

***Caenis cubensis*, a new species of mayflies from Cuba (Ephemeroptera: Caenidae)**

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Abstract

All life stages of *Caenis cubensis* sp. n. are described. This new species of *Caenis* from Cuba is closely related to the species of the South American *C. argentina* and *C. pflugfelderi* groups.

Keywords: Ephemeroptera, mayflies, *Caenis cubensis*, new species, Cuba, Neotropical region

Introduction

Continental America encompasses 33 species of the genus *Caenis* Stephens, 1838 (Ephemeroptera: Caenidae), but only two species are known from the West Indies, namely *C. femina* Hofmann & Sartori, 1999 and *C. catherinae* Hofmann & Thomas, 1999 from Guadeloupe Island of the Lesser Antilles (Hofmann et al. 1999). The first mention of the genus *Caenis* from the Greater Antilles refers to three morphospecies *Caenis* sp₁, *Caenis* sp₂ and *Caenis* sp₃ from Puerto Rico (Traver 1938). Though the presence of species of *Caenis* has been reported from Cuba by Alayo (1977), a formal description of the new species of *Caenis* has not been undertaken so far. However, there is some information on the geographic distribution within the Cuban archipelago at a generic level (Naranjo & Cañizares 1999; Naranjo & Trapero 2000; López et al. 2004; González et al. 2005).

Herein we describe the new Cuban species *C. cubensis* sp. n., based on material (larvae and adults) collected in eastern Cuba and from several localities in the central and western parts of Cuba. The types of the new species are deposited in the following entomological collections: Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia (ZIN), Departamento de Biología, Universidad de Oriente, Santiago de Cuba, Cuba (CEUO) and Instituto de Ecología y Sistemática, La Habana, Cuba (IES).

Systematic account***Caenis cubensis* sp. n.**

= *cubensis* [*Caenis*] in litt.: Kluge 2004, p. 288.

Material

Following arbitrary signs are used: S♂ – male subimago, S♀ – female subimago, I♂ – male imago, I♀ – female imago, L-S-I♂ – male imago, reared from larva, with associated larval and subimaginal exuviae, L-S-I♀ – female imago, reared from larva, with associated larval and subimaginal exuviae.

