when I think of you as a meal
My stomach starts to squeal
Chorus

You have your fun, lay eggs in a tree
And then you die, what more can there be.
Well that's my song and it's been fun
I'll bring it back in two thousand twenty-one
Chorus

[1] 29 Clarks Lane, Reistertown, MD 21136 U.S.A. E-mail: BenGarber@POBox.com or www.BenGarber.com.

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CORRECTIONS AND ADDITIONS TO THE GENUS *AGALLIA* (HOMOPTERA, CICADELLIDAE, AGALLIINAE) OF THE AMERICAS[1]

Paul H. Freytag[2]

ABSTRACT: The species *Agallia lingula* Van Duzee from Jamaica and *A. peregrinans* (Stål) from Brazil are redescribed and discussed. Also three new species, *A. nielsoni* (U.S.A., Mexico, Central America, Columbia and Venezuela), *A. peck* (Ecuador), and *A. rotunda* (Venezuela) are described. The new species were confused with the older species and differences between these species are discussed. Lectotypes are designated for *A. lingula* and *A. peregrinans* to help eliminate confusion.

KEY WORDS: *Agallia*, Homoptera, Cicadellidae, Agallinae, North, Central, and South America.

The *Agallia* species of North, Central, and South America are fairly well known and described, and in general lead to little confusion. However, the species *A. lingula* Van Duzee has been misidentified from the time Oman (1933) published his paper on the North American species of the subfamily Agalliinae. This error is corrected in this paper while describing the five species involved. The species included are the two described species, *A. lingula* and *A. peregrinans* (Stål), and three new species. All five species are nearly the same size and with the same external features (Osborn 1924, plate LIX; Oman 1938, plate XLV) within the common variation that occurs in each of the species. However, the five species belong to three distinct species groups within the genus *Agallia* mainly based on genitalic characters.

Agallia lingula Van Duzee
(Figures 2-4)

Agallia lingula, Van Duzee 1907, p. 54 (Type locality – Jamaica, Montego Bay).

Agallia lingula, Oman 1933, p. 33 (in part, Jamaica records only).

Agallia lingula, DeLong and Caldwell 1937, p. 2 (in part, Jamaica records only).

Agallia lingula, DeLong and Knull 1945, p. 13 (in part, Jamaica records only).

Agallia peregrinans, Linnavuori 1968, p. 149. Misidentified.

Agallia peregrinans, Nielson and Godoy 1995, p. 146 (in part, Jamaica records only). Misidentified not *A. peregrinans* Stål.

Length. Males 3.3-3.6 mm, females 3.4- 3.7 mm. This species is very closely related to *A. lingulata* Olsen found in the United States (Oman, 1933), with the same type of male genitalia only slightly smaller and the same type of female seventh sternum with a lingulate median process.

[1] Received on June 5, 2003. Accepted on March 13, 2004.

[2] Department of Entomology, University of Kentucky, Lexington, Kentucky 40546-0091 U.S.A. E-mail: pfreytag@ix.netcom.com.

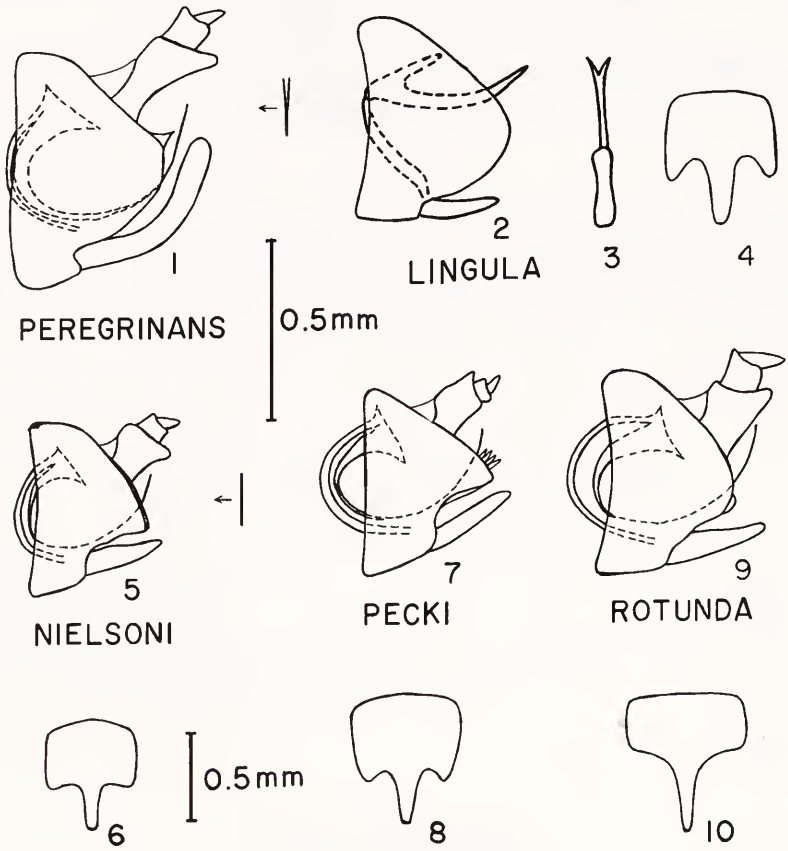

Figure 1. *Agallia peregrinans* (Stål). Figures 2-4. *A. lingula* Van Duzee. Figures 5-6. *A. nielsoni* n. sp. Figures 7-8. *A. pecki* n. sp. Figures 9-10. *A. robusta* n. sp. Figures 1, 2, 5, 7, and 9 depict male genital capsule, lateral view, all drawn to same scale. Figure 3, illustrates male aedeagus, ventral view. Figures 4, 6, 8, and 10 represent female seventh sternum, ventral view, all drawn to same scale.

Male Genitalia. Similar to *A. lingulata* in general appearance (Fig. 2). Plates short, stout. Pygofer with posterior margin evenly rounded. Aedeagus (Fig. 3) with long stem, bifurcate, upturned at apex. Connective long, not bent near base.

Female Genitalia. Seventh sternum (Fig. 4) similar to *A. lingulata* with median lingulate process short and rounded at apex.

Types. Three syntypes (one male and two females) labeled Montego Bay, Jamaica.; Apr. '06; E P Van Duzee Collector, (California Academy of Sciences Collection). The male is herein designated as the Lectotype of this species and is so labeled. The three specimens have type labels indicating Lectotype, Allotype, and Paratype, but these labels have no standing as there has been no reference to this in the literature. For stability, I have chosen the male to represent this species, even though all three types are without a doubt the same species. All three specimens have been examined, and are in good condition, except for one female which shows a small amount of dermestid damage.

Distribution. This species is only known from Jamaica and only from the type series.

Notes. This species has been misidentified almost from the time it was described. Van Duzee (1907) described this species from the three types mentioned above Oman (1933) examined a female syntype and determined that it was the same as the Central American species being described as new in this paper. On the basis of the female the identification of this species was wrongly placed. All subsequent workers followed his identification until recently when Linnavuori (1968) and Nielson and Godoy (1995) misidentified this species further by placing it in synonymy with *A. peregrinans*. This was based on a wrong indication by Linnavuori (1968) and Linnavuori and DeLong (1979), and will be discussed further under that species.

This species belongs to a small group of species which is characterized by having the male aedeagus v-shaped in lateral view extending from a long connective which places the aedeagus near the dorsal part of the genital chamber. and the female seventh sternum with a lingulate median process. This group includes the following three species: *A. lingula* Van Duzee, *A. lingulata* Olsen 1900, and *A. neoalbidula* Oman 1938. Possibly *A. striolaris* (Butler) 1877 also belongs in this group, but the female is unknown.

Agallia nielsoni, NEW SPECIES
(Figures 5-6)

Agallia lingula, Oman 1933, p. 33 (in part, Central America, Mexico and USA records) not *A. lingula* Van Duzee.

Agallia lingula, Oman 1934, p. 454, not *A. lingula* Van Duzee.

Agallia lingula, DeLong and Caldwell 1937, p. 2 (in part, Central American, Mexican and USA records) not *A. lingula* Van Duzee.

Agallia lingula, DeLong and Knull 1945, p. 13 (in part, Central American, Mexican and USA records) not *A. lingula* Van Duzee.

Agallia lingula, Oman 1949, p. 37, not *A. lingula* Van Duzee.

Agallia lingula, Linnavuori 1956, p. 6 and 14, not *A. lingula* Van Duzee.

Agallia peregrinans, Linnavuori 1968, p. 149, misidentified, not *A. peregrinans* Stål.

Agallia peregrinans, Nielson and Godoy 1995, p. 146 (in part, Central American, Mexican and USA records, misidentified, not *A. peregrinans* Stål).

Length. Males 3.4-3.6 mm, females 3.5-3.8 mm.Externally very similar to *A. lingula*, but with quite different male genitalia.

Male genitalia. Plates (Fig. 5) short, extending to near apex of pygofer. Pygofer with dorsal surface rounded to apex, with a thickened margin. apex roundedly pointed. Aedeagus (Fig. 5) strap-like, curving back alongside connective in nearly a complete circle, apex near anal tube, pointed, needle-like. Connective long, arched, extending to near base of anal tube.

Female genitalia. Seventh sternum (Fig. 6) with narrow lingulate process in middle, length of process less then length of segment, with apex somewhat truncate.

Types. Holotype male, Honduras, El Zamorano, December 24, 1960, P. H. Freytag, sweeping sweet potatoes. Allotype female, same data as holotype. Paratypes: One male and two females, same

data as holotype, but without host plant data. Holotype and Allotype in the California Academy of Sciences collection and the three paratypes in the University of Kentucky collection.

Distribution. This species is one of the most common *Agallia* species in Central America. Many specimens have been seen from the USA (Texas), Mexico, all of Central America, Colombia, and Venezuela. Literature citations also record this species from Louisiana, but I have not seen any specimens to back up this locality record.

Etymology. This species is named for Merv Nielson who has done so much recent work on this subfamily.

Notes. This species is the one illustrated in Oman (1933) as *A. lingula* (Figures 6 a-c and 15 h). The genitalia of both the male and female are quite different from *A. lingula* as illustrated. This species is found primarily in Central America and has never been collected in the Caribbean Islands. This species belongs to a group of species that have the recurved aedeagus which is long and needle like, a short genital plate, and the female seventh sternum with a lingulate process. This group is made up of three species described in this paper, *A. nielsoni A. pecki,* and *A. rotunda.*

Agallia pecki, NEW SPECIES
(Figures 7-8)

Length. Males 3.3-3.5 mm, females 3.4-3.6 mm. Similar to *A. nielsoni* in general external characters, but with different male and female genitalia.

Male genitalia. Plates (Fig.7) short, stout, extending to apex of pygofer. Pygofer, in lateral view, nearly triangular, with dorsal surface nearly straight, with three to four papilla-like setae near apex (exaggerated slightly in drawing). Aedeagus similar to *A. nielsoni* in shape, but slightly larger. Connective long, arched, extending to near base of anal tube.

Female genitalia. Seventh sternum (Fig. 8) with lingulate median process, length about half median length of segment, apex bluntly rounded.

Types. Holotype male, Ecuador, Galapagos Islands, Santa Cruz, 1 km S Media Luna, Miconia, 550m., 2-8-II-1989, dung trap, B. J. Sinclair. Allotype female same data as holotype. Paratypes: 31 (17 males, 14 females); 1 male same data as holotype; 2 females, same data as holotype except 600m., 21-I-1989 uv-light, S. Peck 89-6; 16 males, 12 females, same data as holotype except 500m., 1-29-II-1989, FIT-trough, Peck and Sinclair 89-39. Holotype, allotype and 1 male, 2 female paratypes in the California Academy of Sciences; 4 male, 4 female paratypes in the University of Kentucky Collection; 4 male 4 female paratypes in the Canadian National Collection, 4 male, 1 female paratypes in the National Collection in Ecuador; 4 male, 1 female paratypes in the Catholic University Collection in Quito, Ecuador.

Distribution. Over 2,000 specimens of this species have been seen from the following Islands: Santa Cruz, Floreana, Santiago, Isabela and Fernandina. The complete listing of the localities and where the specimens are deposited can be obtained from the author. This is without a question the most common *Agallia* species on the Islands at this time. Three females which fit this species are also known from Guayaquil, Ecuador, in the California Academy of Sciences collection.

Etymology. This species is named for Stuart Peck who collected most of the specimens of this species. His extensive work on the Galapagos Islands is also well known.

Notes. This species appears to be a recent introduction from the costal region of the mainland. It also seems to have replaced the earlier species which were known from the Galapagos Islands. Both previously known *Agallia* species, *A. plana* (Butler 1877) and *A. striolaris* (Butler 1877) have not been collected in recent years.

Agallia peregrinans (Stål)
(Figure 1)

Bythoscopus peregrinans Stål 1859.
Agallia peregrinans Linnavuori and DeLong 1979.

Length. Males 3.6-3.9 mm., females 3.8-4 mm. This species was originally described from Rio de Janeiro, Brazil, although several other localities were mentioned at that time, such as Oahu, Hawaii, Tahiti and California. At the same time an unnamed variety was described from Rio de Janeiro, Brazil. To restrict the type locality and to clarify the identity of this species I designate the male type specimen from Rio de Janerio, Brazil, and illustrated by Linnavuori and DeLong (1979) as the Lectotype of this species. It will be so labeled.

Male gentitalia. This species is in a species complex which has an aedeagus similar to *A. nielsoni* except for the apex of the shaft, which is bifurcate (Fig. 1). This species also has a spur-like extension on the caudal margin of the male pygofer, and the genital plates are curved and much longer. The male genitalia (Fig.1) are not identical to those illustrated of a male type by Linnavuori and DeLong (1979), in that the genital plate is shorter and the process on the pygofer is smaller in their drawing.

Female genitalia. The female of this species appears to not have a lingulate median process on the seventh sternum and is nearly straight across. Another species group of *Agallia* found in South America does have a lingulate process, but these are sinuate in lateral view, and most species of this group are undescribed or the female is not associated with a described male at this time. Also in the three species described in this paper the ligulate process is straight in lateral view, not sinuate. This species is in a species group only found in South America, which have the aedeagus of the male recurved and needle-like, with the apex bifurcate, with a long genital plate; and the female seventh sternum without a lingulate median process.

This group includes the following species: *A. lauta* (Stål) 1862, *A. quadrata* Oman 1938, and *A. longicauda* Linnavuori and DeLong 1979. The illustration of *A. peregrinans* (Fig. 1) would also fit that of *A. lauta* or *A. quadrata,* so this group needs to be revised to verify these species names and to describe the associated females which at this time are mostly unknown.

Note. The localities given in the original description of *A. peregrinans* that are not from Brazil are surely wrong, as all specimens presently known of this species are from Brazil.

Agallia rotunda, NEW SPECIES
(Figures 9-10)

Length. Males 3.6-4 mm., females 3.9-4.1 mm. Similar to *nielsoni* in general appearance, except slightly larger, with larger male genitalia and female seventh sternum.

Male genitalia. Plates (Fig. 9) relatively short, slightly exceding length of pygofer. Pygofer rounded on apical margin. Aedeagus similar to *nielsoni* except larger.

Female genitalia. Seventh sternum (Fig. 10) with lingulate median process, longer then basal part of sternum.

Types. Holotype male, Venezuela, Trujillo, near Mosquey, 1300m, May 17, 1985, on grasses, P. H. Freytag and M. A. Giaiani. Allotype female same data as holotype. Paratypes: 31 males, 27 females same data as holotype. Holotype, allotype and 10 male and 10 female paratypes in the MIZA collection, Maracay, Venezuela. Remainder of the paratypes in the University of Kentucky Collection.

Notes. This species appears to be associated with higher elavations of the Andes Mountains, and the type locality is probably near the Northern Distribution of this species. Other specimens are at hand from the state of Trujillo, Venezuela.

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NEW RECORDS OF ENCYRTID PARASITOIDS OF *KERMES PALESTINIENSIS* BALACHOWSKY (HEMIPTERA: KERMESIDAE), WITH THE DESCRIPTION OF A NEW SPECIES OF *BLASTOTHRIX* MAYR (HYMENOPTERA: ENCYRTIDAE) FROM TURKEY[1]

George O. Japoshvili[2] and Ismail Karaca[3]

ABSTRACT: A new species of the encyrtid wasp genus *Blastothrix* Mayr is described from Turkey. All specimens of the type series of *B. gurselae* n. sp. were reared from *Kermes palestiniensis* Balachowsky on Turkey oak, *Quercus coccifera*. New records of the parasitoids of *K. palestiniensis* in Turkey is given.

KEY WORDS: *Kermes palestiniensis,* Hemiptera, Kermesidae, *Blastothrix gurselae,* Encyrtidae, Turkey.

Chalcid parasitoids are important in regulating the populations of many insect species (Trjapitzin, 1989). Some information about beneficial species of *Chalcidoidea* in Turkey is available (Doganlar, 1985; Trjapitzin and Doganlar, 1997; Japoshvili and Karaca, 2002). However, such information is missing for the Isparta Province, Turkey. The objective of our study was to identify and catalogue parasitoids within this region. Studies were undertaken from June to October in 2001 and 2002 in different regions of the Isparta Province.

The terminology used in the description of the new species follows that of Trjapitzin (1989), Noyes and Woolley (1994) and Noyes et al. (1997). Material of the new species was compared with specimens of type material of *Blastothrix erythrostetha* (Walker) in the Francis Walker collection in Oxford (HDOU), also with material which was borrowed from the collection of the Entomology Research Museum, University of California, Riverside, California, USA (UCRC) and St. Petersburg Museum of Zoology collections (ZIN). Acronyms for other depositories of the specimens are as follows: IZGAS, Institute of Zoology, Georgian Academy of Sciences, Tbilisi, Georgia; AFSDU, Agricultural Faculty, Suleyman Demirel University, Isparta, Turkey; NHM, The Natural History Museum, London, UK.

Abbreviations used in the text include: F1, F2, etc., first funicule segment, second funicle segment, etc.; FV, minimum frontovertex width; GL, maximum gonostylus (= third valvula) length; HW, maximum head width; MT, mid tibia

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[2] Laboratory of Invertebrate Animals Institute of Zoology, Georgian Academy of Sciences, Tbilisi, Georgia. E-mail: giorgij70@yahoo.com.

[3] Agricultural Faculty, Suleyman Demirel University, Isparta, Turkey. E-mail: ikaraca@ziraat.sdu.edu.tr.

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length; OCL, occipital-ocelar line (= the shortest distance between each of posterior ocelus and occipital margin); OL, ovipositor length; OOL, ocular-ocelar line (= the shortest distance between posterior ocelus and adjacent eye margin); AOL, distance between posterior and anterior ocelli; POL, posterior ocelar line (= the shortest distance between the posterior ocelli); SL, scape length; SW, maximum scape width.

Blastothrix gurselae, NEW SPECIES
(Figs. 1-7)

Diagnosis. The new species is most closely related to *B. erythrostetha* [lectotype and material deposited at the University of California (Riverside, CA) of *B. erythrostetha* examined). Both species are diagnosed below.

Blastothrix erythrostetha. Female: Lectotype. Vertex about as wide as 1/3 of head. Diameter of ocelli almost equal to distance between posterior ocelli and eye margin. Legs yellow, only fore coxa slightly darker in the basal part and tibiae in the basal part with a little dark smut. Unfortunately on the lectotype antennae of it missing (Graham, 1969). Flagellum F1 and F2 dark and F3 slightly dark. Clava equal or slightly longer than F5 and F6 together. F1, F2 - 2.7-3; F3 - 2-2.2; F4 - 1.5-1.7; F5 - 1.3-1.5; F6 - 1-1.1 as long as wide. Fore tibia more then 4 x as long as wide. Ovipositor longer than midtibia.

Blastothrix gurselae sp.n. Female: Holotype. Vertex about as wide as 1/3.5 of head. Diameter of ocelli 2 x greater than distance between posterior ocelli and eye margin. All coxae dark, metafemur dark with a yellow apical part, mesofemur dark in basal half, fore femora dark in the middle and this infuscation separated by yellow band in length. All tibiae with infuscation in basal half. Clava slightly shorter than F4, F5, and F6 together. F1 - 2; F2 - 1.6; F3 - 1.44; F4 - 1.25; F5 - 1.13; F6 - 0.9 as long as wide. Foretibia not more then 4 x as long as wide. Ovipositor shorter then midtibia.

Description of *Blastothrix gurselae*. Female. Length 1.5-2.0 mm, holotype 1.63. Body dark, with some parts metallic. Frontovertex, pronotum, mesoscutum, scutellum, and metanotum with a green-bronze metallic luster. Mesopleuron dark yellow. Gaster brownish. Scape dark brown, pedicel also dark brown, with a pale apical part. Flagellum with F1,F2,F3,F4 segments dark. Clava dark brown. Wings hyaline. All coxae dark. Hind and middle femora with basal half dark, forefemur with darkness in the middle and this darkness is separated by yellow band in length. All tibiae in basal part with darkness.

Head width/height 29:25 and length/width 13:29. Vertex about as wide as 9:29 of head. Occipital margin tucked in. Inner orbits of eye slightly diverging anteriorly. Ocelli in a slightly acute triangle (about 80-85°). Distance between posterior ocelli 1.5 x more than distance between posterior ocelli and anterior ocellus. Diameter of ocelli 2 x greater than distance between posterior ocelli and eye margin. Distance between anterior ocellus and eye margin less than distance between posterior ocelli (35:30). Width of oral aperture about 1/3 head width. Malar space about 2/3 maximum height of eye. Mandible with one tooth and a truncation (Fig. 5).

Antenna. Antenna inserted slightly below lower eye margin. Distance between toruli 2 x distance from torulus to mouth margin. Scape strongly flattened (Fig.1), 1.46 x longer then maximum width. Pedicel almost as long as funicle first segment. F1 - 2 (14:7), F2 - 1.6 (12:7.5), F3 - 1.44 (13:9), F4 - 1.25 (13:10.5), F5 - 1.13 (13:11.5), F6 - 0.9 (12:13). Clava 1/2 x as broad as long, its length slightly less than length of F4, F5, F6 segments together (36: 39).

Mesosoma very slightly convex. Pronotum short; mesoscutum 1.5 x as wide as long; scutellum 1.14 x as wide as long, and slightly shorter than mesoscutum. Propodeum very short medially and well developed laterally.

Wings not reduced, reaching apex of gaster. Fore wing about 2.5 x as long as its maximum width. Costal cell 7.8 x as long as wide. Marginal vein (Fig. 7) equal to stigmal and both of them almost equal to postmarginal vein.

Gaster slightly shorter than mesosoma. Ovipositor practically not exserted. Pygostiles inserted slightly at low level of middle of gaster. Outer plate of ovipositor 2 x as long as wide (Fig.3). Maximum gonostylus length of ovipositor 0.15 x as long as ovipositor and 2 x as long as wide. Relative measurements: HW 58; FV 18; PAL 6,5; POL 9; OOL 2; OCL 4; MT 56; OL 47; GL 7; SL 29; SW 19.5.

Sculpture and pubescence. Head, pronotum, mesoscutum, scutellum, metanotum, mesopleura and sides of propodeum reticulate, with white or silver setae.

Male. Length 1.25-1.75 mm. Frontovertex and body as in female, but all body dark with a green luster (without yellow), and with white setae. Fore coxa basally, and meso- and meta-coxae dark; tibiae with infuscation. Ocelli in a slightly obtuse triangle (almost 110-115°). Distance between posterior ocelli 2 x more than distance between posterior ocelli and anterior ocellus. Antenna (Fig. 2). Scape broadened and flattened, about 2 x as long as wide. Pedicel small, rounded, as long as wide. Flagellum with long setae; length of F1:F2:F3:F4:F5:F6:Clava as 19:20:23:24:21:18:30. Width is same for all flagellum and clava. Clava 3 x as long as wide. Mesoscutum about 2 x as wide as long. Fore wing 2.5 x as long as its greatest width. Genitalia as in Fig. 4.

Type Material. Holotype female on card labeled: "*Blastothrix gurselae* Japoshvili and Karaca, 10.VII.2002. (Sutcular), Isparta, Turkey. Ex *Kermes palestiniensis* Balachowsky on *Quercus coccifera*." Holotype deposited in ZIN. Paratypes: same data as holotype, 1♀ and 1♂ on card [AFSDU]; 1♀ and 1♂ on card Natural History Museum Entomology collection, London, UK [NHM]; 2♀, 1♂ on 3 cards, 3♀ and 1♂ on slides; as well as 9♀ and 6♂ in alcohol [IZGAS].

Etymology. This species is named in honor of the Turkish mycologist Dr. Gursel Karaca.

Geographical Distribution. Known from *Q. coccifera* forests in Isparta Province, Turkey.

Host. *Kermes palestiniensis* Balachowsky (Hemiptera: Kermesidae).

Comments. Like other species of the genus, *B. gurselae* n. sp. may not be monophagous; its range of probable Kermes hosts in the area of origin remains to be investigated.

Cheiloneurus quercus Mayr, 1876

Comments. Known as a secondary parasitoid of *Kermes nakagawae* Kuwana on an oak in Primorskiy Kray (Russia) and also from *K. miysakii* Kuwana and *K. nakagawae* (Hemiptera: Kermesidae) on oaks, and from *Eulecanium* spp. (Hemiptera:Coccidae) in Japan.

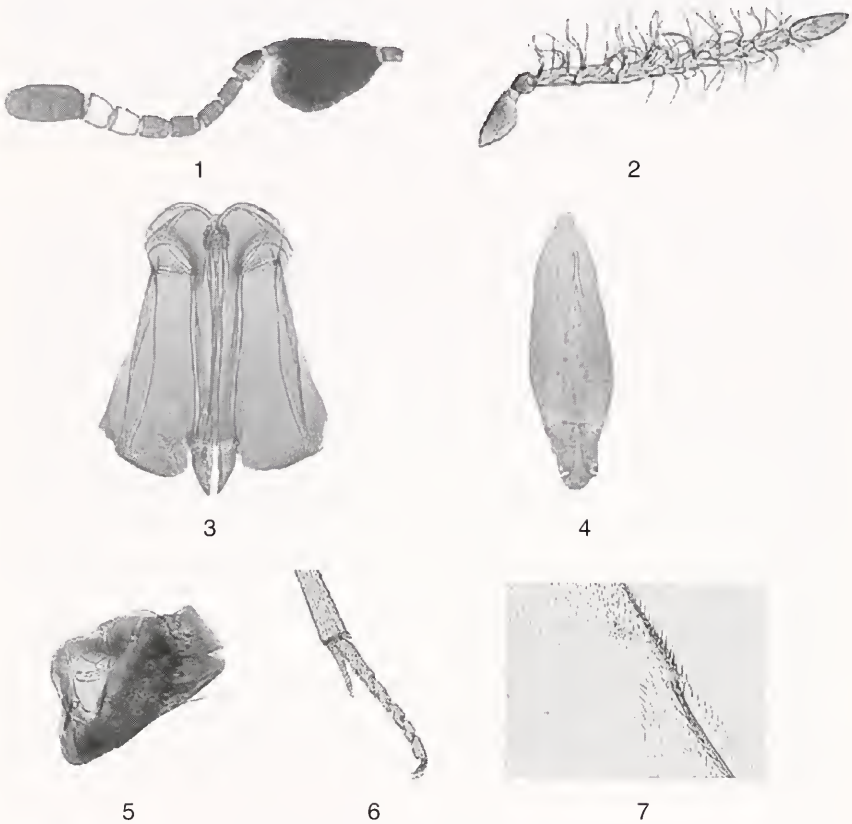
Geographical Distribution. This species is also known from Hungary and Italy (Trjapitzin, 1989). It is first recorded here from Turkey.

Material examined. Turkey, Isparta, Sutcular, 11.VII.2002, G. Japoshvili, 1 ♀.

Psilophrys tenuicornis Graham, 1969

Comments. This species is known as a parasitoid of *Kermes roboris* (Fourcroy), *K. corticalis* (Nassonov), *K. bacciformis* Leon, *K. ilicis* L. (Kermesidae) on oaks *(Quercus* spp.*)*.

Geographical Distribution: Almost all Europe. This species is recorded for the first time for the fauna of Turkey.



Figures 1-7. Blastothrix gurselae new species 1. Antenna, female; 2. Antenna, male; 3. Ovipositor; 4. Gentalia, male; 5. Mandible, female; 6. Middle tarsus, female; 7. venation of fore wing, female.

Material examined. Turkey, Adada, Sutcular, 10-26.VII.2002, G. Japoshvili, 39♀ 4♂.

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A NEW SPECIES OF *HOMALOTYLUS* (HYMENOPTERA: ENCYRTIDAE) FROM MEXICO, PARASITOID OF *AZYA ORBIGERA ORBIGERA* (COLEOPTERA: COCCINELLIDAE)[1]

Vladimir A. Trjapitzin[2] and Serguei V. Triapitsyn[3]

ABSTRACT: A new species of the encyrtid wasp genus *Homalotylus* Mayr is described from the state of Tamaulipas in Mexico. The type series of *H. shuvakhinae* sp. n. was reared from the coccinellid *Azya orbigera orbigera* (Mulsant), a predator of the coccid *Protopulvinaria pyriformis* (Cockerell). A key to the three related species from the *flaminius* group of *Homalotylus* is provided.

Key Words: Encyrtidae, *Homalotylus*, taxonomy, *Azya orbigera orbigera*, parasitoid, Mexico.

In 2000, Elisaveta Ya. Shuvakhina reared a series of *Homalotylus* Mayr (Hymenoptera: Encyrtidae) in the garden of Hacienda Santa Engracia, an historic hotel located near Ejido Benito Juárez, Municipio Hidalgo, Tamaulipas, Mexico. The adult parasitoids emerged from larvae of the ladybird beetle *Azya orbigera orbigera* (Mulsant) (Coleoptera: Coccinellidae) feeding upon the coccid *Protopulvinaria pyriformis* (Cockerell) (Hemiptera: Sternorrhyncha: Coccidae) on an undetermined plant. These parasitoids represent a previously unknown species of *Homalotylus*, which we describe herein as *H. shuvakhinae* n. sp. This is the first known host record of a *Homalotylus* from the coccinellid genus *Azya* Mulsant.

Terms for morphological features are those of Gibson (1997). Acronyms for depositories of specimens are as follows: BMNH, The Natural History Museum, London, England, UK; EMUT, Entomological Museum, Centro de Investigación, U.A.M. Agronomía y Ciencias, Universidad Autónoma de Tamaulipas, Ciudad Victoria, Tamaulipas, Mexico; UCRC, Entomology Research Museum, University of California, Riverside, California, USA; USNM, National Museum of Natural History, Washington, D.C., USA; ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia. An abbreviation used in the text is: F = antennal funicle segment.

Genus *Homalotylus* Mayr, 1876

Type species: *Encyrtus flaminius* Dalman, 1820; by subsequent designation by Ashmead (1900). Synonyms: *Nobrimus* Thomson, 1876; *Mendozaniella* Brèthes, 1913; *Hemaenasioidea* Girault, 1916; *Anisotylus* Timberlake, 1919; *Lepidaphycus* E. Blanchard, 1936; *Neoaenasioidea* Agarwal, 1966.

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[2] Centro de Investigación, U.A.M. Agronomía y Ciencias, Universidad Autónoma de Tamaulipas, Ciudad Victoria, Tamaulipas 87149, Mexico. E-mail: vatrjapitzin@yahoo.com.

[3] Entomology Research Museum, Department of Entomology, University of California, Riverside, California 92521, U.S.A. E-mail: serguei.triapitsyn@ucr.edu.

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Taxonomy. *Homalotylus* is a well-known genus and its generic diagnosis is available elsewhere (Timberlake 1919). Depending on the classification, the genus *Homalotylus* is placed either in the tribe Homalotylini, subtribe Homalotylina (Trjapitzin 1973, 1989) or the tribe Aphycini (Anis and Hayat 1998) of the subfamily Encyrtinae. The senior author does not agree, however, with Anis and Hayat's (1998) synonymy of Homalotylini under Aphycini because these seem to be two very different evolutionary lines of Encyrtinae, infesting basically different groups of hosts: Homalotylini parasitize active larvae of Coccinellidae and Chrysopidae whereas Aphycini attack more or less sedentary Pseudococcidae, and their respective oviposition behaviors are completely different.

The new taxon described herein belongs to the *flaminius* species group of *Homalotylus* as defined by Timberlake (1919). In this group of species, the ovipositor is not exserted and hardly visible except in distorted specimens, or only slightly exserted. *Homalotylus shuvakhinae* sp. n. clearly belongs to the subgroup of the *flaminius* species group in which the head is notably higher than wide in frontal view. The new species from Mexico is closely related to *H. flaminius* (Dalman) and *H. eytelweinii* (Ratzeburg) in having the ocellar triangle distinctly acute. These three species can be distinguished from each other using the following key.

Key to species of *Homalotylus* related to *H. shuvakhinae* sp. n., females.

1 First and third segments of metatarsus white.....*H. flaminius* (Dalman)

or All segments of metatarsus black or dusky 2

2 Tegula with a white base. Mesotarsus white (except distal segment dusky).....
.....*H. eytelweinii* (Ratzeburg)

or Tegula entirely black. Mesotarsus with basal segment black, second to fourth segments light, and distal segment dusky.....*H. shuvakhinae,* sp. n.

Biology. Primary parasitoids of larvae and pupae of various Coccinellidae. Trjapitzin and Ruíz Cancino (1998, 2001) indicated host associations of the two species of *Homalotylus* from Mexico, both of which are unrelated to the new taxon described in this communication.

Homalotylus flaminius in Europe and Asia parasitizes coccinellids of the tribe Scymnini (Klausnitzer & Klausnitzer 1972, Klausnitzer, 1976). According to the determined specimens in ZISP and also Noyes (2002), *H. flaminius* is known from Bulgaria, Georgia, Israel, Mongolia, Russia, Spain, Sweden, and Uzbekistan.

Homalotylus eytelweinii parasitizes coccinellids of the tribes Chilocorini, Coccinellini, Hippodamiini and Psylloborini (Klausnitzer & Klausnitzer 1972, Klausnitzer, 1976). According to the determined specimens in ZISP and also Noyes (2002), it is known from many countries in the Palaearctic region (from Spain to Japan) as well as from India and Thailand in the Oriental region, Republic of South Africa in the Afrotropical region, and Guatemala in the Neotropical region.

