Leaf litter copepods from a cloud forest mountain top in Honduras (Copepoda: Cyclopidae, Canthocamptidae)

FRANK FIERS[1,2] & MERLIJN JOCQUE[1,3,4]
[1] *Royal Belgian Institute of Natural Sciences, Vautierstraat 29, B–1000 Brussels, Belgium*
[2] *Emil Racoviţă Institute of Speology, Clinicilor 5, P.O.Box 58400006 Cluj-Napoca, Romania.*
[3] *Operation Wallacea, Hope House, Old Bolingbroke, Lincolnshire, UK.*
[4] *Laboratory of Aquatic Ecology and Evolutionary Biology, Universiteit Leuven, Ch. Deberiotstraat 32, B–3000 Leuven, Belgium*

Abstract

Introduction

Mapping and understanding biodiversity is an ongoing process (Zhang 2011) with still a long way to go (e.g. Mora et al. 2011). Surveys are often focussed on specific habitats and areas, which are selected based on pre-existing knowledge of the occurrence of the particular taxa under study. Such a selective approach increases survey efficiency, resulting in recording the highest diversity for the taxonomic group under study, but might overlook some species occurring in peripheral habitats that are not part of the survey focus. In some cases, a considerable part of biodiversity can remain hidden for a long time, and subsequent discoveries sometimes challenge our understanding of a taxon's ecology. Such examples can be found in surveys of freshwater biodiversity. Whereas the classic approach focuses on large, clearly definable water bodies, such as lakes and rivers, there is increasing evidence that a large proportion of freshwater (invertebrate) diversity occurs in peripheral aquatic habitats, such as phytotelmata (Frank and Lounibos 2009), water films on vegetation, wet mosses, leaf carpets, and humid soils (Pinto et al. 2008).

It is well known that certain cyclopids and harpacticoids can maintain populations in such semi-terrestrial habitats. Our understanding of their occurrence and diversity, accumulated over more than a century of investigations, has been highlighted and reviewed recently by Reid (2001). Besides some particular environments which have been carefully investigated (phytotelmata, caves, etc), the presence of copepods in humid continental habitats is largely interpreted as coincidental. Their study, however, may forward key factors in order to explain evolutionary and biogeographic theories (Rémy 1932; Lewis 1986; Fiers & Ghenne 2000; see also Frey 1980).

In a recent study of the aquatic invertebrate fauna in bromeliad aquaria in *el Parque National Cusuco* in Honduras, the survey was complemented with sampling invertebrates in litter around some bromeliads on a high cloud forest covered ridge. The present contribution presents records of five copepods encountered in these samples. Their presence and abundance in the small sample extracted from a 200 cm² surface at the foot of the bromeliads is even more surprising considering the absence of copepods in the water filled leaf axils. Five different species of Copepoda were extracted from a leaf litter sample collected on the top (at 2000 m a.s.l.) of a cloud forested mountain in El Cusuco National Park, Honduras. Three of them, one Cyclopidae and two Canthocamptidae are new to science, and are described herein. *Olmeccyclops hondo* **sp. nov.** is the second representative thus far known of this New World genus. *Moraria catracha* **sp. nov.** and *Moraria cusuca* **sp. nov.** are the first formally described members of the genus occurring in Central America. The concept of a "*Moraria*-group" is considered to be an artificial grouping and is limited here to the genera *Moraria* and *Morariopsis* only. The distributional range of this group is essentially Holarctic, with the mountainous regions in Honduras, and probably in west Nicaragua, as the southernmost limits in the New World. **Key words:** Cyclopoida, Harpacticoida, Central America, taxonomy, new species

Material and methods

The copepods were sorted out from a leaf litter residue sample collected at the El Cusuco National Park, west of San Pedro de Sula (Honduras) in the elfin forest (cloud forest) on a wind exposed ridge at 2013 m a.s.l. (15? 30' 29.6"N 88? 13' 57.6"W). Litter was collected by hand from a surface of approximately 2 dm_2, to a depth of 7–8 cm (27 June 2011, leg. M. Jocque) and washed in the field with filtered river water from Rio Cusuco (22 µm filter). Residue preserved in 70% ethanol. All specimens are stored in the Crustacea collection of the Royal Belgium Institute of Natural Sciences, Brussels, registered RBINSc COP #. Dissected animals are mounted in glycerol, preserved specimens are stored in 70 % ethanol.

