

Contribution to the taxonomy of Eastern North American *Epeorus* Eaton (Ephemeroptera: Heptageniidae)

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Abstract

The larva of *Epeorus punctatus* (McDunnough) is described for the first time based on reared specimens from West Virginia. Larvae are differentiated from those of other *E. vitreus* species group species by the bluntly pointed femoral projections, subrectangular head capsule, and short posterolateral abdominal projections. *Epeorus rubidus* (Traver) is considered to be a junior subjective synonym of *E. vitreus* (Walker). A key for the known larvae of the eastern North American species of the *E. vitreus* species group [*E. dispar* (Traver), *E. punctatus*, *E. subpallidus* (Traver), *E. vitreus*] is provided.

Key words: Ephemeroptera, taxonomy, *Epeorus*, Heptageniidae, new synonym, stage description

Introduction

In eastern North America, the species of *Epeorus* Eaton can be divided into two species groups. The *pleuralis* species group includes *E. fragilis* (Morgan), *E. frisoni* (Burks), *E. namatus* (Burks), and *E. pleuralis* (Banks). The *vitreus* species group (equivalent to the subgenus *Proepeorus* Kluge) includes *E. dispar* (Traver), *E. punctatus* (McDunnough), *E. rubidus* (Traver), *E. suffusus* (McDunnough), *E. subpallidus* (Traver), and *E. vitreus* (Walker). Adult males of the two species groups differ in the shape of the penes [see, for example, Traver (1935: Fig. 105)]. Larvae of the *pleuralis* species group are generally characterized by having the lamellae of gills 1 greatly enlarged anteriorly, whereas gills 1 of the *vitreus* species group are not enlarged as such. Additional characteristics associated with each of the species groups are provided in the key below.

The larvae of all eastern North American species of *Epeorus* are described except for those of *E. punctatus* and *E. suffusus*. These two species are known from only a few locations in Ontario, Quebec, and New York (McDunnough 1925; Walley 1927; Traver 1935). In this paper we provide the first description and diagnosis of the larva of *E. punctatus* based on specimens reared by Boris Kondratieff (Fort Collins, CO), an explanation for a new synonym of *E. vitreus*, and a new key for larvae of the *E. vitreus* species group in eastern North America. This key replaces commonly used, but incomplete, keys such as those of Unzicker and Carlson (1982) and Traver (1935).

Material examined is housed in the following collections: Purdue Entomological Research Collection, West Lafayette, Indiana (PERC) and Virginia Tech University, Blacksburg, Virginia (VTU). Material from the Great Smoky Mountains National Park (GSMNP) was collected as part of the All Taxa Biodiversity Inventory (Sharkey, 2001).

Epeorus vitreus (Walker) 1853

Palingenia vitrea Walker, 1853:555

Heptagenia vitrea; Eaton, 1871:143; Traver, 1935:365

Rhithrogena vitrea; Eaton, 1885:254

Epeorus humeralis Morgan, 1911:105

Iron humeralis; McDunnough, 1924:129; Traver, 1933:118; Traver, 1935:404

Iron rubidus Traver, 1933:158; Traver, 1935:409 **N. SYN**

Epeorus rubidus; Traver, 1937:52 **N. SYN**

Iron vitrea; Speith, 1940:330 (= *Epeorus humeralis* Morgan)

Epeorus vitrea; Burks, 1953:195; Flowers & Hilsenhoff, 1975:210; Peterson, 1989:6

Epeorus vitreus; Burian & Bednarik, 1994:209

Discussion: Traver (1933) described *Epeorus rubidus* based on a series of reared specimens from North Carolina (Traver 1933). *Epeorus rubidus* male adults were distinguished from those of *Epeorus vitreus* [as *Iron humeralis* (Morgan)] by Traver (1933, 1935) and Speith (1940) primarily by their smaller size. Traver (1933, 1935) stated the wing length of *E. rubidus* ranged from 8–9 mm and that of *E. vitreus* ranged from 10–11 mm. However, Traver (1937) later noted that some specimens of *E. rubidus* had a wing length up to 10.5 mm. Our examination of material collected from populations throughout much of eastern North America confirms that the range of wing length for *E. rubidus* includes the range for *E. vitreus*. Relative to *E. vitreus*, Traver (1933, 1935) also noted that the eyes of *E. rubidus* were smaller, the lateral spines on the penes were less distinct, and the thorax was pale yellowish brown rather than yellowish white. We found all of these characters to vary within and among populations.