Holotype ♂ imago reared from larva with associated larval and subimaginal exuviae (micro-slide): Cuba, río Guamá, Sonador, municipio Guamá (Sierra Maestra), prov. Santiago de Cuba, 4.02.1989, N. Kluge coll. (ZIN). – Paratypes: **Prov. SANTIAGO DE CUBA**: 2 L-I♂, 1 L-S-I♂, 4 L-S♂, 1 L-S-I♀, 2 L-I♀, 3 L-S♀, 8 larvae, La Alcarraza, El Codillo and Sonador, municipio Guamá, Sierra Maestra, 1–7.02.1989, N. Kluge coll. (ZIN), – 3 larvae, Arroyo Paco (tributary of Río Palma Mocha), Guamá, Sierra Maestra, 9.01.1985 C. Naranjo coll. (ZIN), – 2 larvae, same locality, 6.02.1989 C. Naranjo coll. (ZIN), – 2 larvae, same locality, 18–24.02.1989 N. Kluge coll. (ZIN), – 21 I♂, río Turquino, Guamá, 17.06.2005, D. González and C. Naranjo coll. (CEUO), – 12 larvae, San Lorenzo, Tercer Frente, Sierra Maestra, 1984–1985, C. Naranjo coll. (ZIN), – 2 larvae, río Baconao, Las Yaguas, Sierra Maestra, 12.02.1989, N. Kluge coll. (ZIN), – 8 larvae, Parque Nacional La Bayamesa, Sierra Maestra, 26.01.2003, P. López coll. (CEUO), – 21 larvae, La Purísima, el Cristo, Santiago de Cuba, 27.09.2003 C. Carrisco coll. (CEUO), – 4 larvae, same locality, 9.09.2002, Y. Cambas coll. (CEUO), – 5 larvae, Boniato, 1.03.2003, A. Trapero coll. (CEUO), – 7 larvae, el Zaino, Carretera del Cobre, 4.03.2001, A. Trapero coll. (CEUO), – 4 larvae, La Idalia, Gran Piedra, 9.04.2005, D. González and C. Naranjo coll. (CEUO). – **Prov. GRANMA**: 3 larvae, Río Yara, Arroyo Santana (Sierra Maestra), 3.12.1983 C. Naranjo coll. (ZIN), – 2 larvae, Río Yara, Arroyo Santana (Sierra Maestra), 14.XII.1985 (C. Naranjo) – 4 larvae, río Sevilla, Niquero, 3.02.2003, D. Hernández y Y. Cala coll. (CEUO). – **Prov. GUANTANAMO**: 1 larvae, Baracoa, Imías, Guantánamo (Nipe-Sagua-Baracoa), 12.03.1985, C. Naranjo coll. (ZIN), – 10 larvae, río Cuzco, 21. 03. 2003, S. Muñoz coll. (CEUO). – **Prov. HOLGUIN**: 5 larvae, río Cacoyugüín, Gibara, 30.01.2003, Y. Bauta and Y. Hernández coll. (CEUO). – **Prov. CAMAGÜEY**: 8 larvae, río Máximo, 6.08.2003, O. Bello coll. (CEUO). – **Prov. VILLA CLARA**: 5 I♂, 6 I♀ imagos, Soledad, 10.1964, P. Alayo coll. (CEUO). – **Prov. SANCTI SPIRITUS**: 7 I♂, 1 larva, río Banao, 6.02.2005, P. López coll. (CEUO). – **Prov. CIENFUEGOS**: ca. 10 I♂, Caburni, 14.-18.4.1989, N. Kluge coll. (ZIN), – **Prov. MATANZAS**: 2 larvae, Ciénaga de Zapata, 11.1964, P. Alayo coll. (IES), – 3 larvae, Buena Ventura, Ciénaga de Zapata, 02.1965, P. Alayo coll. (IES). – **Prov. LA HABANA**: 37 larvae, río Quitacalzón, Casiguas, 03.1966, P. Alayo coll. (IES). – **Prov. PINAR DEL RÍO**: 5 I♂, 10 I♀, swimming pools San Vicente Hotel, Viñales, Pinar del Río, 10.1964, P. Alayo coll. (IES), – 5 I♂, San Diego de los Baños, Pinar del Río, 1965, P. Alayo coll. (CEUO), – 4 larvae, Soroa, 06.1965, P. Alayo coll. (IES), – 1 L-I♂, 4 L-S-I♀, 2 L-I♀, 6 larvae, Soroa, 1–7.04.1989, N. Kluge coll. (ZIN). – **ISLA DE LA JUVENTUD**: 2 larvae, Nueva Gerona, 24.02.1965, P. Alayo coll. (IES).

Distribution. Eastern, central and western Cuba.

Male imago

Body length 2.7–2.8 mm; wing length 2.6–2.8 mm; length of foreleg 2.4–2.7 mm. Ratio of forefemur: foretibia = 0.50–0.60; ratio of foretibia: foretarsus = 1.12–1.23; ratio of foreleg: hind leg = 1.78–1.88; ratio of first segment of the foretarsus: 2nd:3rd:4th:5th = 1:4.1–5.3:1.8–2.8:1.8–2.5:1.2–1.6. Ratio of body length: length of cercus: length of terminal filament = 1: ± 3,5: ± 4,4.

Colouration of chitinous layers. Thorax strongly yellowish-brown; other parts brownish to yellowish-white.

Epidermal pigmentation. Dorsal side of head, scape and pedicel of antenna shaded with brown; lateral margin of pronotum dark brown, paired submedian black marks near posterior margin of pronotum; sutures and scutellum of mesonotum with fulvous black markings; wing bases without dark marks; dorsal area of episternum anterior to wing bases (prealar bridge) diffusely shaded; coxal cavities ringed with black; forecoxa and trochanter dark brown, narrow preapical streaks at the forefemora, femora of middle and hind legs with distinctive preapical black triangular marks; abdominal terga shaded with fulvous black – terga I and II stronger – and with black paratergal marks.

Antennal bristle basally not dilated (Figure 1h). Prosternal triangle broad, sometimes nearly rectangular (Figure 1g).

