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BARBAETIS: A NEW GENUS OF EASTERN NEARCTIC MAYFLIES (EPHEMEROPTERA: BAETIDAE)[1]

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ABSTRACT

The new genus *Barbaetis* Waltz and McCafferty, and new species *Barbaetis benfieldi* Kennedy are described from larvae collected from the New River, Virginia. *Barbaetis* is easily told from *Baetis* by the presence of procoxal osmobranchia. Cladistics of *B. benfieldi*, related *Pseudocloeon* species, and the *lutheri* and *pavidus* complexes of *Baetis* are presented and indicate the need for further taxonomic revision. The habitat of *B. benfieldi* is described in terms of several ecological parameters. The new species demonstrates a univoltine life history with postembryonic development restricted to a short springtime period.

The species of Nearctic Baetidae are thought to be relatively well known; however, a number of apparently endemic and problematic taxa have been recently encountered in the southeastern United States. One such taxon is described here as a new genus.

Barbaetis Waltz and McCafferty, **New Genus**

Adult. Unknown.

Larva. Head capsule broad. Mandibles asymmetric; left mandible incisors fused apically; right mandible incisors separated apically; prostheca of right mandible reduced, slender and furcate. Labium with glossa and paraglossa subequal and narrowed apically; base of labial palps broad and subquadrate; labial palps three-segmented, compact, second segment without lateral expansion. Procoxal osmobranchia present. Legs with clavate setae, ventral femoral setal patch present; claws with single row of denticles. Exocuticle scales absent and cuticle with sculptured pattern asperous and areolate (terminology after Harris 1979). Gills rounded, symmetric, without marginal serrations. Median terminal filament subequal to cerci.

Type species: *Barbaetis benfieldi* Kennedy.

Remarks. *Barbaetis* will key to the family Siphlonuridae in Edmunds et al. (1976) based on the short antennal character. It may be distinguished from all siphlonurids by (1) the presence of a well-developed thumb of the left mandible, (2) more elongate glossae and paraglossae, and (3) absence of posterolateral projections on abdominal segments 8 and 9. Within Baetidae *Barbaetis* will key to *Baetis* in Edmunds et al. (1976). It can be easily separated from *Baetis* by the presence of procoxal osmobranchia. The following combination of characteristics will diagnose *Barbaetis* from all other known baetid genera: (1) reduced prostheca of the right mandible, (2) presence of procoxal osmobranchia, (3) prominent hindwing pads, (4) scales absent, (5) asperous and areolate exocuticle as described above, and (6) presence of a median terminal filament subequal to cerci.

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Etymology. Masculine gender. The prefix, "bar", from "barbato", which is Latin for bearded, a reference to the bearded or setaceous condition of the glossal apices of the type species.

Barbaetis benfieldi Kennedy **New Species**

Adult. Unknown.

Mature larva. Body 6.0–7.5 mm. Antennae (Fig. 1) subequal to head capsule in length; scape ca. 0.33x length of pedicel. Labrum (Fig. 2) small, base subequal to 0.33x width of head capsule, emarginate; marginal setae plumose anteriorly, simple laterally; submarginal setal row not simple, but forming medial field of 30–40 setae; five to seven short, ventral, marginal bristles, not attaining margin of labrum. Right mandible (Fig. 3). Left mandible (Fig. 4) with 4 + 3 apical denticles; prostheca with first denticle digitate and curved, and with six to seven bladelike denticles following; thumb large and blunted apically; denticles of molar area peglike and interspersed with small spines. Maxilla (Fig. 5) apically with four broad denticles and two stout anterior bristles, and basally with 1 + 6–7 setae; palp two-segmented with distinct apical protuberance. Hypopharynx with microspine fields on dorsum of lingua. Labium (Fig. 6) with palp segment 3 ca. 0.66x length of segment 2, with apical row of spinelike setae dorsally and with randomly placed bladelike setae and additional fine setae ventrally; segment 2 with four to five dorsal setae and with two to four bristlelike setae and fine setae ventrally; basal segment broad, subquadrate; paraglossa slightly shorter than glossa with three to four apico-marginal setae dorsally and four to five intero-marginal setae ventrally; glossa with apical third covered with fine setae dorsally and with 10–12 intero-marginal setae.

Metathorax with well-developed hindwing pads. Legs (Fig. 7) with clavate setae dorsally on femur, tibia, and tarsus; ventrally with clavate setae on trochanter and femur; ventral setae of tibia and tarsus short, truncate; ventral apical seta of tarsus reduced, rounded. Claw (Fig. 8) with strongly curved apex and 14-15 denticles increasing in length distally.

Abdominal color pattern (Fig. 9); segment 1 light, with red-brown posterior margin; segments 2, 6, and 7 entirely red-brown; remainder of abdominal terga white; ventrally segments 6 and 7 red-brown, remainder of sterna white. Posterior marginal spines (Fig. 10) poorly developed, more evident on most-posterior segments. Abdominal surfaces without scales; fine setae sparsely and randomly scattered on dorsal and ventral surfaces. Abdomen with seven pairs of ovate gills, surfaces identical to body cuticle and without marginal spines or serrations; gill 1 smallest; gills 1, 2, 6, and 7 brown. Paraproct edentate marginally with surface having fine setae and pores. Caudal filaments with distinct medial pigmented band; cerci subequal to 0.5x body length; median filament subequal to cerci.