Traver (1933, 1935) differentiated the larvae of *E. rubidus* from those of *E. vitreus* primarily by gill coloration, assigning specimens with reddish colored gills with purple tracheae to *E. rubidus* and specimens with clear or blackish tinged gills and black tracheae to *E. vitreus*. We observed a gradation between these two character states in a single

population from Mill Creek, TN. Traver (1935) also indicated the posterolateral abdominal projections of *E. rubidus* were longer and more curved than those of *E. vitreus* (Traver, 1935); however, we found this character to vary in almost every large series of specimens that we examined. As all of the characters previously thought to distinguish *E. rubidus* from *E. vitreus* were found to intergrade within and among populations, we place *E. rubidus* as a junior subjective synonym of *E. vitreus*.

Material Examined GEORGIA: 9 larvae, Rabun Co, Betty's Cr 5 mi W Dillard, 20-VI-1973, B Stark (PERC); 2 larvae, White Co, 7 mi NW Cleveland, Hwy 129, 19-VI-1973, B Stark (PERC); MAINE: 35 larvae, Somerset Co, Caratunk, Pleasant Pond Str, 24-VI-1966, R + D Koss (PERC); MASSACHUSETTS: 1 ♂ adult, Hampshire Co, Amherst, 6-VII-1944, JR Traver (PERC); 1 ♂ adult, Hampshire Co, Amherst, 19-VI-1956, JR Traver (PERC); NEW YORK: 3 ♂ adults, 18 ♀ adults, St. Lawrence Co, Ft. Jackson, St. Regis R, 21-VI-1932, L Harper (PERC); 2 larvae, St. Lawrence Co, St. Rd. 3, 1.5 mi E Cranberry L at bridge, VI-15-1976, WP McCafferty, M Minno, AV Provonsha (PERC); NORTH CAROLINA: 1 ♂ genitalia (slide mounted), Buncombe Co, Flat Cr at Black Mtn, VI-6-1929, JR Traver (PERC); 1 ♂ adult, Burke Co, Linville Falls, 3-VI-1940, CP Alexander (PERC); 1 ♂ adult, Haywood Co, GSMNP, Cataloochee Cr at Rd 284, 10-VII-1983, B Kondratieff (VTU); 1 ♂ adult, 5 ♀ adults, Swain Co, unnamed trib Ravens Fk, upstream bridge to Ranger Stn, 31-VII-2001, DR Jones + RC Harrington (PERC); 2 ♂ adults, Watauga Co Valle Crucis, 27-V-1936 JR Traver (PERC); 1 ♂ adult, 2 ♂ subimagos, 1 larval exuviae, Watauga Co, Valle Crucis, 29-V-1936, JR Traver (PERC); 3 ♂ adults, Watauga Co, Banners Elk, 31-V-1936, JR Traver (PERC); PENNSYLVANIA: 21 larvae, Chester Co, East Br White Clay Cr, 0.6 mi W London Grove, 26-V-1980, DH Funk (PERC); TENNESSEE: 2 ♂ adults, 2 ♀ adults, Blount Co, GSMNP, Cades Cove Ranger Station, at light, 35° 36' 10" N 83° 46' 36" W (NAD27), 13-V-2001, CD + RP Randolph, LM Jacobus (PERC); 3 larvae, Blount Co, GSMNP, Forge Cr at Parsons Branch Rd, 35° 35' 03" N 83° 50' 17" W (NAD27), 18-V-2001, CD + RP Randolph, LM Jacobus (PERC); 18 larvae, Blount Co, GSMNP, Cades Cove, Mill Cr near Rabbit Creek Trailhead, 35° 35' 26" N 83° 51' 10" W (NAD27), JM Webb + LM Jacobus (PERC); VIRGINIA: 1 ♂ adult with associated exuviae, 4 larvae, Rappahannock Co, Hughes R at Rt. 707, 7-VII-1979, B Kondratieff (VTU); 1 ♂ adult, Montgomery Co, Mill Cr at Rt 785, 5-VI-1978, B Kondratieff (VTU); 5 ♂ adults, Giles Co, Big Stoney Cr at Rt 635, 13-VII-1977, B Kondratieff (VTU); 5 ♂ adults, Washington Co, Tumbling Cr at Rt 747, 29-VIII-1979, B Kondratieff (VTU); 2 ♂ adults with associated exuviae, Tazewell Co, Stations Spring Cr at Burkes Garden, 14-V-1979, B Kondratieff (VTU).

Epeorus punctatus (McDunnough) 1925

Iron punctatus McDunnough, 1925:189; Traver, 1935:409
Epeorus punctatus; McDunnough, 1929:177

Larval Description: Body length 6.0–8.0 mm; caudal filaments 8.0–9.0 mm. General color light brown with pale markings.

