REINSTATEMENT AND BIOSYSTEMATICS OF *HETEROCLOEON* McDUNNOUGH (EPHEMEROPTERA: BAETIDAE)[1]

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ABSTRACT

Generic characteristics established for the genus *Rheobaetis* Müller-Liebenau are shown to be common to the species of the earlier described genus *Heterocloeon* McDunnough. *Heterocloeon* is therefore removed from synonymy with *Baetis* Leach, and the name *Rheobaetis* is suppressed as a junior synonym of *Heterocloeon*, NEW SYNONYM. The reinstated genus presently includes the following species: *Heterocloeon berneri* (Müller-Liebenau) comb. n., *Heterocloeon curiosum* (McDunnough) (=*Rheobaetis traverae* Müller-Liebenau) NEW SYNONYM, and *Heterocloeon petersi* (Müller-Liebenau) comb. n. Brief notes on the relationships of the species, particularly as evidenced by the larval stage, are included.

Key Words: *Heterocloeon* – reinstatement, *Rheobaetis*, synonymy, Baetidae, phylogeny.

TAXONOMIC STATUS

Centroptilum curiosum McDunnough was originally described in 1923 on the basis of adult material taken from Ontario, Canada. At the time of description McDunnough (1923) pointed out that because of certain characteristics a new generic name may be needed for the species. He later (McDunnough, 1925) proposed the new genus, *Heterocloeon* McDunnough, to accommodate this species. He furthermore believed the new genus to be allied closely to *Baetis* Leach, and because of the reduced hind wings, intermediate between *Baetis* and *Pseudocloeon* Klapalek.

The larvae of *H. curiosum* were first mentioned briefly in the literature in conjunction with a key to the larvae of *Pseudocloeon* species by McDunnough (1932). It was merely stated that the gills of *H. curiosum* were largely blackish with light margination. Traver (1935) again briefly treated the larvae, remarking on the two-tailed condition and the similarity to *Pseu-*

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docloeon. Traver also extended the reported range of *H. curiosum* to Quebec, New York, and Maryland. A more extensive description of the larval stage of this species was presented by Ide (1937); however, it dealt primarily with coloration. At that time Ide also suggested that characteristics of the larval and adult stages would place *H. curiosum* in the *Acentrella* subdivision of the genus *Baetis*. Burks (1953) provided some additional figures of this species and continued to recognize *Heterocloeon* as a valid genus. He mistakenly listed *Baetis curiosus* in the synonymy of the species, obviously believing Ide had formalized a generic synonym (which he had not). The synonymy of *Heterocloeon* with *Baetis* was established by Edmunds and Traver (1954), however, no particular reason accompanied the designation.

In 1971, the senior author collected a large larval series of a species of Beatidae from the Blue River in southern Indiana. On the basis of preliminary examination of this material (which indicated the presence of only two developed tails, minute hind wing pads, thoracic gills, and medially pigmented abdominal gills) it was obvious that the species was not typical of *Baetis*. With the remote possibility that these larvae might represent what had at one time been known as *Heterocloeon* and thereby give new evidence for substantiating the genus, *curiosum* material was borrowed for comparison. The larvae were found to be similar in all structural detail. The association was further confirmed when in 1973, the authors were able to rear out some of the Blue River population, the adults also proving to be similar to McDunnough's species.

Müller-Liebenau (1974) erected the genus *Rheobaetis* for three species described from Georgia. A unique combination of larval characteristics evidently weighed heavily in erecting the new genus. These larval characteristics included the presence of thoracic gills, a rudimentary terminal filament, abdominal gills with darkly pigmented median portions, tarsal claws with two dissimilar rows of teeth, and minute hind wing pads. Our subsequent examination of *curiosum* material revealed all generic character states, including the rows of teeth on the tarsal claws, to be identical with those reported for *Rheobaetis*. Character states of the adults, namely, the presence of extremely minute hind wings with no longitudinal veins and no costal projections, also matched. A possible slight exception is that in a few cases vestiges of one longitudinal vein in McDunnough's species have been reported in the older literature.

Evidently, Müller-Liebenau was not aware of the correlation between *curiosum* and her *Rheobaetis*. In accepting the concept of the genus as presented by her, the name *Heterocloeon* must be considered the valid designation as follows: *Heterocloeon* McDunnough (=*Rheobaetis* Müller-Liebenau) NEW SYNONYM. Presently described species which are now assignable to *Heterocloeon* include *Heterocloeon berneri* (Müller-Liebenau) comb. n., *Heterocloeon curiosum* (McDunnough), and *Heterocloeon petersi* (Müller-Liebenau) comb. n.

Rheobaetis traverae Müller-Liebenau is placed in synonymy as follows: *Heterocloeon curiosum* (McDunnough) (=*Rheobaetis traverae* Müller-Liebenau), NEW SYNONYM. Morphological details of both the adults and

larvae of the material that Müller-Liebenau considered to be a new species are similar to those found in *H. curiosum*. Coloration of the thoracic notum of adults may be slightly darker in Northern populations, however.

In the taxonomic key to the species presented by Müller-Liebenau, *H. curiosum* should be substituted for *traverae*; and, in the second part of couplet 2 to the larvae and pertaining to the labrum, "8-10 submarginal bristles" should be modified to read "6-10 submarginal bristles". In addition, the abdominal tergites are slightly more variable in coloration in *H. curiosum* than is indicated in the key.