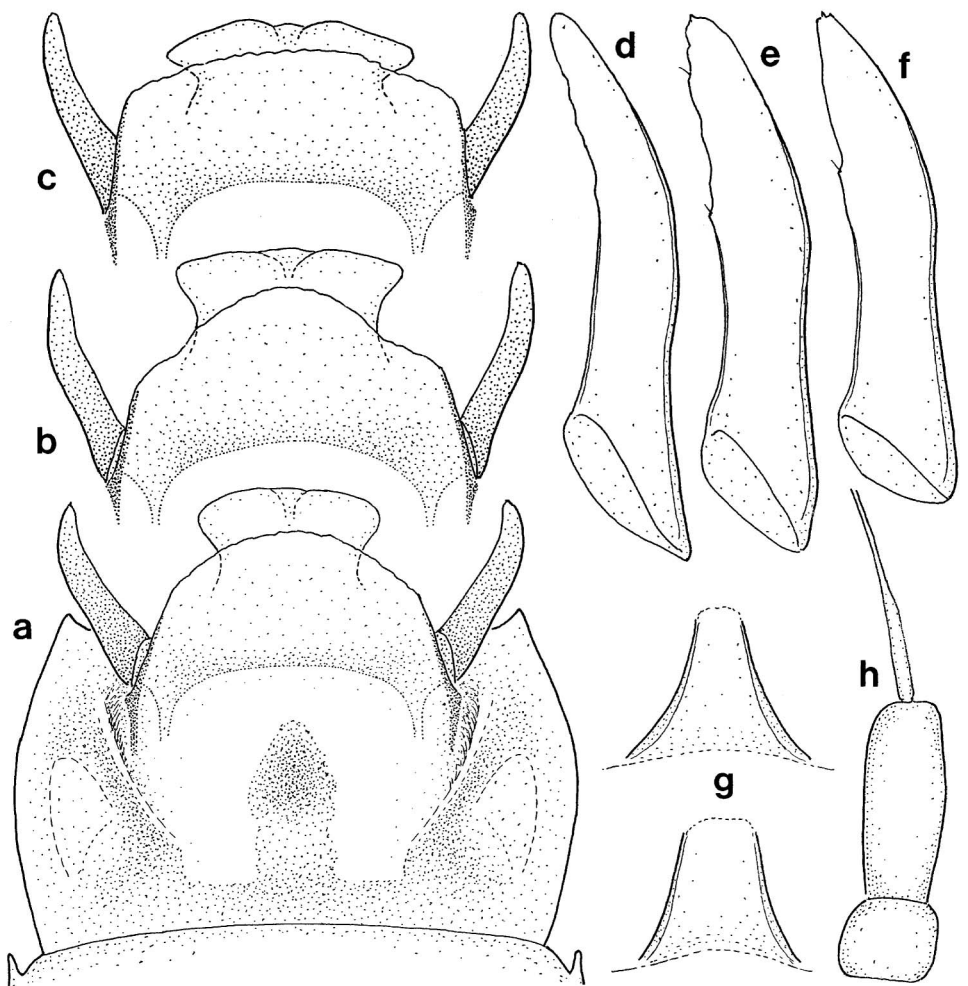


Figure 1. *Caenis cubensis* sp. n., male imago: (a–c) genitalia, different shapes of penis and styli; (d–f) variability of gonostylus shape; (g) prosternal triangle; (h) antenna: scape, pedicel and base of flagellum.

crossvein (fork basally stemmed), marginal setae extend beyond radial sector, reaching wing tip. Tergum II without finger-like process. Lateral filaments of abdominal segments short.

Genital sclerites, gonostyli, and sternum IX weakly brownish coloured. Shape of penis and sclerites variable (Figures 1a–c). Gonostylus with apical third tapering and more or less bent inwards, medially sometimes a little broadened; tip rounded, often with one or two very small pointed projections (Figures 1d–f).

Female imago

Body length 2.0 (? 3.0)–4.0 mm; wing length 2.5–3.3 mm.

General colour yellow-brown, with pattern similar to that of male. Wings as in male. Abdominal terga VII–X pale yellow.

Larva

Body length of mature nymph. Male 2.6–3.0 mm; female 3.7–4.5 mm. Length of cerci and paracercus 3.2–4.5 mm.

Colouration of chitinous layers (Figure 2). Terga reddish brown, sterna pale; vertex medially often with a large, parallel-sided, pale mark frontally pointed; pronotum with pale lateral margins and paired blanks; mesonotum often with 4–5 pairs of small, pale dashes; abdominal tergites with pale median area and pale lateral parts (paratergites); legs with brown bands on distal part of femora, proximal part of tibia and proximal part of tarsus.