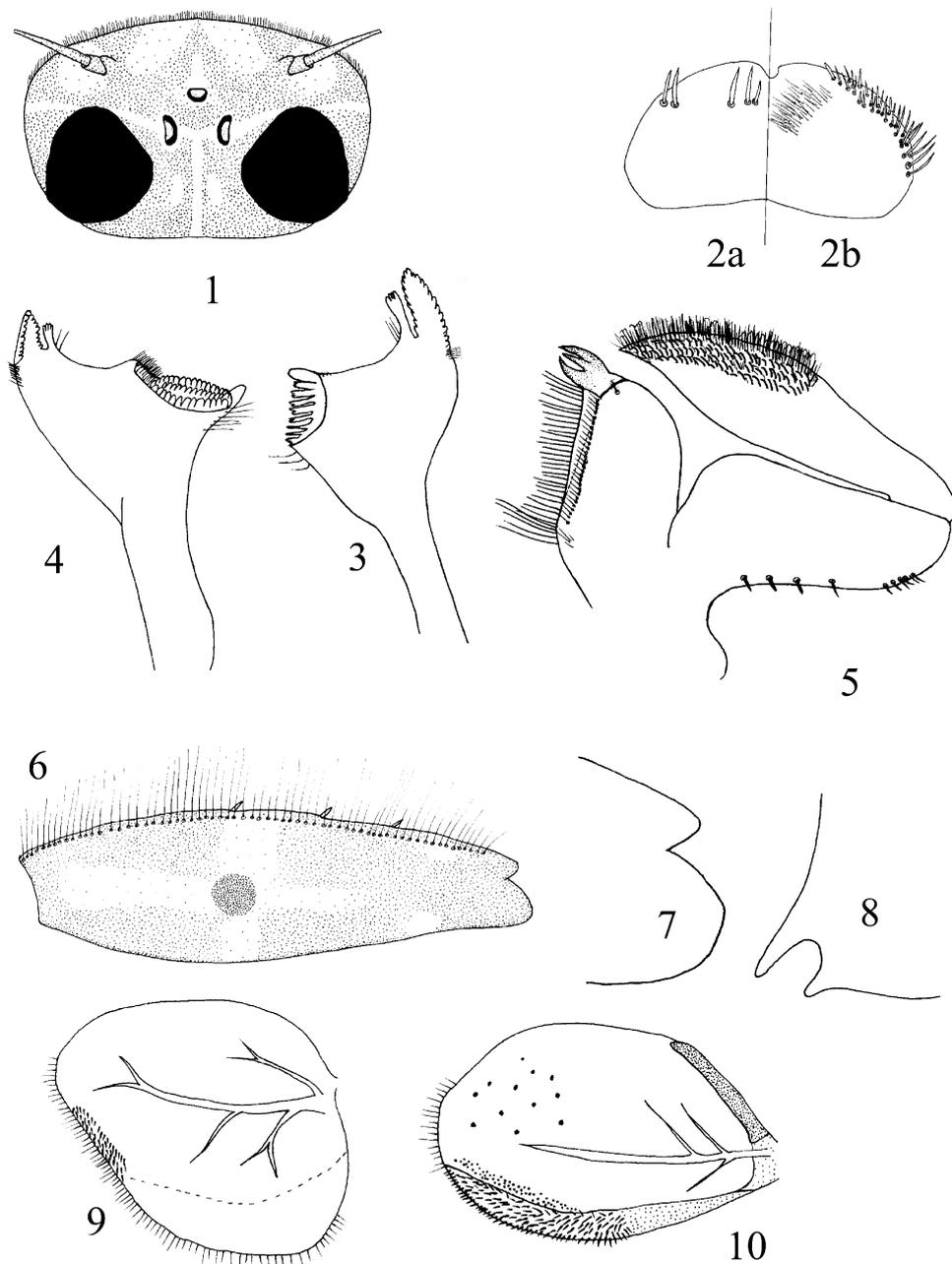
Head: Head capsule subrectangular, brown with pair of pale triangular spots on anteromedian margin and large pale spot on anterolateral margin (Fig. 1). Labrum (Fig. 2) dorsally with two long simple setae laterally and two or three long simple setae medially, ventrally with many long simple setae near lateral margin, approximately 2.0X wider than long. Mandibles as in Figs. 3 and 4. Maxillae (Fig. 5) with single fimbriate seta at base of cluster of apical spines; posterior margin of first segment of palp with sparse row and apical cluster of sharp robust setae.