Homalotylus shuvakhinae sp. n., described below, is known only from the type locality in Tamaulipas, Mexico. Its host, *Azya orbigera orbigera,* belongs to the tribe Azyini of the subfamily Coccinellinae; distribution records of this species in the USA are all from southern Florida (Gordon 1985).

Homalotylus shuvakhinae V. Trjapitzin and S. Triapitsyn, NEW SPECIES (Figs. 1-3)

Diagnosis. See the key and comments above.

Female. Length 1.84-2.03 mm (holotype 1.84 mm). Color. Body black, with slight metallic shine. Frontovertex with faint bronze luster. Antenna black except F6 and clava yellowish-white (apical half of F5 sometimes whitish). Mesonotum with slight violet-bronze-greenish luster; mesopleura with similar, but fainter, luster. Tegula entirely black. Forewing with transverse dark band reaching posterior margin. Legs mostly black, including mesotibial spur (except in one paratype where it is brownish white); mesotarsus with apex of first segment more or less light, second to fourth segments light (yellowish or brownish), and fifth segment dusky.

Head about 1.2 x higher than wide. Frontovertex narrow; vertex 1/4 to 1/5 head width. Ocelli in slightly acute triangle (somewhat less than 60∞). Distance between posterior ocelli less than distance between posterior ocelli to anterior ocellus (4/5 to 5/6); distance from posterior ocellus to eye margin 2 x (or a little less) more than distance between posterior ocelli. Occipital margin slightly concave. Malar space height less than eye height (as 3-4:7). Distance between lower eye margin 3 x more than width of vertex. Inner head margin almost straight (or only slightly convex).

Antenna (Fig. 1) inserted near oral margin. Scape slender, almost 8 x as long as wide. Pedicel about 1/3 length of scape, 2 x as long as wide. F1 slightly longer than wide, about half length of pedicel; F2 and F3 similar to F1; F4 slightly wider than preceding funicle segments; F5 subquadrate; F6 a little wider than long. Clava 3-segmented, about as long as combined length of 3 preceding flagellar segments, obliquely truncate dorsally almost from the base of first claval segment.

Mesosoma. Pronotum short, 7 x wider than long medially, its posterior margin concave. Mesoscutum 1.3-1.7 x as wide as long; notauli not reaching posterior margin of mesoscutum, with apices very close to each other but not meeting. Posterolateral angle of axilla transversely truncate and divided by short, thin keel. Scutellum about as long as wide and about as long as mesoscutum. Propodeum very short medially, 4-5 x shorter than scutellum; posterior part of propodeum strongly concave medially and acute laterally (in dorsal view).

Wings not abbreviated. Forewing (Fig. 2) 2.6-2.7 x as long as its maximum width. Costal cell narrow. Venation as in Fig. 3; marginal vein about 1.5 x as long as wide; stigmal vein almost straight, not strongly widening towards its rounded apex; postmarginal vein about as long as stigmal vein, angle between them about 30∞. Linea calva narrow, 7 x as long as wide, not exceeding limits of dark band, closed beneath by 6 discal setae.

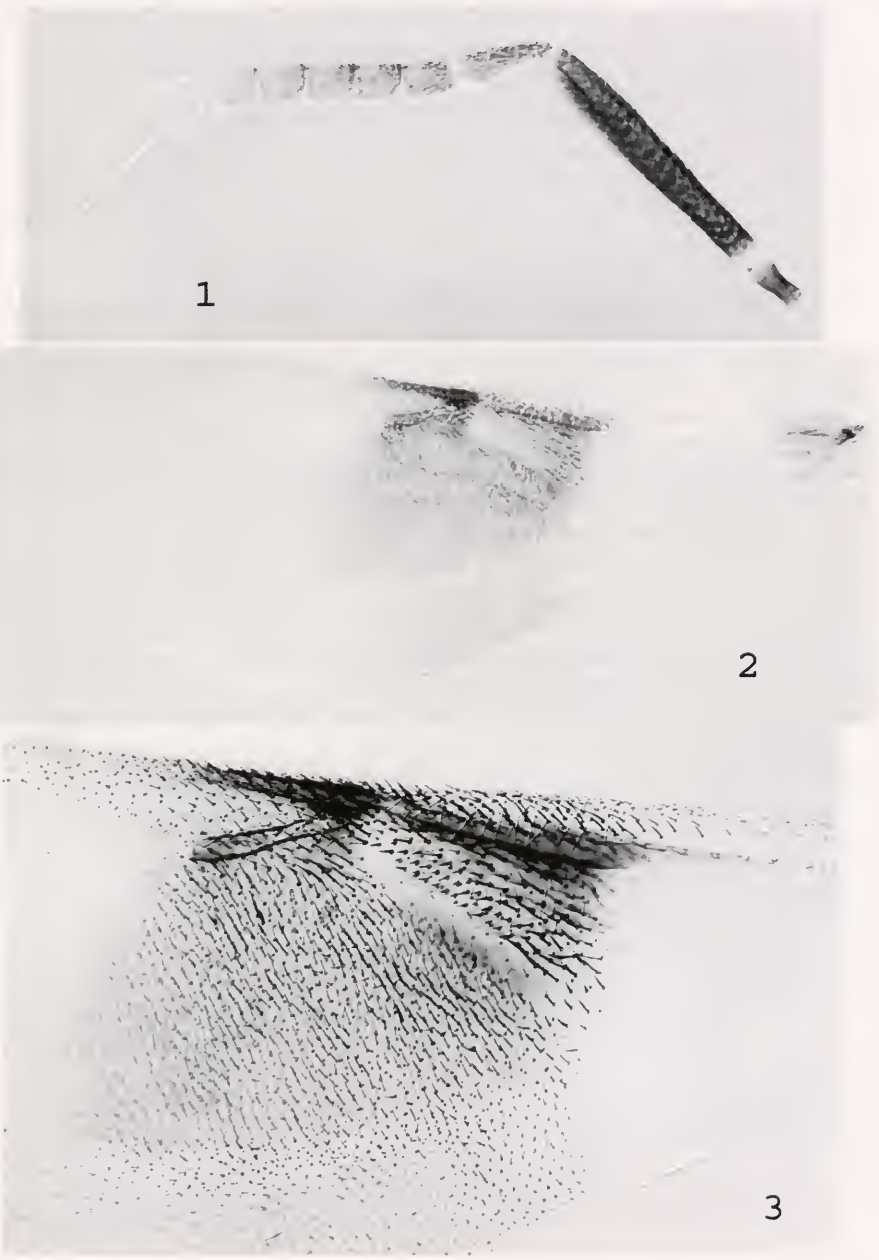
Metasoma about as long as mesosoma. Ovipositor either not exserted or only slightly exserted beyond apex of gaster. Pygostyles at level of 2/7 length of gaster (from its apex).

Sculpture. Frontovertex, mesopleura, and propodeum with microcellulate sculpture. Mesonotum minutely reticulate; scutellum microcellulate, almost matte.

Male. Unknown.

Type material: Holotype female on card, labeled: 1. "MÉXICO, Tam., Cd. Victoria: Sta. Engracia. Jardín del hotel, 14.II.2000 (E. Ya. Chouvakhina)"; 2. "Ex. *Azya orbigera orbigera* Mulsant en *Protopulvinaria pyriformis*"; 3. "*Homalotylus shuvakhinae* Trjapitzin & S. Triapitsyn HOLOTYPE ♀." Holotype deposited in ZISP. Paratypes: same data as holotype, 5 females on cards [BMNH, EMUT, UCRC, USNM, and ZISP] and 1 female on slide [UCRC].

Etymology. This species is named after the collector, Mrs. Elisaveta Yakovlevna Shuvakhina (Chouvakhina), the wife and mother of the senior and junior authors, respectively.



Figures 1-3. *Homalotylus shuvakhinae,* new species (female). (1) Antenna; (2) Forewing; (3) Forewing venation.

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TERRITORIALITY AND SINGING-SITE PREFERENCES IN THE CRICKET, *CYPHODERRIS MONSTROSA* (ORTHOPTERA: HAGLIDAE) IN WESTERN NORTH AMERICA[1]

J. Ladau[2]

ABSTRACT: Many male orthopterans prefer to stridulate from certain microhabitats. However, it is unknown if such preferences exist in *Cyphoderris monstrosa* Uhler (Haglidae). Choice tests indicated that *C. monstrosa* strongly prefer to sing from large trees and clumps of trees, but a survey of singing *C. monstrosa* suggested indifference to tree species. The observed preferences may have implications for understanding the evolution of territoriality in *C. monstrosa*.

KEY WORDS: Orthoptera, Haglidae, Cricket, stridulate, conifer, habitat preference, territoriality, western North America.

The haglid crickets are represented in Western North America by three species: *Cyphoderris monstrosa* in the Cascade and northern Rocky Mountains, *C. strepitans* in the central Rocky Mountains, and *C. buckelli* in the Canadian Rocky Mountains (Morris and Gwynne 1978). Males of all three species sing at approximately 13kHz with essentially the same pulse rate, pulse duration, and amplitude (Morris and Gwynne 1978). However, two of the three species communicate differently with their songs: *C. strepitans* use song to attract mates (Dodson et al. 1983, Snedden and Irazuzta 1994) while *C. monstrosa* use song to mediate territorial disputes (knowledge of *C. buckelli* is lacking; Sakaluk et al. 1995, Mason 1996).

In *C. monstrosa,* territorial disputes can escalate from singing to biting and kicking matches (Mason, 1996), but physical aggression is absent in *C. strepitans* and *C. buckelli.* That difference in aggressiveness is puzzling – why aren't all three species alike? Mason (1996) and Sakaluk et al (1995) suggest that the answer may lie in habitat geometry. Male *C. monstrosa* sing from the branches and trunks of conifer trees, while male *C. strepitans* and male *C. buckelli* sing from bushes (Morris and Gwynne 1978). Since bushes are shorter than conifer trees and have denser branches, the cost of defending a territory in a bush may be relatively high, making territoriality disadvantageous for *C. strepitans* and *C. buckelli* but not *C. monstrosa* (Mason 1996, Sakaluk et al. 1995).

However, rather than a high cost, defending a territory in a bush may entail only a small benefit in comparison with defending a territory in a tree. All bushes could be roughly equivalent, while a limited number of conifers could offer the best protection, food, or access to females. *Cyphoderris monstrosa* may defend territories not because it is relatively "cheap," but because it is relatively beneficial.

[1] Received on August 24, 2002. Accepted on March 13, 2004.

[2] Department of Neurobiology and Behavior, W347 Seeley G. Mudd Hall, Cornell University, Ithaca, NY 14853-2702, U.S.A. E-mail: jl172@cornell.edu.

Mailed on August 25, 2004

According to the latter benefits hypothesis, territoriality and environmental heterogeneity should correlate: When sites are of differing quality, territoriality should be present, while when they are of equivalent quality, it should be absent. Suggesting that sites are indeed equivalent in the absence of territoriality, *C. buckelli* sing from randomly chosen bushes (Morris et al. 2002). However, whether *C. monstrosa* prefer to sing from particular trees is unknown. The aim here is to answer this question, specifically by investigating if *C. monstrosa* prefer to sing from any particular species of tree, size of trees, or size of tree clumps in meadows.

METHODS

Field Site

All experiments were conducted at the headwaters of Snow Creek in the Three Sisters Wilderness of the Cascade Mountains (U.S.A., Oregon; 121°40'5.4"W, 44° 6'4.5"N). The elevation of the site ranged from 2133 to 2225 m.

For experiments, "large" and "small" trees were defined based on their circumference and height (Large Trees: circumference at 1 m = 1.74 ± 0.87 m; height = 15.79 ± 6.63 m; Small Trees: circumference at 1 m = 0.19 ± 0.084 m; height = 2.38 ± 0.72 m). Likewise, "large" and "small" tree clumps were defined based on the number of trees that they contained and the maximum height of their trees (Large Clumps: number of trunks = 24 ± 15; maximum height = 13.8 ± 3.5 m; Small Clumps: number of trunks = 5 ± 6.8; maximum height = 5.3 ± 2.1 m).

Crickets for experiments were collected from trees and tree clumps not used in trials. While in captivity, each cricket consumed apple, carrot, and staminate pinecones (Mason 1991, Snedden and Irazuzta 1994), and each one's pronotum, hind knees, and abdominal tergites VII and VIII were coated with fluorescent or phosphorescent paint (Liquitex No. 2002-981, Liquitex No. 20002-982, and Golden Phosphorescent Medium).

Tree Clump Preferences

These trials tested if male *C. monstrosa* prefer to sing from large or small tree clumps. Each trial occurred in one of five circular arenas (Fig. 1). At the center of each arena, crickets acclimated in a container for 2 hours before each trial began. Crickets were then released between 2000 and 2015 hours and observed every 5 minutes under red light, or when missing, under ultraviolet light. As a cricket crossed the perimeter of an arena, its location and the temperature on the ground were recorded. Each cricket was used only once.

The direction from the center of a given arena to its tree clumps was oriented randomly to control for the possibility that *C. monstrosa* may have tended to walk in a particular compass direction. In addition, interactions between tree size and tree species were accounted for by creating two arenas between clumps of *Tsuga mertensiana* and three arenas between clumps of mixed *Abies/Pinus* spp.

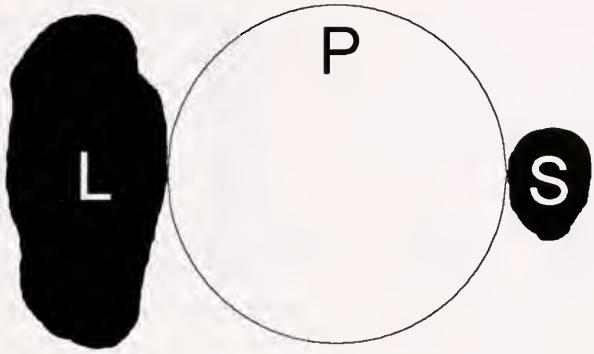

Figure 1. An arena as seen from above. Abbreviations are as follows: *S,* small tree or tree clump; *L,* large tree or tree clump; *P,* perimeter of arena. The perimeter touched each clump or tree tangentially and was marked on the ground with string tied to garden stakes. This string did not impede crickets from walking out of the arena. The mean diameters of arenas were 2.48 ± 0.9m and 1.25 ± 0.4m in Tree Clump Choice Tests and Tree Size Choice Tests, respectively.

Tree Size Preferences

The aim of these trials was to test if *C. monstrosa* prefer to sing from large or small trees. Trials were performed in four arenas, and followed the same protocol as for tree clumps except crickets acclimated for 45-60 minutes rather than 2 hours. In addition, if a cricket exited an arena unobserved, it was assumed to have followed a linear course from its last known location. To account for the corresponding loss of precision, these estimated locations were recorded in 30° increments. Finally, while only one cricket occupied an arena at a time, up to three were released into each arena per night, beginning at between 2100 and 2115 hours and ending by 2400 hours. Each cricket was used only once.

One variable that may interact with tree size is tree species. Hence, arenas were situated so that half were between pairs of *Pinus* trees and half were between pairs of *Tsuga mertensiana* trees. As in the tree clump experiments, the directions to the large and small trees differed for each arena.

Tree Species Preferences

To determine if *C. monstrosa* prefer to sing from a particular species of tree, logistical constraints precluded choice tests. However, surveying singing crickets was possible. To generate a null model for the survey, the relative abundance of *Pinus* sp., *Abies* sp., and *Tsuga* sp. was determined within the tree clumps that crickets sang, or within a 25 m^2 quadrate in the forest.

Analysis

To test if crickets preferred large trees and tree clumps, two alternatives are considered: crickets followed a random walk (implying that the proportion of the perimeter of the arena that a large tree/clump occupied predicted the number of

crickets that chose it) or they distinguished between meadow, large trees/clumps, and small trees/clumps, but had no preference (i.e., they chose each location one third of the time). A binomial test — with the number of crickets expected at large and small trees/clumps grouped together — was used to test the first null hypothesis because fewer than five crickets were expected to choose trees/ clumps (Zar 1996). A G-test was used for the second set of alternatives.

It is possible that crickets walked in a compass direction that they preferred and then merely "bumped" into certain trees/clumps. If there was such a directional preference, the mean directions in which crickets exited each arena would be identical, which is testable with a Watson-Williams Test (used for tree clump data; Zar 1996). However, this test cannot be used for the data from the Tree Size Choice Tests because they were grouped in 30° increments (Zar 1996). To circumvent the problem, consider that if crickets chose a compass direction, half of them from each arena would have chosen to go to either side of the median direction for all of the exits from all of the arenas, a hypothesis testable with a G-test (Batschelet 1981).

All means are reported plus or minus one standard deviation (mean ± SD).

RESULTS

Tree Clumps Preferences

Surveys suggested that singing crickets were more abundant in large tree clumps than small tree clumps. In trials, most crickets walked directly to the large or small tree clump. *Cyphoderris monstrosa* that initially began walking towards the small tree clump usually reversed direction before they were halfway there (n=3). Ultimately, of the 25 crickets that exited arenas, 23 (92 percent) went to large clumps, 1 (4 percent) went to meadow, and 1 (4 percent) went to a small clump. Crickets chose tree clumps more often than is expected had they followed a random walk (Fig. 2a; binomial test, $p<<0.001$). They therefore appear to have chosen the tree clumps prior to leaving the arena. A test of whether their decision was random with respect to clump size indicates that it was not; large tree clumps were preferred (G-test, G=38.219, $p<<0.001$). *Cyphoderris monstrosa* moreover tended to exit arenas at the center of large tree clumps (χ^2 goodness of fit test: $\chi^2=13.272$, $p<0.001$). Those that were permitted to continue into tree clumps commenced singing within five minutes of climbing trees therein if the ambient temperature exceeded 4°C.

The mean compass directions in which crickets exited each arena differed (Watson-Williams test: F=38.503, $p<0.0005$; Zar 1996). This heterogeneity indicates that the locations at which *C. monstrosa* exited did not result entirely from a certain compass direction being preferred.

The preference of *C. monstrosa* for large tree clumps was independent of ambient temperature (Fisher's Exact Test: p=0.708). However, at low temperatures crickets exited arenas less frequently than at high temperatures, burrowing or becoming inactive immediately upon entering the arena (Fisher's Exact Test: $p<0.001$).

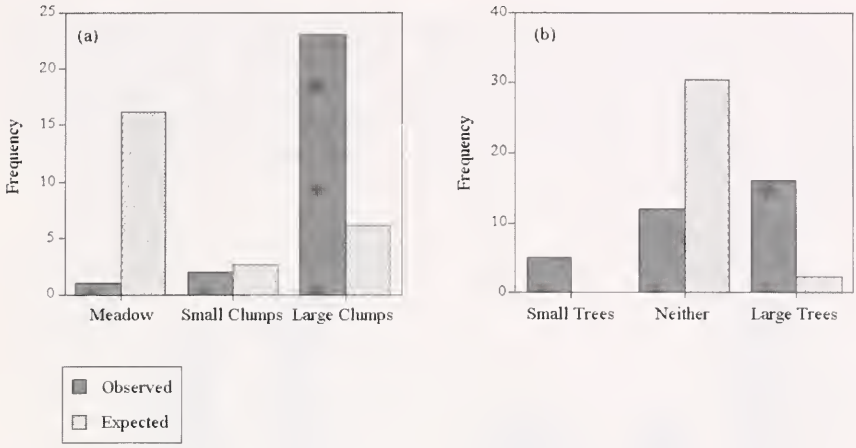

Figure 2. Number of crickets choosing (a) large clumps, small clumps, and meadow and (b) large trees, small trees, and neither. Expectations are calculated from the proportion of the perimeter of the arena that tree clumps or trees occupied.

Cyphoderris monstrosa chose large *Tsuga* clumps as often as they chose large *Abies-Pinus* clumps (Fisher's Exact Test: $p>0.3$), suggesting that their preference for large tree clumps was unaffected by the species of trees growing in them.

Tree Size Preferences

Surveys suggested that singing crickets were more abundant in large trees than small trees. In trials, most *C. monstrosa* walked directly to the large tree, small tree, or a tree that was located outside of the arena. All told, 16 (48 percent) crickets chose to sing in large trees, 5 (15 percent) in small trees, and 12 (36 percent) chose neither, usually walking to a more distant, foreign tree. More crickets chose large trees than can be explained by the proportion of the perimeter that large trees occupied (Fig. 2b; Binomial test: $p<<0.001$). The responses of the crickets also did not conform to the pattern that was expected if they distinguished between large trees, small trees, and meadow but were not predisposed to choose any of the three (G-test: 6.194, $p<0.05$). When crickets chose a tree, they climbed it and began stridulating.

Crickets walked in different compass directions in each arena (G-test: $G=4.321$, $p<0.05$; Batschelet 1981). Therefore, preference for large trees probably did not result spuriously from crickets choosing to walk in a compass direction that they preferred. Furthermore, the preference for large trees was independent of the genus of the trees (G-test: $G=0.279$, $p>0.5$).

Tree Species Preferences

The 14 tree clumps surveyed with singing *C. monstrosa* were composed of 7 *Abies* spp., 160 *Tsuga mertensiana,* and 92 *Pinus* spp. Within eleven 5 x 5 m quadrates centered on stridulating crickets grew 18 *Pinus* spp., 57 *Tsuga mertensiana,* and 35 *Abies* spp.

A total of 12 *C. monstrosa* stridulating in the forest and 18 in tree clumps were surveyed. In both the forest and tree clumps, the crickets were distributed randomly amongst the 3 genera of trees (clumps: Fig. 3a; G-test: G=0.004, p>0.95; forest: Fig. 3b; G-test: G=0.447, p>0.25). Whether crickets inhabited forest or tree clumps did not predict the tree genus from which they called (G-test: G=0.0892, p>0.75).

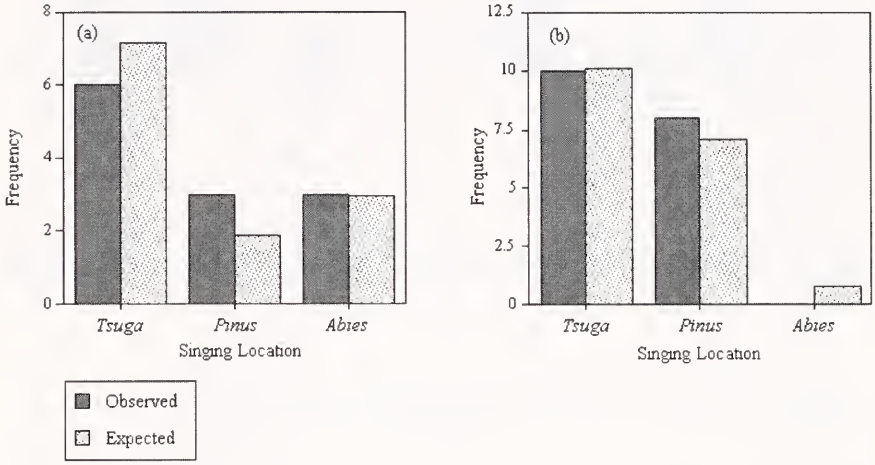

Figure 3. The number of *C. monstrosa* observed and expected (if crickets do not prefer any tree genus) to be singing from *Abies, Tsuga,* and *Pinus* trees in (a) tree clumps and (b) forest.

DISCUSSION

This investigation suggests that male *C. monstrosa* prefer to sing in large tree clumps, independent of the ambient temperature and local tree species. It also suggests that the crickets prefer large trees regardless of genus, and that they sing equally often from *P. contorta, P. albicaulis, Abies* spp., and *T. mertensiana.*

Natural selection is generally modeled as a balance between costs and benefits: selection favors traits only if their benefits exceed their costs (Parker and Maynard Smith 1990). This line of reasoning implies that the benefits of territoriality must exceed the costs in *C. monstrosa* but not in *C. strepitans* and *C. buckelli.* Such a difference may arise in two ways: First, territoriality may cost *C. monstrosa* more than it costs *C. buckelli* and *C. strepitans* (Sakaluk et al. 1995, Mason 1996), and second, territoriality may benefit *C. monstrosa* more than it benefits *C. strepitans* and *C. buckelli.* While these two possibilities are not mutually exclusive, they are distinct, and my results support the second one.

Specifically, I hypothesized that a limited number of sites offer *C. monstrosa* the best protection, food, and/or access to females, while for *C. strepitans C. buckelli,* such sites are either unlimited or nonexistent. This hypothesis predicts that *C. monstrosa* should prefer to sing from particular sites — those with the

best resources — and consistent with this prediction, I have shown that *C. monstrosa* indeed prefer to sing from large trees and large tree clumps.

Whether large trees and tree clumps offer the best resources remains to be tested. However, I speculate that they might for the following reasons:

1. Preliminary data suggest that females abound in large trees and tree clumps (Ladau, personal observation). If females prefer to mate with males that are nearby (Forrest 1983, Mason 1991, Brown and Gwynne 1997) males may have the most opportunities to mate in large trees and tree clumps.
2. A large supply of food is available in large trees and tree clumps, where the staminate pine cones on which *C. monstrosa* feed (Morris and Gwynne, 1978) are numerous.
3. Male *C. monstrosa* can call until the ambient temperature falls below freezing (Morris and Gwynne 1978), which happens later in the night in large trees and tree clumps than in small trees and tree clumps (Brooke 1970, Franklin and Dyrness 1972, Spurr and Barnes 1992, Geiger et al. 1995). Therefore, crickets can sing longer in large trees and tree clumps and possibly increase their likelihood of attracting a mate.
4. Large trees and tree clumps are considerably taller than small trees and tree clumps. Male *Anurogryllus arboreus* climb trees to increase the broadcast range of their song (Paul and Walker 1979, Walker 1983), and climbing benefits other species in a like manner (Ewing 1989). Thus, by singing from high perches that large trees or tree clumps offer, male *C. monstrosa* may optimize the broadcast range of their songs.

In sum, if *Cyphoderris* spp. differ in territoriality because of differing benefits, two predictions should hold: first, within the habitat of *C. monstrosa* certain locations should offer better resources than others, and second, within the habitat of *C. strepitans* and *C. buckelli* such heterogeneity should be lacking. Consistent with the second prediction, Morris et al. (2002) show that *C. buckelli* sing from randomly chosen bushes. Consistent with the first prediction, I here show that *C. monstrosa* prefer large trees and clumps of trees.

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ADULT CHLOROPIDAE (DIPTERA) ASSOCIATED WITH CONSTRUCTED TREATMENT WETLANDS MODIFIED BY THREE VEGETATION MANAGEMENT TECHNIQUES[1]

J. B. Keiper[2], M. Stanczak[2], and W. E. Walton[3]

ABSTRACT: Eight genera of Chloropidae were collected from experimental wetland research cells manipulated by different vegetation control strategies in southern California, U.S.A. After flooding, chloropids were collected with detergent pan traps for 14 months. *Eribolus californicus,* a secondary invader of emergent wetland plants, was the only abundant species. Results indicate that density of adult Chloropidae was not affected differently by the wetland plant management techniques used. However, the techniques slowed the growth of emergent macrophytes (particularly bulrush, *Schoenoplectus* spp.) that are the sites of larval development. Therefore, first year data show low numbers of chloropids, with a two- to three-fold increase by year two.

KEY WORDS: Chloropidae, Diptera, adults, wetlands, vegetation management techniques.

Chloropid flies (Diptera: Chloropidae) represent a large family with about 1300 species worldwide (Rogers et al. 1991). Many species of chloropids are considered to be either primary or secondary invaders of plants, especially grasses, sedges, and rushes (Valley et al. 1969, Todd and Foote 1987, Keiper et al. 2002, Beaulieu and Wheeler 2002). Other species appear to exhibit more scavenging habits (Ferrar 1987, Keiper et al. 2002), and yet others are pest species that may be vectors of ocular diseases (*Liohippelates, Siphunculina* spp.) or cause damage to crops (Ferrar 1987). Most species are not anthropophilic.

Wetland environments provide habitat and food for many chloropid species, and their abundance appears to be tied directly to the wetland plant diversity (Valley and Foote 1997). Large numbers of chloropid individuals and numerous species are frequently found in marsh areas (Todd and Foote 1987). However, due to damage caused by human activities, many wetland habitats are threatened, and the restoration or replacement of wetland areas is common practice today (Hammer 1997). Both comparatively old and newly constructed wetland areas are frequently subjected to vegetation management to prevent aquatic plants from eliminating open water areas. Excessive growth of vegetation in constructed wetlands can lead to decreased efficiency in treating wastewater (Marble 1992, Thullen et al. 2002), and provide less suitable habitat for waterfowl and other wildlife than a hemi-marsh (i.e. a marsh with approximately 50 percent vegetation cover and 50 percent open water) (Batzer et al. 1999). A recent paper showed that vegetation management reduced adult shore fly (Diptera: Ephydridae) densities, but populations required less than one year to produce

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[2] Department of Invertebrate Zoology, Cleveland Museum of Natural History, 1 Wade Oval Drive, Cleveland, Ohio 44106 U.S.A. E-mail: jkeiper@cmnh.org.

[3] Department of Entomology, University of California, Riverside, California 92521 U.S.A.

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equally dense communities during experimental vegetation management in southern California (Keiper and Walton 2002). This study describes the colonization of chloropid flies associated with experimental constructed treatment wetlands subjected to three different vegetation management strategies. It also tests the null hypothesis that densities of abundant species are not significantly affected by these methods of wetland management in southern California, U.S.A.

MATERIALS AND METHODS

The study was conducted at the Hemet/San Jacinto Regional Water Reclamation Facility in western Riverside County, CA (USA) (Keiper and Walton 2002). Eight 0.1 ha research cells (69 x 14m) were used and divided into three categories after all cells were burned and dried to leave only underground rhizomes. Three cells were randomly assigned as control cells (C). Three remaining cells were randomly selected and scoured with a rock bucket attached to a backhoe (S). The remaining two cells had hummocks (earthen mounds) installed in the shallow areas after the cells were scoured (H). Hummocks were designed to provide shallow areas to focus emergent vegetation, primarily California bulrush (*Schoenoplectus californicus* [Meyer] Sojak), while keeping areas between hummocks free of vegetative growth. Each cell received secondary-treated wastewater containing excess nitrogen (~9.9 mg L^{-1} NH^{+}_{4}-N, and <1 mg L^{-1} NO^{-}_{3}-N) from the treatment plant. Other workers studying the research cell complex concurrently found that H cells reduced ammonium levels by 66 percent and 28 percent during 1998 and 1999, respectively. Vegetative cover was reduced by approximately 40 percent in the H cells (Thullen et al. 2002).

Flooding of the cells began July 13, 1998, and was completed after 7 days. On the second day of this flooding, detergent pan traps (23 x 33 cm) were set out along the western edge of each of the cells; one on either end, and one in the middle, to represent a variety of open water, plant, and mud shore microhabitats. Pans were set out every week for the first 12 weeks of inundation, every 2 to 3 weeks in the summer of 1999, and less frequently during early spring and winter. Trapping was concluded on September 10, 1999. Each pan was filled with approximately 5 cm of water, to which a few drops of liquid dishwashing detergent were added; insects alighting on the surface fell through the surface and drowned (Larson and Foote 1997, Keiper and Walton 2002). Pans and their contents were collected after 24 hours and preserved for later analysis. Keiper and Walton (2002) provide a more detailed description of the study site and the methods used. Representative specimens were dehydrated and pinned, and are deposited in the Entomology Research Museum of the University of California – Riverside, or the Department of Invertebrate Zoology, Cleveland Museum of Natural History.

Species were categorized as abundant (>20 percent of all specimens captured), common (>10 but <20 percent), uncommon (>1 but <10 percent), or rare (<1 percent). Statistical analyses were applied only to species that were abundant. Nonparametric (Friedman's repeated measures ANOVA) or parametric (one-way

repeated measures ANOVA) statistics were performed where appropriate to test the hypothesis that the numbers of adults captured differed significantly between the wetland treatments (SigmaStat 1997). Due to the time of initial inundation and dates sampled during each year, the two years were treated separately.

RESULTS

A total of 452 chloropids from eight genera were collected. *Eribolus californicus* was the only abundant species and was first encountered 10 days after flooding began. *Pseudopachychaeta approximatonervis* (Zetterstedt) was common but was not captured until approximately 4 months after flooding of the cells. *Elachiptera nigriceps* Loew Sabrosky arrived quickly (24 days after flooding), but was uncommon. The remaining five genera each accounted for <1 precent of the total number of chloropid flies collected (Table 1).

Eribolus californicus was infrequently collected during the first summer and fall of the study, with mean densities never exceeding two individuals per pan trap in all treatments. However, by early spring of 1999, densities increased two- to threefold and peaked in June at approximately six individuals per trap. Numbers declined during summer (Fig. 1). However, the abundance of adult *E. californicus* during 1998 ($\chi^2 = 0.273$, d.f. = 2, $p = 0.88$) and 1999 ($F_{2,7} = 1.03$, $p = 0.38$) did not differ significantly among the three treatment types.

DISCUSSION

Previous work on shore flies showed that populations of some common taxa were inhibited by the scoured and hummock treatments during the first summer of inundation. However, all treatments produced statistically equal numbers of individuals by the second year (Keiper and Walton 2002). *Eribolus californicus* was the only abundant chloropid species, and adult density was statistically equal in all treatments. The addition of hummocks to cells reduced the vegetation coverage by 40 percent, and was the most successful management technique in terms of reducing lateral growth of bulrush (Thullen et al. 2002). Although we conducted no rearing, California bulrush grew in a virtual monoculture in the cells and is probably the larval food source for *E. californicus*. Other *Eribolus* species exhibit secondary herbivory in the larval stage (Valley and Foote 1997). The relative scarcity of *E. californicus* during 1998 was probably due to a lack of substantive stands of bulrush in the cells, although a modest peak in numbers occurred in November as bulrush stands were maturing. Peaks in 1999 occurred in April and June. Sampling did not continue until November 1999, thus we can not conclude with certainty that November is a period when a late generation of *E. californicus* occurs. From these data, we suggest that in southwestern habitats, *E. californicus* is at least bivoltine with generations in April and June, and is possibly trivoltine with a peak in November. *Eribolus* species are most commonly found in May and early June in more temperate areas but can be found from mid-April to late October (Valley and Foote 1997).

