

**NEW RECORDS AND OBSERVATIONS FOR
PARASITIC CHIRONOMID MIDGES (DIPTERA:
CHIRONOMIDAE) AND THEIR MAYFLY
(EPHEMEROPTERA) HOSTS¹**

B. A. Caldwell², N. A. Wiersema³

ABSTRACT: An additional population of the parasitic chironomid midge genus *Symbiocladius* has been found on a species of mayfly (Heptageniidae) not known previously as a host in Georgia. In on-going studies of the mayfly fauna of Texas, another chironomid midge, *Nanocladius* (*Plecopteracoluthus*) *bubrachiatus*, was found on two species of Leptophlebiidae, a previously unreported association with these taxa, and provides the first report of *N. bubrachiatus* outside of the neotropics.

The chironomid midge genus *Symbiocladius*, previously known in Georgia to the first author from only two localities, has been recently found on *Leucrocuta maculipennis* (Walsh) (Ephemeroptera:Heptageniidae). Specimen data is as follows: Georgia, Heard County, Town Creek, approx. 0.75 miles from confluence with Hillabahatchee Creek, 20 August 1998, leg. J. Maudsley and L. Dorn, 3 *L. maculipennis* larvae, 2 with *Symbiocladius* larva, 1 with larval exuviae in pupal case. All specimens are in the collection of the first author. A species determination was not possible since the Nearctic *S. equitans* Claassen and *S. chattahoocheensis* Caldwell are currently inseparable except as males, with females undescribed.

Also recorded from the collection site was a single mayfly larva identifiable as *L. aphrodite* (McDunnough). It showed no signs of parasitism, but could possibly also serve as a host. Although *L. maculipennis* presence in Georgia is widely accepted, the record reported here is the first published for the state. *S. equitans* has previously been reported from *L. maculipennis* (as *Heptagenia maculipennis*) by Wiens et al. (1975) for Canada, and listed in Jacobsen (1995).

The characters that separate males of *S. chattahoocheensis* from *S. equitans* are a single gonostylar megaseta and more rounded volsella (Caldwell 1984). However, southern hemisphere *Symbiocladius* have been shown to vary in megaseta number both among and within species (Gonser and Spies 1997): thus *S. renatae* Spies carries 0 megasetae, *S. wygodzinskyi* Roback 1 or more, and *S. aurifodinae* Hynes 3 to 5. Moreover, occasional doubling of the megasetae frequently occurs in some other chironomid species, e.g. the tanypod *Coelotanypus concinnus* (Coquille), see Sublette et al. (1998). Thus, a comparative examination of *Symbiocladius* females and additional reared

¹ Received June 5, 2001. Accepted August 25, 2001.

² 1035 Lewis Ridge Circle, Lawrenceville, GA 30045.

³ 4857 Briarbend Drive, Houston, TX 77035.

material from different North American areas is needed to determine if the variation in the males is intra- or inter-specific.

In ongoing studies in Texas by the second author, midges have been found also on the leptophlebiid mayflies, *Traverella presidiana* Traver and *Thraulodes gonzalesi* Traver and Edmunds. Specimen data is as follows: Texas, Kimble County, Junction, South Llano River, Texas Tech. Field Station, 07 October 1997, leg. N. A. Wiersema, 2 *T. gonzalesi* larvae, each with 1 *N. bubrachiatus* larva; 6 *T. presidiana* larvae, 2 each with 1 larva, 3 each with 1 larval exuviae in pupal case, and 1 with 4 larvae of *N. bubrachiatus*. All specimens are in the collection of the first author.

The midges were determined to be *Nanocladius bubrachiatus* Epler. *N. bubrachiatus* is superficially similar to *N. sp. 2* Jacobsen (Jacobsen 1999; Mayo 1969, as *Symbiocladius*). Chironomids have not been recorded previously in association with either of these mayfly species.

