

Systematics of *Alainites* n. gen., *Dipheter*, *Indobaetis*, *Nigrobaetis* n. stat., and *Takobia* n. stat. (Ephemeroptera, Baetidae)

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ABSTRACT

The genus *Nigrobaetis* n. stat. (formerly considered a subgenus of *Baetis*) includes *N. acinaciger* n. comb., *N. bacillus* n. comb., *N. digitatus* n. comb., *N. gracilis* n. comb., *N. harasab* n. comb., *N. minutus* n. comb., and *N. niger* n. comb. Other species traditionally considered in the *Baetis muticus* group and previously included in *Nigrobaetis* are placed in the new genus *Alainites* Waltz and McCafferty and include *A. albinatii* n. comb., *A. kars* n. comb., *A. laetificus* n. comb., *A. muticus* n. comb. (type species), *A. navasi* n. comb., *A. oukaïmeden* n. comb., *A. pekingensis* n. comb., *A. sacishimensis* n. comb., and *A. sadati* (in press). The genus *Takobia* n. stat. (formerly considered a subgenus of *Baetis*) includes *T. maxillaris* n. comb. The genus *Dipheter* includes *D. hageni*, *D. devinctus*, and *D. rhithralis* n. comb. *Alainites*, *Indobaetis*, and *Takobia* share certain apomorphies, indicating a close relationship. Despite certain similarities among all genera treated, *Dipheter* and *Nigrobaetis* are distinct from each other as well as from the lineage represented by the former genera.

Keywords : Ephemeroptera, Baetidae, revision, *Alainites*, *Dipheter*, *Indobaetis*, *Nigrobaetis*, *Takobia*, *Baetis muticus* group.

RÉSUMÉ

Sur la systématique d'*Alainites* n. gen., *Dipheter*, *Indobaetis*, *Nigrobaetis* n. stat. et *Takobia* n. stat. (Ephemeroptera, Baetidae).

Le genre *Nigrobaetis* n. stat. (considéré jusqu'à présent comme un sous-genre de *Baetis*) comprend *N. acinaciger* n. comb., *N. bacillus* n. comb., *N. digitatus* n. comb., *N. gracilis* n. comb., *N. harasab* n. comb., *N. minutus* n. comb. et *N. niger* n. comb. D'autres espèces, traditionnellement considérées comme formant le groupe *Baetis muticus* et incluses précédemment dans *Nigrobaetis*, sont placées dans le nouveau genre *Alainites* Waltz et McCafferty comprenant : *A. albinatii* n. comb., *A. kars* n. comb., *A. laetificus* n. comb., *A. muticus* n. comb. (espèce type), *A. navasi* n. comb., *A. oukaïmeden* n. comb., *A. pekingensis* n. comb., *A. sacishimensis* n. comb. et *A. sadati* (sous presse). Le genre *Takobia* n. stat. (considéré jusqu'à maintenant comme un sous-genre de *Baetis*) est représenté par *T. maxillaris* n. comb. Le genre *Dipheter* inclut *D. hageni*, *D. devinctus* et *D. rhithralis* n. comb. *Alainites*, *Indobaetis* et *Takobia* ont en commun certaines apomorphies traduisant une proche parenté. En dépit de certaines similarités parmi les genres considérés, *Dipheter* et *Nigrobaetis* sont distincts l'un de l'autre aussi bien que de l'ensemble constitué par *Alainites*, *Takobia* et *Indobaetis*.

Mots-clés : Ephemeroptera, Baetidae, révision, *Alainites*, *Dipheter*, *Indobaetis*, *Nigrobaetis*, *Takobia*, *Baetis* groupe *muticus*.

INTRODUCTION

Novikova & Kluge (1987) revised the genus *Baetis* Leach to include subgenera *Baetiella* Uéno, *Acentrella* Bengtsson, *Takobia* Novikova & Kluge, *Labiobaetis* Novikova

& Kluge, and *Nigrobaetis* Novikova & Kluge. The genus *Pseudocloeon* Klapálek was synonymized with *Baetis* without further comment.