Table 1. Chloropidae taken in pan traps at the Hemet/San Jacinto RWRF Research Cell Complex, 1998-1999; taxa arranged phylogenetically. Abundance in parentheses: A = abundant (>20%), C = common (>10 but <20%), U = uncommon (>1 but <10%), R = rare (<1%).

Taxa	Trophic level	Frequency	Days until first appearance
Pseudopachychaeta approximatonervis	Herbivore	0.15 (C)	122
Biorbitella sp.	?	<0.01 (R)	24
Eribolis californicus	Herbivore/ 2^0 invader	0.77 (A)	10
Elachiptera nigriceps	Herbivore/ 2^0 invader	0.06 (U)	24
Liohippelates sp.	Herbivore	<0.01 (R)	248
Gaurax sp.	Scavenger	<0.01 (R)	65
Rhopalopterum sp.	Herbivore/ 2^0 invader	<0.01 (R)	79
Apotropina sp.	Scavenger	<0.01 (R)	72

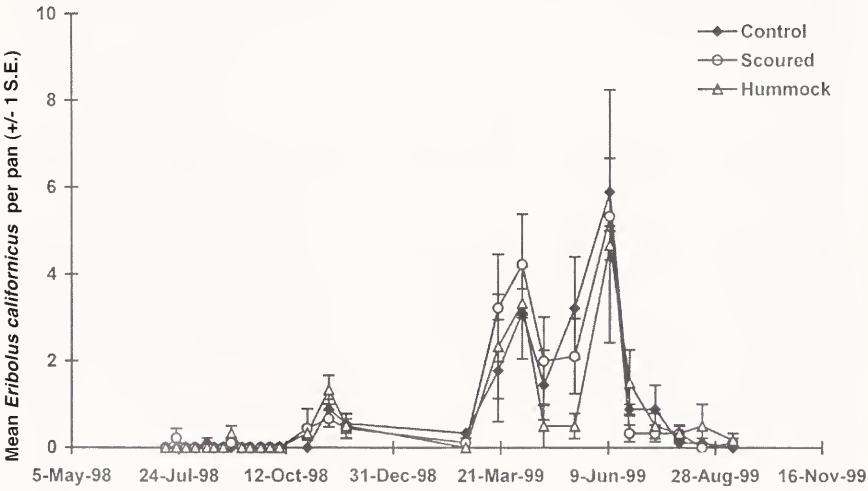

Fig. 1. Mean number of *Eribolus californicus* taken in pan traps from research cells modified by three different vegetation management strategies.

The second most frequently encountered chloropid was *Pseudopachychaeta approximatonervis*, a herbivore which feeds on the inflorescences of plants such as spike-rush (Todd and Foote 1987). Due to repeated captures in a bulrush monoculture, *P. approximatonervis* may be using *S. californicus* as a host plant. The late appearance of *P. approximatonervis* (124 days, Table 1) may have been

due to the time it takes for *S. californicus* to flower and eventually develop seed heads. *Elachiptera nigriceps* (Loew) is a secondary invader that normally feeds on shoots of *Carex* and partially opened flowers of *Iris*; the primary invaders of these plants are larvae of Lepidoptera. *Elachiptera nigriceps* is also known to scavenge decaying skunk cabbage (Ferrar 1987) and may opportunistically scavenge decaying plant matter in the areas where skunk cabbage occurs.

The remaining five genera were rare. Flies of the genus *Apotropina* are scavengers as larvae, and are found in the nests of birds or wasps (Ferrar 1987); tricolor blackbirds and marsh wrens, among other avian taxa, nested in the research cells (JBK, personal observation). Some larvae of *Gaurax* can be found feeding on the decaying plant material in bird nests, while others are found in bracket fungi associated with Coleoptera larvae. It has been suggested that *Gaurax* larvae also feed on beetle frass (Valley et al. 1969), while some species are known to be predators of spider egg cocoons (Ferrar 1987). The genus Liohippelates was a rare genus in this study, and contains flies known as eye gnats, which may be vectors of ocular disorders and yaws—skin ulcers on face, feet, and hands (Rogers et al. 1991). Some have been found on the yellow water lily (Todd and Foote 1987), but no evidence suggests that they are associated with bulrush. *Rhopalopterum* is a genus of secondary invaders that inhabit stems of wetland monocots (Keiper et al. 2002). Some plants attacked by this genus are grasses, sedges, and cattails (Todd and Foote 1987). No information on the biology or feeding habits of the genus *Biorbitella* is known.

In conclusion, the chloropid community in these wetland cells is relatively rich with eight species, with certain species (*Eribolis californicus, Pseudopachychaeta approximatonervis,* and *Elachiptera nigriceps)* occurring frequently. Vegetation management practices did not appear to inhibit species richness within the research cells. However, when compared to what little work has been done in natural wetlands, the constructed wetlands harbored far fewer species of Chloropidae (e.g. Todd and Foote 1987). Perhaps if more than one plant species was seeded, the research cells would support a more species-rich community of chloropid flies. The adult flies may be an important food source for birds and amphibians, and the larvae could represent significant herbivores or scavengers, therefore contributing substantially to energy flow and nutrient cycling within constructed wetland ecosystems.

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HETEROPTERAN ADVENTITIOUS BITERS (HEMIPTERA): PRIMITIVELY PREDACEOUS?[1]

Carl W. Schaefer[2]

ABSTRACT: The foods of most heteropterans are either plants or other arthropods. I surveyed records of bugs which have adventitiously bitten humans, and found that 38 of these records are of bugs whose ancestors were herbivorous. One hundred eighty-four records are of bugs which are, or whose ancestors were, predaceous. The relative ratios of biting records to numbers of bugs in these groups is 3.10 for primarily herbivorous bugs, and 8.50 for primarily predaceous ones. The greater propensity of predaceous bugs to bite humans may reflect similarities between these bugs' usual (or ancestral) hosts and the exudations of humans.

KEY WORDS: Heteroptera, nuisance biters, adventitious biters, predation, herbivory.

Heteropterans that adventitiously bite humans are bugs that normally feed on other hosts. From time to time such bugs may attack people; to call such nuisance attacks "accidental" suggests the bugs are confused or distracted; whereas, in fact, the attack may be quite deliberate — a search for fluid, minerals, warmth (see Schaefer 2000a). While writing a chapter on such bugs (Schaefer 2000a), it occurred to me that many of these records are of bugs which were, or whose ancestors were, predaceous; and that there seemed to be fewer records of herbivorous and ancestrally herbivorous bugs. Here I document that impression and briefly discuss it.

Ryckman (1979), Ryckman and Bentley (1979), and I (2000a) have compiled many records of bugs adventitiously biting humans (Table 1). Not listed are records of two groups, some of whose members feed on human blood. Triatomine reduviids and cimicids both feed exclusively on vertebrate blood, and some (a minority) feed on humans. Although most triatomines do not feed on humans, records of adventitious feeding by triatomines are not included in Table 1.

In addition, of the many references to cimicid bites, most but not all refer, of course, to the bedbugs [*Cimex lectularius* L. and *C. hemipterus* (F.)]. Yet several of the others refer to other cimicids that normally do not feed on humans (see also reports in Schaefer 2000b). Nevertheless, like triatomines, all cimicids feed on vertebrate blood, and so they too are not included in Table 1.

Also absent from Table 1 are records of sternorrhynchous hemipterans biting humans. There are few such records, and this paucity probably reflects their very small size and the consequent difficulty of their penetrating human skin. Sternorrhynchs' relatives, grouped para- (or poly-) phyletically as "Auchenorrhyncha," are usually larger and at many times bite humans (Table 1; Schaefer 2000a).

[1] Submitted on October 11, 2002. Accepted on June 3, 2004.

[2] Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, CT 06269-3043 U.S.A. Schaefer@uconnvm.uconn.edu.

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Table 1. Number of reports of adventitious biting by hemipterans. Several reports contain more than one species, and several reports of the same family may contain the same species. Schaefer's (2000a) reports are in addition to these of Ryckman (1979) and Ryckman and Bentley (1979); the last two reports are combined.

Family of Hemiptera	Ryckman (1979), Ryckman and Bentley (1979)	Schaefer (2000a)
Cydnidae	1	2
Pentatomidae (excluding Asopinae)	—	2
Pentatomidae: Asopinae	—	2
Coreidae	1	—
Rhopalidae	1	—
Pyrrhocoridae	8	—
Lygaeidae *(sensu lato)*	19	1
Berytidae	—	1
Enicocephalidae	2	—
Reduviidae (excluding Triatominae)	74	—
Nabidae	12	1
Anthocoridae	20	7
Miridae	16	10*
Tingidae	—	5
Dipsocoridae, Cryptostemmatidae, Ceratocombidae	2	—
Notonectidae	7	—
Belostomatidae	7	—
Naucoridae	2	—
"Auchenorrhyncha"	21	1

*plus 27 additional species of Miridae from Wheeler (2001); total = 59.

There are 38 reports of adventitious biting by bugs belonging to primarily herbivorous groups (i.e., groups whose ancestors were also herbivorous: Cydnidae through Berytidae in Table 1) and 184 reports of such biting by primarily predaceous bugs or bugs which, although herbivorous now, are evolved from carnivorous groups (Enicocephalidae through Naucoridae in Table 1). "Auchenorrhyncha" are not included in either tally. The reports of Lygaeidae *(sensu lato)* do not distinguish between those that feed only on plants and those that also prey upon insects (Geocorinae). The same is true of Pyrrhocoridae, some of whose species are at least, in part, predaceous (see Schaefer 1999).

In addition, the records in Table 1 here do not distinguish between those biters which took in actual internal fluids (cell contents, blood, lymph) and those which either imbibed external fluid (sweat) or nothing at all. This could be an important distinction, as is also the temperature at which these attacks occurred. Very often, under experimental conditions, predaceous bugs will not feed below a certain temperature threshold (A. C. Cohen, personal communication).

Any analysis of these numbers must be far more qualitative than quantitative; the reports overlap to some extent (including the same species) and several reports include more than one species. But the difference is large: 38 reports of biting by primitively herbivorous bugs and 184 reports of biting by bugs either predaceous or secondarily herbivorous (see Schaefer 1997).

However, there are many far more primarily predaceous bugs than primarily herbivorous ones. All the latter are members of the heteropteran infraorder Pentatomomorpha, which has altogether about 12,400 described species. The primarily predaceous bugs belong to these heteropteran infraorders: Enicocephalomorpha (130 species), Dipsocoromorpha (210), Nepomorpha (1900), and Cimicomorpha (19,400; 10,000 of these species are Miridae [Schuh 1995], the largest by far of the heteropteran families); the total of these primarily predaceous infraorders is 21,640 (numbers from Schaefer unpublished). The relative ratios relative ratio of reports to numbers of bugs is 3.10 for primarily herbivorous bugs [38/12,400 x 1,000] and 8.50 for predaceous or secondarily herbivorous bugs [184/21,640 x 1,000]. Because the ratios are very small, I multiply each by 1,000.

Thus, even taking into account the larger number of primarily predaceous bugs, there are proportionately more reports of them feeding adventitiously than of primarily herbivorous bugs doing so; and the relative ratio rises when Miridae are excluded (see Appendix). In addition, the only secondarily predaceous group among the herbivores (Asopinae) has only two records of adventitious biting (see Schaefer 2000a). Note that the ratio for predaceous bugs would greatly increase if the records of adventitious biting by those cimicids and triatomine reduviids that do not normally attack humans were included in the total.

Miridae are herbivorous; many, many are predaceous; and many are both. The family itself is almost certainly descended from predaceous ancestors and its herbivorous members are therefore secondarily herbivorous (see discussion in Wheeler 2001 and Schaefer 1997). Doubtless many of its predaceous members

are descended from herbivores, whereas the feeding habits of others (e.g. , Isometopinae) are directly descended from that of the predaceous ancestor. Because the family is so large and so diverse, I discuss it separately in an Appendix, while including its species more generally in the discussion here.

These data suggest that ancestral feeding habits (herbivorous and predaceous) are better predictors of adventitious biting than present feeding habits (see Table 2). The reasons for this difference are obscure. Perhaps humans and the usual arthropod prey of predaceous bugs (and formerly predaceous bugs) emit attractants more similar than do plants; and predators (and former predators) are then attracted to such things as volatile amino acids, CO_2, some degree of warmth, and/or something else given off by both the usual (or former) arthropod prey and humans. Perhaps predators are more attracted to the directed movement of animals, whether prey or not, than they are to the less directed movement of plants. It may simply be that predaceous insects are more ready to use their beaks in defense than are herbivorous insects, and that, therefore, at least some of the records in Table 1 reflect defensive, not feeding, bites. This may be especially true of the three water bugs.

However, the circumstances surrounding the various recorded instances suggest that the bugs were seeking *something,* moisture possibly, more probably salts or organic compounds. Many of the adventititous bitings occurred under warm and humid conditions when the attacked human was sweating; but whether the sweat was the attraction or whether biting occurred because some threshold temperature had been reached remains unknown. For further discussion see Wheeler (2001).

We lack the opposing data to help test these statements: we do not know how often predaceous (and formerly predaceous) herbivores are attracted to nonhost plants. We *do* not know how often bugs which feed on humans are attracted to nonhuman animals or to plants. We *do* know that predaceous bugs will suck juices from plants and that herbivorous bugs will sometimes attack other arthropods. But we lack data similar to, and therefore comparable with, those in Table 1.

Nevertheless, experiments with CO_2, different human hosts, various volatiles, temperature gradients, etc. should help clarify how significant the differences among these heteropteran groups are.

Table 2. Ancestrally and/or presently predaceous and herbivorous adventitious heteropteran biters (by family group), with number of reports of adventitious biting in parentheses.

Feeding Habits	Presently Predaceous	Presently Herbivorous
Ancestrally Predaceous	Enicocephalidae (3)	Miridae (53) (see Appendix)
	Reduviidae (excl. Triatominae) (74)	Tingidae (5)
	Nabidae (13)	
	Anthocoridae (27)	
	Dipsocoridae (2)*	
	Cryptostemmatidae (2)*	
	Ceratocombidae (2)*	
	Notonectidae (7)	
	Belostomatidae (7)	
	Naucoridae (2)	
Ancestrally Herbivorous	Asopinae (2)	Cydnidae (3)
		Pentatomidae (excluding Asopinae) (2)
		Coreidae (1)
		Rhopalidae (1)
		Pyrrhocoridae (8)
		Lygaeidae (s.l.) (most) (20)
		Berytidae (1) "Auchenorrhyncha" (22)

*taken together

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APPENDIX

The Miridae are abundant and varied enough to be discussed separately. Wheeler, in his fine book on the family, lists the mirids known to have bitten humans (Wheeler 2001, Table 15.1). If one removes from this list those species given by Ryckman (1979) and Ryckman and Bentley (1979), and by me (Schaefer 2000a), 27 species remain. These bring the total of adventitiously biting mirid species to 53, and the total of adventitiously biting primarily predaceous species to 184. Of these 53 mirid species, the basic feeding preferences of 43 can be classified: 13 are mostly or entirely predaceous; 21 are mostly or entirely herbivorous; and 9 are mixed (feed both ways) (information from Wheeler's book). I list the Miridae as "presently herbivorous" in Table 2.

Miridae themselves bite adventitiously less often than other primarily predaceous bugs .The relative ratio for all nonmirid, primarily predaceous bugs (11,640 species, of which there are 131 adventitious-biting records), is 11.25. Thus, inclusion of Miridae among primarily predaceous adventitious biters brings the ratio of such biters down, from 11.25 to 8.4. The ratio for Miridae alone ([53/10,000] x 1,000) is 5.3.

The relative ratios for herbivorous mirids (21 species) and predaceous mirids (13 species) are 2.1 and 1.3, respectively (for mixed species [9]: 0.9). The relative ratio for those 43 species, whose feeding preferences are known, is 4.3. However, these ratios are artificially low, because in calculating them I divided by the total number of mirids (10,000), not by the total number (unknown) of herbivorous, predaceous, and mixed mirids, respectively.

Why mirids bite adventitiously less often than other primarily predaceous bugs, I do not know. Maybe the fact that so many members of this very large family are tropical, and less likely to be reported, is a factor.

COPESTYLUM CIRCUMDATUM (WALKER) (DIPTERA: SYRPHIDAE): REDESCRIPTION OF A NEOTROPICAL FLOWER FLY, WITH LECTOTYPE DESIGNATIONS, AND NEW SYNONYMS[1]

F. Christian Thompson[2] and Luciane Marinoni[3]

ABSTRACT: *Copestylum circumdatum* (Walker) (Diptera: Syrphidae) is redescribed. Lectotypes are designated for two names and one new synonym is proposed (*Volucella mus* Williston 1888 = *circumdatum* Walker 1857).

KEY WORDS: Diptera, Syrphidae, *Copestylum*, Neotropics, lectotype, synonyms.

Copestylum circumdatum is a widespread species in the Neotropics, which breeds in bromeliads. This species has recently been reared by workers and does appear in biodiversity inventory samples. The proper name for this species has been confused, as there is unrecognized but extensive variation in adult characters, as well as confusion about prior named concepts. We redescribe the species, propose the appropriate name and synonyms for this species, and designate lectotypes as necessary. The critical male genitalia characters are figured. The biology of the species and description of the immature stages will be published by Graham Rotheray and Geoffroy Hancock.

The format, methodology, terminology, and other aspects of this paper follow our general standards, which are enumerated in detail in our prior publications (see Marinoni and Thompson, 2004). Author FCT maintains a system of informal nomenclature for "morpho-species." When we know that something represents a species, but do not know the name, we either assign a Year-Sequence number, such as 73-2, or a CR-sequence for the Costa Rican Biodiversity inventory project. These numbers are all represented by vouchers here at the Smithsonian Institution, and these numbers are provided to users, just like names. These numbers get published sometimes and are used, for example, in database, such as INBio's ATTA system. Hence, author FCT reports them in his papers when the identity was finally resolved. On the Literature Cited, the bracketed codes at the end of each citation represent precise dates of publication. The format of those codes is [year.month.day]. The question mark means unknown. This practice is becoming more common amongst dipterists.

Copestylum Macquart is undoubtedly the largest genus of flower flies in the World. While in terms of the number of species described to date, *Cheilosia* Meigen, a mainly old world (Palaearctic) taxon, contains some 410 species, the

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[2] Systematic Entomology Laboratory, ARS, USDA;NHB-168 Smithsonian Institution; Washington, District of Columbia 20560 U.S.A. E-mail: cthompso@sel.barc.usdad.gov.

[3] Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil. E-mail: lmarinoni@ufpr.br.

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New World endemic group, *Copestylum,* contains 315 described species, as well as more than 100 known, but currently undescribed species.

The current concept of *Copestylum* is very broad and covers a diverse array of adult forms, essentially any New World species with a plumose arista and bristles (see Thompson (1999) for a key to the Neotropical genera; Vockeroth and Thompson (1987) for a key to Nearctic genera). Most of the species fall into a number of well defined groups based on adult characters. While *C. circudatum* does not fall into a group defined by autamorphies, the species does belong to a phenetic group defined by the following shared character states: Cell R1 broadly open apically; bristles all black; scutellum with a pre-apical depression, but without basolateral flattened, rugose areas; scutum without any pre-scutellar bristles; anepisternum bare anteriorly, and katepimeron bare. *Copestylum circumdatum* differs from all other species in this group by the following combination of characters; face with median black vitta, broadly yellow laterally; legs partially pale, usually with coxae yellow; scutum generally black (not entirely pale), scutellum pale along base and marginally; calypter with margin and fringe black. Closely related species are diagnosed below.

Copestylum circumdatum (Walker, 1857)

(Figures 1-5)

Temnocera circumdata Walker, 1857: 154. Type-locality. Brazil [as "Valley of Amazon"]. Lectotype ♀ BMNH here designated. Fluke 1957: 156 (species *incertae sedis*).

Volucella circumdata. Kertész 1910: 188 (combination).

Copestylum circumdatum. Thompson *et alia* 1976: 73 (combination).

Volucella mus Williston, 1888: 274. Type-locality: Brazil, Mato Grosso, Chapada. Lectotype ♂ AMNH here designated. Kertész 1910: 195 (citation); Sack 1921: 137 (Bolivia, biology, immatures, fig. 10 (puparium), fig. 11c (anterior spiracular process); Curran 1926: 52 (key ref.), 1930: 7 (key ref.), 1934: 380 (key ref.), 1939: 2 (key ref.); Fluke 1957: 76 (catalog citation).

Copestylum mus. Thompson *et alia* 1976: 79 (combination).

Copestylum 73-2

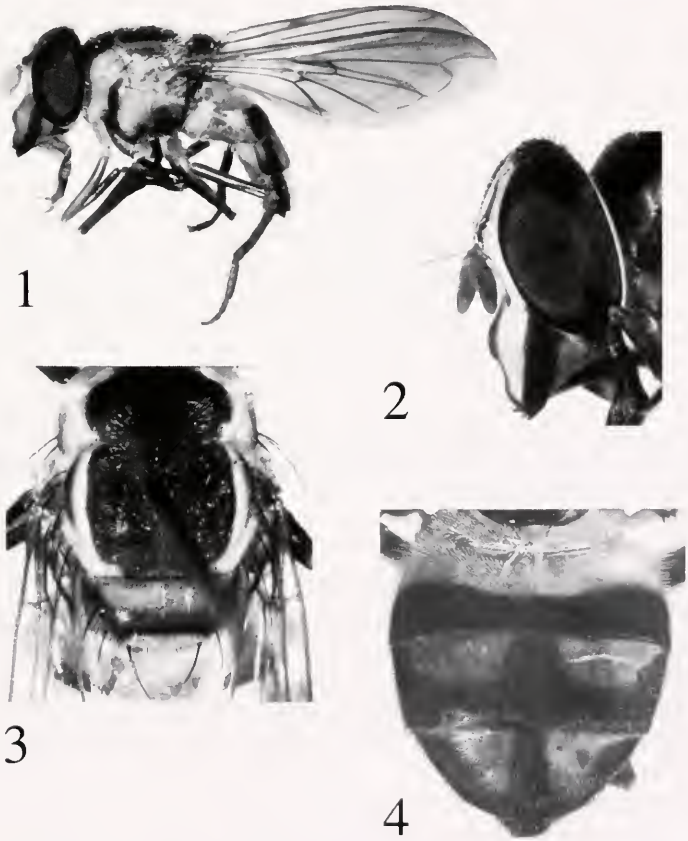
Copestylum CR-43

Head (Fig. 2). Face shiny, yellow with a dark brown medium vitta ventrad to antenna and narrowly brown laterally, white pilose; gena brown except yellow medially, [thus there is a broad brown vitta from eye margin to oral margin partially on face and gena], short white pilose posteriorly; lunule yellow except narrowly brown along posterior margin; frontal triangle yellow, white pilose; frons yellow except for a triangular brown macula dorsad to lunule on ventral 1/2 or less; vertical triangle black, black pilose; vertex dark brown, shiny, black pilose; occiput black except yellow on ventral 1/5, white pollinose, white pilose except black on dorsal 1/8; antenna yellow to orange, black pilose; basoflagellomere elongate, about three times as long as wide; arista orange on basal 2/3, dark apically, with black rays.

Thorax (Fig. 3). Postpronotum yellow, white pilose; scutum bluish black except broadly yellow laterally, except notopleuron brownish laterally, narrowly yellow anterior scutellum in females, some individual also with yellow lateral areas mesial to wing with brown vitta, white pilose with intermixed black pile; bristles black, 2 notopleurals, 3 supra-alars with anterior most weak, about 1/2 size of posterior supra-alar, 3 postalar callars, no pre-scutellars, 3 marginal scutellars, one anepisternal; scutellum with apicomedial depression, yellow, with a narrow transverse brown fascia, black pilose

except bare on the depression, with three pairs of long marginal bristles; pleuron generally brown to blackish, white pilose, yelllow on propleuron, posterior anepisternum, and anterior anepimeron; katepimeron bare; plumula yellow; halter white; calypter pale basally, becoming dark apically, with brown to blackish margin and fringe. Wing: hyaline except stigma dark brown and costal margin slightly brownish, microtrichose except bare base of cell C, basal 2/3 of cell R, anterobasal 3/4 of cell BM, all of cell CuP except apex, and on anal lobe anterior to vein A2; alula trichose; Cell r1 closed at wing margin or before, with or without very short petiole. Legs: dark brown to black, brown and black pilose except procoxa white pilose.

Abdomen (Fig. 4). Brown to bluish-black with yellow maculae, shiny; 1st tergum yellow, white pilose; 2nd tergum yellow laterally and on basal 1/3, dark elsewhere, yellowish-white pilose on basal 1/3, black pilose elsewhere; 3rd and 4th terga bluish-black except with large basal yellow maculae on basal 1/2 and broadly separated medially by about medial 1/4 and yellow laterally or sublaterally, black pilose except yellow pilose on maculae (males) or on basal 1/3 (females); sterna brownish to bluish-black except yellow laterally on 1st through 3rd sterna, white pilose except black pilose on 4th sternum (♂♂) or apical 2/3 (♀♀); ♂ genitalia (Fig. 5) black, black pilose; cercus semi-circular; postcercal area only slightly sclerotized; surstylus approximately triangular; aedeagus rectangular; 9th sternum with a single apicolateral bristle, with large lateral oval membranous area; superior lobe slightly arcuate; lingular area only slightly concave.



Figs 1-4. *Copestylum circumdatum* (Walker): (1) Adult, lateral view; (2) head, lateral view; (3) thorax, dorsal view; (4) abdomen, dorsal view.

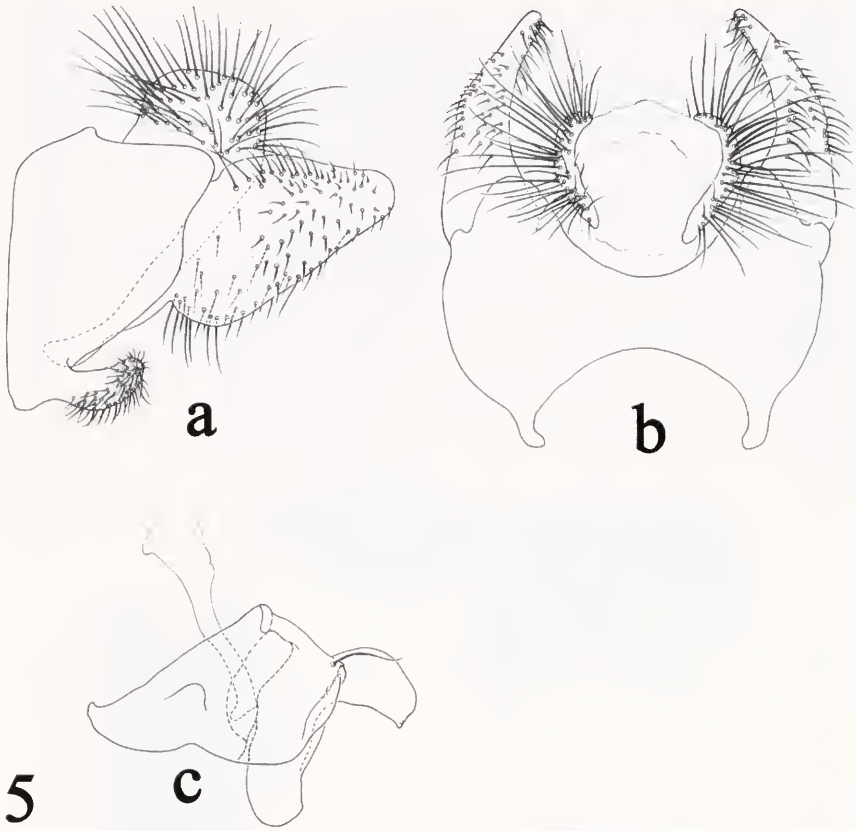


Fig 5. *Copestylum circumdatum* (Walker): (a) 9th tergum and associated structures, lateral view; (b) 9th tergum and associated structures, dorsal view; (c) 9th sternum and associated structures, lateral view.

Variation. As is usual with *Copestylum* species, color develops and darkens after the adult emerges. Freshly emerged adults (young specimens) appear paler and more brownish, whereas older ones are more yellow and bluish-black. Also, some individuals have more extensive pale areas.

Examination of specimens of *C. circumdatum* indicates that the extent of yellow coloration on the scutum is a factor of age and individuals. Freshly emerged specimens have the scutum extensively pale, so as to have a large triangular macula anterior to the scutellum and the lateral margins of the scutum broadly yellow. In older individuals, the scutum becomes darker so that the triangular macula is reduced to a transverse fascia and the lateral margins become more narrowly pale (dark areas expand).

Types. *Temnocera circumdata* Walker was described from an unspecified number of specimens from the "Valley of Amazon" in the Saunders' collection, which was ultimately donated to the Natural History Museum, London. A single specimen remains there and is labeled as follows: Holotype (red circular NMH type label); Cotype (green circular BMNH type label); "Amazon, 66.53;" "Temnocera circumdata Wlk" [E. Austen's hand]; and "Brazil, Amazon, H. W. Bates, 66.53." This specimen is here designated as lectotype to fix the concept of the name and assure the consistent future interpretation of this name.

Volucella mus Williston was described from eleven specimens collected by H. H. Smith in "Chapada, Brazil." A number of specimens agreeing with this data are now found in the American Museum of Natural History, having been donated by Williston's family, and another two syntypes are found in the Cornell University Collection. Of these specimens a male labeled "Chapada," "Type, No., A. M. N. H." [red], "S. W. Williston Collection," "Am. Mus. Nat. Hist., Dept. Invert. Zool., No. 19921," "Volucella, mus, Williston" [red-bordered determination label] "Lectotype, Volucella mus, Williston, Design. Thompson 2002" and in the American Museum of Natural History is here designated as lectotype to fix the concept of the name and assure the consistent future interpretation of this name.

Distribution. Costa Rica, Panama, Suriname, Trinidad, Colombia, Brazil (Bahia, Mato Grosso, Paraná, Santa Catarina), Peru, Paraguay, Bolivia, Argentina.

Material examined (12 ♂♂, 31 ♀♀). **ARGENTINA.** Corrientes: Ytuzaingo, Sep 1982, M. Fritz (USNM ENT 00114123 ♀ USNM). **BOLIVIA.** Beni: Cavinas, Jan 1922, Mulford Bio Exp 1921-1922, W. M. Mann (USNM ENT 00000002 ♀ USNM). **BRAZIL.** Amazonas/Pará: "Amazon," H. W. Bates (Lectotype circumdata Walker, ♀ BMNH). Bahia: Bonfim, 26 Jan 1930, Davis and Shannon (USNM ENT 00000001 ♂ UNSM). Mato Grosso: Maracaju, May 1937, Servico de Febre Amarela. "M.E.S. Bras." (USNM ENT 00000010 ♂ USNM); Chapada dos Guimarães, H. H. Smith (lectotype and paralectotypes of mus Williston, ♂ ♀ AMNH and CU). Paraná: Fênix, Reserva Est ITCF, 10 Sep 1986, Lev. Ent. PROFAUPAR, Malaise Trap (♀, DZUP); Foz do Iguaçú, 11 Dec 1966, AExc. Dep Zool. @ (♂, DZUP); ... 18 Feb 1969 (♀, DZUP). Santa Catarina: Nova Teutônia, Feb, Mar, Apr, Sep, Nov [various years 1964-75), Fritz Plaumann (USNM ENT 00000011-13, 00030703, 00114108-21 3 ♂♂ 14 ♀♀ USNM). COLOMBIA. Dept. Meta, Restrepo, 500 m, 1936, J. Bequaert (USNM ENT 00114127 ♂ CNC). **COSTA RICA.** San Mateo, Hiquito, [no dates], Pablo Schild (USNM ENT 00114106-7 2 ♀♀ USNM); Puntarenas: Est. Quebrada Bonita, Cruce de Quebradas Res. Biol. Carara, LN 195500 470400, 5 Nov-13 Dec 1990, E. Quesada (INBIOCRI000302126 ♀ INBIO). **PANAMA.** Gatun Lake, Cano Saddle, Jun 1923, M. F. Close (USNM ENT 00000000 ♀ USNM). **PARAGUAY.** Villarrica, F. Schade, Jun 1937 (USNM ENT 00000003 ♀ USNM), May 1938 (USNM ENT 00000008 ♂ USNM), Nov 1937 (USNM ENT 00000004-6, ♂ 2 ♀♀ USNM), Dec 1937 (USNM ENT 00000007 ♀ USNM). **PERU.** Loreto: Iquitos, Mar-Apr 1931, R. Shannon (USNM ENT 00000009 ♂ USNM); Rio Momon, ca 25 km NW Iquitos, 13 Feb 1984, W. Mathis (USNM ENT 00114126 ♀ USNM). Madre de Dios: Manu, Rio Manu, Pakitza, 250 m, 12 7S 70 58W, 9-23 Sep 1988, A. Freidberg (USNM ENT 00114124 ♂ USNM), W. Mathis (USNM ENT 00114125 ♀ USNM). **SURINAME.** Paramaribo, 5 54N 55 7W, K. Mayo (USNM ENT 00114128 ♀ USNM). **TRINIDAD.** Apr 1997, G. Rotheray (♂ USNM).

DISCUSSION

Curran (1926, 1930, 1934, 1939), the last worker to publish comprehensive keys of the group now called *Copestylum,* did not recognize the name *C. cir-*

cumdata Walker, as he only worked from specimens previously identified in the collection of his museum. He simply ignored the descriptions of other species by earlier authors. While Williston did attempt to decipher the species described by earlier authors, he apparently was unable to recognize that Walker's description of *C. circumdata* was the same as the species he described as *mus*. In terms of current taxonomy, there is a species called *mus* by Curran, whose senior synonym is *C. circumdata* Walker.

In the last published key to *Copestylum* species (Curran, 1939), *C. circumdatum* runs to couplet #35, *mus,* if the coxae are considered yellow (couplet #28), otherwise it runs to couplet #45, *contumax*. *Copestylum contumax* (Curran, 1939) is known from a unique male specimen which has "unusually large" male genitalia. *Copestylum circumdatum* has small, normal-sized male genitalia, also the male frontal triangle is not produced and the facial tubercle is white pilose, not black (contumax). This species differs from *musana* (Curran, 1930) in having the anepimeron extensively yellow and entirely yellow pilose, not black and black pilose *(musana)*.