Results

Five species of Copepoda were collected from the water residue: one Cyclopidae and four Harpacticoida. In addition to the three new species described herein, the sample yielded specimens of the harpacticoids *Phyllognathopus sp*. (8 females, 1 juvenile), *Epactophanes aff. richardi* Mrázek, 1893 (1 female, 1 male), and a few unidentifiable canthocamptid juveniles. They are stored as vouchers and catalogued RBINSc COP 9938, 9941, and 9942, respectively. Below we provide new species accounts.

Order Cyclopoida Rafinesque 1815
Family Cyclopidae Rafinesque 1815
Genus *Olmeccyclops* Fiers 2012
***Olmeccyclops hondo* sp. nov.**
(Figs. 1–4)

Material examined. Holotype, female, dissected and mounted on 4 slides, registered RBINSc COP 9936A-D; paratype female, preserved, registered RBINSc COP 9937.
Type locality. Honduras, El Cusuco National Park, Elfin forest floor (see: Material and methods for details).
Etymology. From the Spanish word *hondo*, meaning "mysterious, deep" and traditionally said to be used by Christopher Colombus in 1502 to mark the deep waters off the present day Honduras, proposed herein as specific epithet to mark the occurrence of the species deep in the cloud forests of El Cusuco National Park. Gender masculine.
Description. Female. Habitus (Fig. 1A) cyclopid-shaped. Body depressed, widest along posterior margin of cephalothorax. Metasome gently tapering caudally, shorter that cephalothorax (ratio 1/1.2). Transition between prosome and urosome indistinct in dorsal view. Intersomal arthrodial membrane between leg 5-bearing pediger and genital double-somite wide, without particularly reinforced integument (Fig. 2A, B). Genital double-somite vase-shaped in dorsal view (Fig. 1A), widest in anterior third (length:width ratio: 1/1.15). Leg 6 vestiges positioned dorsolaterally in anterior third of double-somite (Fig. 2b). Urosomites 4 and 5 parallel-sided. Ratio urosome/body length: 1:2.6. Body length (holotype) 555 µm and (paratype) 750 µm.
Integument of body somites smooth, integument structure with refractile punctuations (not illustrated). Posterior margin of cephalothorax and metasomites straight. Posterior margin of genital double-somite and urosomites 4 and 5 with wide, transparent, with serrate fringe. Posterior margin of anal somite with uninterrupted girdle of robust spinules (Fig. 1A, 2A, B). Anal operculum wide and prominently expanded caudally, either linguiform with crescentic apex (Fig. 1C: holotype) or irregularly undulate (Fig. 1D: paratype).
Caudal rami (Fig. 1 C, D, 2A, B) twice as long as wide, cylindrical, with large triangular depression along medial margin. Anterolateral seta long, about 3/4 of ramal length, without spinules near insertion. Posterolateral element as long as ramus, rigid, serrate along outer, pinnate along inner margin. Outer terminal seta half as long as inner one, both pinnate and with breaking plane near insertion. Medial seta stout, pinnate, shorter than ramus (2/ 3–3/4 of ramal length). Dorsal seta located near to inner distal corner of ramus, articulating on single basal part, and slightly longer than ramus. Surface of rami smooth except for row of spinules extending from insertion of distolateral setae to halfway posteroventral margin (Fig. 2 A, B).

FIGURE 1. *Olmeccyclops hondo* **sp. nov.** A, habitus, dorsal; B, apical setae of caudal ramus; C, anal somite and caudal rami, dorsal view; D, idem, dorsal view; E, rostrum, dorsal view; F, antennule, ventral view (A–C, E–F: female holotype, RBINSc COP 9936; D: female paratype, RBINSc COP 9937).

FIGURE 2. *Olmeccyclops hondo* **sp. nov.** A, urosome, ventral view; B, urosome, lateral view (A–B: female holotype, RBINSc COP 9936).
Rostrum (Fig. 1E) roughly triangular with pointed apex and pair of sensilla near transition between rostrum and cephalothorax. Sieve plates not observed.
Antennule (Fig. 1F) 10-segmented, reaching halfway along cephalothorax when deflected backwards. Armature formula (from proximal to distal segment; Aesth=aesthetasc):1(7)-2(7)-3(3)-4(1)-5(2)-6(3)-7(2+Aesth)-8(2)-9(2+Aesth)-10(7+Aesth). Aesthetasc on segment 7 linguiform, on segment 9 filiform, and on segment 10 tubiform. First segment with proximal comb of long and slender spinules, subsequent segments without ornamentation. Conical element on segment 4 short.