In making the above determination, the only disagreements with the description of Epler (1986) for Honduran specimens were the apparent lack of a seta interna on the mandible, first lateral mentum teeth not always sharply pointed, and a tendency of the basal and central mandibular teeth to be fused. The seta interna illustrated by Epler (1986) is quite small, and might be lacking in some specimens or possibly become transparent in the mountant. In two *N. bubrachiatus* paratypes examined the seta interna could not be discerned, and there was at least slight fusion of the basal mandibular teeth. Fourth instar larvae of *N. bubrachiatus* are easily separable from *N. sp. 2* by features of the antenna, mentum, and mandible, including a first antennal segment > 41 μm , an AR of 1.66-1.91 (sclerotized length only), 6 lateral mentum teeth, and the non-indented outer margin of the mandible. In *N. sp. 2* the first antennal segment is 25.7-28.0 μm long, the AR is 0.9-1.0, the mentum has 7 lateral teeth, and the outer margin of the mandible is indented (see respective descriptions in Epler, 1986 and Mayo, 1969).

N. bubrachiatus also appears to be parasitic, based upon the Texas specimens. Three immature larvae on *T. presidiana* exhibited a pattern of attachment and positioning consistent with that described by Jacobsen (1999) for his parasitic *N. sp. 2*. Two small larvae (probably second instar) were observed in positions suggestive of attempted penetration, with frontal area of the heads resting on the unsclerotized integument of the host's left hind coxal base and left third gill base, respectively. An additional slightly larger larva (probably third instar) was observed on the left lateral thoracic area between the mid and hind coxae, with the frontal portion of the midge's head capsule appressed to the host's thoracic surface.

Scarring – noted by Jacobsen (1999) as evidence of parasitism – was not apparent, but there were other signs of parasitic feeding by *N. bubrachiatus*, such as a deformed rear wingpad of the host as well as some aberrant gill development. The *Nanocladius* larval guts did not contain boluses of sedi-

ment, algae, and detritus which are usually present in non-parasitic larvae. This is interpreted as a further indication of feeding on the host's hemolymph and was also noted in two larval paratypes examined. However, stable-isotope analysis as reported by Doucett et al. (1999) is a more definitive and unambiguous, though involved, method to identify the dietary carbon source to confirm parasitism.

Epler (1986) termed the association he observed as symphoretic, with no mayfly damage or malformation noted. His larval specimens were apparently all fourth instar. Thus, they might have ceased feeding and positioned themselves for pupation, since all were oriented with heads facing the posterior ends of the mayflies. No signs of possible earlier larval positioning for feeding were evident, even from the several empty cases still attached. *Nanocladius* (*Plecopteracoluthus*) is now known from four zoogeographic regions (Jacobsen 1999; Hayashi 1998), with suspect parasitism known from the Nearctic, Neotropical, and Oriental regions. Although Spies and Reiss (1996) give the second record of occurrence from Belize, *N. bubrachiatus* has not been reported previously outside the neotropics. Very recently, Dorvillé et al. (2000) reported symphoresy between an unnamed species of *N. (Plecopteracoluthus)* and immatures of a perlid stonefly, *Kempnyia tijucana* Dorvillé & Froehlich from Brazil. Callisto and Goulart (2000) also recently reported *N. (Plecopteracoluthus)* sp. from Brazil in a phoretic association with *Thraulodes* sp.

Based upon the habitat and mayfly hosts reported by Epler (1986) and our Texas specimens, *N. bubrachiatus* is now known from two genera of leptophlebiid mayflies in warmer streams at low elevations in the Nearctic and Neotropical regions. Although known from only a single Nearctic site, the host spectrum of *N. sp. 2*, the obviously closest relative, is wider and includes leptophlebiid and heptageniid mayflies in a cold/cool mountain stream at an elevation of about 5,000 ft (1,524 m) in southwestern Arizona.

ACKNOWLEDGMENTS

The authors thank J. H. Epler, Crawfordville, FL, P. A. "Trish" Foster, Buford, GA, R. E. Jacobsen, Homestead, FL, and M. Spies, Munich, Germany for comments on a preliminary draft of the manuscript and/or loan of specimens.

LITERATURE CITED

- Caldwell, B. A. 1984. Two new species and records of other chironomids from Georgia (Diptera: Chironomidae) with some observations on ecology. *Ga. J. Sci.* 42:81-96.
- Callisto, M. and M.D.C. Goulart. 2000. Phoretic association between *Nanocladius (Plecopteracoluthus)* sp. (Chironomidae: Diptera) and *Thraulodes* sp. (Leptophlebiidae: Ephemeroptera). *An. Soc. Entomol. Bras.* 29:605-608.
- Dorvillé, L. F. M., J. L. Nessimian and A. M. Sanseverino. 2000. First record of symphoresy between nymphs of the stonefly *Kempnyia tijucana*, (Plecoptera, Perlidae) and chironomid larvae, *Nanocladius (Plecopteracoluthus)* sp., in the Neotropics. *Stud. Neotrop. Fauna Environ.* 35:109-114.