Epidermal pigmentation. Besides preapical marks on femora and dark margins of coxae, there is only a very sparsely and diffuse pigmentation of gill covers, head, pronotum and abdominal tergites; pronotum often with a pair of small submedian dark spots (Figure 2).

Head. Labrum with broadly notched anterior margin; dorsal surface with long, simple, setae. Right mandible: incisor with 4 and kinetodontium with 3 denticles; left mandible: incisor with 3 and kinetodontium with 2 denticles. First segment of maxillary palp 0.6–0.7 length of 2nd and 3rd segments together, with 5–6 setae dorsally and 3–4 setae ventrally; 3rd segment with 10–14 setae ventrally. Labial palp with first segment subequal to second and third segment together, with 9 setae dorsally; second segment with 10 setae ventrally and 5–7 setae dorsally; second segment 1.5–1.7 times longer than third segment; the latter apically with 8–10 spines and long, fine, simple setae ventrally.

Thorax. Sides of pronotum straight and parallel or more or less rounded and diverging to the front (Figure 2). Coxal processes of medium length, broadly rounded, with marginal teeth and 2–3 curved setae (Figure 3i–j). Forefemur has length/width = 2.7, with transverse row of 5–7 broad, apically frayed, blunt, stout setae (Figure 3e) in distal half (about one third distance from apex), dorsal and ventral margin with broad, apically frayed, blunt, stout setae, and scattered, long, simple setae (Figures 3d–e). Foretibia with about 10 simple setae on inner side; outer side with scattered, long, simple setae. Foretarsus along inner side with a row of 10–11 setae frayed only on one side (Figure 3g); outer side with scattered, long, simple, hair-like setae. Foreclaw slender, with 4–5 stout, marginal denticles. Middle femur with broad, apically frayed, and blunt, stout setae. Middle tibia with row of 10–12 simple or frayed setae on inner side; outer side with scattered, long, simple setae. Middle tarsus with row of 10–12 frayed setae along inner side (Figure 3h); outer side with scattered, long, simple,

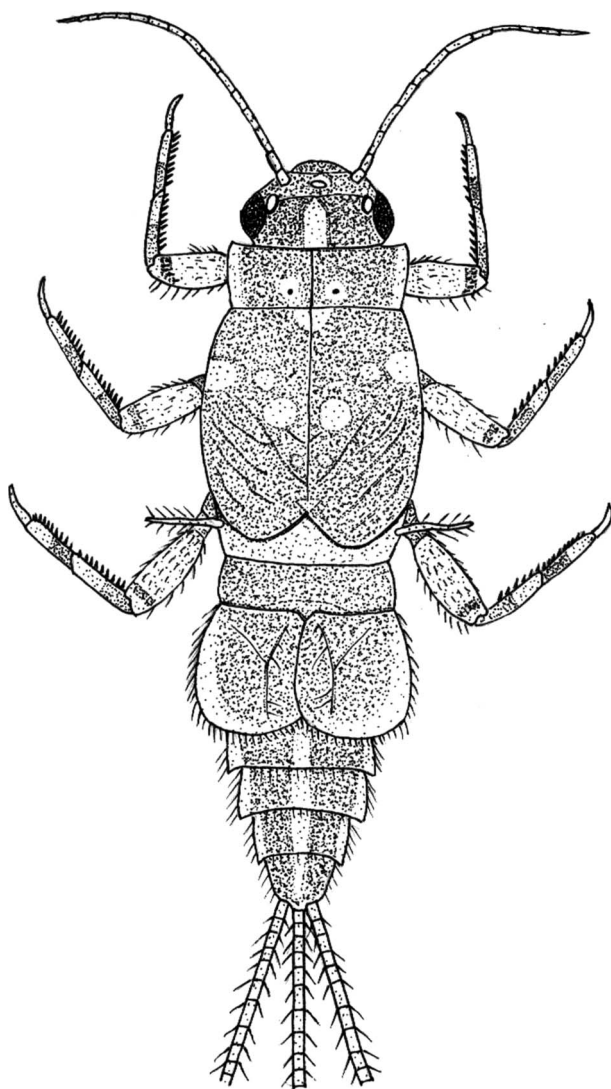


Figure 2. *Caenis cubensis* sp. n.: larva in dorsal view.

