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Larvae of the three common North American species of *Phyloctropus* (Trichoptera: Dipseudopsidae)

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Abstract: The caddisfly genus *Phyloctropus* includes 7 extant species globally, of which 5 occur in eastern North America and 2 in eastern Asia. Larvae of the 3 most common North American species [*Phyloctropus carolinus* Carpenter, *P. lucidus* (Hagen), and *P. placidus* (Banks)] were associated with identifiable adults and diagnostic characters are described. Larvae of these 3 species may be distinguished by overall length of mature larvae, head color pattern, and number of spines on the hind tibiae. Larvae of other species of this genus are unknown.

Key words: *Phyloctropus carolinus*, *Phyloctropus lucidus*, *Phyloctropus placidus*, species diagnosis, water quality monitoring

Introduction

Larvae of the caddisfly genus *Phyloctropus* are best known for the long tubes they construct in the generally sandy substrates where they live, typically in lotic depositional waterways (Vorhies 1909, Wallace *et al.* 1976, Wiggins 1996a, Merritt & Cummins 1996). They are filter feeders, eating fine organic seston removed from suspension in the water column by means of a net spun in an outflow arm of the tube; water is probably circulated through the tube by larval undulations in the vertical part of the tube above the outflow arm (Wallace *et al.* 1976, Wiggins 1996a, Merritt & Cummins 1996).

The genus *Phyloctropus* was recently transferred from Polycentropodidae to the family Dipseudopsidae (Wells & Cartwright 1993) and a phylogeny of the genus within that family inferred (Weaver & Malicky 1994). As a result of these studies, *Phyloctropus* was shown to be the only genus of Dipseudopsidae in North America.

Three of the 5 Nearctic species of *Phyloctropus* are especially common east of the Mississippi River (Schuster & Hamilton 1984). *Phyloctropus carolinus* Carpenter occurs in 2 disconnected regions including Maine, New Hampshire, Ontario,

and Québec in the north and Louisiana to Kentucky to South Carolina in the south. *Phyloctropus lucidus* (Hagen) is known throughout the east from Maine and Québec to Illinois and Louisiana and the Florida panhandle. *Phyloctropus placidus* (Banks) is the most widely distributed species in the genus, with records throughout the east and as far west as Manitoba, Minnesota, and eastern Texas. The remaining 2 North American species are much more restricted in distribution. *Phyloctropus auriceps* (Banks) occurs rarely in the mountainous areas of Georgia, North Carolina, South Carolina, and Virginia. *Phyloctropus harrisi* Schuster & Hamilton is known from a single male specimen captured in southern Alabama. Two described species of *Phyloctropus* are from eastern Asia (*Phyloctropus orientalis* Banks from Malaysia and *P. shigae* Tsuda from Japan). The remaining 4 species of the genus are fossil species described from Baltic amber (*Phyloctropus antiquus* Ulmer, *P. ligulatus* Ulmer, *P. simplex* Ulmer, and *P. spiniger* Ulmer).

Larvae of *Phyloctropus* may be distinguished from those of other North American caddisfly genera by the membranous meso- and metanota and tergum IX, the acute prothoracic trochantins

each completely fused with its episternum, and tarsi all flattened and broader than their tibiae (Wiggins 1996a, 1996b; Morse & Holzenthal 1996).

Different congeneric species of aquatic insects often have different ecological requirements and frequently vary greatly in their responses to environmental changes (Resh & Unzicker 1975). Consequently, it is important to be able to diagnose these species in their benthic forms. The larvae of the 3 most common North American species of *Phylocentropus* have been described, but the descriptions are inadequate for diagnosis. The larvae of *P. auriceps* and *P. harrisi* remain unknown. Consequently, biotic indices for water quality assessments have been computed for only the generic level of identification (Lenat 1993) except where only 1 species occurs (e.g., Hilsenhoff 1982). The larva of *P. carolinus* was described by Wiggins (1996a), that of *P. lucidus* by Sibley (1926), and that of *P. placidus* by Vorhies (1909, as *P. maximus* Vorhies).

The purpose of this paper is to provide diagnoses of the larvae of the 3 most common species of *Phylocentropus*.

Materials and methods

Numerous *P. carolinus* larvae were collected at the Walhalla State Fish Hatchery, Oconee County, South Carolina. Other specimens of various *Phylocentropus* species were collected by previous researchers from other areas, especially in South Carolina, but also from streams in Tennessee, Georgia, and North Carolina. All the specimens examined for this study are in the Clemson University Arthropod Collection.