Thorax: Coloration light brown with pale markings. Pronotum with transverse ridge. Femora (Fig. 6) with subdorsal row of long simple setae and dorsal row of three or four short robust setae; anterior face with both fine and paddle shaped robust setae, more numerous basally; ventral margin with fine setae and few robust setae basally; apices with dorsal projection bluntly pointed (Fig. 7); color brown with pale markings and dark spot centrally. Tibiae pale with basal and medial brown bands. Tarsi brown. Tarsal claws with four or five denticles on inner margin.

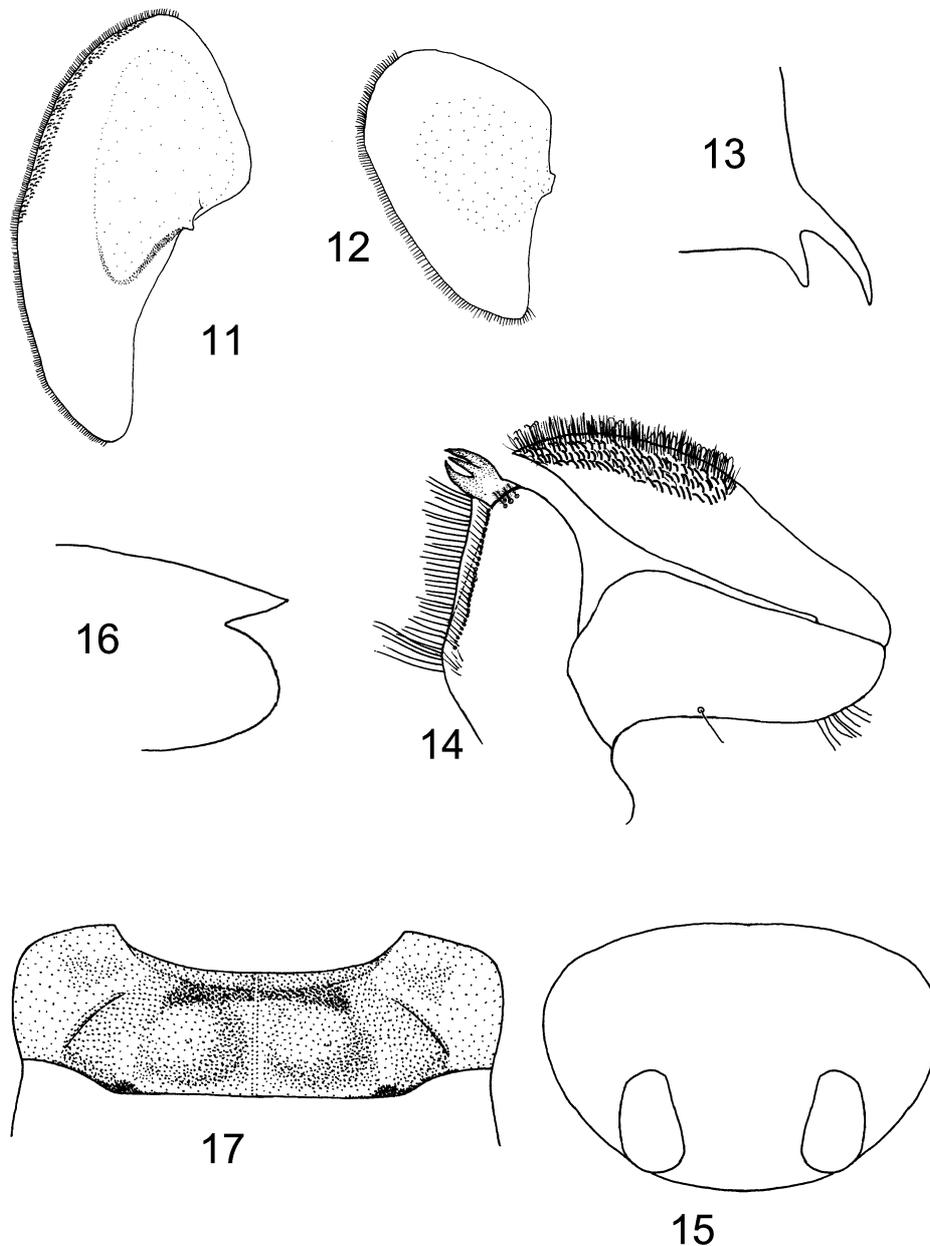
Abdomen: Terga light brown with various pale markings and median row of long fine setae; tergum 1 mostly light brown; terga 2–10 with submedian pair of dark spots with dark shading extending posteriorly (except tergum 6), and laterally with oblique dark mark surrounded by pale area. Terga 2– or 3–7 with minute posteromedian tubercle. Posterolateral spines short, with dorsal (outer) and ventral (inner) pair subequal in length (Fig. 8). First pair of gill lamellae (Fig. 9) not enlarged anteriorly; lamellae of gills 2–6 as in Fig. 10; lamellae of gills 7 not folded longitudinally. Cerci with small spines at articulations and dorsal row of fine setae.

