Nigrobaetis Novikova & Kluge (Ephemeroptera: Baetidae): first record and new species from southern Africa, with reassignment of one northern African species

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Nigrobaetis bethuneae sp. n. (Ephemeroptera: Baetidae) is described from larvae collected from the Cunene (Kunene) River between Angola and Namibia. The new species represents the first record of Nigrobaetis Novikova & Kluge from southern Africa and a considerable extension of the distribution range for the genus. Nigrobaetis bethuneae is characterized by the presence of a small interantennal carina, arrangement of dorsal setae on the labrum, mandibular denticulation and setation, apicolaterally bluntly pointed labial palp segment 3, absence of hind-wing pads, presence of the first pair of gills, and general abdominal coloration. Ecological data on the new species are provided. The Algerian species Baetis rhithralis Soldán, previously considered to belong in Diphetor Waltz & McCafferty, is transferred to Nigrobaetis, and the biogeographic implications of the new assignment are discussed.

Key words: Ephemeroptera, Baetidae, Nigrobaetis bethuneae, new species, N. rhithralis, new combination.

INTRODUCTION

Nigrobaetis Novikova & Kluge (Ephemeroptera: Baetidae) is an Indobaetis-complex genus (see Waltz et al. 1994; Waltz & McCafferty 1997) whose larvae are distinguished by the following combination of characteristics: presence of a small interantennal carina (Fig. 1), elongate glossae and paraglossae, presence of dorsal setae on the glossae, tarsal claws without preapical setae, and paraprocts without a distomedial prolongation. Larvae of Nigrobaetis vary considerably with respect to the presence or absence of hind-wing pads and the first pair of gills, and therefore the presence or absence of those features cannot be used for diagnostic purposes. As in the case in most baetid genera, adults of Nigrobaetis cannot be reliably distinguished from other baetid adults owing to the prevalence of reductive trends and consequent morphological similarity across evolutionary lineages within the family. The attribution of the name Nigrobaetis to Novikova & Kluge (1994), as well as the taxonomic status of certain species of Diphetor Waltz & McCafferty assigned to Nigrobaetis, have been addressed by Waltz et al. (1994) and Waltz & McCafferty (1997).

Fifteen species of Nigrobaetis are at present known from the Palaeartic and Oriental Regions (Waltz et al. 1994; Waltz & McCafferty 1997), however, inadvertently suggested that Nigrobaetis also occurred in the Nearctic Region by stating that it has a Holarctic distribution. In the Afrotropical Region, Nigrobaetis was previously known from only one species, N. harasab (Soldán), from eastern Sudan (Soldán 1977).

A new species of Nigrobaetis was discovered from the Cunene (Kunene) River between Angola and Namibia during an intensive survey of the mayfly fauna of southern Africa that is currently under way. The new species represents the first record of Nigrobaetis from southern Africa. The new species is described and the biogeographical significance of the discovery is discussed below. Ecological data on the new species is also provided. It was also found that Baetis rhithralis Soldán & Thomas (1983) from Algeria, recently assigned to Diphetor Waltz & McCafferty by Waltz et al. (1994), agrees with the concept of Nigrobaetis, and the species is transferred to this genus. The new assignment has important biogeographical implications that are discussed below.

The material studied is housed in the following institutions: the Albany Museum (AM), Grahamstown, South Africa (AMGS); the Institute of Entomology, Czech Academy of Sciences, Czech Republic (IECAS); the State Museum, Windhoek, Namibia (SMWN), and the Purdue Entomological
Research Collection, West Lafayette, Indiana, U.S.A. (PERC). Codes after institutional abbreviations are for cataloguing purposes at the Albany Museum.

*Nigrobaetis bethuneae* sp. n., Figs 1–12

**Description of larva**

Lengths. Body: 3.6–3.8 mm; caudal filaments: 1.9–2.0 mm.

Head. Yellow-brown, with no distinct colour pattern. Small interantennal carina present (Fig. 1). Antennae approximately 2.0–2.5 times length of head capsule. Labrum (Fig. 2) anteriorly broadly rounded, with abundant branched setae, dorsally with anterolateral row of 3–4 long, fine, simple setae and submedial irregular row of 3–4 long, fine, simple setae on each side of midline, and with scattered short, fine, simple setae throughout. Hypopharynx as in Fig. 3. Right mandible (Fig. 4) with 3+4 denticles, incisors slender; prostheca uniformly slender, apically setose; row of 8–10 short, robust, simple setae between prostheca and mola. Left mandible (Fig. 5) with 3+4 denticles, incisors robust; prostheca basally slender, apically robust and denticulate; row of 4–5 short, robust, simple setae between prostheca and mola; triangular process slender. Maxillae (Fig. 6) with four falcate denticles on apex of galealacinia and submarginally with 4–5 short, fine, simple setae; medial hump with short, stout, simple setae; palp segment 1 subequal in length to segment 2, palp extending slightly beyond galealacinia. Labium (Fig. 7) with numerous long, somewhat robust, simple setae medially on glossae and paraglossae; glossae dorsally and ventrally with minute, fine, simple setae; palp segment 1 subequal in length to segments 2 and 3 combined; palp segment 2 dorsally with row of 4–5 short, fine, simple setae; palp segment 3 apicodorsally bluntly pointed, with numerous short, fine, simple setae scattered over entire surface.