hairlike setae. Middle claw slender, with 4–5 stout, marginal denticles. Hind femur with broad, apically frayed, and blunt, stout setae. Hind tibia with 10–15 simple or frayed setae on inner side; dorsal side with scattered, long, simple, hair-like setae. Hind tarsus with a row of 10–12 simple or frayed setae on inner side and with a row of shorter, pinnate setae on posterior side; dorsal side with scattered, long, simple, hair-like setae. Hind claw slender, with 35–45 denticles, length of denticles increases toward tip, distal denticle very strong, basal 2–5 denticles larger than proceeding ones (Figure 3f).

Abdomen. Posteromedian projection of tergum II broader at base, small, triangular and pointed. Lateral abdominal projections of middle segments moderately developed (Figure 3a). Sternum IX with distal margin slightly notched (Figures 3a–c). Shagreen field on sternum IX consists of two to four irregular rows of small teeth near hind margin. Ridges on operculate gills

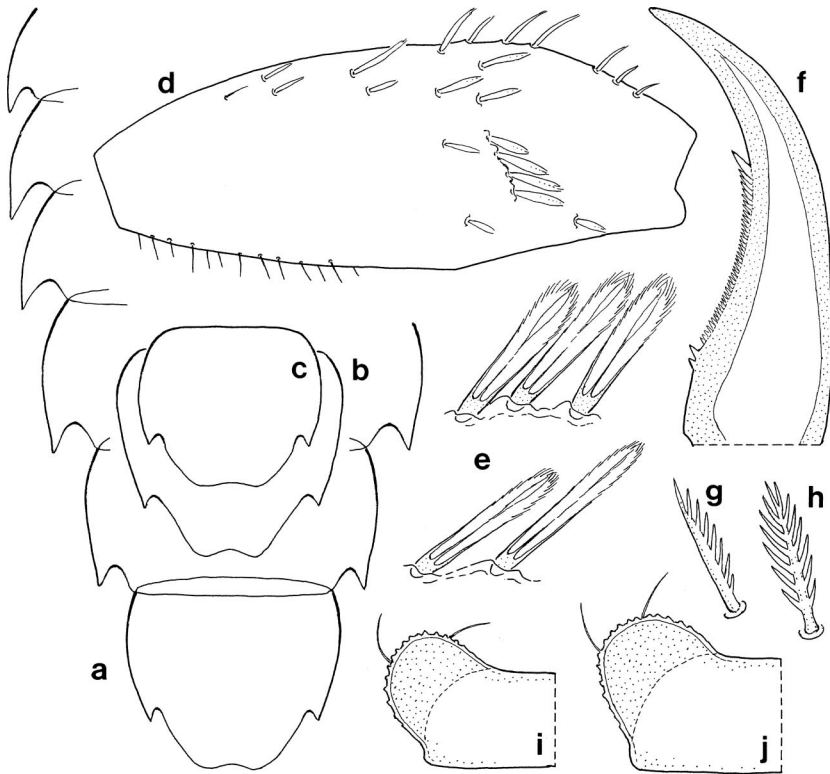


Figure 3. *Caenis cubensis* sp. n., larva: (a) outline of IV–IX abdominal sterna of mature female larva; (b) IX abdominal sternum of another mature female larva; (c) IX abdominal sternum of mature male larva; (d) forefemur; (e) setae of transverse row on forefemur, two different shapes; (f) claw of hind leg; (g) seta of foretarsus; (h) seta of middle tarsus; (i) coxal process of hind leg; (j) coxal process of middle leg.

with some long tapering bristles; surface with a number of setae of decreasing length, the shorter ones blunt. Terminal filaments pale yellow, middle portion of each terminal filament with long lateral setae on each segment, setae as long as space between them.

Eggs

Ovate (length/width = 1.4), surface of chorion nearly without granulation. Two large flat epitemata. With one micropyle laying in equatorial plane, mouth abruptly broadened.

Etymology. The new species is named in allusion to the island of Cuba.