No rearing attempts were made; the specimens were put in 80% ethanol immediately after collection. Associations of larvae with identifiable adults were accomplished by the metamorphotype method (Milne 1938, Wiggins 1996a). In this method, identifiable pharate adults and their larval sclerites occasionally were found inside pupal cocoons; the larval sclerites were compared with sclerotized structures of intact larvae.

Drawings were produced by superpositioning an ocular grid in a Wild M5A dissecting microscope over the body part to be illustrated, matching grid points with a grid visible through vellum drawing paper.

Results

Genus *Phylocentropus* Banks 1907: 130.

Type species: *Holocentropus placidus* Banks (original designation).

Synonym *Acrocentropus* Betten 1934: 209, 213 (synonymized by Milne 1936: 84, 88); type species: *Polycentropus lucidus* Hagen (original designation).

Larvae of *Phylocentropus* species recognizable from among those of all other North American genera by flattened and paddle-like tarsi (Figs. 1B, 2B, 3B), short and stout tarsal claws of middle and hind legs (Figs. 1B, 2B, 3B), and very long labium lacking palpi (Figs. 1A, 2A, 3A) (Wiggins 1996a). In addition, larvae long and slender. Head: mandibles broad, each with large setal brush on mesal surface, and left mandible grooved to fit right one (Menking 1978). Thorax: prothoracic segment much narrower than mesothorax and metathorax, and bulbous membranous area projecting between membranous meso- and metanota (Menking 1978); each foretrochantin fused with its pleuron as in Polycentropodidae (Wiggins 1996a); sclerites of all legs bordered with black. Abdomen: filaments on sides of abdomen single, unlike bifid filaments in Integripalpia larvae (Kerr and Wiggins 1995); no gills, but prominent lobes resembling anal papillae arising between long anal legs caudally. North American species and their larval diagnostic characters, where known, are as follows:

Phylocentropus auriceps (Banks 1905a: 218), *Plectrocnemia*; southern Appalachian Mountains; synonym *Phylocentropus rabilis* Milne, 1936: 84, 88 (synonymized by Ross, 1944: 293).

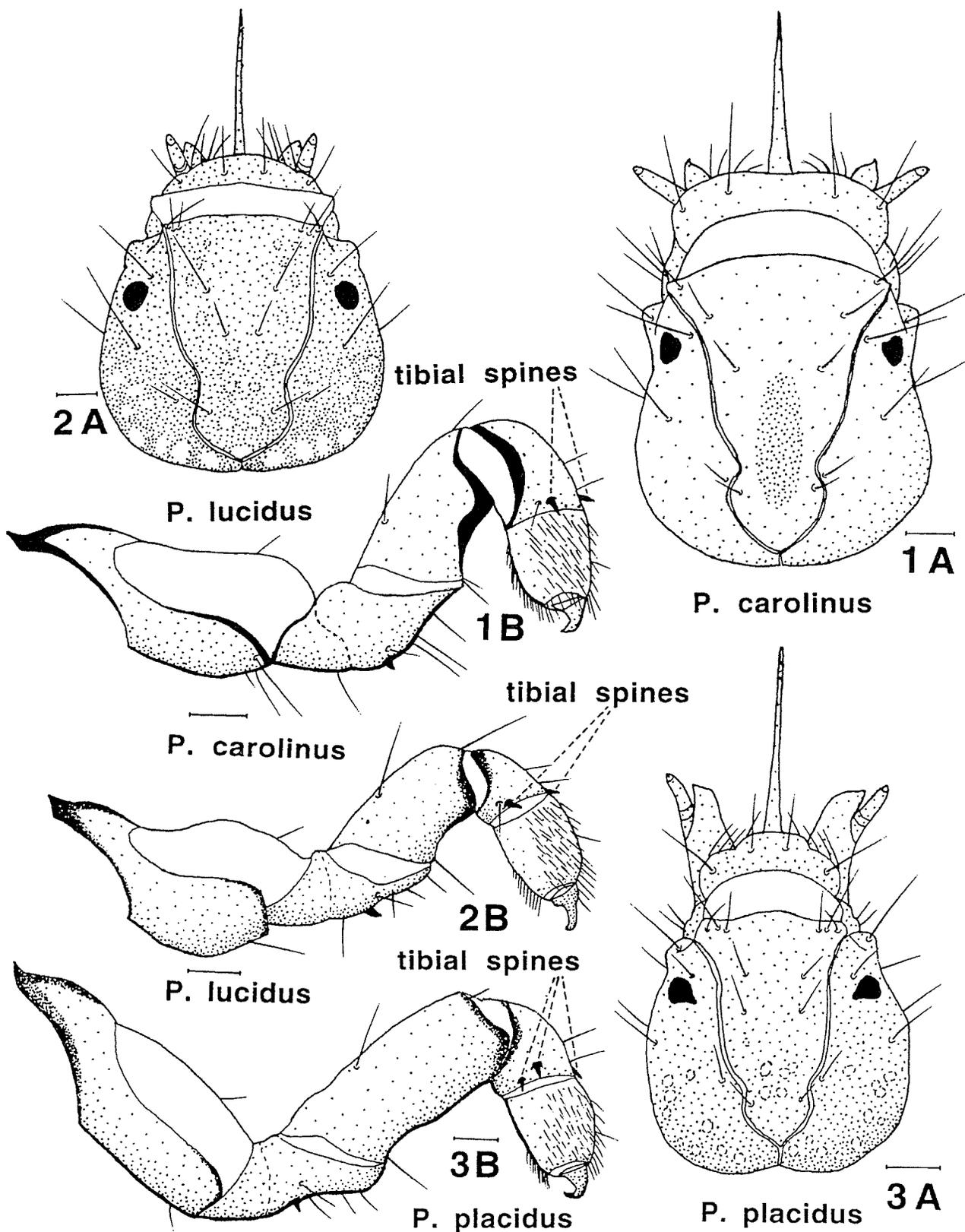
Larva unknown.