In independent studies, Waltz & McCafferty (1987a,b) recognized *Acentrella*, *Baetiella*, and *Pseudocloeon* as restricted genera distinct from *Baetis* and erected several new

genera for species previously included in *Baetis* that lacked the synapomorphic villopore found in all species of *Baetis* and *Baetis* cognates. The villopore (terminology modified in McCafferty & Waltz, 1990) is a useful apomorphy uniting *Baetis* and its cognate genera, a lineage known as the *Baetis* complex of genera, and including *Acentrella*, *Baetiella*, *Baetis*, *Barbaetis* Waltz & McCafferty, *Gratia* Thomas, *Heterocloeon* McDunnough, *Liebiella* Waltz & McCafferty, and *Platybaetis* Müller-Liebenau.

Among the North American genera described for those distinct taxa that do not possess the villopore was the genus *Dipheter* Waltz & McCafferty. Species assigned to *Nigrobaetis* and *Takobia* by Novikova & Kluge (1987) also lack the villopore. Based on data that have been available in all of the above cited works and other previous works assigning the involved species variously to the *niger*, *gracilis*, and *muticus* species groups of *Baetis* (Müller-Liebenau 1970, 1974; Morihara & McCafferty 1979), there has been considerable confusion concerning the integrity of all of these particular taxa that lack a villopore. In this work we have addressed this situation with a revision of certain of the concepts, compositions, and taxonomic statuses of these taxa. We also treat the genus *Indobaetis* Müller-Liebenau & Morihara because we have confirmed a close relationship with it and other treated genera as first suggested by Müller-Liebenau & Morihara (1982). A short synopsis of each of the genera involved is given in alphabetical order. This is followed by a generic key to the known larvae and adults.

***Alainites* Waltz & McCafferty, n. gen.**

Type species : *Baetis muticus* L., 1758.

Larval diagnosis : [Treated as *Baetis gracilis* group Müller-Liebenau 1970, as *Baetis muticus* group Müller-Liebenau 1974, Sartori & Thomas 1991]. Body laterally compressed (Müller-Liebenau 1970, 1974). Glossae with dorsal setae (Müller-Liebenau 1970 : fig. 143f). Prosthema of right mandible reduced. Femoral villopore absent. Claws dentate and without seta. Hind wingpads present or absent. Gill 1 present or absent. Paraproct with prolongation (Müller-Liebenau 1970 : fig. 143g; Sartori & Thomas 1991 : pl. 1).

Adult diagnosis : Hindwings present or absent; when present, hindwings with three veins, and second vein forked distad or basad of midline. Terminal segment of male forceps spherical to slightly elongate and curved.

Species included : *Alainites albinatii* (Sartori & Thomas), 1989 n. comb. ; *A. kars* (Thomas & Kazanci), 1989 n. comb. ; *A. laetificus* (Müller-Liebenau), 1984 n. comb. ; *A. muticus* (L.), 1758 n. comb. ; *A. navasi* (Müller-Liebenau), 1974 n. comb. ; *A. oukaimeden* (Thomas & Sartori), 1992 n. comb. ; *A. pekingensis* (Ulmer), 1936 n. comb. ; *A. sacishimensis* (Uéno), 1969 n. comb. ; and *A. sadati* Thomas, in press.

Distribution : Europe, Turkey, Morocco, China, Ryukyu Islands (Japan).

Etymology : The first two authors of this paper name this genus in honor of our colleague, Alain Thomas, who has contributed much work and knowledge on this group of baetids. *Alainites* is a Latinized transliteration of a Greek substantive of masculine gender. With the suffix thus applied, it can be taken to mean « belonging to Alain » (Borror 1960).

***Dipheter* Waltz & McCafferty**

Type species : *Baetis hageni* Eaton, 1885, original designation Waltz & McCafferty, 1987a.

Larval diagnosis : Body cylindrical in cross section. Prosthema of right mandible reduced in all known species; incisors distinct (Morihara & McCafferty 1979 : fig. 34b). Glossae without dorsal setae. Femoral villopore absent. Claws dentate and without subapical seta. Hind wingpads present in all known species. Gill 1 absent in all known species. Paraproct without prolongation (Morihara & McCafferty 1979 : fig. 34h).

Adult diagnosis : Hindwings (Edmunds *et al.* 1976 : fig. 251) present in all known species and with two or three veins, second vein is forked at midline or basad of midline; costal process erupting from margin. Terminal segment of male forceps elongate.