Footnote. This species is similar to the species named *obscurior* by Curran and so cataloged by Fluke (1957: 78). However, due to an ignorance of Latin, this epithet became incorrectly changed to *obscurius* in the Neotropical Diptera catalog (Thompson, *et alia* 1976: 80).

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This study resulted from an investigation of the flower fly fauna of southeastern Brazil. The junior author initiated the faunal survey of this area, doing the preliminary sorting and identification to morphospecies. The senior author is responsible for the taxonomy, recognizing that there is a single widespread species masquerading under various names. Together, we prepared this manuscript.

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A CHECKLIST OF THE STONEFLIES (PLECOPTERA) OF THE DANIEL BOONE NATIONAL FOREST IN KENTUCKY, U.S.A.[1]

Donald C. Tarter[2] and Dwight L. Chaffee[3]

ABSTRACT: A total of 69 species representing nine families and 30 genera of stoneflies are found in the Daniel Boone National Forest in eastern Kentucky. Two hundred and fifty-five new county records were identified from 163 streams in 21 counties. Three new state records, including *Pteronarcys biloba* Newman, *Paracapnia angulata* Hanson, and *Perlesta decipiens* (Walsh), and *Isoperla orata* Frison, were identified from the study area.

KEY WORDS: Plecoptera, stoneflies, Daniel Boone National Forest, Kentucky, U.S.A.

The Daniel Boone National Forest was established as the Cumberland National Forest on February 23, 1937. The name was officially changed on April 11, 1966, to honor the great Kentucky Pioneer, Daniel Boone (Collins, 1975). Previously, aspects of the stonefly fauna of the Daniel Boone National Forest in eastern Kentucky have been recorded by Picazo and DeMoss (1980), Tarter et al. (1982,1984), Allen and Tarter (1985), Surdick (1985), Kondratieff and Kirchner (1988,1996), and Pond (1999). The checklist presented herein represents the first attempt to list the stoneflies (nymphs and adults) found in the streams located in 21 counties within the Daniel Boone National Forest. The list indicates nine families, 30 genera, and 69 species. Additionally, 255 new county records were added to the study area. Of the known stonefly species in Kentucky (91), 76 percent were found in the Daniel Boone National Forest.

The Daniel Boone National Forest is located in the Cumberland Plateau and Cumberland Mountain region of eastern Kentucky and encompasses approximately 849,870 hectares within its proclamation boundary (Fig. 1). The land is rugged and characterized by steep forested ridges, narrow valleys, and contains approximately 11,900 km of perennial streams and rivers. Collections for this investigation were made from 163 streams. They were taken mostly from stream orders 1-3, and many collections were taken from very small unnamed branches and tributaries. Stoneflies and detailed data (streams, collection dates, collector) were deposited in the West Virginia Benthological Survey at Marshall University. The following counties (21) have land areas that are contained within the proclamation boundary of the Daniel Boone National Forest: Bath, Clay, Estill, Harlan, Jackson, Knox, Laurel, Lee, Leslie, McCreary, Menifee, Morgan, Owsley, Perry, Powell, Pulaski, Rockcastle, Rowan, Wayne, Whitley, and Wolfe.

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[1] Received on December 6, 2002. Accepted on April 10, 2004.

[2] Department of Biological Sciences, Marshall University, Huntington, West Virginia 25755, U.S.A. E-mail: tarter@marshall.edu.

[3] Forest Biology Consultant, P.O. Box 814, Richmond, Kentucky 40476 U.S.A.

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Figure 1. Map of Kentucky (U.S.A.) highlighting the Daniel Boone National Forest in the eastern portion of the state.

Stoneflies were collected from the following streams and rivers within three drainage basins (Cumberland, Kentucky, and Licking rivers): Bath Co.: Big Cave Run, Caney Creek, Clear Creek, Joes Branch, Licking River, Salt Lick Creek. Clay Co.: Buzzard Creek, Red Bird River, Spring Creek. Estill Co.: Oak Creek, Station Camp Creek, Sudders Fork. Harlan Co.: Abner Branch, Bills Branch, Big Laurel Creek, Little Laurel Creek, Laurel Fork. Jackson Co.: Brashears Creek, Cavenaugh Creek, Horselick Creek, Owsley Fork, Panther Creek, Peter Branch, Raccoon Creek, Rockcastle River, South Fork, War Fork. Knox Co.: Disappointment Creek. Laurel Co.: Cane Creek, Hawk Creek, Pine Creek, Rockcastle River, Wood Creek. Lee Co.: Little Sinking Creek, Ross Creek, Smith Branch, Stillwater Creek, Sturgeon Creek. Leslie Co.: Cutshin Creek, Elkorn Creek, Middle Fork (Kentucky River), Sugar Creek. McCreary Co.: Beaver Creek, Cogur Creek, Cumberland River, Eagle Creek, Indian Creek, Marsh Creek, Rock Creek, Yahoo Creek. Menifee Co.: Beaver Creek, Clifty Creek, Copperas Creek, Dunkan Branch, Edwards Branch, Gladie Creek, Indian Creek, Klaber Branch, Sal Branch, Sargent Branch, Wolfpen Creek. Morgan Co.: Buckhorn Creek, Licking River, Open Fork, Yocum Creek. Owsley Co.: Buck Creek, Cow Creek, Crane Fork, Wild Dog Creek. Perry Co.: Pig Pen Branch, Squabble Creek, Stable Fork. Powell Co.: Amburgy Hollow Branch, Auxier Branch, Fish Trap Branch, Grays Branch, King Branch, Mill Creek, Nation Camp Creek, Red River (Middle and South Forks), Rush Branch, Upper Hood Branch, Whittleton Branch. Pulaski Co.: Big Lick Branch, Bear Creek, Buck Creek. Rockcastle Co.: Brush Creek, Crooked Creek, Renfro Creek, Rockcastle River, Roundstone Creek, White Oak Creek. Rowan Co.: Abner Tackett Branch, Claylick Branch, Dry Creek, Elk Lick Fork, Hays Branch, Kiser Branch, Licking River, Logan Hollow, Mills Branch, Ramey Creek, Scott Creek, Slabcamp Creek, Sugar Camp Creek, Triplett Creek, White Pine Branch. Wayne Co.: Burnett Creek, Little South Fork, Lonesome Creek.

Whitley Co.: Bark Camp Creek, Brier Creek, Cumberland River, Dog Slaughter Creek, Little Dog Slaughter Creek, Poplar Creek, Little South Fork. Wolfe Co.: Chestnut Log Branch, Chimney Top Creek, Laurel Branch, Parched Corn Creek, Red River (Middle and North Forks), Rockbridge Fork, Swift Camp Creek.

The Red River Gorge Geological Area, which is confined to Menifee, Powell, and Wolfe counties, is a unique and scenic area in the Daniel Boone National Forest. Within the Red River Gorge is an area classified as the Clifty Wilderness Area. These two areas together form a rugged and picturesque forest area of more than 10,117 ha. This gorge area features numerous stone arches, precipitous cliffs, craggy pinnacles, cascading waterfalls, and many other natural features (McGrain, 1983). Nine families, 2 genera, and 36 species of stoneflies were found in this area, including three new state records. The 36 species comprised 52 percent of the stoneflies in the Daniel Boone National Forest and also 40 percent of the known species in Kentucky.

The following new state records were identified from the Daniel Boone National Forest (M represents male and F represents female): 1) *Pteronarcys biloba* Newman (nymphs) (Menifee County/Wolfpen Creek, May 23, 2002; Wolfe County/Parched Corn Creek, June 3, 2000, and Chimney Top Creek, June 1, 2000, and Rowan County/Licking River, July 3, 2001). 2) *Paracapnia angulata* Hanson (adult/M) (Powell County/Amburgy Hollow Branch, March 2, 1974), 3) *Perlesta decipiens* (Walsh) (adults/M, F) (Wolfe County/Red River Gorge, June 23, 1992).

Acroneuria abnormis was identified from all 21 counties in the study area, while *A. carolinensis* was found in 18 counties (86 percent). Two perlids have their type-locality in the Daniel Boone National Forest: *Acroneuria hitchcocki* Kondratieff and Kirchner (Rowan County/Ramey Creek, April 30, 1987) and *Hansonoperla hokolesqua* Kondratieff and Kirchner (Rowan County/Abner Tackett Branch/May 16, 1990). The following sentential (threatened) taxa were found in the study area: *A. hitchcocki, Alloperla hamata* Surdick and *H. hokolesqua.*

Checklist of the Daniel Boone National Forest in Kentucky

Below is a checklist of 69 stonefly species identified from the Daniel Boone National Forest. Counties of collection are enclosed in parenthesis. New county species records are indicated with an asterisk, while new state species records are denoted by a double asterisk.

Euholognatha
Capniidae
- *Allocapnia curiosa* (*Clay, *Jackson, *Menifee)
- *A. forbesi* Frison (Lee, *Rowan)
- *A. frisoni* Ross and Ricker (*Rowan)
- *A. granulata* Claassen (*Laurel, *Rockcastle)
- *A. indianae* Ricker (Rowan)
- *A. mystica* Frison (*McCreary, *Morgan)

A. navicola (Fitch) (*Clay, *Estill, *Jackson, *Rockcastle)
A. ohioenis Ross and Ricker (Rowan)
A. pygamea (Burmeister) (*Clay, *Estill, *Leslie, *Menifee, *Morgan, *Powell, *Rowan, *Wolfe)
A. recta (Claassen) (*Estill, *Jackson, *Laurel, *Menifee, *Morgan, *McCreary, Powell, *Rockcastle, *Rowan,*Wolfe)
A. rickeri Frison (Bath, *Estill, *Laurel, *Lee, *Menifee, *Morgan, *Powell, *Rockcastle, Rowan, *Wolfe)
A vivipara (Claassen) (Rowan)
A. zola Ricker (*Morgan)
***Paracapnia angulata* Hanson (*Jackson, *Powell)

Leuctridae
Leuctra ferruginea (Walker) (*Knox, McCreary, *Powell, Wolfe)
L. rickeri James (Menifee, Rowan)
L. sibleyi Claassen (Rowan)
L. tenuis (Pictet) (Jackson)
Paraleuctra sara (Claassen) (*Menifee)
Zealeuctra claasseni (Frison) (*Morgan)

Nemouridae
Amphinemura delosa (Ricker) (*Clay, *Harlan, *Knox, *Lee, *Leslie, McCreary, Menifee, *Morgan, *Owsley, *Perry, *Powell, *Pulaski, *Rowan, *Whitley, *Wolfe)
A. nigritta (Provancher) (McCreary, *Morgan, Rowan)
A. wui (Claassen) (McCreary)
Prostoia completa (Walker) (*Menifee, Pulaski)
P. similis (Hagen) (*Clay, *Jackson, *Menifee, Morgan, *Powell, *Rowan)
Soyedina vallicularia (Wu) (*Powell)

Taeniopterygidae
Oemopteryx contoria Needham and Classen (*Bell, *Harlan, Rowan)
Strophopteryx fasciata (Burmeister) (*Clay, Estill, Jackson, *Leslie, *Menifee, *Morgan, *Perry, *Powell, *Rowan, *Wolfe)
Taeniopteryx burksi Ricker and Ross (*Clay, *Estill, Jackson, *Laurel, *Perry, Rockcastle, *Rowan)
T. maura (Pictet) (*Clay, *Estill, Jackson, *Leslie, *Menifee, *Morgan, *Owsley, *Powell, *Pulaski, *Rockcastle, *Rowan, Wayne, *Whitley, *Wolfe)
T. metequi Ricker and Ross (Jackson, *Morgan, *Powell, Pulaski, Rockcastle, *Rowan, Whitley, *Wolfe)

Systellognatha
Chloroperlidae
Alloperla chloris Frison (Jackson, Menifee)
A. hamata Surkick (Rowan)
A. idei (Ricker) (Morgan)
A. imbecilla (Say) (Jackson)
Haploperla brevis (Banks) (Bath, *Harlan, *Knox, *Leslie, McCreary, *Menifee, Morgan, *Owsley, *Powell, *Pulaski, *Rowan, Whitley, Wolfe)
Sweltsa onkos (Ricker) (*Lee, *Menifee, *Powell, Rowan)

Peltoperlidae
Peltoperla arcuata Needham (*Clay, *Harlan, *Jackson, *Laurel, *Leslie, McCreary, Menifee, *Morgan, *Owsley, *Powell, *Rowan, Wolfe)

Perlidae
Acroneuria abnormis (Newman) (Bath, *Clay, *Estill, *Harlan, *Jackson, *Knox, *Laurel, *Lee, *Leslie, McCreary, Menifee, *Morgan, *Owsley, *Perry, Powell, *Pulaski, *Rockcastle, *Rowan, *Wayne, *Whitley, *Wolfe)

A. carolinensis (Banks) (*Clay, *Estill, *Harlan, Jackson, *Knox, *Laurel, *Lee, *Leslie, *Menifee, *Morgan, *Owsley, *Perry, *Powell, *Pulaski, *Rockcastle, *Rowan, *Whitley, *Wolfe)
A. filicis Frison (Whitley)
A. frisoni Stark and Brown (*Bath, *Jackson, *Laurel, *McCreary, *Owsley, *Powell, *Rockcastle, *Rowan, *Whitley)
A. hitchcocki Kondratieff and Kirchner (Rowan)
A. internata (Walker) (*Wayne)
A. lycorias (Newman) (McCreary, *Rockcastle, *Rowan, *Whitley)
A. perplexa Frison (*Jackson)
Eccoptura xanthenes (Newman) (*Clay, *Knox, Laurel, *Lee, *Leslie, *McCreary, *Menifee, *Owsley, *Powell, *Pulaski, *Rockcastle, *Rowan, Whitley, Wolfe)
Hansonoperla hokolesqua Kondratieff and Kirchner (Rowan)
**Perlesta decipiens* (Walsh) (*Wolfe)
Perlinella drymo (Newman) (Rowan)
Neoperla gaufini Stark and Baumann (*Morgan)
Agnetina capitata (Pictet) (*Jackson, *Lee, *Pulaski, *Wayne, *Whitley)
A. flavescens (Walsh) (*Harlan, *Jackson, *Rockcastle)
Paragnetina immarginata (Say) (Harlan)

Perlodidae
Clioperla clio (Newman) (*Bath, *Clay, *Estill, *Harlan, *Laurel, *Lee, *Leslie, *Menifee, *Morgan, *Powell, *Rockcastle, *Rowan, *Wayne, *Wolfe)
Diploperla robusta Stark and Gaufin (*Bath, *Knox, *McCreary, *Morgan, *Powell, Rowan)
Isoperla burksi Frison (Menifee, *Rowan)
I. holochlora (Klapalek) (*Bath, *Harlan, *Knox, *Morgan, *Owsley, *Perry, *Powell, *Rowan, *Wolfe)
I. namata Frison (*Clay, *Menifee, *Powell, Wolfe)
I. richardsoni Frison (Jackson, *Menifee)
I. similis (Hagen) (*Harlan, *Jackson, *Knox, *Laurel, McCreary, *Powell, Wolfe)
I. transmarina (Newman) (*Bath, *Jackson, Menifee, *Perry, *Powell, Rowan, *Wolfe)
Malirekus hastatus (Banks) (*Harlan, *Knox, *Leslie, McCreary, *Menifee, *Perry, *Powell, *Rowan)
Remenus bilobatus (Needham and Claassen) (*Bath, *Harlan, McCreary, *Menifee, *Morgan, *Powell, *Rowan, *Wolfe)
Yugus kirchneri Nelson (*Harlan, *Knox, *Morgan, *Perry)

Pteronarcyidae
***Pteronarcys biloba* Newman (*Menifee, *Rowan, *Wolfe)
P. comstocki Smith (Jackson)
P. dorsata (Say) (Rowan)
P. proteus Newman (*Harlan, *Knox, *McCreary, *Menifee, *Perry, *Powell, *Rowan, Wolfe)

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NEW RECORDS OF MAYFLIES (EPHEMEROPTERA) FROM ALBERTA, CANADA[1]

J. M. Webb[2] and W. P. McCafferty[3]

ABSTRACT: Eleven species of Ephemeroptera are reported from Alberta for the first time. Among them, the reports of *Ametropus ammophilus* and *Baetisca columbiana* also represent the first records from Canada. The validity of *B. columbiana* and the status of the genus *Baetisca* in western North America are discussed. A total of 122 mayfly species are now known from Alberta.

KEY WORDS: Ephemeroptera, mayflies, Alberta (Canada), new records.

In their compendium of Canada mayflies, McCafferty and Randolph (1998) reported 102 species of mayflies from Alberta, Canada. Jacobus and McCafferty (2001) reported an additional nine species [although *Pseudocloeon dardanum* (McDunnough) was previously reported from Alberta by Soluk (1981)], and Sun et al. (2002) described a new species from southern Alberta. A previous report of *Baetisca obesa* (Say) from Alberta by Lehmkuhl (1972) is applicable to *B. laurentina* McDunnough (Pescador and Berner 1981) and should not be included in the Alberta species list. This brought the total number of species known from Alberta prior to this study to 111. Herein, we report an additional 11 species. Collections were made by, and are in the possession of, JMW, unless otherwise indicated as being deposited in the Purdue Entomological Research Collection (PERC).

Ametropodidae

Ametropus ammophilus Allen and Edmunds. Material examined: 20 larvae, Wapiti R. at Hwy 40, IX-4-2001; 2 larvae, Wapiti R. at Hwy 13, IX-5-2001.

Baetidae

Baetis brunneicolor McDunnough. Material examined: 3♂ and 3♀ imagos, Bigoray R, VIII-15-1973, no collector indicated (PERC).

Fallceon quilleri (Dodds). Material examined: 4 larvae, Milk R north of Aden, VII-31-1999; 3 larvae, 1 ♂ subimago, South Saskatchewan R at Hwy 879, VII-31-1999, VIII-1-1999; 2 ♂ imagos, Red Deer R, VII-7-2003.

Heterocloeon anoka (Daggy). Material examined: 1 larva, Athabasca R at junction with Calling R, IX-10-2001; 1 larva, Milk R north of Aden, VII-31-1999.

The taxonomic status of the species [formerly considered a synonym of *Plauditus punctiventris* (McDunnough)] will be elaborated on elsewhere by R. D. Waltz and WPM.

[1] Received on February 24, 2003. Accepted on March 27, 2004.

[2] Department of Entomology, Purdue University, West Lafayette, Indiana, U.S.A. 47907. E-mail: jmw975@yahoo.com. Corresponding Author.

[3] Department of Entomology, Purdue University, West Lafayette, Indiana, U.S.A. 47907. E-mail: pat_mccafferty@entm.purdue.edu.

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Baetiscidae

Baetisca columbiana Edmunds. Material examined: 1 larva, Muskeg R 57°07'N 111°38' VII-16-1976, D. R. Barton (PERC).

Baetisca columbiana was definitively known only from the single larval holotype specimen collected by J. J. Davis in 1948 from the Columbia River in Franklin County, Washington (Edmunds 1960). Pescador and Berner (1981) repeated the species description in their revision of the genus *Baetisca* Walsh, but did not comparatively treat or key the species, doubting its legitimacy and indicating that the single specimen on which the original description was based had been lost. Pescador and Berner (1981) also did not believe that any *Baetisca* occurred west of the Continental Divide in North America, discounting reports of the genus by Eaton (1885) and Edmunds (1960) as being due to mislabeling of specimens. Since that time, however, *B. lacustris* McDunnough has been collected in Nevada (Baumann and Kondratieff 2000) and Idaho (Lester et al. 2002), and based on information from D. Goodger of the British Museum (pers. comm.), we consider the historical record of *B. obesa* (Say) from California by Eaton (1885) to be a misidentification of *B. lacustris*.

We recently confirmed the presence of the holotype of *B. columbiana* in the California Academy of Sciences and can confirm the distinctiveness of the species. Another larval specimen of *B. columbiana* was recently made available to us by G. Lester of Moscow, Idaho. Unfortunately, there were no specific locale data associated with the latter specimen, although according to Lester (pers. comm.), it presumably came from the Snake River in eastern Idaho.

A previous report of *B. columbiana* from Alberta by Barton (1980) was rejected by Pescador and Berner (1981), who considered the material on which it was based to represent an aberrant larval variant of *B. laurentina*. Our data here and the fact that the so-called variant of *B. laurentina* is morphologically similar to *B. columbiana* suggest that the Barton report was possibly valid.

Caenidae

Brachycercus edmundsi Soldàn. Material examined: 7 ♂ imagos, Red Deer R, VII-7-2003.

Brachycercus prudens (McDunnough). Material examined: 6 larvae, Red Deer R. at Hwy 41, VIII-3-1999; 11 larvae, Milk R. north of Aden, VII-31-1999.

Heptageniidae

Heptagenia pulla (Clemens). Material examined: 8 larvae, Athabasca R at junction with Calling R, IX-10-2001; 7 larvae, South Saskatchewan R at Hwy 879, VIII-31-1999.

Leucrocuta maculipennis (Walsh). Material examined: 6 larvae, South Saskatchewan R at Hwy 879, VIII-1-1999; 1 larva, Red Deer R at Jenner Bridge, VII-9-2003.

Leptohyphidae

Asioplax edmundsi (Allen). Material examined: 1 larva, Red Deer R. at Hwy 41, VIII-3-1999.

Oligoneuriidae

Lachlania saskatchewanensis Ide. Material examined: 21 larvae, Milk R. north of Aden, VII-31-1999.

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SCIENTIFIC NOTE

TRIACANTHAGYNA TRIFIDA (ODONATA: AESHNIDAE): NEW STATE RECORD OF DRAGONFLY FROM SOUTH CAROLINA, U.S.A.[1]

R.A. Jenkins[2] and J.M. Jenkins

Prior to this report, 109 dragonfly (Odonata) species were known in South Carolina (R. Mancke, pers. comm.). On August 14, 2003, a female of *Triacanthagyna trifida* (Aeshnidae) (Fig. 1), the phantom darner, was captured at Clemson University's Sandhill Research and Education Center (REC) in Richland County, Columbia, South Carolina. This represents the first record of occurrence for *T. trifida* in South Carolina. In the United States, this species was previously known only from Florida, Georgia, and North Carolina (Needham et al. 2000). The species seems most common in Florida, but records such as this one suggest some northward shift in distribution. In North Carolina, *T. trifida* is known from Carteret, Craven, and Pender Counties (N. Donnely, pers. comm.). Further, *T. trifida* is known to be coastal in distribution, and this specimen was captured farther inland than previously known(R. Mancke, pers. comm.).

Figure 1. *Triacanthagyna trifida* prior to capture on August 14, 2003. Photo by Jack Jenkins.

[1] Received on March 10, 2004. Accepted on March 26, 2004.

[2] Department of Forest Resources, Clemson University, 261 Lehotsky Hall, Clemson, SC 29634, U.S.A. E-mail: robertj@clemson.edu.

Mailed on August 25, 2004

Members of the genus *Triacanthagyna* are restricted to the Neotropics, with the exception of *T. trifida* and *T. septima* (Needham et al. 2000). The former is the only member of its genus known to occur in the continental United States. *Triacanthagyna trifida* is further differentiated from *T. septima* by having dark legs and abdomen, the anterior margin of the frons abruptly convex to angulate, and dark markings on the thorax (Needham et al. 2000). The genus *Triacanthagyna* is distinguished by having two rows of cells between M1 and M2, beginning beyond the proximal end of the pterostigma in the hindwing. Females have a three-spined process on the sternum of abdominal segment 10 (Needham et al. 2000), making field identification easy with the use of a hand lens. This specimen is deposited in the Clemson University Arthropod Collection.

This specimen probably was not the only conspecific in the immediate area. It was teneral (not fully sclerotized) and retained its cerci. Insects need time for the hardening of the exoskeleton after molting, and female *Triacanthagyna* species eventually lose their cerci with age (Dunkle 2000). Eye marks are punctures in the compound eyes left by the males clasping the females by the head during mating behavior. Prereproductive females of *Triacanthagyna* also can show eye marks (Dunkle 1979). Eye marks were absent on this particular insect, further supporting our hypothesis that the specimen was a young adult. The above observations suggest the recent emergence of the specimen and perhaps its siblings on the property and the presence of at least one other conspecific female that oviposited in the vicinity.

Triacanthagyna trifida favors temporary forest pools for its breeding. The adult flight season extends from July until February, with late-flying individuals surviving frosts due to their preference for woodland habitats (Dunkle 2000). Found within the Fall Line Sandhills, Sandhill REC has been influenced largely by agriculture and, in recent years, urban development. However, favorable habitats for *T. trifida* do occur on the property. The presence of *T. trifida* at Sandhill REC in Columbia, South Carolina, suggests the same in places farther north and inland than once thought.

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SCIENTIFIC NOTE

FIRST RECORD OF *DASYCORIXA RAWSONI* (HEMIPTERA: CORIXIDAE) IN THE UNITED STATES[1]

Bruce A. Hanson[2], Ned H. Euliss, Jr.[2], David M. Mushet[2], and Steve W. Chordas III[3]

Hungerford (1948) described the genus *Dasycorixa* in his monograph of the Corixidae of the Western Hemisphere. This genus contains the three species *Dasycorixa hybrida* (Hungerford 1926), *Dasycorixa johanseni* (Walley, 1931), and *Dasycorixa rawsoni* (Hungerford 1948), all of which are known from Canada. Prior to this paper, only one *Dasycorixa* species *(D. hybrida)* was known from the United States. The purpose of this note is to report an additional *Dasycorixa* species *(D. rawsoni,* Fig. 1) as a new country record for the United States.

Types of *Dasycorixa rawsoni* collected from Lizard Lake in Saskatchewan, Canada, on August 10, 1938, were archived in the Francis Huntington Snow Entomological collection, University of Kansas. This species has been collected in Alberta, British Columbia, Manitoba, and the Northwest Territories.

Fig. 1. Dorsal view of *Dasycorixa rawsoni* (Hungerford 1948).

[1] Received on August 16, 2002. Accepted on March 13, 2004.

[2] U. S. Geological Survey, Northern Prairie Wildlife Research Center, 8711 37th Street SE, Jamestown, North Dakota 58401, U.S.A. E-mail of author BAH: bruce_hanson@usgs.gov.

[3] The Ohio State University, Museum of Biological Diversity, 1315 Kinnear Road, Columbus, Ohio 43212, U.S.A.

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In July 1999, we collected two males of *D. rawsoni* at the Cottonwood Lake Study Area. This area is located in Stutsman County, North Dakota, and was described by Swanson (1978). Voucher specimens are archived in the aquatic invertebrate collection at the U.S. Geological Survey, Northern Prairie Wildlife Research Center in Jamestown, North Dakota. Both specimens were captured using a funnel trap (Swanson 1978) set in 84 cm deep water in the deep marsh zone (open water phase) of a semipermanent wetland (Stewart and Kantrud 1971). At the time of sampling, water temperature was 260 C, and the specific conductance was 2250 $\mu S\ cm^{-1}$. Aquatic plants in the vicinity of the capture site included sago pondweed [*Stuckenia pectinatus* (L.) Boerner], shortspike water milfoil (*Myriophyllum sibiricum* Komarov), coontail (*Ceratophyllum demersum* L.), star duckweed (*Lemna trisulca* L.), and broad-leaved cattail (*Typha latifolia* L.). As is typical for the prairie pothole region, this wetland fluctuates between wet and dry phases, but it was in lake phase (van der Valk and Davis 1978) and had a maximum water depth of 3.55 m when we collected the two specimens of *D. rawsoni*. The hydrologic setting, geology, water chemistry, and wetland plant communities of focal wetlands at the Cottonwood Lake Study Area have been described by Winter and Carr (1980), Swanson (1990), LaBaugh et al. (1996), and Poiani et al. (1996), respectively.

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BOOK REVIEW

QUALITY CONTROL AND PRODUCTION OF BIOLOGICAL CONTROL AGENTS. THEORY AND TESTING PROCEDURES. J. C. van Lenteren [Editor]. 2003. CABI Publishing. 44 Brattle Street, 4th Floor, Cambridge, MA 02138 United States. 327 pp. Hardcover $US195.00 (approximately).

The use of biological control agents or natural enemies is increasing worldwide in horticultural cropping systems. The success of a biological control program is strongly correlated with the quality of the natural enemies that are released to control plant-feeding arthropods. Quality control of biological control agents is a critical issue especially with the mass-production worldwide by many companies. This is why the book, *Quality Control and Production of Biological Control Agents Theory and Testing Procedures* could not be available at a more appropriate time. This book covers in detail the many facets associated with quality control of natural enemies. Some of the key topics covered in the book include: need for quality control of mass-produced biological control agents (Chapter 1), the parasitoids' need for sweets (Chapter 5), comparison of artificially vs. naturally reared natural enemies and their potential for use in biological control (Chapter 9), pathogens of mass-produced natural enemies and pollinators (Chapter 10), commercial availability of biological control agents (Chapter 11), mass production, storage, shipment, and release of natural enemies (Chapter 12), and guidelines for quality control of commercially produced natural enemies (Chapter 19).

The chapters discuss the specific subject matter interwoven with pertinent references to specific scientific publications. Each chapter contains numerous references that allow the reader to obtain further information if interested. In fact, I obtained copies of a number of the references that I perceived as relevant for future reading. The format of the writing, which includes appropriate sub-headings, makes it easy for the reader to comprehend the applicable information without feeling overwhelmed by the specific, detailed information or listing of references.

This book is extremely well written and edited, with only minor flaws. It is a "must" purchase for practitioners, educators, and researchers that are involved in biological control, whether it be implementing programs or conducting applied or basic research with biological control agents.

Raymond A. Cloyd
University of Illinois
384 National Soybean Research Laboratory
1101 West Peabody Drive
Urbana, IL 61801 U.S.A.
E-mail: rcloyd@uiuc.edu

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BOOK REVIEW

THE GENUS *ADELPHA:* ITS SYSTEMATICS, BIOLOGY AND BIOGEOGRAPHY (LEPIDOPTERA: NYMPHALIDAE: LIMENITIDINI). K. R. Willmott. 2003. Scientific Publishers, P.O. Box 15718, Gainesville, Florida, USA, ppbk, $65 US.

To revise a large nymphalid butterfly genus like *Adelpha* is a Herculean task. Tens of thousands of specimens belonging to hundreds of named taxa are scattered in museum collections all over the world. Reviewing the literature on nomenclature, taxonomy, immatures, morphology, and distribution is an immense undertaking. I would not have considered it a feasible dissertation project, but then Willmott would have proved me wrong. I cannot adequately express my awe at his accomplishment; this book is a lifetime's work completed in a few years.

Some historical perspective may be helpful. *Adelpha* is one of those conspicuous, species-rich, overwhelmingly Neotropical nymphalid genera that are frequently encountered and easily recognized in the field. However, specific identification and relationships were traditionally based on wing pattern characters that were often difficult to interpret. Aiello (1984) noticed that the larval and pupal characters were at odds with adult classification and found an unpublished manuscript in which W.T.M. Forbes remarked that *Adelpha* wing pattern characters were incongruent with those of the genitalia. Aiello suggested that the wing pattern characters were "deceptive," divided the genus preliminarily into species groups using characters of the immatures from a limited number of species, and presented data suggesting that *Adelpha* might not be monophyletic.

Willmott tackled these issues broadly, and the result is a multi-layered monograph. At one level, it is a beautifully illustrated alpha taxonomy of the 209 taxa (85 species) that Willmott recognizes. Those barely acquainted with *Adelpha* will use the 450+ superb color illustrations of adults to identify specimens. At a second level, there are illustrated keys in the appendices to guide the reader through identification of those species with exceedingly similar wing patterns. At a third level, the monograph is a mammoth reference that draws together information from the literature, from collection specimens, and from Willmott's extensive field work. At a fourth level, Willmott has summarized and digested data on distribution and habitat. If I may oversimplify, species richness is maximal at the eastern base of the Andes and latititudinal richness depends upon whether any of the major biogeographical zones proposed years ago by Keith Brown meet at that latitude. At a final level, Willmott discusses phylogenetic issues and the evolution of larval food plants and convergent wing patterns, but to gain a more complete and up-to-date picture, the serious reader needs Willmott's later-completed, but earlier-published, article (Willmott 2003).

The taxonomic framework for *Adelpha* is likely complete, although parts will be polished as new information becomes available. In 100 years, the information in this book—however transformed—will still be used to identify *Adelpha*. Quite an accomplishment! It is perhaps fair to ask about the impact of this monograph, given that it is one of the finest of this genre to be published. Will those with visions of web-accessed biodiversity databases find the resources to transfer and maintain the reference information and identification schemes from the book to the web? Will those who do research on diversity and "mimicry" find and use the wealth of data in the monograph? Will the taxonomic framework for *Adelpha* spur researchers other than Willmott to use *Adelpha* as research animals? If there is justice in this world, the answers in a decade will be resoundingly positive.

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Robert K. Robbins, Department of Entomology, Smithsonian Institution
P. O. Box 37012, NHB Stop 127, Washington, DC 20013-7012 U.S.A.
E-mail: Robbins.Robert@nmnh.si.edu

Mailed on August 25, 2004

SOCIETY MEETING OF MARCH 23, 2003[1]

The Ecology of Aquatic Beetles

Dr. G. Winfield Fairchild
Department of Biology, West Chester University, West Chester, Pennsylvania, U.S.A.

Dr. G. Winfield Fairchild presented a wide-ranging and stimulating talk on two topics concerning aquatic beetles: the diversity and ecology of beetles inhabiting ponds, and the feeding ecology of Haliplidae (this latter work directed by his student Ann Faulds). The summary here covers his investigation of the composition and dispersal of the beetle communities inhabiting temporary and permanent ponds in Blackbird State Forest in Delaware. The state forest has a range of water bodies in close proximity, including closed-canopy vernal pools, open-canopy pools and permanent sites. The study carried out benthic sampling of the ponds to note habitat selection by the beetles, and also UV (black) light sampling to ascertain seasonal dispersal. In the smallest of the temporary ponds, species of beetles were the top predators, while in the largest, permanent ponds, species of fish served that role.