Discussion

Unlike many other species of *Caenis*, the male imago of *C. cubensis* has gonostyli with rounded tips, without conspicuous projections. Neotropical species of *Caenis* with such rounded gonostyli tips were divided into four species groups (Malzacher 2001):

the *C. reissi*-group including *C. reissi* Malzacher, 1986, *C. quatipuruica* Malzacher 1986, *C. sigillata* Malzacher, 1985 and *C. cigana* Pereira & Da-Silva, 1990;

the *C. pflugfelderi*-group including *C. pflugfelderi* Malzacher, 1990, *C. chamie* Alba-Tercedor & Mosquera, 1999 and *C. panamensis* Malzacher, 2001;

the *C. argentina*-group including *C. argentina* Navás, 1915, *C. ludicra* Navás, 1924, *C. dominguezii* Malzacher, 2001, *C. plaumanni* Malzacher, 2001, and *C. gonseri* Malzacher, 2001;

the *C. tenella*-group (= *Caenis grimi*-group) represented only by *C. tenella* (Navas 1932). *Caenis grimi* is a junior synonym of *Eurycaenis tenella* Navas 1932 (Molineri & Malzacher).

From these groups the *reissi*- and the *tenella*-group show the most undifferentiated genitalia. The *reissi*-group is characterised by a very short and broad penis nearly without lobes, weak and uncoloured sclerites, often nearly invisible, and simple, short, and broadly rounded gonostyli with a distance between the lateral points of their bases of 2.2–2.8 their length. The same proportions and colour can be observed in *C. tenella*, but more differentiated penis lobes and gonostyli allow one to separate this species from the *reissi*-group. In *C. cubensis* gonostyli are longer, so that the distance between the lateral points of their bases is 1.6–1.9 of their length.

The *argentina*-group shows the following characters: foreleg of male imago twice as long as hind leg or longer, fore tibia about twice as long as femur. Second abdominal tergum of male with finger-like processes. Genital sclerites and gonostyli more or less strongly coloured. In the *pflugfelderi*-group and in *C. cubensis*, the forelegs do not reach this length and a finger-like process is lacking.

The knowledge of the larvae of all species of the *argentina*-group (Molineri & Malzacher) allows a further subdivision: *C. argentina*, *C. ludicra*, *C. plaumanni* and the newly described *C. uruzu* have operculate gills with a dorsal surface densely covered with short, bifid, frayed and more or less broadened microtrichia. These microtrichia are lacking in *C. dominguezii*, *C. gonseri*, and also in the *pflugfelderi*-group and in *C. cubensis*.

In the *pflugfelderi*-group (as well as in the *argentina*-group) the gonostyli taper to the tip more or less regularly. In *C. cubensis* the longer gonostyli have nearly parallel sides in their basal half, and are often somewhat broadened and abruptly bent in the middle. There is also a larval character that separates *C. cubensis* from the *pflugfelderi*-group, namely the specific structure of the setae on the hind margin of sternum IX. In the *pflugfelderi*-group there are 4–5 lateral setae that are very long and pointed. The setae that are located medially to the lateral ones are much shorter and bifid. The respective setae in *C. cubensis* become gradually shorter from the sides to the middle.

In the *C. pflugfelderi*-group and the *C. tenella*-group the foretibia is only $1\frac{1}{4}$ – $1\frac{1}{3}$ times longer than the forefemur. In the *argentina*-group the foretibia is $1\frac{3}{4}$ – $2\frac{2}{3}$ times as long as the forefemur. In *C. cubensis* and *C. chamie* this proportion lies in between these two groups: the foretibia is $1\frac{2}{3}$ –2 times longer than the forefemur.

Although the gonostyli of *C. cubensis* are apically rounded like in the other groups here mentioned, they show a tendency to develop pointed, apically tapering tips, which are provided with one or two minute denticles. This could be a transitional stage to the Nearctic *C. diminuta*-group (Provonsha 1990) and the Palearctic *C. horaria*-lineage (Malzacher 1984), which shows more or less strongly sclerotised tips of gonostyli. Among Neotropical species, such sclerotised tips of gonostyli are present in *C. pseudamica* Malzacher, 1990 (which is very similar to the species of the *diminuta*-group). More strongly sclerotised tips are present in *C. burmeisteri* Malzacher, 1990; species of the *C. fittkau*-group (*C. fittkau* Malzacher 1986 and *C. candelata* Malzacher 1986), and the genus *Brasilocaenis* (Malzacher 1986, 1990, 1991).