Thorax. Yellow-brown to medium brown, with no distinct pattern. Hind-wing pads absent. Legs (Fig. 8) pale to medium yellow-brown; dorsally with 8–10 long, robust, apically-pointed simple setae (last two almost contiguous), ventrally with scattered short, stout, apically-pointed simple setae; tibiae ventrally with row of 6–8 short, robust, apically-pointed simple setae; tarsi dorsally with row of 10–11 robust, apically-pointed simple setae, increasing in length apically; tarsal claws (Fig. 9) narrow-elongate, with 13–15 slender, sharp denticles, increasing in length apically.

Abdomen. Pale to medium yellow-brown and cream. Terga 1–3 and 5–7 uniformly pale to medium yellow-brown; tergum 4 anteriorly pale to medium yellow-brown, posteriorly cream; terga 8–10 cream. Terga (Fig. 10) creased, with numerous scale bases and scattered scales, posteriorly with irregular triangular spination. Sterna pale yellow-brown to cream. Gills (Figs 11, 12) on segments 1–7, narrow-elongate, apically pointed, poorly tracheated, marginally strongly serrate and with minute, fine, simple setae; middle gills approximately 1.5 times length of corresponding segments. Paraprocts (Fig. 13) with 10–12 slender, sharp marginal spines. Caudal filaments basally pale yellow-brown, apically cream; terminal filament approximately 0.75 times length of cerci.

Adult. Unknown.

**Etymology.** This species is named after Shirley Bethune, for her contributions to the understanding and preservation of aquatic ecosystems in southern Africa.

**Type material examined.** Holotype: Larva, Namibia–Angola border, Cunene River, 800 m upstream of Epupa Falls, marginal vegetation along riffle, 17°00'05''S 13°14'52''E, 19.xi.1997, F.C. de Moor (SMWN; KUN 80F). Paratypes: three larvae, Namibia–Angola border, Cunene River, Otjihandjavero Guard Post, rapids, 17°05'58''S 13°31'11''E, 16.xi.1997, F.C. de Moor (mouthparts, forelegs, tergum 4, gills 3–4, and paraproct of one larva, and mouthparts, right foreleg, and tergum 4 of another...
larva mounted on slide (medium: euparal) (two larvae in AMGS, one larva in PERC; KUN 51H); larva, Namibia-Angola border, Cunene River, Baynes Mountains, stones out of current, heavily covered in mud and algae, 17°01’12’’S 12°56’42’’E, 21.xi.1997, F.C. de Moor (AMGS; KUN 100D).

Additional material examined. Five larvae, Namibia-Angola border, Cunene River, Otjihandjavero Guard Post, rapids, 17.05S 13.31E, 16.xi.1997, F.C. de Moor (AMGS; KUN 100D).

Figs 2–13. Nigrobaetis bethuneae, larva. 2, labrum; 3, hypopharynx; 4, right mandible; 5, left mandible; 6, right maxilla; 7, labium (left, ventral view; right, dorsal view); 8, left foreleg; 9, tarsal claw; 10, tergum 4 (detail of posterior margin); 11, gill 4; 12, gill 4 (detail of margin); 13, paraproct.

larva mounted on slide (medium: euparal) (two larvae in AMGS, one larva in PERC; KUN 51H); larva, Namibia-Angola border, Cunene River, Baynes Mountains, stones out of current, heavily covered in mud and algae, 17°01’12’’S 12°56’42’’E, 21.xi.1997, F.C. de Moor (AMGS; KUN 100D).