Dr. Fairchild found a diverse community of 74 species of beetles, with Dytiscidae and Hydrophilidae predominant, but including species of Noteridae, Haliplidae and Gyrinidae. Twenty-five species were collected only at the UV lights, and 16 species were only found in the benthic samples. Hydrophilidae dominated the light trap samples relative to their abundance in the ponds, indicating species of this family are especially likely to disperse.

In other entomological notes, this was the first meeting with Dr. Susan Whitney King serving as President of the Society. Howard Boyd noted the first emergence of adult bees of *Colletes thoracicus* on March 18, 2003, at an aggregation nest area near his home in Tabernacle, New Jersey. He noted this is exactly one month later than the first emergence in 2002, indicating the severity of this past winter and early spring.

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

[1] The report for the AES Society Meeting that took place in of February 26, 2003, was published in Entomological News 113(5), p. 356 of "2002," mailed on April 9, 2003.

SOCIETY MEETING OF OCTOBER 22, 2003

Genetics of parthenogenesis in two *Centroptilum* mayflies: Is facultative parthenogenesis in mayflies a backup reproductive strategy?

David H. Funk
Stroud Water Research Center, 970 Spencer Road, Avondale, Pennsylvania, U.S.A.

Parthenogenesis and its genetic consequences in two species of baetid mayflies (Ephemeroptera: Baetidae) was discussed in a talk by David Funk, of the Stroud Water Research Center. *Centroptilum triangulifer* (McDunnough), an obligately parthenogenetic mayfly, was shown to be clonal, as evidenced by no change in multilocus genotypes for 25 allozyme loci over 27 generations in the laboratory. This also suggests the mechanism of parthenogenesis is apomictic or a functionally equivalent form of automixis, with high (20 percent) observed heterozygosity. Phylogenetic analysis of 52 clones indicates a polyphyletic origin for this species that was preceded by a transition to clonality.

Centroptilum alamance (Traver) is facultatively parthenogenetic, and is the sister species (most closest relative) of *C. triangulifer*. *C. alamance* is primarily sexual, as indicated by a 1:1 sex ratio with no significant departures from Hardy-Weinberg equilibrium and little or no linkage disequilibrium. Parthenogenetic development took significantly longer than for fertilized eggs. Allozyme data show a heterozygosity loss of approximately 20% per generation, indicating parthenogenesis in this species is automictic, with crossing over.

Although obligate parthenogenesis appears to be rare in mayflies, a survey of parthenogenetic egg hatching rates in normally sexual mayflies indicates faculatative parthenogenesis is common and widespread, averaging about 20 percent. Mr. Funk hypothesized that: (i) a high incidence of facultative parthenogenesis, which appears to occur after the normal period of fertilization, may give normally sexual females a "second chance" at offspring should their eggs fail to be fertilized; and (ii) parthenogenetic progeny can subsequently reenter the sexual pool.

In other entomological news at the meeting, Dr. Hal White noted his capture of a Zebra Longwing butterfly *(Heliconius charitonius)* in White Clay Creek State Park, Newcastle County, Delaware on June 29, 2003. Because adults of this species are poor fliers, and not known much further north than South Carolina, Dr. White supposed this adult came from a possible release of butterflies at a local wedding or some other function. This specimen is now in the University of Delaware insect collection. About 30 members and visitors were present at the meeting.

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

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SOCIETY MEETING OF NOVEMBER 19, 2003

Two Entomological Perspectives of New Zealand

Joe Sheldon, Department of Biology, Messiah College, Grantham, Pennsylvania, U.S.A. and Greg Cowper, Philadelphia, Pennsylvania, U.S.A.

New Zealand's diverse and interesting insect fauna was the focus of the Society's November meeting at The Academy of Natural Sciences. Joe Sheldon began the evening presentation with an overview of the geological, climatological, and cultural features that have shaped New Zealand's unique and amazing biodiversity. The human impact on native species was examined beginning with the arrival of the Maori 900 to 1000 years ago and followed by the European colonization and attempted pastoralism of the country over the past 200 years. The late 20th century environmental awakening in both the Maori and European community has turned the eyes of New Zealand toward the preservation and restoration of its native ecological systems and species. Sheldon provided an overview of the current threats to biodiversity and then turned the remaining evening program to Greg Cowper.

Greg Cowper presented *"Weta Conservation in New Zealand: A Successful Translocation of the Mahoenui Giant Weta."* He and his son traveled to New Zealand in February and March 2003 to assist the Department of Conservation in monitoring the results of a weta translocation experiment. The endangered Mahoenui Giant Weta *Deinacrida mahoenui* (Gibbs, 1999) (Orthoptera: Anostostomatidae), occurs only on a 240 hectare reserve in the North Island's Southern King Country. Here the giant weta have colonized remnant farmland reverting to gorse, *Ulex europeans,* a dense, thorny, introduced bush. In 2000/2001 approximately 170 weta were relocated to private land, and by 2002, nymphs had been observed. Volunteers of the 2003 "Weta Weekend" collected, measured, sexed & released 22 sub-adult Mahoenui Giant Weta demonstrating these orthopterans had been bred on site and underscoring the first successful translocation of these animals.

The attendees of the meeting were treated to displays of specimens of weta from the Academy of Natural Sciences's Entomology Collection. Dr. Sigitas Podenas, visiting from Lithuania, and on staff at the University of Vilnius and Amberworld, set up a display of specimens in Baltic Amber of the newly described order of insects Mantophasmatodea. Nearly 45 members and visitors were present at the meeting.

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

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REUSE OF OLD *TRYPOXYLON POLITUM* NEST BY *CHALYBION CALIFORNICUM* (HYMENOPTERA: SPHECIDAE) IN NEW YORK, U.S.A.[1]

Frank E. Kurczewski[2]

ABSTRACT: The re-use of an old *Trypoxylon politum* mud pipe organ nest by a female *Chalybion californicum* is described and illustrated. The female *C. californicum* cleaned, renovated, and stocked with paralyzed spiders 19 of the abandoned 25 *T. politum* cells. Some *C. californicum* behavioral components are delineated.

KEY WORDS: Re-use of nests, *Trypoxylon, Chalybion,* Hymenoptera, Sphecidae.

Species of *Chalybion* build mud nests in preexisting cavities and crevices and renovate the abandoned mud nests of other species of wasps (Bohart and Menke 1976). Females carry water to a nearby earthen source and mold mud to partition and seal these nests (Rau 1928, Ward 1971). Species of *Chalybion* renovate and stock with paralyzed spiders the abandoned mud nests of *Sceliphron* and *Trypoxylon* (Bohart and Menke 1976). Old nests of the yellow and black mud dauber, *Sceliphron caementarium* (Drury), are sometimes reused for nesting by the blue mud dauber, *Chalybion californicum* (Saussure) (Rau 1928). The re-use of an abandoned mud pipe organ nest of *Trypoxylon politum* Say by a female *C. californicum* is unusual, has not been previously documented, and is detailed below.

RESULTS

An old *T. politum* nest located on the outskirts of Syracuse (Onondaga County, New York, U.S.A.) had seven pipes affixed near the top of a vertical cedar siding board underneath a 70 cm-wide roof overhang (Fig. 1). The seven pipes were built consecutively from left to right by one female in July 1999. The three shortest pipes on the right side of the nest were the last three built by the aging wasp. The individual pipes were 11-13 mm wide and 89-124 mm long. Twenty-five exit holes of wasps that emerged the following year [2000] were spaced 16-20 mm apart along the seven pipes. The number of holes per pipe [3-4] varied with pipe length. Thirteen of the holes were 6 mm in diameter and probably resulted from female emergence. Twelve of the holes were either 4 or 5 mm wide and may have been made by emerging males, assuming they were smaller than the females.

The female *C. californicum* was first observed on the old *T. politum* nest on July 12, 2002. Through July 26 she renovated, provisioned, and closed 13 cells

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[2] Environmental and Forest Biology, State University College of Environmental Science and Forestry, Syracuse, New York 13210-2778. Mailing Address: P. O. Box 15251, Syracuse, New York 13215 U.S.A.

Figure 1. Old nest of *Trypoxylon politum* about midway through nesting sequence of *Chalybion californicum*. Female *C. californicum* is resting head downward near top of second pipe from left. Three pipes to right have been provisioned and sealed with mud.

during mainly sunny, unusually warm [air temperature in shade, 24.4-36.7°C] dry weather. Her earliest and latest hours working at the nest were 0946 and 1945 (EDT), respectively. She was seen bringing prey to the nest as early as 1006 h (EDT) at an air temperature [shade] of 26.7°C. She did not work at the nest on one rainy day or on a cool [16.7-22.8°C] but dry day. She worked intermittently at the nest from July 26 to August 5 between sporadic periods of rainfall renovating, stocking with prey, and closing with mud six additional cells/emergence holes.

Her daily routine consisted of (1) searching for and finding an unoccupied *T. politum* emergence hole/cell, (2) working in the emergence hole and cell removing old cell contents, (3) walking around the emergence hole and on the nest surface before taking flight, (4) returning in flight with a small paralyzed spider, (5) placing the spider in the cell, repositioning it with the mandibles and, later, tightly packing in other spiders using the front of the head, (6) ovipositing on one spider outside the cell and then placing it inside, (7) cleaning the antennae and mandibles with the forelegs before taking flight, and (8) bringing mud pellets from the other side of the nest, after depositing water on the old mud, and plastering the hole shut.

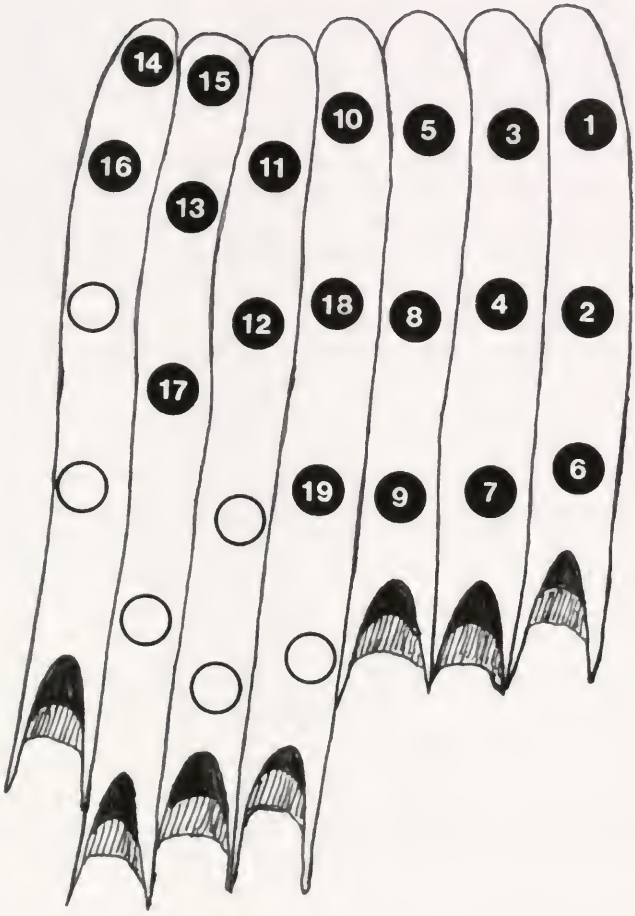

Figure 2. Diagram of old nest of *Trypoxylon politum* showing chronological order in which 19 of 25 cells were provisioned (stocked with prey) and closed by female *C. californicum*. Open circles designate cells that were not provisioned.

The female *C. californicum* spent 58-132 minutes [mean = 84.3 ± 32.97 standard deviations of the mean, n = 8] searching for and renovating an unoccupied *T. politum* cell prior to introducing prey. The wasp utilized 2-24 [mean = 13.6 ± 7.62, n = 12], 3-23 [mean = 12.3 ± 7.11, n = 8], 4-36 [mean = 17.4 ± 9.84, n = 11], 3-35 [mean = 10.6 ± 9.60, n = 12] and 3-47 minutes [mean = 20.8 ± 12.26, n = 12] between consecutive returns with prey for cells 15-19, respectively. She used 3-41 minutes [mean = 21.4 ± 11.23, n=14] between returns to the nest without prey. She spent from 10 seconds to 1-2 minutes walking around the emer-

gence hole and on the nest exterior after placing a spider in the cell and before taking flight. She expended 36-68 minutes [mean = 55.0 ± 14.41, n = 9] to plaster shut an old *T. politum* emergence hole. She used 11-41 minutes [mean = 21.9 ± 13.33, n = 5] to temporarily plug an emergence hole in order to finish the cell the next morning.

The wasp stocked with spiders and plastered over the three pipes to the right beginning always with the uppermost holes/cells, as numbered in order of completion (Fig. 2), before moving to the other pipes. She then worked on the upper holes/cells of the remaining four pipes moving mainly from right to left. The cells that were renovated, provisioned, and closed first were usually most protected by the roof overhang.

Re-stinging a spider was observed several times on the nest exterior. Once, re-stinging preceded oviposition. Oviposition was seen five times on the nest exterior beside an old emergence hole. Prior to ovipositing on the spider, the wasp bent her abdomen in the shape of a letter C and rocked it slowly forward and backward. Keeping the abdomen bent, she placed the tip against the convex surface of the base of the spider's abdomen and affixed a whitish, sausage-shaped egg. She deposited eggs on the 2nd, 3rd, 4th, 5th, and 6th prey brought for cells that, when completed, contained 12, 12, 8, 12, and 11 spiders, respectively.

Six fully provisioned cells (nos. 14-19) held 8-12 (mean = 11.0 ± 1.73) spiders. Most of the spiders brought to the nest were about the size of the wasp's thorax, some smaller, and a few larger. Once, the female flew in with a relatively large immature *Neoscona arabesca* (Walckenaer) weighing 38 mg. This prey was too large to fit into the opening, was carried away by the wasp, and released on the ground. One small *Theridion frondeum* Hentz was accidentally dropped outside as the wasp was attempting to place it in a cell. The spider discharged silk from its spinnerets as it fell downward. The female flew rapidly downward, caught the spider in midair, flew back to the opening, landed, and placed it in the cell.

A sample of prey spiders recovered from four cells consisted of male and female Theridiidae [*Steatoda borealis* (Hentz), 8; *Theridion tepidariorum* (C. L. Koch), 8; *T. frondeum,* 23] and immature Araneidae [*Neoscona arabesca,* 3; *Araneus diadematus* Clerck, 1].

DISCUSSION

Prior studies link *C. californicum* with reusing old nests of the yellow and black mud dauber, *Sceliphron caementarium* (Rau 1928). *Chalybion californicum* has not been noted reusing old mud nests of the pipe organ wasp, *Trypoxylon politum.* However, other *Chalybion* species are known to reuse abandoned nests of other *Trypoxylon* species (Bohart and Menke 1976).

There is disagreement as to where and when the egg of *C. californicum* is laid (Bohart and Menke 1976). Yamamoto (1942) observed that the egg of *C. japonicum* (Gribodo) was affixed to the spider's abdomen before the prey was placed

in the cell, as I noted for *C. californicum*. Rau (1928) may have unknowingly witnessed oviposition on a prey of *C. californicum* outside the cell, but he reported the behavior as stinging. He described a wasp curling its abdomen underneath that of the first spider brought to the nest and inserting the sting for 15 seconds. All of the stings I observed administered to *C. californicum* prey were in the underside of the prey's cephalothorax, not in the abdomen.

Rau (1928), as reported by Bohart and Menke (1976), believed that the egg of *C. californicum* is laid on the last spider brought to the cell. Muma and Jeffers (1945) noted that the egg of this species is placed on the first prey for the cell, but they indicated that this might not always be the case. I found that the egg of *C. californicum* was laid on a spider early in the provisioning sequence, usually before half the spiders were introduced to the cell. Yamamoto (1958) found similarly in *C. japonicum* that the egg was usually laid on a spider before half the prey had been placed in the cell.

In previous studies on *C. californicum* the predominant prey family was Theridiidae (Rau 1935; Irving and Hinman 1945; Muma and Jeffers 1945), as I found in my study. Common use of the black widow spider, *Latrodectus mactans* (Fabricius), a theridiid, was noted in these reports.

ACKNOWLEDGMENTS

Bonnie Brierton identified the species of prey Theridiidae. Tsutomu Nakatsugawa translated Yamamoto's (1958) paper from Japanese to English.

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PRELIMINARY INVENTORY OF THE PLANTHOPPERS (HEMIPTERA: FULGOROIDEA) OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK, NORTH CAROLINA AND TENNESSEE, U.S.A.[1]

Charles R. Bartlett[2] and Jacob L. Bowman[3]

ABSTRACT: The Fulgoroidea of the Great Smoky Mountains National Park was investigated in July 2002 as part of an ongoing all-taxa biotic inventory. Sweep samples were taken by three investigators from 28 localities throughout the Park with all specimens of the target taxon retained. This preliminary inventory obtained 1,290 specimens, representing 8 families, 23 genera and 37 species. Species accumulation curves and nine estimators of species richness were explored, all of which predicted a species richness of approximately 50 species (range of estimates 44-58 species). This approximation probably underestimates the true species richness of planthoppers because of seasonal, spatial and methodological limitations of this initial estimate.

KEY WORDS: Auchenorrhyncha, Fulgoromorpha, All Taxa Biodiversity Inventory (ATBI), species richness estimation.

In late 1997, an all-taxon biodiversity inventory (ATBI) was initiated in the Great Smoky Mountain National Park (GSMNP) (Sharkey 2001). This study represents the first effort to inventory the Fulgoroidea (planthoppers) of the GSMNP. Brimley (1938) and Wray (1967) provide a list of insect species for North Carolina, but there does not appear to be a similar publication for Tennessee. Published species records for the Park appear to be limited to two species: *Haplaxius pictifrons* (Cixiidae) and *Bruchomorpha minima* (Issidae) (Wray 1967, see Holzinger et al. 2002 for recent generic nomenclature for cixiids). Unpublished Park records include 5 species: *Acanalonia bivittata* (Acanaloniidae), *Bruchomorpha oculata* (Issidae), *Anormenis chloris* (as septemtrionalis, Flatidae), *Scolops perdix* (Dictyopharidae), and *Liburniella ornata* (Delphacidae). The objectives of the study were to produce a preliminary inventory of the fulgoroid species and to estimate richness through a species accumulation curve and a series of sample-based richness estimators.

METHODS

Three investigators conducted sweep samples at 28 widely dispersed locations (Figure 1) in the GSMNP during July 8-12, 2002. The samples were generally taken in readily accessible portions of the Park, and were loosely stratified by elevation and general region of the Park. The length of time spent at individual sample locations was not uniform, but it was recorded as a measure of sampling

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[2] Department of Entomology and Wildlife Ecology, 250 Townsend Hall, University of Delaware, Newark, Delaware 19717-1303 U.S.A. E-mail: 02542@udel.edu. Corresponding author.

[3] Department of Entomology and Wildlife Ecology, University of Delaware, 250 Townsend Hall, Newark, Delaware 19717-1303 U.S.A. E-mail: jbowman@udel.edu.

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"effort." All specimens of target taxa were aspirated and retained from the samples in the field. Specimens were layered and stored dry in a freezer until they could be processed.

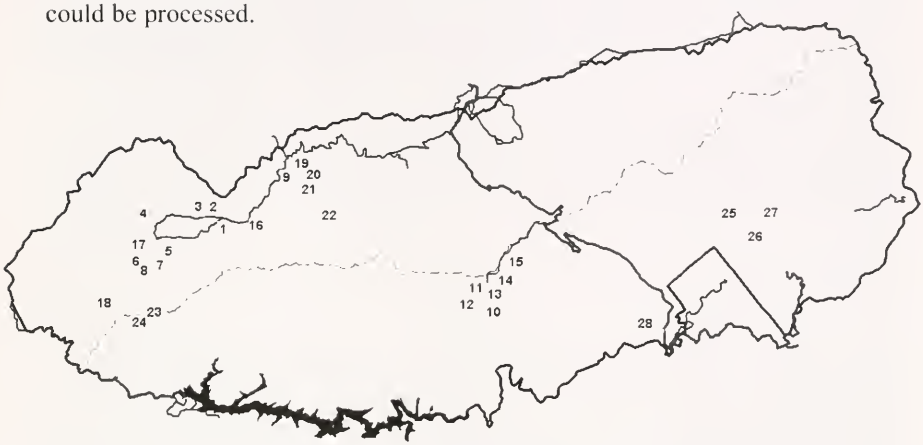

Figure 1. Map of Great Smoky Mountains National Park with sample locations: 1) Cades Cove House in Cades Cove campground; 2) Cades Cove loop road, north side, woods; 3) Cades Cove loop road, north side, field; 4) Cades Cove loop road, Cooper Road and Wet Bottom Trail; 5) Cades Cove, Forge Creek Road, north end roadside, wet meadow; 6) Cades Cove, Forge Creek Road, roadside, woods; 7) Cades Cove, Forge Creek Road, Henry Whitehead cabin, lawn and adjacent herbs; 8) Cades Cove, Forge Creek Road, wet meadow; 9) Laurel Creek Road, at underpass, roadside; 10) Andrew's Bald, North Side; 11) Andrew's Bald, South Side; 12) Forney Ridge Trail, south of Andrew's Bald; 13) Forney Ridge Trail, north of Andrew's Bald; 14) Clingman's Dome Road pullout, near Noland's Divide Trail, roadside; 15) Clingman's Dome Road pullout past Noland's Divide Trail, roadside; 16) Laurel Creek Road, Crib Gap Trail; 17) Forge Creek Road, Wet Meadow; 18) Parson Branch Road, woods, roadside; 19) Laurel Creek Road near jct. Rt 73; 20) Road to GSM institute at Tremont at bridge over Middle Prong, Little River, roadside; 21) GSM Institute at Tremont, fields; 22) Middle Prong Trailhead, woods understory; 23) Gregory Ridge Trail ca. 2 mi from Gregory Bald, woods; 24) Gregory Bald; 25) Hyatt Ridge Trail ca. 1.5 mi from Straight Fork Road, woods understory; 26) Straight Fork Road at Hyatt Ridge Trail trailhead, woods understory at roadside; 27) Horse Camp on Straight Fork Road, grass and woods understory; 28) Mingo's creek trail, trailside

All adult fulgoroids were identified and counted to produce a species-by-sample abundance matrix. A species accumulation curve (e.g. Colwell and Coddington 1994, Hayek and Buzas 1996) and estimates of species richness were created using the EstimateS (v6.0b1) software program using 50 randomizations (Colwell 1997). A series of estimators of species richness are presented because there has yet to be a clear indication of which estimator is statistically and empirically superior. The reported species richness estimates (and standard deviations as appropriate) are as follows: Abundance-based Coverage Estimator (ACE) (Chao et al. 1993, Chazdon et al. 1998), Incidence-based Coverage Estimator (ICE) (Lee and Chao 1994, Chazdon et al. 1998), Chao 1 richness estimator (Chao 1) (Chao 1984, 1987), Chao 2 richness estimator (Chao 2) (Chao 1987), First and Second order Jackknife Richness estimators (Jack 1, Jack 2) (Burnham

Table 1. Species found at Great Smoky Mountains National Park. Numbers in **bold** indicate not previously recoded in state [North Carolina (NC) and Tennessee (TN)]; *Italics* indicate recorded from state, but not found in study.

Species	Total No. Specimens	No. Sites	Specimens by state NC	TN
Acanaloniidae				
Acanalonia bivittata	21	6	0	**21**
Achilidae				
Synecdoche grisea	1	1	1	*0*
Synecdoche impunctata	2	1	*0*	2
Cixiidae				
Haplaxius pictifrons	10	6	1	9
Melanoliarus chuliotus	14	3	2	**12**
Melanoliarus sp. (female)	1	1	*0*	**1**
Pintalia vibex	2	1	*0*	**2**
Delphacidae				
Delphacodes andromeda	20	5	14	**6**
Delphacodes bifurca	3	2	**2**	**1**
Delphacodes campestris	18	3	11	7
Delphacodes laminalis	13	6	3	**10**
Delphacodes lutulenta	3	2	2	**1**
Delphacodes nitens	25	4	0	**25**
Delphacodes perusta	1	1	0	**1**
Delphacodes puella	222	18	123	99
Delphacodes sagae	1	1	**1**	0
Isodelphax basivitta	85	15	60	25
Kelisia curvata	19	5	*0*	**19**
Liburniella ornata	379	25	232	147
Nothodelphax lineatipes	112	1	*0*	**112**
Pareuidella spatulata	5	2	*0*	**5**
Pissonotus aphidioides	1	1	**1**	0
Pissonotus brunneus	14	6	13	1
Pissonotus guttatus	1	1	*0*	1
Pissonotus marginatus	1	1	*0*	1
Ribautodelphax sp. (female)	127	2	**127**	0
Saccharosydne saccharivora	1	1	**1**	0
Stenocranus lautus	40	7	1	**39**
Stenocranus pallidus	4	2	0	**4**
Toya propinqua	4	2	3	**1**
Derbidae				
Anotia westwoodi	24	2	*0*	**24**
Cedusa obscura	93	5	*0*	**93**
Dictyopharidae				
Scolops perdix	2	1	*0*	**2**
Flatidae				
Anormenis chloris	1	1	*0*	1
Metcalfa pruinosa	4	4	1	3
Ormenoides venusta	9	1	*0*	9
Issidae				
Bruchomorpha oculata	7	4	*0*	**7**
Total Specimens	1290	—	599	691

and Overton 1978, 1979; Smith and van Bell 1984, Heltshe and Forrester 1983, Palmer 1991), Bootstrap richness estimator (Bootstrap) (Smith and van Belle 1984), and Michaelis-Menton richness estimators averaged over randomizations (MMRuns) and computed for mean species accumulation curve (MMMean) (Raaijmakers 1987).

All target specimens were mounted, labeled and placed in the University of Delaware Insect Reference Collection (UDCC) in Newark, DE, with a synoptic collection deposited in the Museum Collection of the Great Smoky Mountains National Park (GSNP) in Gatlinburg, TN. Collection acronyms follow Arnett and colleagues (1993).

RESULTS

A total of 1,290 planthopper specimens representing 8 families, 23 genera and 37 species were obtained (Tables 1 and 2). By comparison, there are 10 families, 56 genera and 162 species of planthoppers previously recorded from North Carolina (viz. Brimley 1938, Wray 1967, Wilson and McPherson 1980, Kramer 1981, 1983; Wilson 1982, Bartlett and Deitz 2000). There were 25 new state records (Table 1): 5 for NC and 20 for TN. Eight taxa had not been previously recorded from either state, 31 had not previously been reported from the Park.

The species accumulation curve (Figure 2) appears to have approximately reached its asymptote. The estimators of species richness generally predicted a richness of approximately 50 species, with a range between 44 (Bootstrap) to 58 (Jack2) species (Table 3, Figure 2).

Table 2. Comparison of numbers of taxa recorded from North Carolina and found in the present study. Sources: Brimley (1938), Wray (1967), Wilson and McPherson (1980), Kramer (1981, 1983), Wilson (1982), O'Brien (1985), and Bartlett and Deitz (2000).

	Taxa recorded from NC[a]		Taxa found in GSMNP	
Family	Genera	Species	Genera	Species
Delphacidae	20	61	11	23
Cixiidae	8	23	3	4
Derbidae	10	28	2	2
Dictyopharidae	3	11	1	1
Achilidae	3	14	1	2
Issidae	2	11	1	1
Flatidae	5	5	3	3
Acanaloniidae	1	4	1	1
Fulgoridae	3	4	0	0
Tropiduchidae	1	1	0	0
Total	56	162	23	37

Table 3. Estimates of planthopper species richness in GSMNP, with standard deviation as appropriate. See methods for acronyms and references.

Estimator	Result (± SD)
ACE	47.61 (± 1.99)
ICE	49.99 (± 0.02)
Chao1	49.57 (± 12.46)
Chao2	51.07 (± 9.90)
Jack1	51.50 (± 4.05)
Jack2	58.24 (± 3.59)
Bootstrap	44.08
MMRuns	51.58
MMMean	48.78

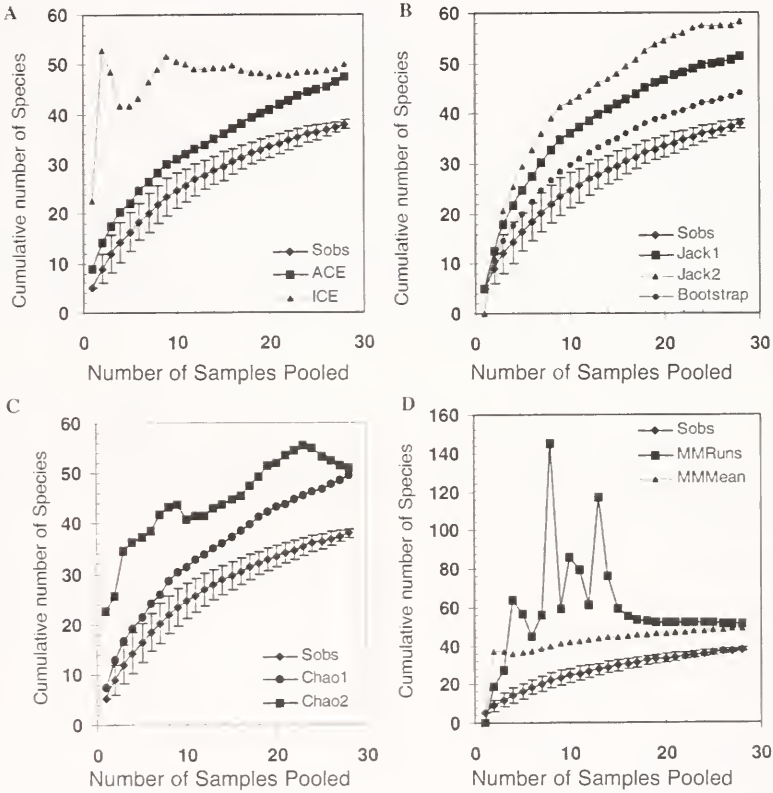

Figure 2. Species accumulation curves and estimated species richness based on 9 estimators. (A) Species observed (Sobs) with standard deviation and Abundance-based (ACE) and Incidence-based (ICE) Coverage Estimator of species richness, (B) Species observed, first and second order Jacknife Richness estimators (Jack1, Jack2), and Bootstrap richness estimator (Bootstrap), (C) Species observed, Chao 1 and Chao 2 richness estimators (Chao, Chao2), (D) Species observed, Michaelis-Menton richness estimators averaged over randomizations (MMRuns) and computed for mean species accumulation curve (MMMean).

Among the species collected, the most abundant 6 species *(Liburniella ornata, Delphacodes puella, Ribautodelphax* sp., *Nothodelphax lineatipes, Isodelphax basivitta* [all Delphacidae], and *Cedusa obscura* [Derbidae]), or 16% of the species collected, represented 79 percent of the individuals collected (Figure 3). Conversely, there were 9 species (29 percent) represented only by a single specimen. This result is similar to that obtained by Wilson and colleagues (1993) at the Paintbrush Prairie, Missouri, who found the top 8 common species (17 percent) representing 79 percent of the total specimens collected (n=1,676), and 10 species represented by a single specimen each.

Two of the 6 most abundant species were collected in very few locations; *Nothodelphax lineatipes* was collected only at Gregory Bald, and the *Ribautodelphax* species was collected only at two sites on Clingman's Dome Road. A patchy distribution of species was expected given that many species are thought to have limited host ranges (Wilson 1992, Wilson *et al.* 1994). The top two most abundant species, however, were also widely distributed in the Park, with *Liburniella ornata* found at 25 of 28 sample sites, and *Delphacodes puella* found at 18 sites (Table 1). The *Ribautodelphax* species represents an unusual record in part because this genus (as currently understood) has not before been reported in the eastern United States south of Michigan (*Ribautodelphax pusilla* Emeljanov, by Wilson 1992), but also because all 127 specimens collected were females, thus its specific identity could not be determined.

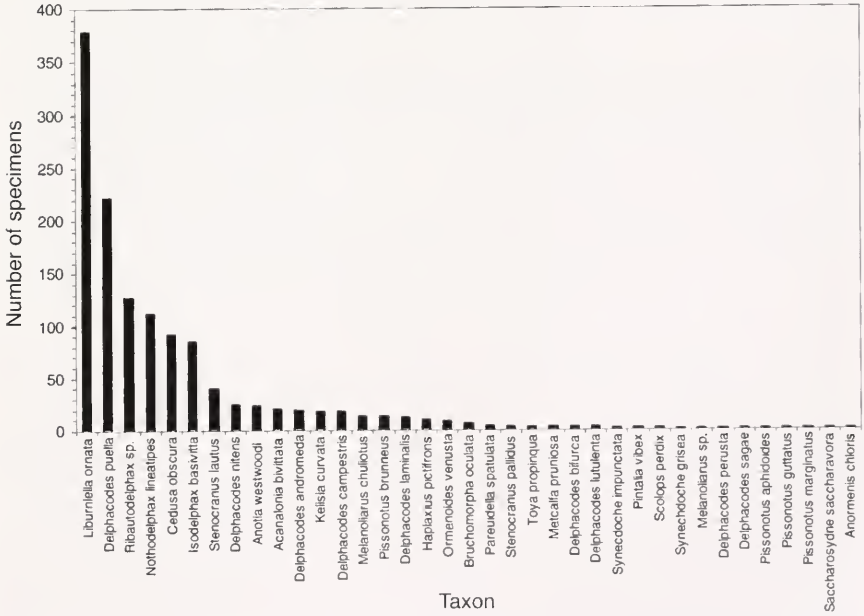

Figure 3. Frequency distribution for each planthopper species collected at the GSMNP. Number of individuals provided in Table 1.