Species included : *Dipheter devinctus* (Traver), 1935; *D. hageni* (Eaton), 1885; and *D. rhithralis* (Soldán & Thomas), 1989 n. comb.

Distribution : North America and Algeria.

***Indobaetis* Müller-Liebenau & Morihara**

Type species : *Indobaetis costai* Müller-Liebenau & Morihara (1982) by original designation.

Larval diagnosis : Body laterally compressed. Prosthema of right mandible slender and pointed; incisors fused (Müller-Liebenau and Morihara 1982 : fig. 1f). Glossae with transverse row of dorsal setae (Müller-Liebenau & Morihara 1982 : fig. 1b). Femoral villopore absent. Claws with single long seta between apical denticles (Müller-Liebenau & Morihara 1982 : fig. 1k). Hind wingpads absent in all known species. Gill 1 absent in all known species. Paraproct with prolongation (Müller-Liebenau & Morihara 1982 : fig. 1g).

Adult diagnosis : Adults unknown.

Species included : *Indobaetis costai* Müller-Liebenau & Morihara and *I. starmuehlneri* Müller-Liebenau & Morihara.

Distribution : Sri Lanka.

***Nigrobaetis* Novikova & Kluge, n. stat.**

Type species : *Ephemera niger* L., 1761, originally misapplied by Kazlauskas (1972) (*nomen nudum*). The Kazlauskas (1972) work was abstracted without

bibliographic reference or discriminating description, and therefore was an unavailable name under Article 13, ICZN (see Peters & Peters, 1974; Hubbard, 1979). Cited as a *nomen nudum* and reinstated under ICZN Articles 50 and 21 by Novikova & Kluge (1987) as a subgenus of *Baetis* Leach (for application see ICZN, 3rd Edition, Glossary, p. 260). By ICZN convention, Novikova & Kluge became the authors of *Nigrobaetis*.

Larval diagnosis: [Treated by Müller-Liebenau (1970, 1973, 1974) as *Baetis niger* group]. Body cylindrical in cross section. Prosthema of right mandible normal or reduced (Müller-Liebenau 1970: fig. 128b). Glossae with few to many (2-15+) dorsal setae (Müller-Liebenau 1970: fig. 128g). Femoral villopore absent. Claws without preapical seta. Hind wingpads present or absent. Gill 1 present or absent. Paraproct without prolongation (Müller-Liebenau 1970: fig. 128i).

Adult diagnosis: Hindwings (Müller-Liebenau 1970: fig. 122), when present, with two veins, second vein forked basad of midline; costal process erupting from margin. Terminal segments of male forceps elongate (Müller-Liebenau 1970: figs. 123, 124).

Species included: *Nigrobaetis acinaciger* (Kluge), 1983 n. comb.; *N. bacillus* (Kluge), 1983 n. comb.; *N. digitatus* (Bengtsson), 1912 n. comb.; *N. gracilis* (Bogoescu & Tabacaru), 1957 n. comb.; *N. harasab* (Soldán), 1977 n. comb.; *N. minutus* (Müller-Liebenau), 1984 n. comb.; and *N. niger* (Linnaeus), 1761 n. comb.

Distribution: Europe, Sudan, Primor'ye region of the Russian Federation, West Malaysia.

Takobia Novikova & Kluge, n. stat.

Type species: *Centroptilum maxillare* Braasch & Soldán, 1983 by original designation as *Baetis* (*Takobia*) *maxillaris* by Novikova & Kluge (1987).

Larval diagnosis: Body laterally compressed. Glossae with cluster of dorsal setae (Braasch & Soldán 1983: fig. 17). Prosthema of right mandible reduced (Braasch & Soldán 1983: fig. 14). Maxillary palps greatly enlarged and elongated (Braasch & Soldán 1983: fig. 15). Claws nearly rectilinear, edentate or with minute spines (Braasch & Soldán, 1983: fig. 18; Novikova & Kluge 1987: pl. 2, fig. 18). Femoral villopore absent. Gill 1 present. Paraproct with prolongation (Novikova & Kluge 1987: pl. 2, fig. 20).

Adult diagnosis: Head with unique posterior crest (Novikova & Kluge 1987: pl. 1, fig. 2). Hindwings (Novikova & Kluge 1987: pl. 1, fig. 6) with three veins, second vein forked distad of midline; costal process erupting from margin. Terminal segment of male forceps spherical.