Phylocentropus carolinus Carpenter 1933: 43-44; eastern North America.

Larva described by Wiggins (1996a).

Body of mature larva 15-20 mm long. Larval head light yellowish brown, its frontoclypeus with darkened posterior region (Fig. 1A); this pigmented region covering most of posterior part of frontoclypeus with variable darkness. Tibia of each hind leg with 1 stout spine and 1 long seta on its caudolateral surface and one stout spine and 2 hairs on its anterior edge (Fig. 1B).

Phylocentropus harrisi Schuster and Hamilton 1984: 359-360, figs. 4, 15, 20; Alabama.



Figures 1-3. Larvae of *Phylocentropus* species. 1, *P. carolinus*; 2, *P. lucidus*; 3, *P. placidus*; A = head, dorsal view; B = right hind leg, caudal view. Scale lines each represent 0.1 mm.

Larva unknown.

Phylocentropus lucidus (Hagen 1861: 294), *Polycentropus*; eastern North America.

Larva described by Sibley (1926).

Body of mature larva less than 15 mm, generally shorter than for *P. carolinus* or *P. placidus*. Head uniformly brown with white spots ("muscle scars"), its frontoclypeus without evident darkened region posteriorly (Fig. 2A). Tibia of each hind leg with 1 stout spine and 1 hair on caudolateral surface and with 1 stout spine and 2 hairs on anterior edge (Fig. 2B).

Phylocentropus placidus (Banks 1905b: 15-16), *Holocentropus*; eastern North America;

Synonyms: *Phylocentropus hansonii* Root 1965: 85-87 (synonymized by Schuster and Hamilton, 1984: 358); *Phylocentropus irroratus* Navás 1934: 20-21, f 106, "*Philocentropus*" (synonymized by Schuster and Hamilton 1984: 358); *Phylocentropus maximus* Vorhies 1909: 711-713, pl 53 f 8, pl 61 f 1-13 (synonymized by Milne 1936: 88).

Larva described by Vorhies (1909, as *P. maximus* Vorhies); biology discussed by Wallace *et al.* (1976).

Body of mature larva 15-19 mm long. Larval head brown, covered dorsally by many small, white spots ("muscle scars"), frontoclypeus not evidently darkened posteriorly (Fig. 3A). Tibia of each hind leg with 2 stout spines and no hairs on caudolateral surface and with 1 stout spine and 2 hairs on anterior edge (Fig. 3B).

Key to Common North American Species of *Phylocentropus* Larvae

(larvae of *P. auriceps* and *P. harrisi* unknown)

1. Head light yellowish brown, with posterior region of frontoclypeus darkened (Fig. 1A); hind tibiae each with 2 stout spines and 3 long hairs in lateral view (Fig. 1B); body length of mature larva 15-20 mm *P. carolinus* Carpenter
- 1'. Head uniformly brown with light spots, posterior region of frontoclypeus not darkened (Figs. 2A, 3A); hind tibiae each with 3 stout spines (Fig. 3B) or 2 stout spines (Fig. 2B); body length of mature larva variable 2
- 2(1'). Hind tibiae each with 2 stout spines (Fig. 2B); body length no more than 15 mm *P. lucidus* (Hagen).
- 2'. Hind tibiae each with 3 stout spines (Fig. 3B); body length of mature larva 15-19 mm *P. placidus* Banks.

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