DISCUSSION

The estimators of species richness indicate that the true species richness, based on the samples presented here, should be approximately 50. This estimate, however, is limited by the methods used (only sweeping), season, and geographic distribution of the samples. It was necessary, however, to use a single sampling method to meet the species richness estimator's assumption of sample homogeneity. Early July was chosen for this study because it is a period of time when planthopper richness and abundance is relatively high (e.g., Davis and Gray 1966, Wilson et al. 1993), although seasonality varies species by species. This study does appear to have been conducted early relative to the life history of some planthopper taxa, for example flatid nymphs were commonly observed, but adults were scarce and found only at low elevations. Also, the habitats sampled in this study may have disproportionately represented relatively open, grassy areas (roadsides, fields, and balds) because many fulgoroid species feed on herbaceous hosts, leaving woody plant feeders poorly represented in this study. Therefore, the estimate of species richness presented here is more carefully circumscribed as the number of species that can be collected at GSMNP in mid-July by sweeping in relatively accessible locations. It seems extremely likely that additional sampling methods (especially light collecting and vacuum sampling), and a broader spatial and temporal scale of collecting will ultimately produce more than 50 species for the Park.

Many of the species found in this study are taxa that are relatively widespread in occurrence. A few taxa were only collected at high elevations, and some of these represent unusual taxa or records. A *Ribautodelphax* species was collected at two locations on Clingman's Dome Road. The total collection represented 127 specimens, all female, and mostly (121 specimens) brachypterous. The reason for the unusual sex ratio requires further investigation (parthenogenesis is known from delphacids [de Vrijer 1986, den Bieman and de Vrijer 1987], but it is exceedingly unusual). Three *Ribautodelphax* species have been reported in the New World (*R. pusilla* Emeljanov, *R. albostriata* (Fieber), and *R. bidentatus* Anufriev), whose known New World distribution consists mostly of Canada and Alaska, but both also are distributed widely in the Palearctic (Wilson 1988, 1992, 1997; Maw et al. 2000). *Ribautodelphax bidentatus* was reported from Canada by Maw and colleagues (2000), however the correct combination for this species appears to be *Megadelphax binotatus* (Anufriev) (Vilbaste 1980).

There is a series of species where GSMNP represents the southernmost point within the known distribution. These species, in addition to *Ribautodelphax*, include *Delphacodes bifurca*, *D. sagae*, *D. nitens*, *D. perusta*, and *Stenocranus pallidus* (all Delphacidae). *Delphacodes bifurca*, for example, was described from Kansas (Beamer 1946), and later found in Missouri on tallgrass prairie (with *D. sagae*, Wilson et al. 1993). *Delphacodes bifurca* was collected at both Andrew's and Gregory Bald, but nowhere else. *Delphacodes bifurca*, *D. sagae* (found only on Clingman's Dome Road), *Ribautodelphax* and possibly *Nothodelphax lineatipes* (Gregory's Bald only, but reported from Raleigh, NC; Wray 1967), may be restricted to high elevation in the southern Appalachians.

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I would particularly like to thank my field assistants Jeremy Brodt and Mike Cacciapaglia, both students at the University of Delaware, and Keith Langdon, Jean Hilton, and Becky Nichols (National Park Service, Gatlinburg, TN). This study was conducted under the support of a Discover Life In America (DLIA) grant.

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TAXONOMIC AND ECOLOGICAL NOTES ON *LEUCOTRICHIA PICTIPES* (TRICHOPTERA: HYDROPTILIDAE), A MICROCADDISFLY NEWLY RECORDED FROM OHIO, U.S.A.[1]

J. B. Keiper[2] and R. J. Bartolotta[3]

ABSTRACT: The microcaddisfly *Leucotrichia pictipes* (Banks) (Trichoptera: Hydroptilidae) was collected for the first time in Ohio at the Chagrin River in Cuyahoga County, and the mature larva is described. We give details on the larval habitat in an attempt to describe the ecological requirements for this species in Ohio.

KEY WORDS: *Leucotrichia*, Trichoptera, Hydroptilidae, Ohio (U.S.A.), new state record.

The caddisfly genus *Leucotrichia* (Trichoptera: Hydroptilidae) is a new world taxon (Flint 1970) with three species in the United States (Wiggins 1996). *Leucotrichia pictipes* (Banks) has a northern distribution (Flint 1970) where it builds fixed retreats on riffle rocks in streams and grazes periphyton (McAuliffe 1982). Although widespread in North America, this species has not been reported from Ohio. Light trapping for adults has been conducted intensively near Ohio streams, particularly in the northeast (Huryn and Foote 1983), but no adults have been taken. Adults are not readily attracted to lights, and survey work for larval Trichoptera throughout the state by the senior author has not previously produced immatures of this species. *Leucotrichia pictipes* occurs in states adjacent to Ohio, such as Michigan, Pennsylvania, and Kentucky (Blickle 1979). We recently collected *L. pictipes* for the first time in Ohio, and investigated the ecological conditions of the larval habitat. During our investigation, we found that although brief larval descriptions and illustrations have been given in the excellent works of Ross (1944), Flint (1970), McAuliffe (1982), and Wiggins (1996), no detailed morphological description of the mature larva is available. To supplement the data provided by previous investigators, we give a description of the fifth instar to provide details similar to those given for other Ohio Hydroptilidae (e.g., Keiper 1999, 2002; Keiper and Foote 1999).

METHODS

On September 14, 2001, six fifth instars were collected from the upper surfaces of riffle rocks of the Chagrin River 0.5 km south (upstream) from the Fairmount Road bridge in Hunting Valley, Cuyahoga County, Ohio (41.4846°N, 81.3949°W). On 14 September 2002 six additional larvae and numerous fixed

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[2] Cleveland Museum of Natural History, 1 Wade Oval Drive, Cleveland, Ohio 44106. E-mail: jkeiper@cmnh.org.

[3] Cleveland Museum of Natural History, 1 Wade Oval Dr., Cleveland, Ohio 44106. E-mail: rbartolot @cmnh.org.

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retreats were taken. All larvae were placed in KAA solution (Wiggins 1996) and transferred to 70 percent ethanol after 24 hours. Specimens (n = 12) were examined with a Leica MZ-12.5 microscope, and measurements were taken with image analysis software; only undamaged specimens were used for length and width (n = 6). All specimens are currently housed in the Department of Invertebrate Zoology of the Cleveland Museum of Natural History.

Water chemistry and stream bed composition data were collected at the site 34 times since 1985, primarily in the months of June, July, September and October. Values are reported as mean ± 1 S.D. unless otherwise noted. These data have been generated in conjunction with stream water quality monitoring for the Ohio Department of Natural Resources (ODNR), Division of Natural Areas and Preserves, Scenic Rivers Program. This site is designated by ODNR as Chagrin River 21.0 (Ohio Department of Natural Resources 2001).

RESULTS AND DISCUSSION

Fifth Instar: Total length, $\overline{x} = 2.45 \pm 0.45$ mm.

Head capsule: width $\overline{x} = 0.27 \pm 0.05$ mm; dark brown, labrum blackish-brown, eyespot black with pale ring; long seta lacking near eye spot; mandibles asymmetrical, left broad and robustly cusped with one seta on posterolateral corner, pubescent setae on inner margin, darker posteriorly; right pointed apically, one seta on posterolateral corner, lacking setae on inner margin (Fig. 1).

Thorax: All notal sclerites brown with blackish periphery, dark margin thicker along posterior border; pronotal sclerite convex anteriorly, meso- and metanotal sclerites flat anteriorly; prosternal sclerites small, sub-circular, widely separated along posterior margin, positioned near posterior corner of trochantin; meso- and metathoracic sterna lacking sclerites; soft tissue of thoracic segments milky white with scattered green blotches (completely green in life); legs uniformly dark brown, foreleg $\overline{x} = 0.42 \pm 0.05$ mm, midleg $\overline{x} = 0.46 \pm 0.05$ mm, hindleg $\overline{x} = 0.45 \pm 0.03$ mm, leg ratio 0.91:1.00:0.98.

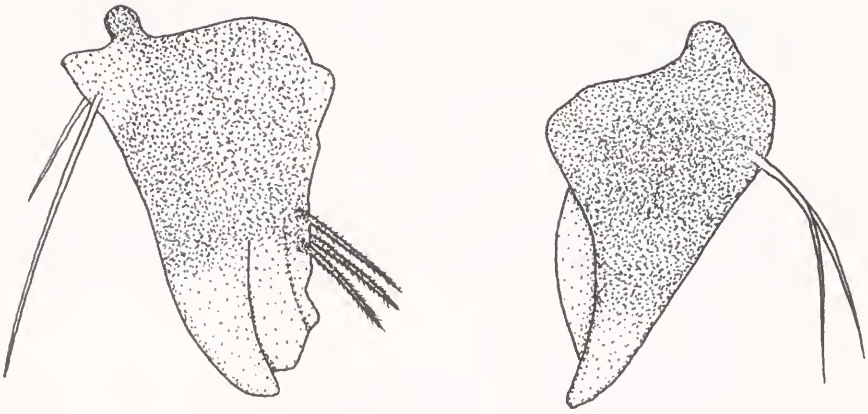

Fig. 1. Right and left mandibles of fifth instar *Leucotrichia pictipes*, ventral view.

Abdomen: Milky white, concolorous with thoracic soft tissue, completely green in life; widest at segments 5 and 6 ($\bar{x}$ = 0.59 ± 0.29 mm); first abdominal segment with posterodorsal sclerite 0.20-0.25x as long as metathoracic sclerite; segments 2-7 each with small sub-rectangular brown sclerite; segment 8 with rectangular sclerite approximately 0.25x length of metathoracic sclerite; segment 9 with rectangular dorsal brown sclerite; segment 10 with prolegs, each with sheath-like sclerite positioned laterad, prolegs with apical hook strongly curved to 900 angle; abdominal setal areas sa2 a small sclerotized dot with one seta, sa3 similar to sa2 but with 2 setae. Refer to figures given in Ross (1944, p. 120), McAuliffe (1982, p. 1559), and Wiggins (1996, p. 89) for further illustrations of larval and case morphology.

Average water depth was 39.8 (15.0) cm, pH was 7.2 (0.7), and water temperature was 21.5 (3.2) °C. Total suspended solids (TSS) were only measured four times (2000-2002) with a mean of 24.7 (5.5) mg/L. One TSS reading was 411 mg/L and treated as an outlier; this value was the result of heavy rains and subsequent siltation, and illustrates the variability of physical parameters that *L. pictipes* and other invertebrate taxa face in the Chagrin River. Bed composition of the riffle varied from 50-80 percent gravel and cobble with few boulders, with the remainder composed of sand and silt. Since 1985, the Cumulative Index Value has averaged 22.6 (5.8) which represents the low end of the excellent range (Ohio Department of Natural Resources 2001). Benthic macroinvertebrates co-occurring with *L. pictipes* often included water penny beetle larvae (Coleoptera: Psephenidae), riffle beetle adults (Elmidae), mayfly nymphs (Ephemeroptera), stonefly nymphs (Plecoptera: Perlidae), dobsonfly larvae (Megaloptera: Corydalidae), net-spinning caddisfly larvae (Trichoptera: Hydropsychidae), damselfly nymphs (Odonata: Coenagrionidae), crane fly larvae (Diptera: Tipulidae), midge larvae (Diptera: Chironomidae), crayfish (Decapoda), aquatic worms (Annelida), leeches (Hirudinea), clams (Bivalvia: Sphaeriidae), and pouch snails (Gastropoda: Physidae). Overall, the Chagrin River represents a clean water stream with a large proportion of gravel and cobble in the substrate that supports a diverse macroinvertebrate assemblage.

The cause for the narrow distribution of *L. pictipes* in Ohio remains unknown. The habitat parameters and macroinvertebrate assemblage of the Chagrin River, while in seemingly good condition for its proximity to a major metropolitan area (Cleveland), do not appear unusual. However, our information illustrates the benefits of repeated collections of immatures and adults even when an area has been well-studied. The fixed retreats of *L. pictipes* are firmly attached to rock substrates (McAuliffe 1982) making them difficult to obtain with standard sampling devices such as kick nets. The larvae were initially found in 2001 only after lifting a riffle rock from the water and examining the surface closely. However, studies of adult distribution and abundance have also failed to obtain this species. It is also possible that *L. pictipes* has only recently become established in Ohio and the Chagrin River.

The final instar of *L. pictipes* is easily distinguished from other co-occurring species of Hydroptilidae based on the enlarged abdomen. However, other characters are notably different from other microcaddisflies. The legs of *L. pictipes* are subequal, whereas other species for which the larvae are described exhibit a shortened foreleg compared to the middle and hind legs. The prosternal sclerites

of *L. pictipes* are quite small and widely separated, whereas other genera possess large sclerites that are approximated medially. Lastly, each dorsal abdominal sclerite is large, dark, conspicuous, and lacking central membranous areas.

The larval morphology is fairly unusual for Hydroptilidae and Trichoptera in general as is typical for the tribe Leucotrichiini, as the abdominal segments are greatly distended. Enlarged abdomens are also seen in *Zumatrichia* (Flint 1970, Wiggins 1996) and Wiggins' (1996, p. 75) key to hydroptilid genera gives characters that separate *Zumatrichia* and *Leucotrichia*. The mandibles of *L. pictipes* are asymmetrical, which is the norm for microcaddisflies (see Keiper and Foote 2000, Keiper 2002, and references therein). When compared to other species of Hydroptilidae, the mandibles exhibit similarity to species that specialize at piercing algal cells and draining their contents, such as *Hydroptila* (Nielsen 1948, Keiper and Foote 1999, 2000), *Oxyethira* (Nielsen 1948, Keiper and Walton 1999, Keiper 2002), and *Orthotrichia* (Nielsen 1948, Keiper 2002), or species that are more generalized trophically and scrape periphyton and pierce large algal cells, such as *Ochrotrichia* (Keiper and Foote 2000). In all those taxa, the right mandible is more pointed than the left, and indeed those species that pierce algal cells invariably maintain a grip on the algal cell with the strongly cusped or serrated left mandible while the acutely pointed right punctures the cell wall. The mandibles of *L. pictipes* are strongly cusped and seemingly appropriate for scraping algal substrates (McAuliffe 1982), but the outer cusp of the right mandible is pointed even though there is no evidence that this species attacks large algal cells. The setae on the inner edge of the left mandible are strongly textured with pubescence not seen on other microcaddisfly scrapers such as *Ochrotrichia*. The advantage to having the inner setae pubescent is unknown, but may aid the collection of scraped material (e.g. diatoms). This synthesis of mandibular morphology information among Hydroptilidae suggests that larvae were originally adapted to feed on algal filaments (such as the green alga *Cladophora*). *Leucotrichia* then radiated to the scraping guild, retaining some of the primitive morphological characters such as an acutely pointed right mandible that does not aid the scraping of periphyton. However, because the immatures of only a handful of the approximately 300 Nearctic species (Morse 1993) have been described, this hypothesis remains tentative.

ACKNOWLEDGEMENTS

We thank Marianne Stanczak and Biz Turnell for their help collecting specimens. M. Stanczak and Joseph T. Hannibal (CMNH) kindly reviewed a draft of this paper. Descriptions of larvae were facilitated with support from the National Science Foundation (award no. 0216039).

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BREVICORYNELLA (HEMIPTERA: APHIDIDAE), A NEWLY RECORDED GENUS FROM CHINA, WITH THE DESCRIPTION OF A NEW SPECIES AND A NEW RECORD[1]

Gexia Qiao[2], Liyun Jiang[3], and Guangxue Zhang[4]

ABSTRACT: The aphid genus, *Brevicorynella* Nevsky, is newly recorded from China. A new species, *Brevicorynella sexmaculata* Qiao, Jiang, and Zhang, and a new record for China, *B. quadrimaculata* Nevsky, are described. *Tamarix* sp. (Tamaricaceae) is the host plant genus for both species.

KEY WORDS: Insecta, Aphididae, Macrosiphinae, *Brevicorynella,* new species, new record, *Tamarix,* China.

Nevsky (1929) erected *Brevicorynella* in the Aphidinae for *Brevicorynella quadrimaculata* collected from *Tamarix* sp. (Tamaricaceae) in Kazakhstan and Tadzhikistan in Central Asia. By careful examination, those specimens from Xinjiang Autonomous Region, China, include two species, such as type species and a new species, *Brevicoryella sexmaculata.* The host plants of *Brevicorynella, Tamarix* spp., are important sand binders in northwestern China. Biological studies on these aphids will have important effects on preventing deserts and binding sands.

Brevicorynella Nevsky was originally described in the Aphidinae because the distance between stigmal pori on 2nd and 3rd abdominal segments is less than twice as long as the distance between stigmal pori on 1st and 2nd abdominal segments. Also, its antennae are similar to in *Brachyunguis* (Blackman and Eastop, 1994). However, Remaudière and Remaudière (1997) placed *Brevicorynella* in the Macrosiphinae. The correct placement of *Brevicorynella* is still in question. Here, we follow Remaudière and Remaudière (1997) and think genus *Brevicorynella* is in Macrosiphinae, based on lacking lateral abdominal tubercles. These have the same shape of siphunculi as *Brevicoryne* van der Goot (in the Macrosiphinae).

METHODS

The specimens were collected from inflorescences, leaves, and stems of *Tamarix* located in the Xinjiang Autonomous Region of the People's Republic of China (Baicheng County, 1280m; Jinghe County, 300m; Minfeng County,

[1] Received on December 24, 2002. Accepted on May 24, 2004.

[2] Institute of Zoology, Chinese Academy of Sciences, 25 Beisihuanxi Road, Haidian, Beijing 100080, P.R. China. E-mail: qiaogx@panda.ioz.ac.cn.

[3] Institute of Zoology, Chinese Academy of Sciences, Beijing 100080 P. R. China. E-mail: jiangliyun 2000@hotmail.com

[4] Institute of Zoology, Chinese Academy of Sciences, Beijing 100080 P. R. China. E-mail: zhanggx@panda.ioz.ac.cn

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1300m; Shihezi City, 450m) by Liyun Jiang. All specimens are deposited in the Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, Beijing, China. Nomenclature and descriptions follow Nevsky (1929). All measurements are given in millimeters (mm).

Brevicorynella Nevsky, 1929 NEW RECORD FOR CHINA

Brevicorynella Nevsky, 1929, Bull. Pl. Prot. Stn., Taskennt, 16:257.
Brevicorynella Nevsky: Blackman and Eastop, 1994:587; Remaudière and Remaudière, 1997:82.

Type Species. *Brevicorynella quadrimaculata* Nevsky, 1929, by original designation.

Diagnosis. Body elliptical, posterior of abdomen tapered. Frons convex; frontal tubercles indistinct. Eyes protuberant, lacking ocular tubercles. Antennae 6-segmented, shorter than body; antennal segment III with 1 or 2 small round secondary rhinaria medially; processus terminalis 1/4-1/3 base of the segment. Mesosternal furca with separated two arms. All first tarsal segments bearing 5 setae. Spiracular plates well-developed, long finger-shaped in thorax, or lower cone in abdomen; spiracles small rounded, posteriorly. Pronotum with 2 pairs of short cylindrical spinal tubercles and 1 pair of cone marginal tubercles. Abdomen without marginal tubercles, dorsum of abdomen with 4 to 6 large dorsal patches. Siphunculi short, slightly swollen, constricted at basally, and with apical flange; on 5th abdominal segment. Cauda tongue-shaped, slightly constricted at medially.

Host plants. *Tamarix* spp. (Tamaricaceae)

Distribution. In Central Asia (China, Kazakhstan and Tadzhikistan).

The genus is represented by two species: *Brevicorynella quadrimaculata* Nevsky and *Brevicorynella sexmaculata* Qiao and Zhang new species. This is the first record of *Brevicorynella* for China.

KEY TO SPECIES APTEROUS VIVIPAROUS FEMALE *BREVICORYNELLA* FROM CHINA

Vertex without distinct sculptures; dorsum of abdomen with 2 pairs of large spino-pleural patches; siphunculi distinctly shorter than cauda; cauda with 30-39 hairs ..... *Brevicorynella quadrimaculata* Nevsky

Vertex with distinct sculptures; dorsum of abdomen with 3 pairs of large spino-pleural patches; siphunculi about as long as or slightly longer than cauda; cauda with 48-59 hairs ..... *Brevicorynella sexmaculata* n. sp.

Brevicorynella quadrimaculata Nevsky, 1929 NEW DISTRIBUTION
(Figs. 1-7, 18-28)

Brevicorynella quadrimaculata Nevsky, 1929:257-259.
Brevicorynella quadrimaculata Nevsky: Blackman and Eastop, 1994:587; Remaudière and Remaudière, 1997:82.

Diagnosis: This species is close to *Brevicorynella sexmaculata* Qiao, Jiang, and Zhang, but differs from the latter (parenthesized) as follows: vertex without distinct sculptures (vertex with distinct sculptures); dorsum of abdomen with 2 pairs of large spino-pleural patches (dorsum of abdomen with 3 pairs of large spino-pleural patches); siphunculi distinctly shorter than cauda (siphunculi about as long as or slightly longer than cauda); cauda with 30-39 hairs (cauda with 48-59 hairs).

Description of apterous viviparous females. Body (Fig. 18) small, oval, dark green in life with 2 pairs of black patches on dorsum of abdomen (Fig. 19), and covered with a fine pruinose secretion, 1.200-1.300mm long, 0.725-0.825mm wide at thorax. In mounted specimens: dorsal of head, apex of rostrum, 1st antennal segment, distal of 3rd antennal segment, tip of 4th and 5th segments, distal half of basal of 6th segment, distal 1/3 of tibia and tarsi darkly brown; eyes, femora, cauda, anal plate, and genital plate brown; 2nd antennal segment, processus terminalis, and siphunculi pale brown; others pale.

Vertex arc-shaped, antennal tubercles weak (Figs. 1, 20). Dorsal hairs of body fine and pointed. Head with 2 pairs of cephalic hairs, 4 or 5 dorsal hairs between two antennae, and 2-3 pairs of dorsal hairs between eyes (Fig.1). Length of cephalic hairs 0.021-0.031 mm, 0.8x–1.2x as long as widest diameter of 3rd antennal segment. Antennae 6-segmented (Figs. 2, 21), shorter, 0.613-0.721 mm long, 0.49x-0.58x as long as body; 3rd-6th segments with weak imbrications. Proportion of 1st-6th segments: 52: 38: 100: 96: 95: 85+32; processus terminalis 0.36x-0.41x as long as basal part. Antennal hairs short and pointed, 1st-6th segments each with 4 or 5, 2 or 3, 2-5, 3 or 4, 2-7, 3+0 hairs, respectively; apex of processus terminalis with 3 hairs; length of hairs on 3rd antennal segment 0.018 mm, 0.69x as long as widest diameter of this segment. Middle of 3rd antennal segment with one small round secondary rhinarium. Rostrum reaching 2nd to 3rd abdominal segments; ultimate rostral segment wedge-shaped (Figs. 3, 22), 2x-2.22x as long as its basal diameter, 0.68x as long as 2nd segment of hind tarsi, with 2 accessory hairs. Thorax tergum membranous. Pronotum with 2-4 spinal, 1 pair of pleural and 1 pair of marginal hairs; with 2 pairs of short cylindrical spinal tubercles and 1 pair of cone marginal tubercles. Hind femur 0.330-0.361 mm long, 2.35x-2.65x as long as 3rd antennal segment. Hind tibia 0.515-0.577 mm long, 0.38x-0.41x as long as body. Hairs on legs short and pointed; length of hairs on hind tibia 0.036-0.046 mm, 1.18x-1.5x as long as middle diameter of the segment. First tarsal chaetotaxy: 5, 5, 5. Mesosternal furca with two arms separated. Abdomen tergum membranous, with 2 pairs of large brown spino-pleural patches on 2nd and 5th abdominal tergites (Fig. 4); dorsal hairs on abdominal tergites short and pointed; 1st abdominal tergite with 9-12 hairs; 8th tergite with 8 hairs, 6 or 7, occasionally. Length of marginal hairs on 1st tergite 0.021-0.031 mm, which of dorsal hairs on 8th tergite 0.026-0.042 mm, 0.8x-1.2xand 1x-1.6x as long as widest diameter of 3rd antennal segment, respectively. Spiracles (Figs. 23, 27) small, round and posteriorly directed, spiracular plates well-developed, long finger-shaped thoracially, or lower cone in abdomendly, brown. Siphunculi short, slightly swollen, constricted at base, with flange (Figs. 5, 28), with weakly imbrications; 0.093-0.124 mm in length, distal diameter 0.04 mm, length 2.25x-2.5x as long as its basal width, 0.75x-0.91x as long as cauda. Cauda tongue-shaped, slightly constricted medially (Figs. 6, 24), with weakly spinulose short imbrications, 0.113-0.134 mm long, 0.92x-1.08x as long as its basal diameter, with 30-39 hairs. Anal plate (Fig. 25) circular at apex with weakly spinulose short imbrications and 40-54 hairs. Genital plate (Figs. 7, 26) with 13-17 hairs, 2 anterior hairs among them.

Alate and oviparae: Not seen.

Examined Specimens. 7 apterous viviparous females, deposited in Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, P. R. China, data: CHINA, XINJIANG AUTONOMOUS REGION, JINGHE *Co.*: 82.9°E, 44.6°N, 300 m, 30 Aug. 2002, on *Tamarix chinensis,* by Liyun Jiang (No. 13742); 3 apterous viviparous females, deposited in Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, P.R.China, data: CHINA, XINJIANG AUTONOMOUS REGION, SHIHEZI *CITY.*: 86.0°E, 44.2°N, 300 m, 17 Aug. 2002, on *Tamarix chinensis,* by Liyun Jiang (No. 13659); 7 apterous viviparous females, deposited in Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, P. R.China, data: CHINA, XINJIANG AUTONOMOUS REGION, MINFENG *Co.*: 82.6°E, 37.0°N, 300 m, 27 Sep. 2002, on *Tamarix chinensis,* by Liyun Jiang (No. 14012).

Distribution. Central Asia: China: Xinjiang (Jinghe, Shihezi, Minfeng); Kazakhstan, Tadzhikistan.

Biology. The aphids cluster on floscules, leaves, and stems of *Tamarix chinensis* or *Tamarix* sp., and are attended by ants.

Brevicorynella sexmaculata Qiao and Zhang, NEW SPECIES
(Figs. 8-17, 29-39)

Diagnosis. The new species is near to *Brevicorynella quadrimaculata* Nevsky, but differs from it as follow: vertex with distinct sculptures (the latter: vertex without distinct sculptures); dorsum of abdomen with 3 pairs of large spino-pleural patches (the latter: dorsum of abdomen with 2 pairs of large spino-pleural patches); siphunculi about as long as or slightly longer than cauda (the latter: siphunculi distinctly shorter than cauda); cauda with 48-59 hairs (the latter: cauda with 30-39 hairs).

Description of apterous viviparous females. Body (Fig. 29) medium, oval, green in life with 3 pairs of black patches on dorsum of abdomen (Fig. 30), and covered with a fine pruinose secretion, 1.250-1.625mm long, 0.875-1.200mm wide. In mounted specimens: dorsal of head, apex of rostrum, distal of 3rd and 4th antennal segments, distal 1/3 of 5th segment, distal half of basal of 6th segment, processus terminalis, outer distal half of femora, basal and distal 1/3 of tibia, tarsi, cauda, and anal plate darkly brown; 1st antennal segment brown; 2nd antennal segment pale brown; others pale.

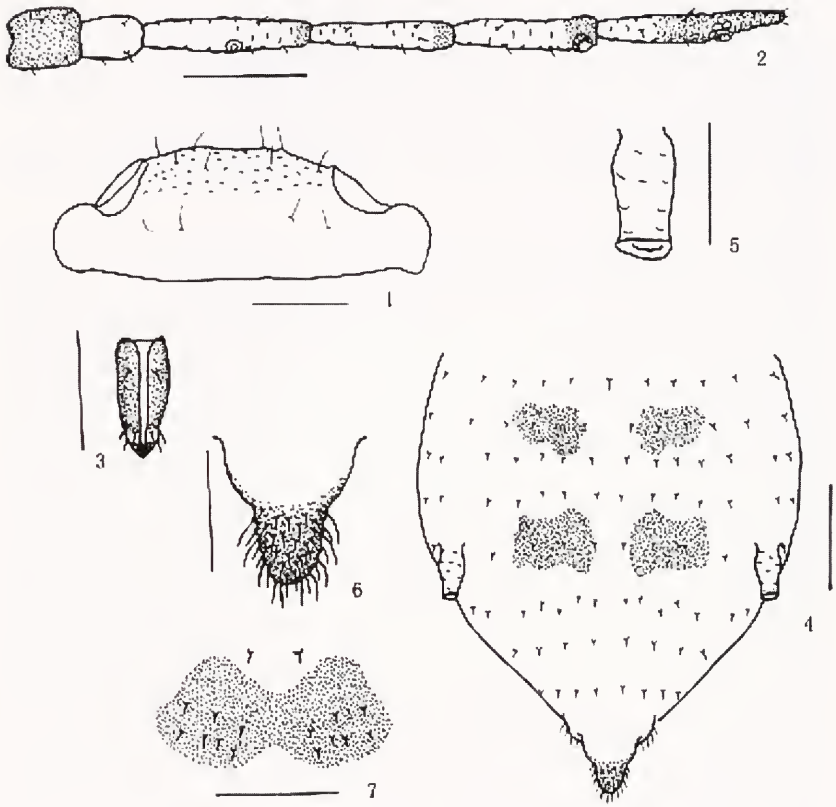
Vertex arc-shaped, antennal tubercles weak (Figs. 8, 31). Dorsal of head with distinct sculptures. Dorsal hairs of body fine, acute. Head with 2 pairs of cephalic hairs, 5-7 dorsal hairs between two antennae, and 2 pairs of dorsal hairs between eyes (Fig. 8). Length of cephalic hairs 0.031-0.036 mm, 1.17x–1.4x as long as widest diameter of 3rd antennal segment. Antennae 6-segmented (Figs. 9, 32), shorter, 0.793-0.892mm long, 0.53x-0.6x as long as body; 3rd-6th segments with weak imbrications. Proportion of 1st-6th segments: 33: 33: 100: 88: 88: 74+24; processus terminalis 0.29x-0.38x as long as basal part. Antennal hairs short, acute, 1st-6th segments each with 4 or 5, 3, 3-6, 3-6, 3 or 4, 2-4+0 hairs, respectively; apex of processus terminalis with 3 hairs; length of hairs on 3rd antennal segment 0.015-0.021 mm, 0.5x -0.8x as long as widest diameter of this segment. One small rounded secondary rhinarium on middle of 3rd antennal segment. Rostrum reaching 1st to 3rd abdominal segments; ultimate rostral segment wedge-shaped (Figs. 10, 33), 2x-2.22x as long as its basal diameter, 0.68x as long as 2nd segment of hind tarsi, with 2 accessory hairs. Thorax tergum membranous. Pronotum with 2 pairs of spinal, 1 pair of pleural and 1 pair of marginal hairs; with 2 pairs of short cylindrical spinal tubercles and 1 pair of cone marginal tubercles (Figs. 11, 31). Hind femur 0.391-0.422 mm long, 2.05x-2.17x as long as 3rd antennal segment. Hind tibia 0.639-0.721 mm long, 0.43x-0.49x as long as body. Hairs on legs short and pointed; length of hairs on hind tibia 0.046-0.052 mm, 1.32x-1.67x as long as middle diameter of the segment. First tarsal chaetotaxy: 5, 5, 5. Mesosternal furca with two arms separated. Abdomen tergum membranous, with 3 pairs of large brown spino-pleural patches on 2nd - 5th abdominal tergites (Figs. 14, 30); dorsal hairs on abdominal tergites short and pointed; 1st abdominal tergite with 7-11 hairs; 8th tergite with 6 hairs, or 7, occasionally. Length of marginal hairs on 1st tergite 0.31 mm, which of dorsal hairs on 8th tergite 0.031-0.052 mm, 1x-1.2x and 1x-2x as long as widest diameter of 3rd antennal segment, respectively. Spiracles small, round and posterior-ward, spiracular plates very developed, brown; long finger-shaped in thorax (Figs. 12, 34), or lower cone in abdomen (Figs. 13, 38). Siphunculi short, slightly swollen, constricted at base, with flange (Figs. 15, 39), with weakly imbrications; 0.144-0.165 mm in length, distal diameter 0.045 mm, length 2.33x-4x as long as its basal width, 0.93x-1.07x as long as cauda. Cauda tongue-shaped, non-constricted medially (Figs. 16, 35), with weakly spinulose short imbrications, 0.144-0.165 mm in length, 1.08x-1.33x as long as its basal diameter, with 48-59 hairs. Anal plate (Figs. 17, 36) circular at apex with weakly spinulose short imbrications and 51-68 hairs. Genital plate (Figs. 18, 37) with 18-21 hairs, 2 anterior hairs among them.

Alate and oviparae: Not seen.

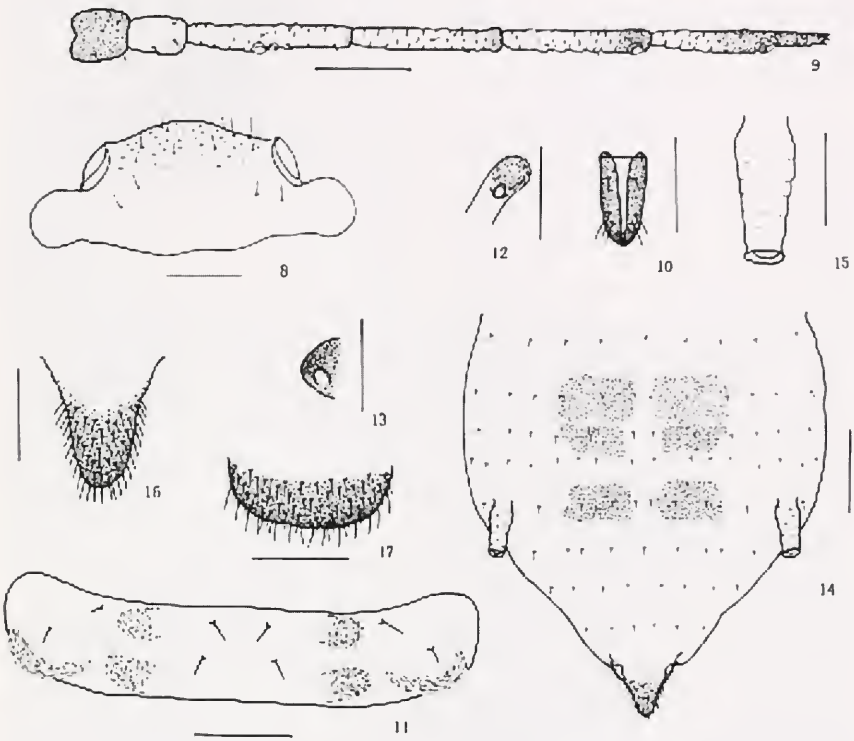
Types. Holotype, apterous viviparous female (Figs. 8-17), deposited in Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, P.R. China, data: CHINA, XINJIAG AUTONOMOUS REGION, BAICHENG *Co.*: 81.8°E, 41.8°N, 1280 m, 12 Sep. 2002, on *Tamarix*

chinensis, by Liyun Jiang (No.13864); paratypes: 19 apterous viviparous females, other data same as holotype.