- Doucett, R. R., D. J. Giberson, and G. Power.** 1999. Parasitic association of *Nanocladius* (Diptera: Chironomidae) and *Pteronarcys biloba* (Plecoptera: Pteronarcyidae): insights from stable-isotope analysis. *J. N. Am. Benthol. Soc.* 18:514-523.
- Epler, J. H.** 1986. A novel new Neotropical *Nanocladius* (Diptera: Chironomidae), symphoretic on *Traverella* (Ephemeroptera: Leptophlebiidae). *Fla. Entomol.* 69:319-327.
- Gonser, T. and M. Spies.** 1997. Southern hemisphere *Symbiocladius* (Diptera, Chironomidae) and their mayfly hosts (Ephemeroptera, Leptophlebiidae). Pp. 455-466. In: P. Landolt and M. Sartori (eds.), *Ephemeroptera & Plecoptera. Biology - ecology - systematics*. MTL, Fribourg (Switzerland).
- Hayashi, F.** 1998. *Nanocladius (Plecopteracoluthus) asiaticus* sp. n. (Diptera: Chironomidae) phoretic on dobsonfly and fishfly larvae (Megaloptera: Corydalidae). *Aquat. Insects* 20:215-229.
- Jacobsen, R. E.** 1995. Symbiotic associations between Chironomidae (Diptera) and Ephemeroptera. Pp. 317-332. In: L. D. Corkum and J. J. H. Ciborowski (eds.), *Current directions in research on Ephemeroptera*. Canadian Scholars' Press, Toronto.
- Jacobsen, R. E.** 1999. The symbiotic relationship of a chironomid with its ephemeropteran host in an Arizona mountain stream. *J. Kans. Entomol. Soc.* 71:426-438.
- Mayo, V. K.** 1969. Nymph of *Thraulodes speciosus* Traver with notes on a symbiotic chironomid. *Pan.-Pac. Entomol.* 45:103-112.
- Spies, M. and F. Reiss.** 1996. Catalog and bibliography of Neotropical and Mexican Chironomidae (Insecta, Diptera). *Spixiana Supplement* 22:61-119.
- Sublette, J. E., L. E. Stevens and J. P. Shannon.** 1998. Chironomidae (Diptera) of the Colorado River, Grand Canyon, Arizona, USA, I: systematics and ecology. *Gr. Basin Natural.* 58:97-146.
- Wiens, A. P., D. M. Rosenberg and K. W. Evans.** 1975. *Symbiocladius equitans* (Diptera: Chironomidae), an ectoparasite of Ephemeroptera in the Martin River, Northwest Territories, Canada. *Entomol. Germanica* 2:113-120.

BOOK REVIEW

TIGER BEETLES, THE EVOLUTION, ECOLOGY, AND DIVERSITY OF THE CICINDELIDS. D.L. Pearson & A.P. Vogler. 2001. Comstock Publishing Assoc's, Cornell Univ. Press. 333 pp. Hard. \$39.95.

Beyond any doubt, this is the most complete and comprehensive review of all that is presently known about the evolution, speciation, molecular composition, genetics, biogeography, ecology, and diversification of this exciting group of insects we call tiger beetles. In fact, it is almost a complete compendium of all major research, supported with abundant citations, in its review of present day thinking about the many world wide taxa of the Cicindelidae.

The book consists of twelve chapters divided into three parts: I. Taxonomic Diversity: Tiger Beetles in Space and Time, II. Ecological Diversity: Tiger Beetles in their Environment, III. Interaction of Ecological and Taxonomic Diversity. There are 29 color plates and copious figures and tables throughout the text. There are two appendices: A. Observing and Collecting Tiger Beetles, and B. Natural History of the major Tiger Beetle Genera of the World. Included is a substantial Literature Cited section and both a Taxonomic Index and a Subject Index.

This book is not intended to be a complete, final answer to all that will ever be known about tiger beetles. Rather, it raises as many questions for future research as it answers based on past research. Anyone looking for field test organisms for future research studies would do well to consider tiger beetles.

In conclusion, this is a superb book, one that every cicindelid worker **MUST** have and every coleopterist **SHOULD** have.

H.P.B.