Additional material examined. Five larvae, Namibia-Angola border, Cunene River, Otjihandjavero Guard Post, rapids, 17.05S 13.31E, 16.xi.1997, F.C. de Moor (AMGS; KUN 100D); larva, Namibia-Angola border, Cunene River, below Epupa Falls, vegetation and driftwood wedged between boulders in swift current, 17.00S 13.14E, 19.xi.1997, F.C. de Moor (AMGS; KUN 76D); two larvae, Cunene River, Namibia-Angola border, Baynes Mountains, stones in current covered with moss, 17.01S 12.57E, 21.xi.1997, F.C. de Moor (AMGS; KUN 98N); two exuviae, Namibia-Angola border, Cunene River, drift net, ca 18h30-
Remarks. *Nigrobaetis bethuneae* is distinguished by the small interantennal carina (Fig. 1), arrangement of dorsal setae on the labrum (Fig. 2), mandibular denticulation (Figs 4, 5), apicolaterally bluntly pointed labial palp segment 3 (Fig. 7), absence of hind-wing pads, presence of the first pair of gills, and general abdominal coloration.

During two surveys of the Cunene River (November 1997 and November 1998), the flow was at a seasonal low. Furthermore, due to hydroelectric power demands, the river was subjected to regular fluctuations in flow discharge that resulted in a one-day 1.1 m rise and fall in the water level a few kilometres downstream of the Onduruso Falls and 38 km downstream of the Ruacana Falls at the hydroelectric power station. Larvae of *N. bethuneae* were collected from seven localities on the Cunene River between the Ohangonga Guard Post (50 km downstream from the Ruacana Falls and 700 m asl) and the Orokawe Guard Post in the Baynes Mountains area (30 km downstream of the Epupa Falls and 450 m asl). The Cunene River in this region flows mostly over bedrock and produces a large number of rapids and riffles, and *N. bethuneae* appears to be fairly widespread but uncommon in this lower, rejuvenated portion of the river. Larvae occurred mostly on stones in swift-flowing water, usually in the thalweg region that remained completely submerged and unaffected by water level fluctuations, and were commonly associated with the rooted macrophyte *Hydrostachys polymorpha* Klotzch (Hydrostachyaceae) or with marginal trailing vegetation and wedged driftwood. Only in one sample were larvae found out of the main current on a stone covered with sediment and filamentous algae. Larval exuviae were collected in drift nets.

Species of Baetidae commonly associated with *N. bethuneae* included *Centroptiloides bifasciata* (Esben-Petersen), *Dabulamanzia media* (Crass), *Pseudocloeon glaucum* (Agnew), and *P. vinosum* Barnard. Mayfly species from other families frequently collected with *N. bethuneae* included *Ephoron savignyi* (Pickett) (Polymitarcyidae), *Euthraulus elegans* Barnard (Leptophlebiidae), *Tricorythodes tinctus* Kimmins (Tricorythidae), and *Afronurus barnardi* Schoonbee (Heptageniidae).

The presence of *N. bethuneae* in the Cunene River is of biogeographical significance because it represents a considerable southward extension of the range of *Nigrobaetis*. The occurrence of *N. harasab* in northeastern Africa (Soldán 1977) and *N. bethuneae* in southern Africa, together with the reassignment of the Algerian species *D. rhithralis* to *Nigrobaetis*, suggest that *Nigrobaetis* is well established in Africa and that further species will be found throughout the northern and central parts of the continent. It is also possible that *Nigrobaetis* occurs south of the Cunene River.

**Nigrobaetis rhithralis** (Soldán & Thomas) comb. n.

*Batis rhithralis* Soldán & Thomas, 1983: 356.

*Diphetor rhithralis* (Soldán & Thomas): Waltz et al. 1994: 34.

Type material examined. Paratypes: Three larvae, one male adult, Algeria, Chiffa, Oued Merdja, Rouisseau des Signes, 8.x.1981, T. Soldán (IECAS).

Remarks. Soldán & Thomas (1983) described *Baetis rhithralis* from larvae and male and female adults from Algeria. The species is assigned to *Nigrobaetis* because the larval description and figures provided by Soldán & Thomas (1983: Figs. 1–11) agree with the concept of the genus as discussed by Waltz et al. (1994). The species does not belong in *Diphetor* because it lacks the distinctive bifid prostheca of the right mandible characteristic of that genus (Waltz & McCafferty 1987; Morihara & McCafferty 1979: Fig. 34b).

The new assignment is of considerable biogeographical importance because it indicates that *Diphetor* does not occur on the African continent. Moreover, it indicates that *Diphetor* is probably endemic to the Nearctic Region, because no species referable to the genus have been reported from the Palearctic, Oriental or Australian Regions. In the Nearctic, *Diphetor* is represented by *D. devinctus* (Traver) and *D. hageni* (Eaton). Both species have a primarily northern distribution in that region (McCafferty & Waltz 1990; McCafferty & Randolph 1998).

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REFERENCES


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