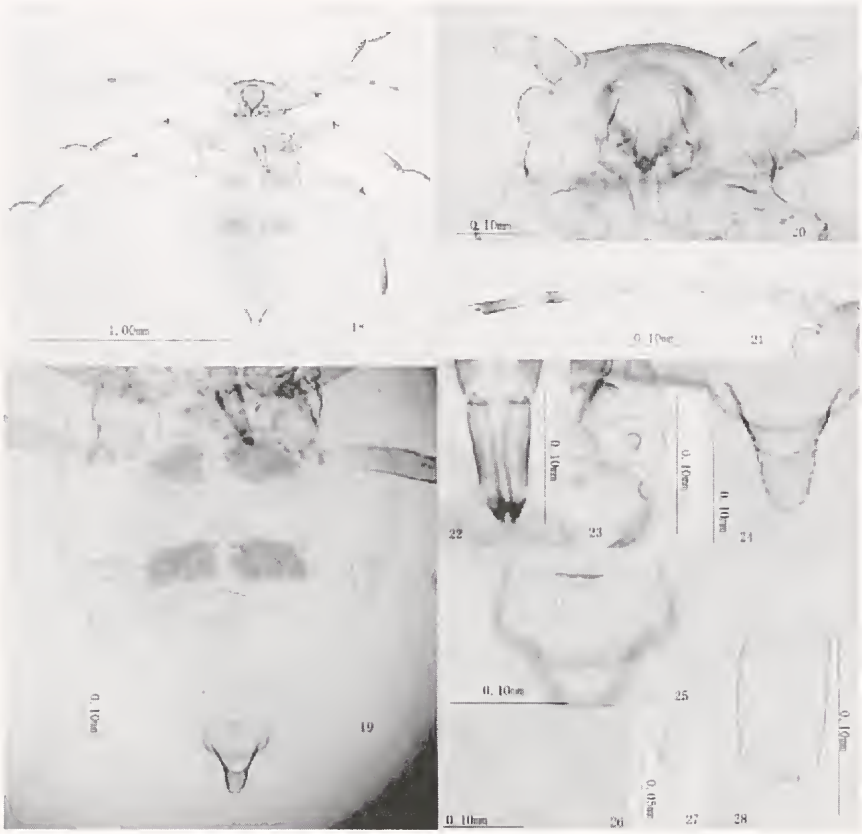
Etymology. The new species is named for the 6 large dorsal patches on dorsum of abdomen.



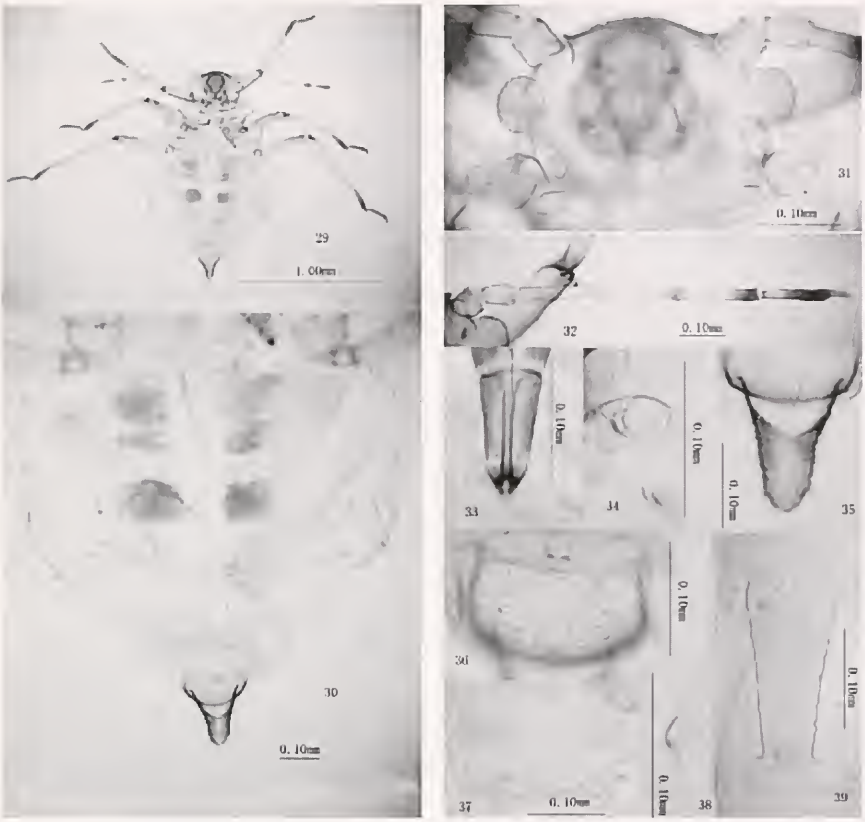
Figures 1-7 Apterous viviparous females of *Brevicorynella quadrimaculata*. Figure 1 Dorsal view of head. Figure 2 Antenna. Figure 3 Ultimate rostral segment. Figure 4 Dorsal view of abdomen. Figure 5 Siphunculus. Figure 6 Cauda. Figure 7 Genital plate. Scale bar: Figs. 1-3, 5-6 = 0.1 mm; Fig. 4 = 0.2 mm.



Figures 8-17 Apterous viviparous females of *Brevicorynella sexmaculata*. Figure 8 Dorsal view of head. Figure 9 Antenna. Figure 10 Ultimate rostral segment. Figure 11 Dorsal tubercles on pronotum. Figure 12 Spiracle and spiracular plate on metathorax. Figure 13 Spiracle and spiracular plate on abdominal segment. Figure 14 Dorsal view of abdomen. Figure 15 Siphunculus. Figure 16 Cauda. Figure 17 Anal plate. Scale bar: Figs. 8-12, 15-17 = 0.1 mm; Figs. 13, 14 = 0.2 mm.



Figures 18-28 Apterous viviparous females of *Brevicorynella quadrimaculata.* Figure 18 Dorsal view of body. Figure 19 Dorsal view of abdomen. Figure 20 Dorsal view of head and pronotum, showing tubercles on pronotum. Figure 21 Antenna. Figure 22 Ultimate rostral segment. Figure 23 Spiracle and spiracular plate on metathorax. Figure 24 Cauda. Figure 25 Anal plate. Figure 26 Genital plate. Figure 27 Spiracle and spiracular plate on abdominal segment. Figure 28 Siphunculus.



Figures 29-39 Apterous viviparous females of *Brevicorynella sexmaculata*. Figure 29 Dorsal view of body. Figure 30. Dorsal view of abdomen. Figure 31 Dorsal view of head and pronotum, showing tubercles on pronotum. Figure 32 Antenna. Figure 33 Ultimate rostral segment. Figure 34 Spiracle and spiracular plate on metathorax. Figure 35 Cauda. Figure 36 Anal plate. Figure 37 Genital plate. Figure 38 Spiracle and spiracular plate on abdominal segment. Figure 39 Siphunculus.

Table. 1 Measurements of apterous viviparous females of *Brevicorynella quadrimaculata* (mm).

No.	Body length	Body width	Hind femur	Hind tibia	2nd hind tarsus	URS length	Ant. III	Ant. IV	Ant. V	Base of ant. VI	Processus terminalis	Siphunculi length	Cauda length
1	1.200	0.800	0.361	0.577	0.155	0.103	0.144	0.144	0.139	0.124	0.046	0.103	0.134
2	1.225	0.750	0.330	0.525	0.144	0.103	0.144	0.124	0.124	0.113	0.046	0.103	0.124
3	1.300	0.825	0.340	0.525	0.144	0.103	0.129	0.103	0.118	0.113	0.042	0.103	0.134
4	1.275	0.825	0.340	0.556	0.144	0.103	0.144	0.155	0.139	0.124	0.046	0.103	0.124
5	1.250	0.825	0.330	0.515	0.134	0.093	0.124	0.118	0.113	0.103	0.042	0.093	0.124
6	1.200	0.725	0.330	0.536	0.155	0.093	0.124	0.129	0.134	0.113	0.042	0.124	0.124
7	1.250	0.775	0.350	0.567	0.144	0.103	0.149	0.144	0.144	0.118	0.046	0.103	0.113
Average±	1.243±	0.789±	0.340±	0.543±	0.146±	0.100±	0.137±	0.131±	0.130±	0.115±	0.044±	0.105±	0.125±
1 sd	0.029	0.036	0.008	0.019	0.019	0.004	0.010	0.014	0.011	0.006	0.002	0.009	0.006

Table. 2 Measurements of apterous viviparous females of *Brevicorynella sexmaculata* (mm).

No.	Body length	Body width	Hind femur	Hind tibia	2nd hind tarsus	URS length	Ant. III	Ant. IV	Ant. V	Base of ant. VI	Processus terminalis	Siphunculi length	Cauda length
1	1.600	0.975	0.422	0.700	0.155	0.103	0.196	0.175	0.165	0.144	0.042	0.165	0.154
2	1.550	0.900	0.391	0.69	0.155	0.103	0.185	0.165	0.155	0.134	0.052	0.144	0.144
3	1.250	0.775	0.402	0.680	0.165	0.103	0.196	0.165	0.175	0.144	0.042	0.144	0.155
4	1.525	0.975	0.412	0.680	0.155	0.103	0.175	0.160	0.160	0.139	0.046	0.155	0.144
5	1.475	0.875	0.391	0.680	0.165	0.103	0.185	0.155	0.155	0.144	0.046	0.155	0.155
6	1.375	0.900	0.422	0.711	0.165	0.103	0.185	0.175	0.180	0.134	0.046	0.165	0.155
7	1.500	0.900	0.402	0.721	0.165	0.103	0.196	0.185	0.175	0.144	0.042	0.165	0.160
8	1.525	1.200	0.422	0.721	0.165	0.103	0.206	0.175	0.155	0.139	0.042	0.165	0.165
9	1.625	1.025	0.391	0.639	0.155	0.093	0.180	0.144	0.165	0.134	0.046	0.155	0.144
10	1.400	1.000	0.422	0.721	0.165	0.093	0.196	0.185	0.185	0.149	0.052	0.165	0.165
Average±	1.483±	0.963±	0.408±	0.694±	0.161±	0.101±	0.190±	0.168±	0.167±	0.141±	0.046±	0.158±	0.155±
1 sd	0.091	0.104	0.012	0.028	0.004	0.004	0.009	0.014	0.011	0.005	0.003	0.006	0.008

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NOTES ON *DOLICHOPUS, ALLOHERCOSTOMUS,* AND *PHALACROSOMA* FROM NEPAL (DIPTERA: DOLICHOPODIDAE)[1]

Ding Yang[2], Toyohei Saigusa[3], and Kazuhiro Masunaga[4]

ABSTRACT: One species is described as new to science: *Dolichopus nepalensis* sp. nov. Two species are recorded from Nepal for the first time: *Allohercostomus rotundatus* (Yang and Saigusa, 1999), *Phalacrosoma amoenum* Becker, 1922.

KEY WORDS: Diptera, Dolichopodidae, *Dolichopus, Allohercostomus, Phalacrosoma,* new species, Nepal.

The fauna of Dolichopodidae from Nepal is not well known. The major studies on Dolichopodidae from Nepal were made by Hollis (1964) and Yang, Saigusa and Masunaga (2001, 2002, 2003). In the present paper, the following three genera and five species of the subfamily Dolichopodinae from Nepal are listed: *Dolichopus* (two species), *Allohercostomus* (two species), and *Phalacrosoma* (one species). One species is described as new to science, *Dolichopus nepalensis,* and two species are recorded from Nepal for the first time.

The types of the new species are deposited in the Biosystematics Laboratory of Kyushu University, Fukuoka, Japan. The following abbreviations are used: acr-acrostichal, ad-anterodorsal, apv-apicoventral, av-anteroventral, d-dorsal, dc-dorsocentral, LI-fore leg, LII-mid leg, LIII-hind leg, npl-notopleural, pd-posterodorsal, pv-posteroventral, v-ventral.

Genus *Dolichopus* Latreille, 1796

The species of the genus *Dolichopus* from the Oriental region were reviewed by Olejníček (2002). One species was known from Nepal: *Dolichopus exsul* Aldrich, 1922 (Hollis, 1964; Dyte, 1975). Here one new species is added to the fauna of Nepal.

Dolichopus exsul Aldrich, 1922

Dolichopus exsul Aldrich, 1922. Proc. U.S. National Museum 61(25): 15. Type locality: Hawaii.

Distribution: Nepal, India, China (Jiangsu, Taiwan), Hawaii.

Remarks: Hollis (1964) recorded this species from Nepal.

[1] Received on March 13, 2004. Accepted on May 18, 2004.

[2] Department of Entomology, China Agricultural University, Haidian, Beijing 100094, China. E-mail: dingyang@cau.edu.cn or dyangcau@yahoo.com.cn.

[3] 7-1-402, Baikoen 2-Chome, Fukuoka, 810-0035 Japan. E-mail: toyohei.saigusa@ma2.seikyou.ne.jp.

[4] Lake Biwa Museum, 1091 Oroshimo-cho, Kusatsu-shi, Shiga, 525-0001 Japan. E-mail: moai@lbm.go.jp.

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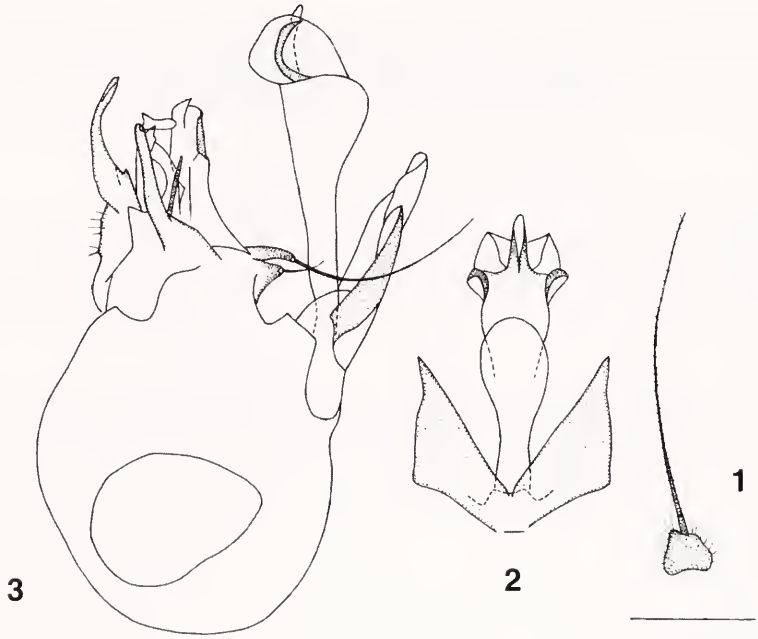

Figs. 1-3. *Dolichopus nepalensis,* n. sp. (male). 1, Antenna (excluding scape), lateral view; 2, genitalia, lateral view; 3, apical genital processes, lateral view. Scale 0.25 mm.

Dolichopus nepalensis Yang, Saigusa and Masunaga, NEW SPECIES
(Figs. 1-3)

Diagnosis: Antenna wholly black; first flagellomere as long as wide. All coxae (except narrow apex) black. Hypandrium hook-like apically.

Description: Male. Body length 4.5-4.9 mm, wing length 4.7-5.1 mm.

Head metallic green with gray brown pollen; lower occiput with pale gray pollen; frons subshiny with thin pollen; face distinctly wider than first flagellomere, with dense brownish yellow pollen, clypeus with dense pale gray pollen. Hairs and bristles on head black; middle and lower postocular bristles (including ventral hairs) pale. Antenna wholly black; first flagellomere rather small, as long as wide, obtuse apically; arista subapical, black, with very short hairs, with basal segment 0.6 times as long as apical segment. Proboscis dark brown with black hairs; palpus brownish yellow, with black hairs and 1 black apical bristle.

Thorax metallic green with pale gray pollen; mesonotum (except notopleural area) and scutellum subshiny with gray brown pollen. Hairs and bristles on thorax black; 6 strong dc (5th pair of dc slightly convergent), 8-9 irregularly paired acr short and hair-like; scutellum with pale discal and marginal hairs. Propleuron pale haired, with 1 black bristle on lower portion. Pteropleuron with group of pale hairs in front of metaspiracle; metapleuron with some pale hairs on antero-lower corner. Legs yellow; all coxae (except narrow apex) black; fore and mid tarsi from tip of basotarsomere onward black, apex of hind tibia and entire hind tarsus black. Hind tibia slightly thickened apically. Hairs and bristles on legs black, coxae with some pale hairs basally; fore coxa with 5-6 bristles, mid and hind coxae each with 1 outer bristle; mid and hind femora with 1 preapical bristle. Fore tibia with 3ad, 2

pd and 2 pv, apically with 2 bristles and 1 short apv (slightly longer than tibia thickness); mid tibia with 4 ad, 2 pd and 1 av, apically with 5 bristles; hind tibia with 5 ad, 3 pd and 3 av, apically with 3 bristles. Tarsomere 5 slightly thickened with distinct dorsal and lateral hairs. Hind basotarsomere with 2 ad and 4-5 v. Relative lengths of tibia and 5 tarsomeres LI 2.8 : 1.4 : 0.6 : 0.5 : 0.3 : 0.45; LII 3.9 : 2.0 : 1.1 : 0.9 : 0.6 : 0.5; LIII 4.2 : 1.85 : 1.85 : 1.3 : 0.85 : 0.6. Wing nearly hyaline; veins dark brown, costal callus punctiform, M with a weak Z-bend but without rudimentary M2; CuAx ratio 0.65. Calyptera yellow with black hairs. Halter yellow with brown base.

Abdomen metallic green with pale gray pollen; cercus yellow with black margin. Hairs and bristles on abdomen black. Male genitalia (Figs. 2-3): Epandrium distinctly longer than wide, with rather wide outer lateral lobe bearing 2 short spine-like apical bristles, and narrow inner lateral lobe finger-like; cercus nearly quadrate with distinct marginal denticles; hypandrium hook-like apically.

Female. Body length 4.8-5.3 mm, wing length 5.0-5.3 mm. Similar to male, but face distinctly wider than first flagellomere.

Type Data: Holotype, male. Nepal, Topke Gola (3700 m), 1972. VII. 8, J. Emoto, deposited in the Biosystematics Laboratory of Kyushu University, Fukuoka, Japan. Paratypes, 4 males, 3 females, same data and repository as holotype.

Distribution: Nepal.

Etymology: The specific epithet refers to the type locality Nepal.

Remarks: The new species is similar to *Dolichopus ancistrus* Yang from Yunnan, China, in having the black antenna and hypandrium hook-like apically, but may be separated from the latter by the black fore coxa and hind femur without long ventral bristles. In *ancistrus,* the fore coxa is yellow, and the hind femur has long black ventral bristles (Yang, 1997).

Genus *Allohercostomus* Yang, Saigusa and Masunaga, 2001

One species was known from Nepal: *Allohercostomus nepalensis* Yang, Saigusa and Masunaga, 2001. Here 1 new record species from Nepal is reported: *Allohercostomus rotundatus* (Yang and Saigusa, 1999).

Allohercostomus rotundatus (Yang and Saigusa, 1999)

Hercostomus (Hercostomus) rotundatus Yang and Saigusa, 1999. Bull. Inst. R. Sci. Nat. Belg. Ent. 69: 244. Type locality: Sichuan (Emei Mountain).

Specimens Examined: 4 males, **NEPAL:** Handurung (800 m) – Linba (1200 m), 1972. VI. 27, H. Makihara; 3 males, 1 female, **Nepal:** Jilikinpthi (1850 m) – Pontak (1800 m), 1972. V. 13, H. Shima; 1 male, **Nepal:** Chiliwa (1350 m) – Shibku (2100 m), 1972. VI. 7, J. Emoto; 9 males, 3 females, **Nepal:** Lelep (1770 m), 1972. VI. 4, J. Emoto.

Distribution: Nepal, China (Sichuan, Shaanxi).

Allohercostomus nepalensis Yang, Saigusa and Masunaga, 2001

Allohercostomus nepalensis Yang, Saigusa and Masunaga, 2001. Ent. Sci. 4(2): 182. Type locality: Nepal (Topke Gola).

Distribution: Nepal.

Genus *Phalacrosoma* Becker, 1922

The genus *Phalacrosoma* is recorded from Nepal for the first time with 1 species: *Phalacrosoma amoenum* Becker, 1922.

Phalacrosoma amoenum Becker, 1922

Phalacrosoma amoenum Becker, 1922. Capita Zool. 1(4): 45. Type locality: Taiwan (Kosempo).

Specimens Examined: 2 males, 3 females, **Nepal:** Thudam (3500-3800 m), 1972. VI. 16, H. Shima; 1 male, **Nepal:** Lelep (1770 m), 1972. VI. 2, Y. Nishida; 1 male, **Nepal:** Chiliwa (1350 m), 1972. VI. 7, J. Emoto; 5 males, 3 females, NEPAL: Basantapur (2300 m), 1972. V. 29, H. Shima; 5 males, 1 female, **Nepal:** Dobham (800 m), 1972. V. 20, H. Shima; 2 males, 6 females, **Nepal:** Jilikinpthi (1850 m), 1972. V. 13, H. Shima.

Distribution: Nepal, China (Taiwan).

DISCUSSION

The genus *Dolichopus* has two species in Nepal, of which the known species is distributed also in Central China and South China; the new species is close to the species from South West China. The genus *Allohercostomus* has two species in Nepal, of which one species is endemic and the other is distributed also in Central China. The genus *Phalacrosoma* has only one species in Nepal which is distributed also in Taiwan of South China. The genus *Hercostomus* has 25 species in Nepal (Yang, Saigusa and Masunaga, 2002), of which 18 are endemic but the other 7 species are distributed also in Central China and South West China. Obviously, the fauna of the subfamily Dolichopodinae from Nepal has the close relationship with that of Central China, South West China, and South China.

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Yang, D., T. Saigusa, and K. Masunaga. 2003. A review of the genus *Neurigonella* from Nepal (Diptera: Empidoidea: Dolichopodidae). Annales Zoologici 53(4): 663-665.

A NEW SPECIES OF *NEPALOMYIA* FROM INDONESIA (DIPTERA: DOLICHOPODIDAE)[1]

Ding Yang[2], Toyohei Saigusa[3], and Kazuhiro Masunaga[4]

ABSTRACT: *Nepalomyia baliensis*, sp. nov. from Indonesia is described as new to science which represents the southernmost distribution range of the genus in Asia. Diagnostic features are discussed. Due to the recent synonymy of *Neurigonella* with *Nepalomyia*, the following new combinations are proposed: *Nepalomyia nepalensis* (Yang, Saigusa and Manusuga, 2003) comb. nov. and *Nepalomyia nigra* (Yang, Saigusa and Manusuga, 2003) comb. nov.

KEY WORDS: Diptera, Dolichopodidae, *Nepalomyia*, new species, Indonesia.

The peloropeodine genus *Neugrigonella* Robinson, 1964 has recently been synonymized with *Nepalomyia* Hollis, 1964 by Runyon and Hurley (2003). It is characterized by an arista arising from the apical concavity of the first flagellomere and a first tarsomere of leg III with one basal spur on the inner surface directed upward. *Nepalomyia* is represented by 4 species in the Nearctic Region (Runyon and Hurley, 2003) and 1 species in the Far East of Russia (Palaearctic: Negrobov, 1991). Until the mid-1970s, no species have been recorded from the Oriental Region before (Dyte, 1975). Recently 20 species were reported from China by Yang and Saigusa (2001a, b), and 4 species from Nepal by Yang, Saigusa and Masunaga (2003). In this paper, one species of *Nepalomyia* is described from Indonesia for the first time which represents the southernmost distribution range of the genus in Asia.

The following abbreviations are used: acr-acrostichal, ad-anterodorsal, ap-apical, dc-dorsocentral, LI-fore leg, LII-mid leg, LIII-hind leg, MSSC-male secondary sexual character, oc-ocellar, pd-posterodorsal, v-ventral.

Nepalomyia baliensis, NEW SPECIES
(Figs. 1-3)

Diagnosis: Belonging to *N. henanensis* species group. First flagellomere nearly trapezoidal, 0.9 times as long as wide, with weak lower apical corner. Coxae dark brown. Male fore tarsomeres 1-3 with one row of long posterior hairs (MSSC). Male cercus without distinct basal tubercle.

Description: Male: Body length 2.6-2.7 mm, wing length 3.1-3.3 mm.

[1] Received on March 4, 2004. Accepted on May 18, 2004.

[2] Department of Entomology, China Agricultural University, Haidian, Beijing 100094, China. E-mail: dingyang@cau.edu.cn or dyangcau@yahoo.com.cn.

[3] 7-1-402, Baikoen 2-Chome, Fukuoka, 810-0035 Japan; Email: toyohei.saigusa@ma2.seikyou.ne.j.

[4] Lake Biwa Museum, 1091 Oroshimo-cho, Kusatsu-shi, Shiga, 525-0001 Japan; Email: moai@lbm.go.jp.

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Head dark metallic green with gray brown pollen; face with pale gray pollen. Hairs and bristles on head black; postocular bristles (including ventral hairs) black. Ocellar tubercle weakly raised, with 2 strong oc and 2 short posterior hairs. Antenna (Fig. 1) black; first flagellomere nearly trapezoidal, 0.9 times as long as wide, with weak lower apical corner; arista black, long, with rather short basal segment. Proboscis black with black hairs; palpus black with black hairs and 1 black apical bristle.

Thorax dark metallic green with gray brown pollen; pleuron with pale gray pollen. Hairs and bristles on thorax black; 5 strong dc, 6 irregularly paired acr; scutellum with 2 pairs of bristles, outer pair weak and nearly 1/4 as long as inner pair. Propleuron with 2 black hairs and 1 black bristle on lower portion. Legs brownish yellow; coxae dark brown; tarsi brown to dark brown from tip of tarsomere 1 onward. Hairs and bristles on legs black; coxa I with 5-6 bristles, coxa II with 1 anterior bristle, coxa III with 1 outer bristle. Femora II and III with 1 preapical ad. Tibia I apically with 2 bristles; tibia II with 2 ad, 2 pd and 1 v, apically with 4 bristles; tibia III with 2 ad and 3 pd, apically with 3 bristles. First three tarsomeres of leg I with one row of long posterior hairs (MSSC). First tarsomere of leg III with 1 v at base. Relative lengths of tibia and 5 tarsomeres LI 1.8 : 1.2 : 0.5 : 0.5: 0.35 : 0.35; LII 2.6 : 1.5 : 0.9 : 0.8 : 0.5 : 0.3; LIII 3.1 : 0.65 : 1.2 : 0.9 : 0.6 : 0.3. Wing hyaline; veins dark brown, basal costal section before h slightly thickened, R4+5 and M parallel apically; CuAx ratio 0.35. Squama dark yellow with dark brown margin, with black hairs. Halter yellow with dark brown knob.

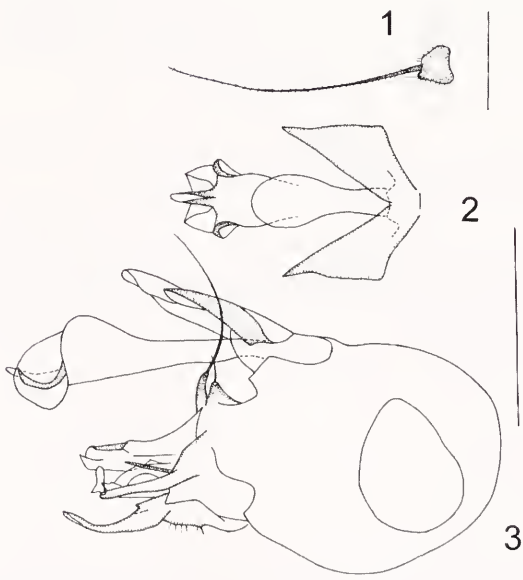
Abdomen dark brown with gray brown pollen. Hairs and bristles on abdomen black; tergites 1-5 each with one row of posterior bristles.

Male genitalia (Figs. 2-3): Surstylus on epandrium with thick dorsal lobe nearly straight, and thin ventral lobe weak curved (which bears 1 long thin process at base); cercus basally with 6-7 short hairs, but without distinct tubercle; hypandrium deeply incised into two lateral portions nearly triangular; aedeagus nearly straight and distinctly swollen apically, with mid-ventral process large and rounded apically.

Female: Body length 2.6-3.0 mm, wing length 3.0-3.3 mm.

Type Data: Holotype, male, Indonesia, Bali Is., Botanical Garden (1300 m), 4. x. 2000, T. Tachi (deposited in the collection of the Biosystematics Laboratory of Kyushu University, Fukuoka). Paratypes: 13 males 30 females, same data and depository as holotype.

Etymology: The name refers to the type locality Bali.



Figs. 1-3. *Nepalomyia baliensis, n.* sp. (male). 1, Antenna (excluding scape and pedicel); 2, hypandrium and aedeagus, ventral view; 3. hypopygium, lateral view. Scale 0.25 mm.

DISCUSSION

The new species is somewhat similar to *Nepalomyia pallipilosa* (Yang and Saigusa) from Yunnan in the shape of aedeagus, but may be separated from the latter by a longer first flagellomere (vs. 0.6 as long as wide in *pallipilosa*), R4+5 and M being parallel at wing apex (vs. convergent at wing apex), and tarsus 1 brown to dark brown from tip of tarsomere 1 onward (vs. tarsus 1 partly white) (Yang and Saigusa, 2001b).

Due to the synonymization of *Neurigonella* Robinson, 1964 with *Nepalomyia* Hollis, the recently described species are proposed as new combinations: *Nepalomyia nepalensis* (Yang, Saigusa and Manusuga, 2003) comb. nov. and *Nepalomyia nigra* (Yang, Saigusa and Manusuga, 2003) comb. nov.

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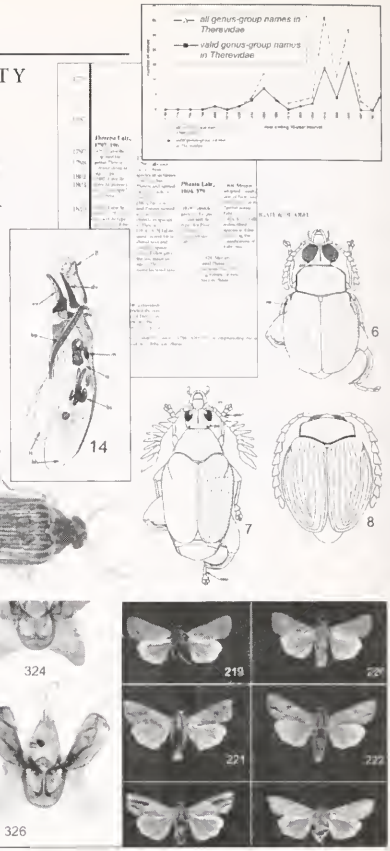

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NOTES ON THE GENUS *CHAETOGONOPTERON* FROM GUANGXI, CHINA (DIPTERA: DOLICHOPODIDAE)[1]

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

ABSTRACT: The genus *Chaetogonopteron* is recorded from Guangxi (China) for the first time with six species. One species is described as new to science: *Chaetogonopteron guangxiense*. A key to the species from Guangxi is presented.

KEY WORDS: Dolichopodidae, *Chaetogonopteron*, new species, Guangxi, China.

The genus *Chaetogonopteron* de Meijere is characterized by the shortened hind basotarsomere (Meuffels and Grootaert, 1987, 1997). The species of the genus *Chaetogonopteron* from China were mainly studied by Yang and Grootaert (1999a, b), Yang and Saigusa (2001), and Yang (2002). In the present paper, the genus *Chaetogonopteron* is recorded from Guangxi for the first time with 6 species, based on the material collected by the second author with sweep net in Guangxi in 2002. Among them one species is described as new to science. The type of new species is deposited in the insect collection of China Agricultural University, Beijing. The following abbreviations are used: acr-acrostichal, ad-anterodorsal, av-anteroventral, d-dorsal, dc-dorsocentral, h-humeral, ih-inner humeral, LI-fore leg, LII-mid leg, LIII-hind leg, npl-notopleural, oc-ocellar, pd-posterodorsal, ph-posthumeral, psa-postalar, pv-posteroventral, sa-supraalar, su-sutural, v-ventral.

Key to species of *Chaetogonopteron* from Guangxi, China

1. Only hind tarsomere 1 shortened 2
   Hind tarsomeres 1-2 shortened 4

2. Acr uniseriate 3
   Acr biseriate; thorax and abdomen largely yellow ..... *C. chaeturum* Grootaert and Meuffels

3. First flagellomere short conical, nearly as long as wide ..... *C. luteicinctum* (Parent)
   First flagellomerere much elonagated ..... *C. concavum* Yang and Grootaert

[1] Received on March 14, 2003. Accepted on May 18, 2004.

[2] Department of Entomology, China Agricultural University, Haidian, Beijing 100094, China. E-mail: tolily@126.com.

[3] Department of Entomology, China Agricultural University, Haidian, Beijing 100094, China. E-mail: dingyang@cau.edu.cn or dyangcau@yahoo.com.cn. Corresponding author.

[4] Lake Biwa Museum, 1091 Oroshimo-cho, Kusatsu-shi, Shiga, 525-0001 Japan. E-mail: moai@lbm.go.jp.

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4. Mid tibia without rowed v.....5
   Mid tibia with rowed v .....*C. guangxiense* sp. n.

5. Fore tarsomere 5 wholly whitish..... *C. ceratophorum* Yang and Grootaert
   Fore tarsomeres 2-5 whitish with dark dorsal surface .....
   .....*C. pallipilosum* Yang and Grootaert

Chaetogonopteron ceratophorum Yang and Grootaert

Chaetogonopteron ceratophorum Yang and Grootaert. 1999. Bull. Inst. R. Sci. Nat. Belg. Ent. 69:269. Type locality: Yunnan (Menglun).

