Stygologia, 7 (4) 219-224 (1992)
SPB Academic Publishing bv, The Hague

The genus *Hesperocyclops* Herbst: an update, and description of *Hesperocyclops venezuelanus* n. sp. from Venezuela (Crustacea Copepoda: Cyclopidae)

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Keywords: Copepoda Cyclopidae, *Hesperocyclops*, ground waters, Venezuela

Abstract

Hesperocyclops venezuelanus n. sp. is described from ground waters of North Venezuela. *Metacyclops* (*Apocylops*) *stocki* Pesce, 1985 is definitively allocated to the genus *Hesperocyclops* and synonymized with *Hesperocyclops improvisus* Herbst, 1984. An emended diagnosis of the genus, a distribution map and a key to the species of *Hesperocyclops* are presented.

Résumé

Hesperocyclops venezuelanus n. sp. est décrit des eaux souterraines du Venezuela septentrional. *Metacyclops* (*Apocyclops*) *stocki* Pesce, 1985 est transféré au genre *Hesperocyclops* et synonymisé avec *H. improvisus* Herbst, 1984. Est aussi proposée une nouvelle diagnose du genre *Hesperocyclops*, avec une carte de distribution et une clé de détermination des espèces.

Introduction

In a collection of cyclopid copepods from different groundwater habitats of Venezuela, entrusted to us for study through the kindness of Prof. J.H. Stock and Dr. L. Botosaneanu (Amsterdam), there occurred a new species of the genus *Hesperocyclops* Herbst, 1984, which is described herein as *Hesperocyclops venezuelanus* n. sp.

The genus *Hesperocyclops* is rediagnosed, giving additional information of certain features, such as the basipodite of the antenna, the spine formula of Exp2 of P_1-P_4 and the armature of leg 5, to complement Herbst's otherwise excellent original description. Moreover, reexamination of paratypes of *H. improvisus* Herbst, 1984 and *Metacyclops* (*Apocyclops*) *stocki* Pesce, 1985 let us to definitely synonymize the latter with the former species.

A distribution map and a key to females of all known species of *Hesperocyclops* are presented.

Type material is preserved in the collections of the Zoölogisch Museum, Amsterdam, The Netherlands (ZMA) and in the zoological collections of the "Dipartimento di Scienze Ambientali", University of L'Aquila, Italy (GPC).

The following abbreviations are used in the descriptive text and figures: A_1 = antennula; A_2 = antenna; Mx_1 = maxillule; Mx_2 = maxille; Mxp = maxillipede; P_1-P_6 = 1st to 6th legs; Basp 1/2 = first to second segments of basipodite; Enp2 = 2nd segment of the endopodite; Exp2 = 2nd segment of the exopodite; T_e = outer apical furcal seta; T_i = inner apical furcal seta.

Family Cyclopidae G.O. Sars, 1913
Subfamily Cyclopinae Kiefer, 1927
Genus *Hesperocyclops* Herbst, 1984

Hesperocyclops venezuelanus n. sp.
(Figs. 1–13, 18)

Material. – Amsterdam Expedition 1982 to Venezuela, Sta. 82/548. Venezuela, Pos by Orituco, 4.4 km on road from railway station to Paso el Caballo. 9 March 1982. 08°46'26''N 67°18'22''W.