Although Müller-Liebenau had designated *Rheobaetis petersi* as the type-species of her genus, *Centroptilum curiosum* McD. must remain the valid type-species of *Heterocloeon* as originally designated by McDunnough (1925) and by the preclusion of monotypy.

PHYLOGENY

From the known morphology of the larvae of the three species of *Heterocloeon* certain inferences concerning their evolutionary relationships can be made at this time. (For detailed morphological description and illustrations of these species, reference should be made to Müller-Liebenau's work.) As has been alluded to in the past, this group is closely allied to *Baetis*. *Heterocloeon* was probably derived from a two-tailed, minutely hind winged, *Baetis*-like ancestor. The ancestral *Heterocloeon* stock gave rise to two phyletic lines, one leading directly to *H. berneri* and the other leading to the common ancestor of the sibling species (after the terminology of McCafferty and Chandler, 1974), *H. curiosum* and *H. petersi*. In assuming the *Baetis*-like ancestry, the more outstanding morphological changes in the larvae must have taken place in these lines of descent as discussed below.

First, the hypothetical *Heterocloeon* ancestor (A in Figure 1), besides having attained or retained those attributes common to all *Heterocloeon*, probably possessed a labrum with bristle-like setae scattered randomly over most of the surface, mandibles with a series of canines produced more or less evenly throughout, labial palpi with well demarked second segments, generalized thoracic and abdominal sternites, and an apparent tracheation pattern in the abdominal gills.

In the phyletic line leading to *H. berneri* specialized setae-bearing protuberances on the meso- and metathoracic and first abdominal sternites evolved. Except for this specialization, however, *H. berneri* may be considered a relatively ancestral species.

In the phyletic line leading to the common ancestor of *H. curiosum* and *H. petersi* (B in Figure 1) random setae on the surface of the labrum became more oriented as a submarginal row consisting of 1 + 6 – 10 stout setae on each half of the labrum. In addition, the slight terminal expansion of the second segment of the labial palpi was reduced and the terminal segmentation became obscure.

Ancestor B then gave rise to one line leading to *H. petersi* where the rows of submarginal setae of the labrum became further reduced in number (1 + 3

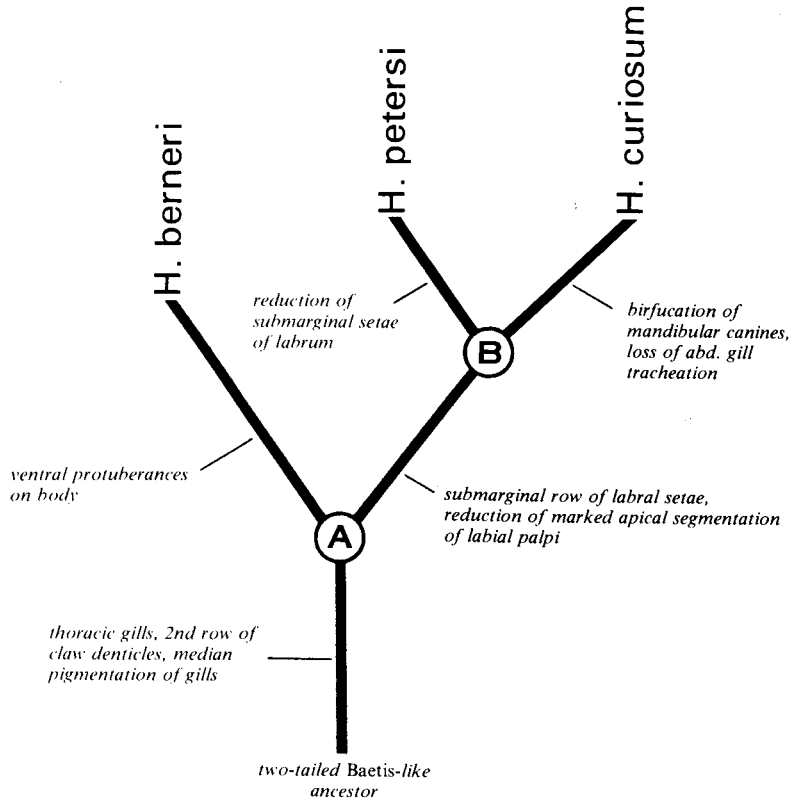

Fig. 1. The proposed phylogeny of *Heterocloeon* spp.

– 5), and to another line leading to *H. curiosum* where the canines of the mandibles became specialized into two slightly bifurcate groups and the apparent tracheation in the abdominal gills was lost.

There is presently no existing evidence from the adults that would contradict the above phyletic inferences. Adult specific differences, however, are of little analytical consequence in this instance since they consist mainly of size and coloration and have not as yet been described for *H. berneri*. Evolutionary direction concerning adult characters will best be surmised in light of the presented phylogeny. The evolution of the discussed larval characteristics have been, we believe, reliably hypothesized due essentially to their structural nature and our knowledge of related taxa.

Moreover, if presently known distributional patterns are any indication, the proposed phylogeny would lead to the conclusion that the origin of *Heterocloeon* was Southeastern with only *H. curiosum* having become more widespread to the North.

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