Type material. HOLOTYPE: female larval exuviae (in alcohol), Virginia, Carroll Co., New River riffle, Rt. 721 bridge, V-11-1977. J. H. Kennedy; deposited Purdue University Entomological Research Collection, PARATYPES: two female larval exuviae (slide mounted: euparal, abs. alc.), one female larva (alcohol), and one male larva all same location as holotype, V-11,12-1977. Deposition of paratypes: one female larval paratype in alcohol deposited with the United States National Museum, Washington, D.C.; two slide mounted female paratypes and male larva (mouthparts slide mounted; euparal, abs. alc.) same deposition as for holotype.

Etymology. This species is named in honor of Dr. Ernest F. Benfield, Virginia Polytechnic Institute and State University, for his many contributions to the study of the New River.

PHYLOGENY

The genus *Barbaetis* appears to be most closely related to the Nearctic *Pseudocloeon cestum* Provonsha and McCafferty and an undescribed southeastern cognate of this

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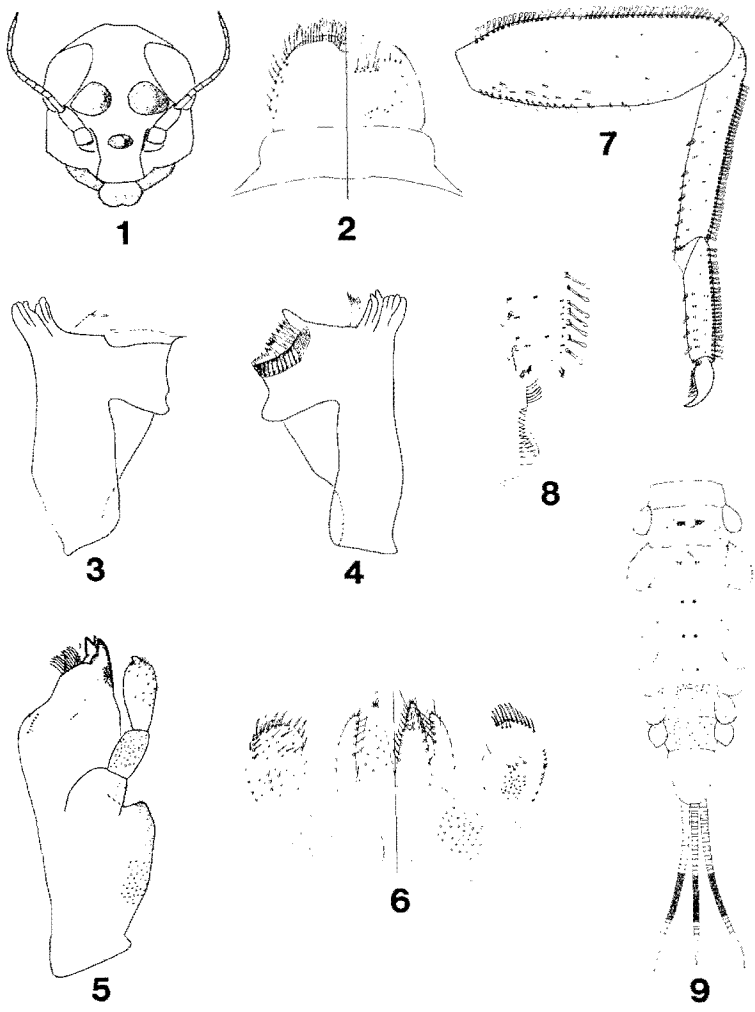

Figs. 1-9. *Barbaetis benfieldi* larva: (1) head capsule, (2) labrum (left, ventral view,; right, dorsal view), (3) right mandible, (4) left mandible, (5) maxilla, (6) labium (left, ventral view; right, dorsal view), (7) leg, (8) claw, (9) dorsal abdominal color pattern.

species, and the *lutheri* and *pavidus* species complexes of European *Baetis* (Müller-Liebenau 1967, 1970).

A cladistic analysis of larval characters (Nearctic *Baetis* have provided the outgroup comparison for determining character polarity) indicates that from a hypothetical *Baetis*-like ancestor two main lineages arose. One lineage includes the *lutheri* and *pavidus* complexes with synapomorphies of a reduced median terminal filament (subequal to one-half length of cerci) and the fusion of the incisors of the right mandible. *Baetis pavidus*