The relationship of the species *C. femina* Hofmann and Sartori, 1999 and *C. catherinae* Hofmann and Thomas, 1999 from Guadeloupe cannot be resolved at present, because

their males are unknown. *C. femina* even seems to be a parthenogenetic species. However, the larvae of these two species and *C. cubensis* are very similar to each other, especially those of *C. cubensis* and *C. femina* are phenetically very close to each other. *C. catherinae* can be separated by the deep, v-shaped notch on the posterior margin of sternum IX. So these species could be considered members of the same group as *C. cubensis* (*femina*-group).

Ecology

C. cubensis is the most widespread and abundant mayfly species of Cuba. It has a wide rank of altitudinal variation, from 0 to 900 m above sea level (m a.s.l.), but has been captured more frequently below 500 m a.s.l. and with less frequency between 750 and 900 m a.s.l., the latter records located within the Bayamesa National Park. It also has been captured in polluted rivers, ponds, and even in swimming pools.

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References

- Alayo P. 1977. Introducción al estudio del orden Ephemeroptera en Cuba. Informe Científico del Instituto de Zoología 7:1–15.
- Alba-Trecedor J, Mosquera S. 1999. *Caenis chamie*, a new species from Colombia (Ephemeroptera: Caenidae). Pan-Pacific Entomologist 75(2):61–67.
- González D, Trapero A, Naranjo C. 2005. Insectos Acuáticos del Parque Nacional “Alejandro de Humboldt”, Cuba. Boletín de la Sociedad Entomológica Aragonesa 36:257–261.
- Hofmann C, Sartori M, Thomas A. 1999. Les Ephéméroptères (Ephemeroptera) de la Guadeloupe (petites Antilles française). Mémoires de la Société Vaudoise des Sciences Naturelles 20(1):48–60.
- Kluge NJ. 2004. The phylogenetic system of Ephemeroptera. Dordrecht/Boston/London: Kluwer Academic Publishers. p 1–442.
- López P, Naranjo C, Fernández J, González D, Trapero A, Pérez J. 2004. Insectos acuáticos del Parque Nacional “La Bayamesa”, Cuba. Boletín de la Sociedad Entomológica Aragonesa 35:225–231.
- Malzacher, P. 1984. Die europäischen Arten der Gattung *Caenis* Stephens (Ephemeroptera, Caenidae). Stuttgarter Beiträge zur Naturkunde (Serie A) 373:1–48.
- Malzacher P. 1986. Caenidae aus dem Amazonasgebiet (Insecta, Ephemeroptera). Spixiana 9(1):83–103.
- Malzacher P. 1990. Neue Arten der Eintagsfliegen-Familie Caenidae (Insecta, Ephemeroptera) aus Südamerika. Studies on Neotropical Fauna and Environment 25(1):31–39.
- Malzacher P. 1991. Genital-morphological features in the Caenidae (Ephemeroptera). In: Alba-Trecedor J, Sanchez-Ortega A, editors. Overview and strategies of Ephemeroptera and Plecoptera. Gainesville: The Sandhill Crane Press, Inc. p 73–85.

- Malzacher P. 2001. South and Central American *Caenis* species with rounded gonostyli tips (Insecta: Ephemeroptera: Caenidae). Stuttgarter Beiträge zur Naturkunde (Serie A) 626:1–20.
- Molineri C, Malzacher P. The genus *Caenis* Stephens (Ephemeroptera, Caenidae) in Argentina, new species and stage descriptions. Zootaxa (in press).
- Naranjo C, Cañizares M. 1999. Situación actual del orden Ephemeroptera (Insecta) en Cuba. Cocuyo 8:17–19.
- Naranjo C, Trapero A. 2000. Insectos acuáticos del macizo montañoso de La Gran Piedra. Biodiversidad de Cuba Oriental 5:89–93.
- Navás, L. 1932. Insectos de la Argentina. Revista de la Academia de Ciencias de Zaragoza 16:87–120.
- Provonsha A. 1990. A revision of the genus *Caenis* in North America (Ephemeroptera: Caenidae). Transactions of the American Entomological Society 116(4):801–884.
- Traver J. 1938. Mayflies of Puerto Rico. Journal of Agriculture of the University of Puerto Rico 22(1):22–24.

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