Diagnosis: Larvae of *Epeorus punctatus* are differentiated from those of all other North American *Epeorus* species by the following combination of characters: the lamellae of the first pair of gills are not enlarged anteriorly; the apex of the hindfemur has a bluntly pointed projection; the setae of the subdorsal row on each femur are simple; and the dorsal and ventral posterolateral spines of the abdomen are subequal in length. *Epeorus punctatus* appears to be most similar to *E. subpallidus*. Male adults of *E. punctatus* are most reliably differentiated from those of *E. subpallidus* by the absence of lateral spines on the penes. Additionally, the abdominal terga of *E. subpallidus* are darkened only medially on the posterior margin and there are not any dark markings laterally; in *E. punctatus* there is a dark line along the entire posterior margin of each abdominal tergum that broadens laterally and there are also small, dark lateral maculae. The thorax of *E. subpallidus* is a pale yellowish brown whereas that of *E. punctatus* is a dark chestnut brown. Larvae of *E. punctatus* are smaller in size than those of *E. subpallidus*; the femoral flanges of the former are bluntly pointed rather than sharply pointed; and the pair of small pronotal protuberances of *E. subpallidus* are absent in *E. punctatus*.

Material Examined: WEST VIRGINIA: 2 ♂ adults, 3 ♀ adults with 4 associated exuviae (1 slide-mounted in Euparal), 1 larva, Fayette Co, Meadow R at Rt 19, 15-IX-1982, B Kondratieff (VTU).



FIGURES 1–10. *Epeorus punctatus*. 1, head capsule; 2, labrum; a: dorsal, b: ventral; 3, left mandible; 4, right mandible; 5, maxilla; 6, hind femur; 7, apex of hind femur; 8, abdominal segment 7; 9, Gill 1, lamella; 10, gill 6, lamella.



FIGURES 11–17. 11, *Epeorus pleuralis*, Gill 1, lamella; 12, *Epeorus namatus*, gill 1, lamella; 13, *Epeorus vitreus*, abdominal segment 7; 14, *Epeorus namatus*, maxilla; 15, *Epeorus dispar*, head capsule; 16, *Epeorus subpallidus*, apex of hind femur; 17, *Epeorus subpallidus*, pronotum, dorsal view.

Key to known larvae of the eastern north American *vitreus* species group

1. Lamellae of first pair of gills each with large anterior expansion, usually meeting or nearly meeting ventrally (Fig. 11) [lamellae of gills 1 of *E. namatus* only slightly

- expanded anteriorly (Fig. 12)]; subdorsal setae on femora pectinate; maxillae with more than one seta at base of apical tooth complex (Fig. 14); dorsal projection at apex of femora blunt; lamellae of gills 7 usually with longitudinal fold.....
*E. pleuralis* species group
- Lamellae of first pair of gills cordate, not expanded anteriorly (Fig. 9); subdorsal setae of femora simple; maxillae with single fimbriate seta at base of apical tooth complex; dorsal projection at apices of femora blunt or sharp; lamellae of gills 7 usually without longitudinal fold.....*E. vitreus* species group, 2
 - 2. Dorsal (outer) posterolateral projections of abdomen distinctly longer than ventral projections (Fig. 13)*E. vitreus*
 - Dorsal (outer) posterolateral projections of abdomen subequal to or only slightly longer than ventral posterolateral projections (Fig. 8) 3
 - 3. Abdominal terga each with small but distinct median protuberance on posterior margin, increasing in size posteriorly; head distinctly wider anteriorly (Fig. 15) and nearly uniform brown; gills 7 with longitudinal fold.....*E. dispar*
 - Abdominal terga without posterior median protuberances or terga 2 or 3–7 each with small median protuberance, decreasing in size posteriorly; head subrectangular (Fig. 1), with four large pale markings; gills 7 without longitudinal fold 4
 - 4. Dorsal projection at apex of hind femur sharply pointed (Fig. 16); pronotum with small pair of tubercles (Fig. 17); mature larvae >8.0 mm long.....*E. subpallidus*
 - Dorsal projection at apex of hind femur bluntly pointed (Fig. 7); pronotum without pair of small tubercles; mature larvae 6.0–8.0 mm long.....*E. punctatus*

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