Specimens Examined: 11 males, 8 females, Guangxi: Tiane, Buliuhe (300m), 2002. VIII. 9, D. Yang.

Distribution: China (Guangxi, Yunnan).

Chaetogonopteron chaeturum Grootaert and Meuffels

Chaetogonopteron chaeturum Grootaert and Meuffels, 1999. Belg. J. Ent. 1(2): 335. Type locality: Thailand.

Specimen Examined: 1 male, Guangxi: Tiane, Buliuhe (300m), 2002. VIII. 9, D. Yang.

Distribution: China (Guangxi, Yunnan), Thailand.

Chaetogonopteron concavum Yang and Grootaert

Chaetogonopteron concavum Yang and Grootaert, 1999. Bull. Inst. R. Sci. Nat. Belg. Ent. 69:271. Type locality: Yunnan (Menglun).

Specimens Examined: 2 males, Guangxi: Tianlin, Langping (1300m), 2002. VIII. 14, D. Yang.

Distribution: China (Guangxi, Yunnan).

Chaetogonopteron guangxiense Zhang, Yang and Masunaga NEW SPECIES (Figs 1-4)

Diagnosis: Antennal scape and pedicel black, first flagellomere blackish. R_{4+5} and M more or less parallel apically. Male hind tarsomere 2 distinctly longer than tarsomere 1, with a large appendage.

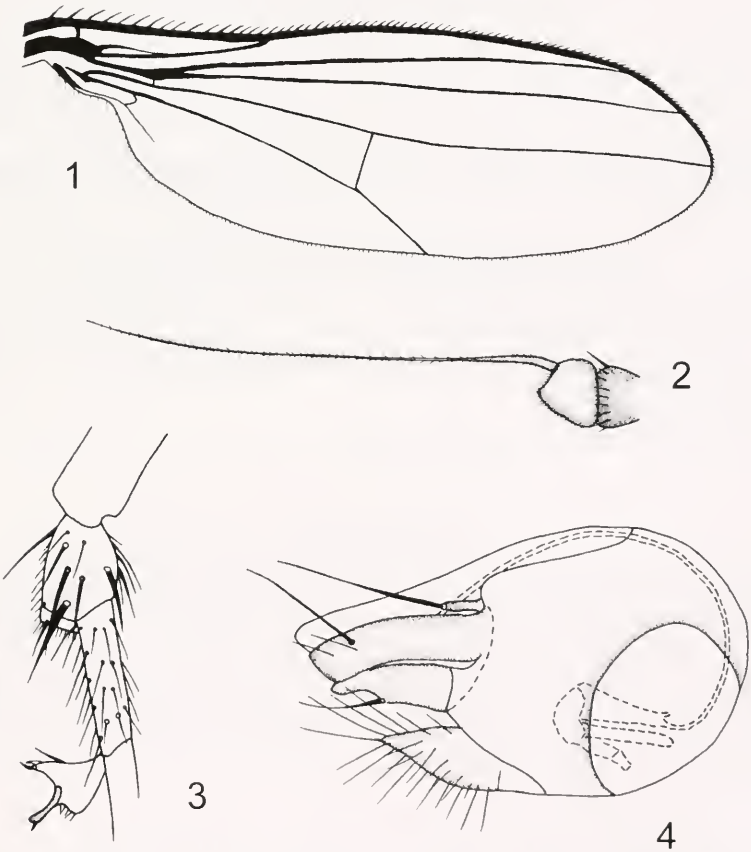
Description: Male. Body length 5.0 mm, wing length 5.3 mm.

Head metallic green with pale gray pollen. Eyes contiguous on face; face distinctly narrower than frons. Hairs and bristles on head black; postocular bristles black, postero-ventral hairs pale. Ocellar tubercle weak, with 2 long oc and 2 short posterior hairs. Antennal scape and pedicel black, first flagellomere blackish, subtriangular, as long as wide; arista subapical, blackish, and short pubescent. Proboscis dark brownish yellow with black hairs; palpus dark brownish yellow with black hairs and 1 black apical bristle.

Thorax yellow with gray pollen; mesonotum brilliant metallic green with anterior and lateral portions yellow; scutellum with a large metallic green basal spot; metanotum metallic green. Pteropleuron and laterotergite each with blackish or black anterior upper corner. Hairs and bristles on thorax black; 5 strong dc, 6-7 irregularly paired acr short and hair-like; 1 long h, 1 long ph, 1 slightly short ih, 1 short su, 1 long anterior and 1 slightly short posterior npl, 1 short anterior and 1 long posterior sa, 1 long psa; scutellum with 1 pair of long bristles and 8 very short marginal hairs. Propleuron

with 2 black hairs and 1 black bristle on lower portion. Metapleuron with 4 black hairs on postero-upper corner and 2 black hairs on antero-lower corner. Legs yellow; mid coxa with black dot on posterior upper corner; tarsomere 5 brown. Hairs and bristles on legs black. Fore coxa apically with 6 weak or strong bristles; mid coxa with 1 weak anterior bristle near apex; hind coxa with 1 outer bristle at base. Fore femur apically with 1 pv; mid femur apically with 1 preapical bristle, 1 weak av and 1 distinct pv; hind femur with one row of 8 ventral bristles, apically with 1 preapical bristle, 1 weak av and 1 distinct pv. Fore tibia apically with 2 bristles; mid tibia with 2 ad, 2 pd and 1 pv, apically with 4 bristles; hind tibia with one row of 10 recumbent v (except narrow base and wide apical portion), apically with 3 bristles. Fore basotarsomere (except basal portion) with one row of 6 rather long av; tarsomeres 2-4 with one row of long hair-like v curved apically. Hind tarsomeres 1-2 shortened, tarsomere 2 distinctly longer than basotarsomere, with a wide ventral appendage. Relative lengths of tibia and 5 tarsomeres LI 3.1 : 1.9 : 1.0 : 0.8 : 0.55 : 0.45; LII 4.8 : 2.9 : 1.5 : 1.15 : 0.6 : 0.45; LIII 5.2 : 0.6 : 0.95 :1.75 : 1.2 : 0.5. Wing hyaline; veins dark brown, R_{4+5} and M more or less parallel apically; CuAx ratio 0.6. Calyptera dark brown with black hairs. Halter dark yellow with brown knob.

Abdomen yellow with gray pollen; tergum 1 and lateral portion of tergum 2 brownish yellow. Hairs and bristles on abdomen black. Male genitalia chiefly yellow, cercus with pale hairs. Male genitalia (Fig.4): Sternum 8 with 2 bristles; epandrium with 1 strong bristle on finger-like lateral process;



Figs 1-4 *Chaetogonopteron guangxiense* n. sp. (male). 1, Wing; 2, antenna (excluding scape), lateral view; 3, hind tarsomeres 1-2, lateral view; 4, genitalia, lateral view.

surstylus with dorsal lobe more or less acute apically, and ventral lobe rather wide apically; cercus acute apically; hypandrium obtuse apically.

Female. Unknown.

Holotype: Male, Guangxi: Tiane, Buliuhe (300 m), 2002. VIII. 9, D. Yang, deposited in the insect collection of China Agricultural University, Beijing.

Distribution: China (Guangxi).

Etymology: The species is named after the type locality Guangxi, China.

Remarks: The new species is somewhat similar to *Chaetogonopteron seriatum* Yang and Grootaert from Yunnan, but may be separated from the latter by the postocular bristles wholly black and antenna black with blackish first flagellomere. In *minutum,* the middle and lower postocular bristles are pale, and the antenna is yellow with first flagellomere black (Yang and Grootaert, 1999b).

Chaetogonopteron luteicinctum (Parent)

Sympycnus luteicintus Parent, 1926. Encycl. Ent. (B II) Dipt., 3:134. Type locality: Shanghai (Zi-Ka-Wei).

Specimens Examined: 5 males, Guangxi: Tiane, Bojie (1100 m), 3 August, 2002, leg. D. Yang; 16 males 12 femlaes, Guangxi: Tianlin, Langping (1300m), 14 August, 2002, leg. D. Yang.

Distribution: China (Guangxi, Yunnan, Shanghai, Zhejiang, Fujian, Henan).

Chaetogonopteron pallipilosum Yang and Grootaert

Chaetogonopteron pallipilosum Yang and Grootaert, 1999. Bull. Inst. R. Sci. Nat. Belg. Ent. 69:274. Type locality: Yunnan (Jinghong, Mengyang).

Specimen Examined: 1 male, Guangxi: Tiane, Buliuhe (300 m), 9 August, 2002, leg. D. Yang.

Distribution: China (Guangxi, Yunnan).

DISCUSSION

Guangxi, with a tropical or subtropical climate, faunistically belongs to South China of the Oriental biogeographic realm. Six species of *Chaetogonopteron* are now known to occur in Guangxi. One species is endemic to Guangxi, four species are distributed also in South West China of Oriental realm, and one species is widely distributed also in Central China, South West China and other areas of south China. It is obvious that the specific composition of *Chaetogonopteron* from Guangxi has the close relationship with that of southwestern China.

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We are very grateful to Dr. H. Ulrich (Bonn, Germany) and Dr. P. Grootaert (Institut Royal des Science Naturelles, Brussels, Belgium) for their kind help. Author DY wishes to express his sincere thanks to Professor Guofang Jiang (Nanjing Normal University, Nanjing) for his kind help during the survey to Guangxi in 2002. The research is supported by the National Natural Science Foundation of China (No. 30225009).

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NARROW CRAWL SPACE INCREASES CAPTURE OF COCKROACHES (BLATTODEA) IN ADHESIVE TRAPS[1]

Rif S. El-Mallakh[2] and Michael J. Hartmann[3]

ABSTRACT: Cockroaches are a significant public health problem and are the most disliked urban pests. Cockroach control relies heavily on the use of chemical pesticides, which are equally disliked by the general public. Nontoxic, effective methods of eliminating cockroaches are in general demand. The double-surface habitat adhesive cockroach trap is a novel design that takes advantage of the cockroaches' predilection for narrow spaces as its major attractant. The trap also takes advantage of the broad, flat dorsal surface of the cockroach by utilizing adhesive on both the floor and the ceiling of the insects' crawl space. This trap was tested under laboratory conditions and found to be seven times more effective than popular Roach Motel®. The addition of pheromonal attractants might increase the effectiveness of the trap further.

KEY WORDS: Blattodea, nonchemical control, narrow crawl space, adhesive traps.

Cockroaches are probably among the most common and the most despised urban pests (Potter and Bessin 1998). Furthermore, they have been implicated as vectors of bacterial pathogens (Burgess and Chetwyn 1981, Graffer and Mertens 1960; Mackerras and Mackerras 1949) and may harbor these organisms for prolonged periods of time (Stek 1982, Stek, Peterson and Alexander 1978). More recent data suggest that cockroaches are an important etiological factor in human asthma (Rosenstreich et al. 1997, Sarpong et al. 1997). Among professional entomologists, cockroaches are responsible for 78 percent of occupational allergies (Wirtz 1980).

There are many approaches to cockroach control, including fumigation, directed spraying, and baited traps. In a survey of attitudes among the general public, Potter and Bessin (1998) found that 77 percent were either very or somewhat concerned about the use of pesticides to control insects in the home. As a consequence of this, the use of baited traps has greatly increased in recent years (Potter and Bessin 1998).

This report describes the laboratory effectiveness of an adhesive trap for cockroaches, where the "bait" is the cockroaches' own predilection for narrow crawl spaces. The trap's design also makes use of the insect's broad flat dorsal surface by having adhesive on both the "floor" and the "ceiling" of the trap. The results suggest that this is a very effective design.

[1] Received on August 16, 2002. Accepted on March 13, 2004.

[2] Mood Disorders Research Program, Department of Psychiatry and Behavioral Sciences, University of Louisville School of Medicine. Louisville, Kentucky 40202 U.S.A. E-mail: rselma01@louisville.edu.

[3] Electrical Geodesic, Inc. Eugene, Oregon 97403 U.S.A. E-mail: aafan@mindspring.com.

Mailed on September 30, 2004

METHODS

The trap is constructed of three sheets of cardboard measuring 11.5 x 15 cm and separated by spacers 5 mm high. The internal crawl spaces are lined with two-sided tape (Scotch Rug and Carpet Tape, 3M, St Paul, MN) (Figure 1). Since the trap was designed to utilize the cockroaches' behavioral predilection to tight spaces, it is called a "habitat" trap. Similar designs have been patented (Grey 1977, Gang 1995).

The testing of the traps was performed in plastic chambers measuring 41 x 21 x 18 cm. These were attached to each other by polyethylene tubing (2.5 cm diameter) to form a three-chambered testing arena (Figure 2). Ten adult American cockroaches *(Periplaneta americana)* were placed in the middle chamber, which also contained food (a cut apple) and water. One of the end chambers contained a Roach Motel® (Black Flag), and the other a habitat trap. The Roach Motel® is approximately 12 x 8 cm with a crawl space that is some 6 cm high. It contains a gel-like glue on both broad inside surfaces of the trap so that the trap can be placed on either side, however, the inside space is very large in relation to the size of the cockroach. The chambers were then sealed with a ventilated plastic cover and placed in the dark at 24 - 26°C for one week. At the end of that time, the chambers were opened and the cockroach position noted. The experiment was conducted in quadruplicate.

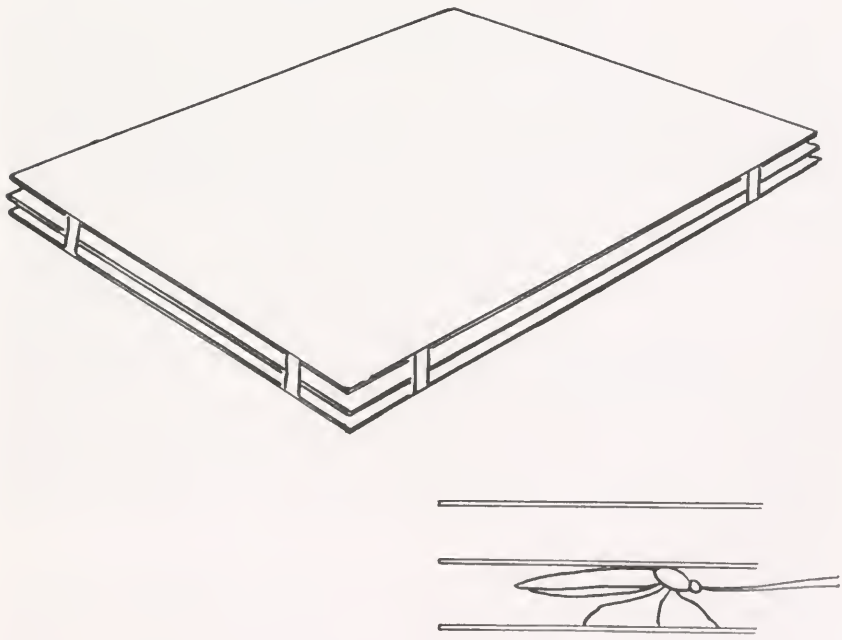

Figure 1. Schematic diagram of the habitat cockroach trap and an entrapped cockroach.

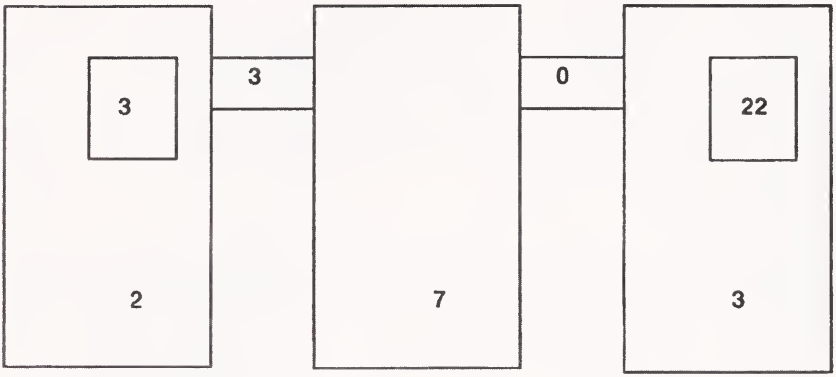

Figure 2. Schematic of the experiments comparing the Roach Motel® (left inner box) and the habitat trap (right inner box). Three identical plastic chambers were connected by plastic tubing. Ten adult *P. americana* were placed in the middle chamber (which also contained food and water), and the chambers were sealed for one week. At the time of the reopening of the chambers, the positions of the cockroaches were noted. The experiment was conducted in quadruplicate, for a total of 40 cockroaches.

RESULTS AND DISCUSSION

Figure 2 presents the cockroach distribution at the end of one week for 40 cockroaches. The habitat trap captured over seven times as many cockroaches as the alternative baited adhesive trap ($P < 0.01$, $z = 5.06$, using a test for examining proportional data [El-Mallakh et al. 1994]). This is especially notable given that the cockroaches had to physically engage with the habitat trap as a consequence of their exploratory behavior, whereas the Roach Motel® possesses a pheromone attractant in addition to its physical profile.

The "attractant" of the habitat trap is the narrow space into which cockroaches escape for safety. The current study suggests that this behavior is a powerful force in cockroaches. However, the design of the habitat trap does not exclude the use of another bait. For example, a pheromone could be added to the trap to potentially further increase the efficacy of the trap.

It is believed that the utilization of adhesive on both the floor and the ceiling of the trap increased its efficiency. As the cockroach enters the narrow space and struggles to free its legs from the adhesive on the floor, it pushes its broad dorsal surface up against the adhesive on the ceiling of the space, effectively anchoring the animal to the trap (Fig. 1).

There are limits to the conclusions that can be drawn from these studies. The experimental setup had no "safe" hiding place for the cockroaches. Thus, it is important to examine this trap under "field" conditions where alternative narrow crevices are available for the animals. Furthermore, the concentration of cockroaches per area is much higher in the experimental setup than would occur

under field conditions. This factor may have increased the apparent effectiveness of the traps. Finally, since the efficacy of the trap is dependent on adhesively capturing the cockroach by its dorsal surface, the size of the spacing may be species-specific. If this is true, then a separate trap type would be needed for different target species. In this regard, the sloped ceiling design of Gray (1977) may be superior. Despite these shortcomings, the data suggest that the habitat trap is superior to other widely used baited adhesive traps for the *P. americana*. Field trials are warranted.

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BOOK REVIEW

THE PASSIONATE OBSERVER. WRITINGS FROM THE WORLD OF NATURE. Jean-Henri Fabre. Watercolors by Marlene McLoughlin. 1998. Chronicle Books. 85 Second Street, San Francisco, California 94105 U.S.A. Price, including shipping, varies considerably (e.g. http://www.addall.com/, http://www. alibris.com/home.cfm, http://www.bookfinder.com/, and others).

Fabre's *The Passionate Observer,* intertwines his love for nature with his life. A college math teacher, Fabre ponders about what could have happened "if unobsessed by the *x* and *y*, I had devoted myself wholeheartedly to my inclinations"! Moquin-Tandon, a mentor, encouraged Fabre to follow his vocation with confidence using these words: "Get to the beast, the plant; and, if, as I believe, the fever [for their study] burns in your veins, you will find men to listen to you." While profession is what one does for a living, vocation (< Latin, *vocare,* or call) is the seizing of a joyful something that resides within oneself. As Fabre puts it, "from early childhood, from the moment of my first mental awakening, I have felt drawn towards the things of nature … I had the gift, the bump of observation." Vocation is what brings humans to life as it helps us find meaning in our everyday actions.

This collection of short stories, mostly about the little creatures and their surroundings, is filled with natural history (e.g. omnivory in some grasshoppers, including eating cicadas on their diet; reproduction in some grasshoppers), political and social commentary (e.g. "We are celebrating to-day, with greater uproar than conviction…the fall of the Bastille…In a century or two, will anyone, outside the historians, give a thought"), a cavalcade of poetry, insightful reflections on his life, and, above all, the wonders of the insect world (e.g. the evolution of parental care and other behaviors of insects or how some pentatomid nymphs ecclose). Fabre was a strong believer in combining field and laboratory observations, modeling, and experimentation. Interestingly, numerous remarks by Fabre show his keen awareness of the importance of behavior, genetics, whose details were unknown at that time: the environment, trade-offs, biomechanics, functional morphology, and their impact on insect evolution that are ahead of his time.

As in *Souvenirs Entomologiques,* Fabre's prose is ornate yet simple and it captivates the attentive reader. In contrast to those who talk or write to impress others with "barbarous vocabulary" or those who believe truth is related to authority, Fabre believes that "lucidity is the sovereign politeness of the visitor". There is a beautiful element of wholesomeness, such as in his "vast cobalt blue skies" or the "small boys of the neighborhood" that made us recall tales of Hans Christian Andersen or Circe du Soliel's movie *Journey of Man.* How would Fabre have reacted if he would have had access to the tools of modern biology, such as a scanning electron microscope, to satiate his desire for life-long learning?

The *Passionate Observer* made us recall times when life seemed simpler. Surrounded by the gentleness of pastel colored aquarelles and frequent flashbacks to his younger years, Fabre's wit (e.g. "no pleasure… can be fully relished without an added condiment of pain") brought the same smile to our hearts that our dear European friends Niilo Virkki and Pierre Jolivet have, especially when they tell us stories about the natural world. This book has gems for many readers, especially for those who are still children at heart, on how to find answers to queries about the natural world or how to learn about the historical background upon which the life of one scientist is unraveled (e.g. remarks on a marine biology laboratory interested in finding out "how the yolk of annelid's egg is constructed" in contrast to his pleas for "an entomological laboratory for the study … of the living insect"), or just how to have some good fun reading "in the middle of July… [t]he astronomical dog-days."

We recommend savoring *The Passionate Observer* during quiet moments of reflection. Fabre's sense of vocation can be best enjoyed when one gets to do what he does: observing the natural world in quiet and reverent appreciation. Perhaps, this can help us gain our own inner sense of vocation and make us remember what it was that called us into our passion in the first place.

Jorge A. Santiago-Blay
Department of Paleobiology
MRC-121, National Museum of Natural History
Smithsonian Institution, P.O. Box 37012
Washington, District of Columbia 20013-7012 U.S.A.
E-mail: santiago-blay@nmnh.si.edu.

Suzanne C. Shaffer
Center for Teaching and Learning
Montgomery College
7600 Takoma Avenue
Takoma Park, Maryland 20912 U.S.A.
E-mail: suzshaff@yahoo.com.

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SCIENTIFIC NOTE

CONFIRMATION OF THE PYGMY SNOWFLY, *ALLOCAPNIA PYGMAEA* (BURMEISTER) (PLECOPTERA: CAPNIIDAE), FROM NORTH DAKOTA, UNITED STATES[1]

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

Kondratieff and Baumann (1999) listed fifteen stonefly taxa, including eleven confirmed species for North Dakota. Included only as a genus record was the snowfly genus *Allocapnia* based on nymphs. We predicted that based on known distributional proximity, the most likely species of *Allocapnia* occurring in North Dakota would be *A. pygmaea* (Burmeister). Recently, a vial of *Allocapnia* specimens was brought to our attention by eminent coleopterist Robert D. Gordon at the National Museum of Natural History. He collected these stoneflies from a small stream in southeastern North Dakota, Sargent County. These specimens included four adult males of *A. pygmaea* allowing species confirmation. This subboreal species occurs in a transverse band across the northern United States and southern Canada, south to Tennessee, with disjunct populations in the Ozark Mountains of Missouri (Ross et al. 1967, Ross and Ricker 1971, Poulton and Stewart 1991). *Allocapnia* is considered an eastern deciduous forest associated group of stoneflies (Ross and Ricker 1971), and presently includes 43 species (Kondratieff and Kirchner 2000).

Ross et al. (1967) postulated that during the Wisconsin glacial maximum, *A. pygmaea* occurred south of the ice sheets in the Cumberland Plateau region of east central United States. Dispersal northward and westward of this species occurred during the post-Wisconsinan times, into deglaciated regions, following a northern route over the Great Lakes (see Ross et al. 1967, Fig. 2). An alternative hypothesis proposes that these North Dakota populations are remnants of northern dispersals from the Missouri Ozark populations. However, the North Dakota males are clearly most similar to northeastern populations and not to the males described by Ross et al. (1967) from Missouri. The Minnesota records of *A. pygmaea* are from areas along Lake Superior and south of Minneapolis next to nearby Michigan (Ross and Ricker 1971, Lager et al. 1979). Recently, Heimdal et al. (2004) reported *A. pygmaea* from northeastern Iowa. It then appears that the southeastern North Dakota populations of this species clearly fit the dispersal pattern proposed by Ross et al. (1967), and have originated from a single source.

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[2] Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, Colorado 80523 U.S.A. E-mail: Boris.Kondratieff@colostate.edu.

[3] Department of Integrative Biology, Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah 84602 U.S.A. E-mail: Richard_Baumann@byu.edu.

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The Sargent County record represents the most western record for *Allocapnia* and outside the eastern deciduous forest biome.

Material Examined: North Dakota: Sargent Co., South of Cayuga, 7 miles NW of Verblen, South Dakota, 21 March 1966, R. D. Gordon, Aarhus and Tweten, 4 males, 1 female, 7 nymphs (National Museum of Natural History, Entomology, Washington, District of Columbia, U.S.A.).

ACKNOWLEDGEMENTS

We thank Dr. Robert Gordon for encouraging us to look for these specimens at the Smithsonian Institution. Dr. Oliver S. Flint, Jr. facilitated the loan that led to this paper.

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SCIENTIFIC NOTE

MYIASIS IN BRISTLE-SPINED PORCUPINE, *CHAETOMYS SUBSPINOSUS* (OLFERS, 1818), IN BAHIA, BRAZIL[1]

Adriana Akemi Kuniy[2] and Caroline Nascimento Santos[2]

Two specimens of *Chaetomys subspinosus* (Olfers, 1818) (Rodentia, Echimyidae, Chaetomyinae) infested by screwworm *Cochliomyia hominivorax* (Coquerel, 1858) (Diptera: Calliphoridae) were captured in an Atlantic Forest fragment at Salvador, northeastern Brazil, on March 24 and April 12, 2003. One of them had parasite infestation on the left of its face, between its ear and buccal cavity (Fig. 1); the other one had 70 percent tail infestation. The specimens were brought to a Wild Animal Rehabilitation Center due to screwworm infestation located in the body of the animals and were treated with chemical products (clorpirifos, diclorvos), before their translocation to a permanent place in reserve. Despite this procedure, none of them survived treatment more than one day. *Cochliomyia hominivorax* is an ectoparasite usually found in skin and mucous secretion during its larval phases. This screwworm develops in live tissues of their hosts in only one lesion considered relatively large, with repulsive secretion (Koller et al., 2002). *Cochliomyia hominivorax* has been reported in humans (Duque et al., 1990; Leclercq 1990; Mehr et al., 1991; Boulard and Quiroz 1991; Kron, 1992) and in domestic mammals, such as cattle (Sanavria et al., 1996; Moya Borja et al., 1993), sheep, pigs, goats, mules, donkeys, dogs, and cats (Rawlings and Cheng Sang 1984; Costa et al., 1985; Amarante et al., 1992; Mariluis et al., 1994). It also can be found in Brazilian sylvan mammals, like the porcupine *(Coendou prehensilis prehensilis)* (Lacey and George 1981). This is the first record of an infestation by *Cochliomyia hominivorax* in *Cochliomyia subspinosus* porcupines.

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We are grateful to Mr. Marco Túlio R. Brasileiro and MSc Adriana Lampert who identified the parasite, to Dr. Mário de Vivo that encouraged this paper, and MSc Cristiane Villaça and Mr. Guilherme Barco for their comments and review.

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[1] Received on August 12, 2004. Accepted on August 13, 2004.

[2] JGP Consultoria e Participações Ltda.R. Américo Brasiliense, 615, 04715-003, SP, Brazil. E-mails: araradri@ig.com.br; caledog@bol.com.br, respectively.

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Fig. 1. *Cochliomyia subspinosus* porcupine infested by *Cochliomyia hominivorax* screwworms. Note lesions on left side of the face, between its ear and buccal cavity.

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Faith B. Kuehn, *Business Manager*

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No.	Date of Issue	Pages	Mailing Date
1	Jan. & Feb. 2003	1-60	April 9, 2004
2	Mar. & Apr. 2003	61-120	June 23, 2004
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4	Sept. & Oct. 2003	181-240	August 25, 2004
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Jorge A. Santiago-Blay[1]

I am profoundly grateful to colleagues from around the world who have generously donated their time and energy to review numerous articles, some submitted as early as May 2001. Their names, arranged alphabetically by last name, and affiliations, or addresses, follow.

Anonymous (several) – various affiliations

J. D. Barbour – University of Idaho, Research and Development Center, Parma, Idaho, United States

Richard W. Baumann – Department of Zoology and Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, United States

Daniel J. Bickel – Entomology Section, Australian Museum, Sydney, Australia

Art Borkent – Royal British Columbia Museum, Enderby, British Columbia, Canada

Howard P. Boyd – Tabernacle Township New Jersey, United States

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Steven Chordas – Vector-Born Disease Program, Ohio Department of Health, Columbus, Ohio, United States

Stephen G. A. Compton – Centre for Biodiversity and Conservation, School of Biology, University of Leeds, Leeds, England, United Kingdom

Charles V. Covell, Jr. – Department of Biology, University of Louisville, Louisville, Kentucky, United States

Mark Deyrup – Archbold Biological Station, Lake Placid, Florida, United States

Christopher H. Dietrich – Illinois Natural History Survey, Champaign, Illinois, United States

Donna R. Ellis – Department of Plant Sciences, University of Connecticut, Storrs, Connecticut, United States

Gregory Evans – Florida State Collection of Arthropods, Gainesville, Florida, United States

Neal L. Evenhuis – Department of Natural Sciences, Bernice P. Bishop Museum, Honolulu, Hawaii, United States

Oliver Flint – Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, District of Columbia, United States

[1] Department of Paleobiology, MRC-121 National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, Washington, District of Columbia 20013-7012, U.S.A.

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Suzanne McIntire, Carmen Montopoli, Judith Barr, Suzanne C. Shaffer, and Jorge A. Santiago-Blay

Addresses in Acknowledgments

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OOK REVIEW

Cricket Boy: A Chinese Tale Retold by Feenie Ziner. Illustrated by Ed Young. Double Day and Company, Inc. Garden City, New York, USA. 47 pages. Hard Cover US$6.95.

Cricket Boy: A Chinese Tale Retold takes place in Yung Ping, China. Scholar Hu is a single father who works hard on his education in spite of poverty. He has a son named Hu Sing who works in the fields to support the family, plays with crickets, and feels uninspired by books. To understand his son more, Scholar Hu decides to take interest in crickets. His time with Hu Sing and the crickets made him question the nature of animals and humans. Scholar Hu asks: "Is there not as great as a mystery in the life of a cricket as there is in the life of a Man? How is it that some crickets are naturally shy, and others are born fighters? What happens to the spirit of a cricket when the summer ends, and its body dies?" I like the way the author made connections between humans and nature. (DA)

Little things could be strong. This is a story about a boy who had a cricket that inspired him to do better. It gave the boy skills to carve a tickling rod and determination to have the best crickets in the kingdom. The boy works very hard with his father to collect the best crickets and train them to be smart fighters. The story also questions the soul of a cricket. Are animals like us? Is there a cricket heaven? It doesn't matter what you believe, the story is still very good to read! (NP)

The book has many lessons like if you find a loud chirping cricket (or person), it doesn't always mean that it is the best: "The loudest chirper often sings only to keep his courage up. Listen, instead, for the quiet fellows. There you will find true pride." The quote is like "Still waters run deep. Babbling brooks are shallow." There are lots of other lessons that are good for character improvement at all ages. (KR)

I liked this story because it shows us how to be brave. Scholar Hu lived and brought fame to the city of Yung Ping even when he was very sad about his son's death. Although the relationship between the father and son was over, Hu Sing did not really die forever. By turning into a cricket to fight against the Emperor's cricket champion, Hu Sing's spirit lives. (EM)

Cricket Boy: A Chinese Tale Retold makes you think a lot. The father, Scholar Hu, gives his son, Hu Sing, a lot of advice from what he has learned from books that can be used to understand the similarities between animals and humans. Scholar Hu advises Hu Sing on how to catch a cricket and question the spirit of the cricket. Also, Hu Sing himself turns into a cricket. These things show us how close we are connected to nature. If you are curious about how animals and humans are related, you should read this book. Plus, it is also good to see life differently. (JS)

This is a book about a boy who cares for his crickets and the love between a father and his son. They get together and collect the best crickets. Their love is so much that the son, Hu Sing, came back as a cricket after he accidentally kills their prized cricket, Black Dragon. Black Dragon was going to fight the Emperor's champion. His father, Scholar Hu, did not know that the cricket that beat the Emperor's cricket was Hu Sing until he came back to the village and woke up from his death to tell his father. Hu Sing had a dream of battling against the Emperor's generals. I think that the love in this story shows us that it can give us the courage to do anything. (AS)

I like this tale because it shows character and feelings. I was shocked to find out that Hu Sing dies in the middle of the story. However, when he is reincarnated into a cricket and defeats the Emperor's cricket champion, I thought it was very magical. It is like when you have a dream or passion about something that you cannot let go of even when you pass away. I want everybody to read this and see a different kind of life from us here in America. (TB)

Cricket Boy: A Chinese Tale Retold shows that we can learn a lot about ourselves by watching animals. Animals can sometime resemble us: "… for the catcher of crickets must be silent and swift, and not be too proud to kneel before the smallest creature". I think kings, queens, and presidents should think about this. It teaches us that no one is better than others. (MP)

Students' artwork can be seen at: http://geocities.com/entomologicalnews/archives.htm.

Dominique Atwell, Tiffany Brown, Erika Mendoza, Marlon Padrón, Nallely Prudencio, Kimberley Routt, Ana Sánchez, Jennifer Sánchez, other 5th & 6th graders, and Yen T. Nguyen
John F. Kennedy Elementary School, Houston Independent School District
Houston, Texas 77022 U.S.A.
E-mail: yentnguyen111@yahoo.com.