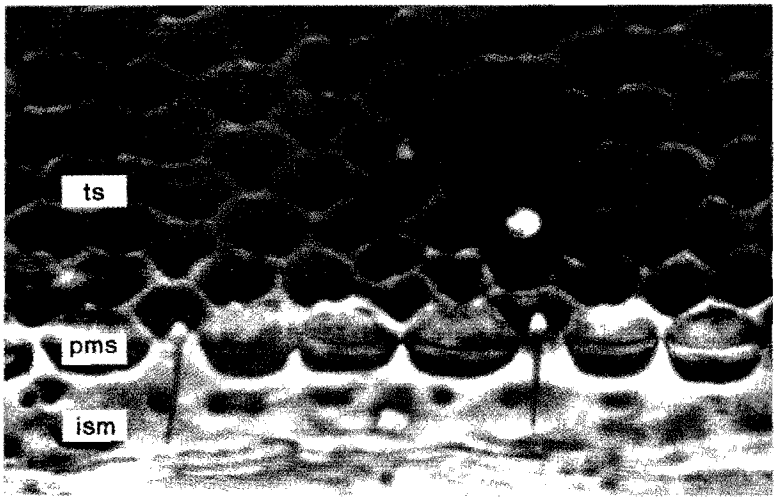

Fig. 10. *Barbaetis benfieldi* larva: posterior margin of tergite and exocuticle (ts—tergite surface, pms—posterior marginal spine, ism—intersegmental membrane).

Grandi appears to have further undergone the autapomorphic loss of tergal scales along with a reduction in the setation of the labrum and legs. The second lineage includes *Barbaetis*, *P. cestum*, and the previously mentioned undescribed species with synapomorphies of reduced length of the antennae, development of red-brown pigment, some darkly ringed abdominal segments, blotched pigmentation, loss of tergal scales, reduction in the size of the labial palps, clavate setae on the dorsum of the femur, loss of marginal serrations on the gills, and more rounded gills that lack a chitinized anterior margin. This second major lineage split into two daugher lineages. In one daughter lineage leading to *P. cestum* and its cognate, the median terminal filament became reduced to a rudiment, the incisors of the right mandible became fused, and the hindwings were lost. The loss of hindwings and median terminal filaments are strong evolutionary tendencies that demonstrate numerous convergences and have led to polyphyletic (or artificial) taxa in Baetidae, such as *Pseudocloeon*. In the other daugher lineage leading to *Barbaetis* the following autapomorphies are found: (1) loss of submarginal setal row and presence of medial field setae of the labrum, (2) reduction of the right mandible prostheca to a slender, furcate seta, (3) protuberance on the apex of the maxillary palp, (4) presence of many setae dorsally on the apical half of the glossae, (5) presence of procoxal osmobranchia, (6) a closely set row of clavate setae on the dorsum of the tibia and tarsus, and (7) reduction of the apical spine of the tarsus to a small rounded structure.

ECOLOGY AND BIOLOGY

Although several samples of adults and larvae of *B. benfieldi* were received by the third author, most of this material, including all of the adults, cannot now be located, and new descriptions are based on the available larval specimens. Nevertheless, we can present considerable field data from observation on larvae and adults. Larvae were collected from New River riffles in Carroll County, Virginia (County 721) near the North Carolina border (36°39.5′N, 80°59′W). At this site the river was approximately 150 m wide, with average depths of 0.5–2.5 m and an average annual flow of approximately 50 m/s. The substrate was tilted bedrock strewn with sand, gravel, and rock rubble. Dense mats of *Podostemum ceratophyllum* covered the substrate in riffle areas.

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Physical and chemical properties of the New River at this site were monitored monthly 1970–1975. Ranges of selected physical and chemical parameters are as follows: calcium, 2.00–6.50 mg/ml; magnesium, 0.80–2.10 mg/ml; sulfate, 0.00–7.40 mg/ml; chloride, 0.30–5.40 mg/ml; pH, 6.10–8.45; hardness, 9.90–22.40 mg/ml; biological oxygen demand 0.01–6.15 mg/ml; and nitrate, 0.30–3.49 mg/ml. Temperatures ranged from 0.0°C (February) to 27.0°C (August). Dissolved oxygen was generally near the saturation point. Water quality in this region of the New River is excellent because the drainage basin has few major industrial sites (Benfield and Cairnes 1974).

Macroinvertebrate samples were collected from the study site with a D-frame kick net and drift nets. Collections were made using these techniques monthly, November to April, and approximately every two weeks during the remainder of the year. *Barbaetis benfieldi* was clearly univoltine with all adults emerging from mid-April until mid-May. Maximum emergence was observed on 11 May. Water temperature was 19.5°C when emergence was first observed in April and 21.5°C during the period of maximum emergence. Emergence of *B. benfieldi* occurred during late afternoon. No *B. benfieldi* larvae were observed in the New River from late May through February. Larvae were first observed when water temperature reached 10°C. *Barbaetis benfieldi* larvae were observed drifting in the New River during March, April, and May. Maximum drift densities for *B. benfieldi* of 10 individuals/100 m^3 occurred on 12 May in post-midnight collections.

The New River has a diverse benthic macroinvertebrate population. Baetid larvae associated with *B. benfieldi* include *Baetis ephippiatus* Traver, *B. intercalaris* McDunnough, *B. pluto* McDunnough, *Centroptilum* spp., *Heterocloeon curiosum* (McDunnough), *H. petersi* (Müller-Liebenau), and *Pseudocloeon* spp.

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