Antenna (Fig. 3A) 4-segmented with 2 abexopodal setae but without exopodite vestige on coxobasis; spinule pattern on coxobasis limited to small cluster of minute spinules near middle of outer margin; endopodite segments (from proximal to distal) with 1, 5 and 7 setae, respectively. Outer margin of endopodite segments with spinules, surfaces smooth.
FIGURE 3. *Olmeccyclops hondo* **sp. nov.** A, antenna, caudal view; B, mandible; C, mandibular cutting edge, frontal view; D, maxillulary gnathobasis (dashed line indicates location of palp insertion); E, maxillulary palp; F, labrum; G, maxilla; H, maxillary endopodite, detached showing claw shaped aspect of terminal element; I, maxilliped, frontal view (A–I: female holotype, RBINSc COP 9936).

FIGURE 4. *Olmeccyclops hondo* **sp. nov.** A, leg 1, frontal view; B, leg 2, frontal view; C, leg 3, caudal view; D, leg 4, caudal view (endopodites illustrated detached, marked by arrows; A–C: female holotype, RBINSc COP 3936).

Mandible (Figs. 3B, C) with robust multi-cuspidate medial margin; palp obsolete, represented by single stout seta. Accessory element on cutting edge associated with large prominent spinule. Surface of gnathobasis smooth, except for few minute spinules on outer half of frontal margin and near the medial margin.

Labrum (Fig. 3F) with multicuspidate margin and two combs of long and widely spaced slender spinules. Maxillulary arthrite (Fig. 3D) with 3 medial claw-shaped naked elements, confluent with segment. Ventral subdistal element naked and long. Dorsal margin bearing 5 elements with outermost one (broken in Fig. 3D) long and densely pinnate. Maxillulary endopodite fused with basis (Fig. 3E), bearing 3 pinnate setae. Basis with seta representing exopodite. Medial margin with 1 pinnate and 1 serrate element. Subdistal element naked.

Maxilla (Fig. 3G) 4-segmented with incomplete remnant separation between precoxa and coxa. Proximal and distal endite with 2 terminal setae, median endite represented by single seta. Basis with smooth claw, serrate accessorial element, and short seta on posterior surface. Endopodite (Fig. 3H) 2-segmented with, on proximal segment, 2 rigid elements, on distal segment, 2 slender lateral setae and a stout claw-shaped smooth terminal element. Surface of segments without ornament.

Maxilliped (Fig. 3I) composed of 3 segments: syncoxa, basis and one-segmented endopodite. Syncoxa with 3 elements: 1 precoxal and 2 coxal. Basis with one seta, endopodite with 2. Two spinule rows along outer margin of syncoxa and one medial cluster near insertion of coxal setae.

Legs 1–4 (Figs. 4A–D, respectively) intercoxal sclerites large, with crescentic distolateral edges and concave distal margin. Surface and margins devoid of spinular ornamentation. Precoxa smooth. Medial coxal seta present in legs 1–4, rather long and pinnate. Coxal surface smooth frontally and caudally in legs 1 and 2. Coxa of leg 3 frontally smooth, caudally with spinular comb near proximal outer corner. Coxa of leg 4 frontally smooth, with spinular comb near proximal outer corner and near distal margin on caudal surface. Medial spine on leg 1 basis robust, serrate along outer margin only. Medial basis margin of legs rounded and hairy. Distal margin of leg basis set with spinules midway (legs 1–4, not illustrated for legs 3 and 4) and near insertion of medial spine in leg 1. All rami distinctly 2-segmented, exopodites with solid appearance. Setal armature slender and pinnate. Distal spine of second leg 4 endopodite segment longer than segment (ratio 1/1.5) and inserted between 2 minute triangular expansions on distal segment margin. Exopodite spine formula: 2.3.3.2, exopodite seta formula 4.4.4.3.

TABLE 1. Female leg armature of *Olmeccyclops hondo* **sp. nov.**

	Endopodite	Exopodite
Leg 1	I.0 - II.2.2	0 1 - 1.I+1.2
Leg 2	I.0 - II.I+1.3	0.1 - 1.I+1.2
Leg 3	I.0 - II.I+1.3	0.1 - 1.I+1.2
Leg 4	I.0 - I.I+1.2	0.1 - 1.I.2