Species included: *T. maxillaris* (Braasch & Soldán, 1983) n. comb.

Distribution: Uzbekistan.

DISCUSSION

The genera *Alainites*, *Indobaetis* and *Takobia*, are clearly related by synapomorphic character states in the larvae, including elongated paraprocts, laterally compressed body form, and dorsal setae of the glossae. This relationship was first proposed by Müller-Liebenau & Morihara (1982). The autapomorphies associated with *Takobia* distinguish that genus from *Alainites*, and include in the adult the posteriorly produced head capsule, and in the larvae the highly modified maxillary palps, the increased setation on the mouthparts and labrum, and the extreme reduction or loss of claw denticles. In larvae of *Alainites* and *Takobia* the dorsal setae of the glossae are clustered and the mandibular incisors are separate, whereas in *Indobaetis* the dorsal setae of the glossae are arranged in a linear row and the incisors are fused and highly modified. The adults of *Indobaetis* remain unknown.

Dipheter and *Nigrobaetis* do not possess the above mentioned apomorphies, except for the presence of the dorsal setae of the glossae in *Nigrobaetis*. This character, however, appears to be subject to homoplasy in Baetidae (e.g., it is present in the genus *Guajirulus* Flowers). *Dipheter* and *Nigrobaetis* are distinguished from each other by differences in tergal armature, including the type of scales on the body and posterior marginal spines, and by the presence of apomorphic character state of setae on the glossae present in *Nigrobaetis* but not *Dipheter*. The precise phylogenetic relationship of these two genera to each other and to the lineage represented by *Alainites*, *Takobia*, and *Indobaetis* is not yet known.

Adults of all of the genera treated herein possess a forked second vein in the hindwings when hindwings are present (all known species of *Indobaetis* and some species of *Alainites* and *Nigrobaetis* lack hindwings). Certain baetids other than those treated in this paper, however, also possess a forked second vein in the hindwing, and most are clearly assignable to other known genera. For example, some aberrant individuals of *Baetis magnus*, a species belonging to the *Baetis rhodani* group, possess such a forked second vein of the hindwing (Durfee & Kondratieff, 1993), and *Baetis diablus* Day, known only from adults, is another such species. Other species with this hindwing venation must await further study before they can be placed in any genus with certainty.

As is often the case, characters that may be used to delineate genera of baetids in the adult stage are not as stable as those associated with the larval stage. This situation occurs in some of the genera treated here and is reflected in the following keys, where, in the adult section, distribution is also of use and all species of every genus are keyed but may not always key out together.

Key to the Larvae of *Alainites*, *Dipheter*, *Indobaetis*, *Nigrobaetis*, and *Takobia*

1. Setae present on dorsal surface of glossae 2
- 1'. Setae absent from dorsal surface of glossae *Dipheter*

2. Body laterally compressed in cross section ; paraproct with prolongation 3
- 2'. Body round in cross section ; paraproct without prolongation *Nigrobaetis*
3. Maxillary palps not extended ; claws strongly curved and dentate 4
- 3'. Maxillary palps greatly extended ; claws narrowly acute, nearly rectilinear and edentate or with minute spines only *Takobia*
4. Glossae with few to many clustered setae dorsally ; claws without preapical seta ; hindwing pads present or absent *Alainites*
- 4'. Glossae with dorsal setae arranged in a transverse, linear row ; claws with preapical seta ; hindwing pads absent *Indobaetis*

Key to the Adults of *Alainites*, *Dipheter*, *Nigrobaetis*, and *Takobia*

1. Hindwings with three veins ; distal segment of male forceps spherical or elongate 2
- 1'. Hindwings with two veins ; distal segment of forceps elongate 4
2. Distal segment of male forceps spherical to slightly elongate ; second vein of hindwings forked distad or basad of midline ; Palearctic 3
- 2'. Distal segment of male forceps elongate, much longer than wide ; second vein of hindwings forked basad of midline ; Nearctic *Dipheter* (in part)
3. Head capsule with well-developed posterior crest *Takobia*
- 3'. Head capsule without posterior crest ... *Alainites*
4. Second vein of hindwings forked basad of midline ; Eurasia *Nigrobaetis*
- 4'. Second vein of hindwings forked at midline ; northern Africa *Dipheter* (in part)

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