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

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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

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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 mediposteriorly; 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.

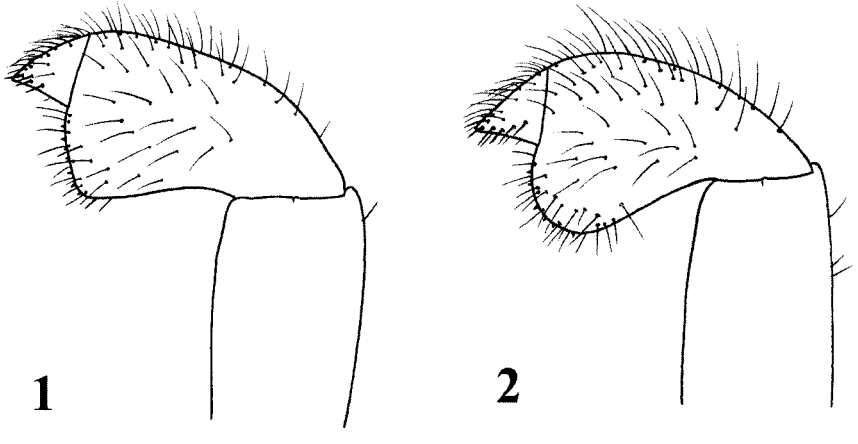
Additional material examined. *Paracloeodes fleeki:* NORTH CAROLINA, Gaston Co, unnamed tributary of Crowders Cr at SR 2416, IX-1989, D. Penrose and D. Lenat (larva); Guilford Co, Richland Cr at SR 1945, VII-1993, D. Lenat and D. McPherson (early instar larvae); same data as holotype (larva). *P. lugoi:* 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, Queratero (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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