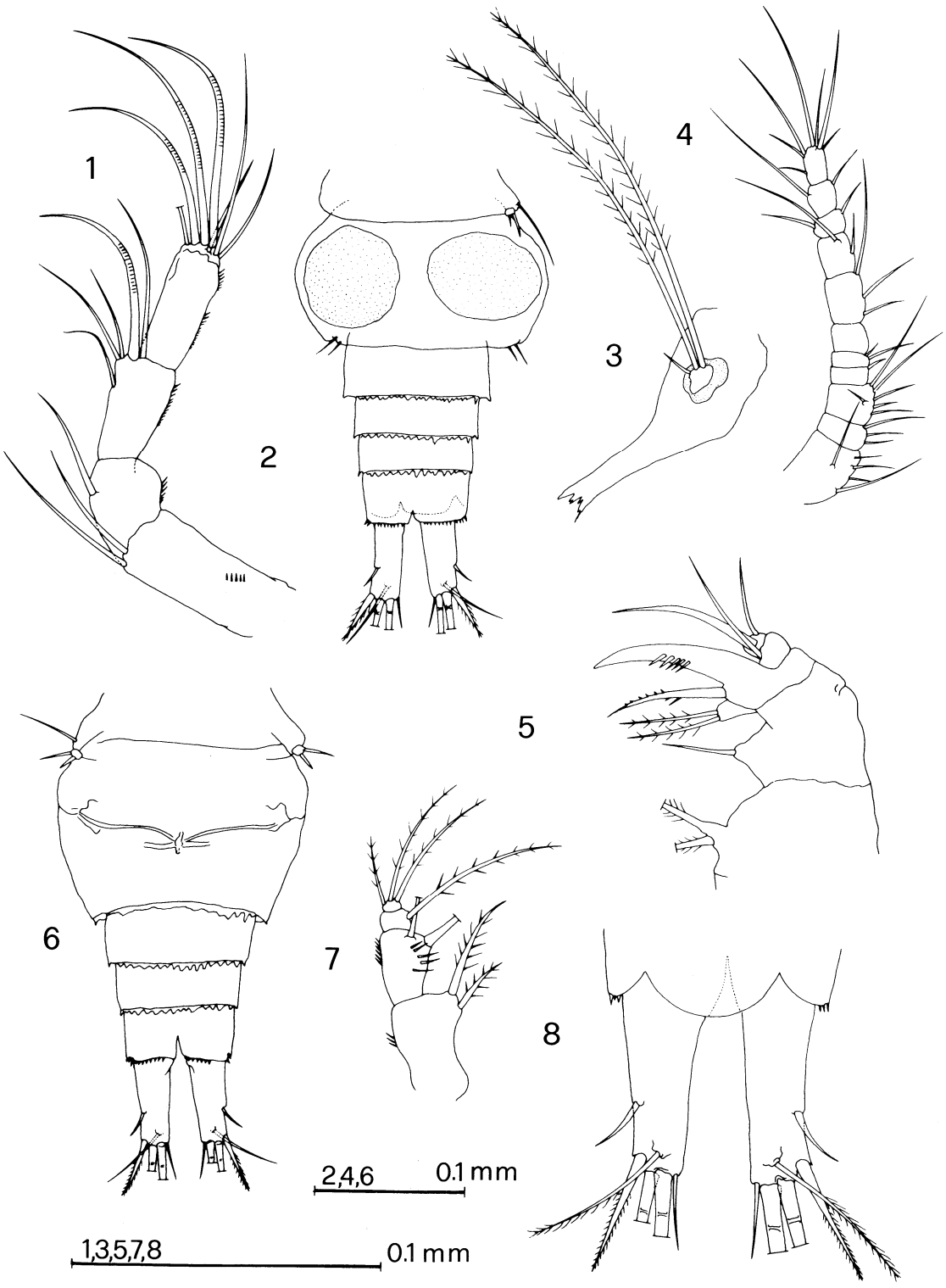

Fig. 1–8. Hesperocyclops venezuelanus n. sp. 1,3–8: female; 2: male. (1) A_2; (2) abdomen and furcal rami, ventral view; (3) mandible; (4) A_1; (5) Mx_2; (6) abdomen and furcal rami, ventral view; (7) Mxp; (8) furcal rami, dorsal view.

Coll. L. Botosaneanu. Clean water, chlorinity < 1 mg/l.

Holotype (♀), 8 ♀ ♀ and 1 ♂ (paratypes), completely dissected and mounted in Faure's medium, 3 female paratypes in ZMA, holotype and remaining paratypes in GPC.

Description. – Female. Length 0.64–0.76 mm ($\bar{x}$ = 0.71), holotype 0.76 mm. Prosome: urosome = 1.35:1. Distal border of genital complex and of first two urosomal somites crenulate (fig. 6). Genital complex about 1.5 times wider than long; receptaculum seminis as in fig. 6. Anal somite expanded dorsally into a rounded operculum reaching about its posterior border.

Caudal rami (figs. 6,8) about 3 times longer than wide; T_e strong and approximately 1.65 times as long as T_i. Dorsal seta implanted on protuberance and shorter than ramus. Lateral seta placed at posterior third of ramus.

A_1 11-segmented, shorter than cephalic segment and ornamented as in fig. 4. A_2 4-segmented; Basipodite with 2 inner setae and without outer seta (vestigial exopod); other ornamentation as in fig. 1.

Mx_1 and Mx_2 without particular characteristics as compared to other species of the genus. Mxp four-segmented and ornamented as follows (Roman numerals = segments, Arabic numerals = setae): I/2; II/2; III/1; IV/3 (fig. 7).

P1–P4, each with seta on the inner corner of Basp 1. Basp 2 P_1 with inner corner expanded into long, rounded and ciliate protuberance. Basp 2 P_2–P_4 with inner corner expanded into large, pointed protuberances, much developed in Basp 2 of P_4. Spine formula of Exp2 of P_1–P_4: 3.4.3.3. Expodite and endopodite of P_1–P_3 and exopodite of P_4 2-segmented; endopodite of P_4 1-segmented, pear-shaped, about 1.35 times as long as wide, bearing 5 setae, shorter than the article, and one apical spine, much shorter than the article (1:3.0); inner setae short, subdistal setae well overreaching apical spine.

Distal segment of P_5 (figs. 11, 18) free, wider than long, with short seta and spine, former only 1.4 times longer than latter.

Male. Length 0.64 mm. Swimming legs as in female, except endopodite of P_4 which is 2-segmented and with longer apical setae and apical spine. Terminal segment of P_5 with outer seta about twice longer than apical spine. P_6 represented by 2 short setae (outer slightly longer than inner one) implanted on posterior edge of genital somite. Other characteristics as in female.

Affinities. – The new species is included in the genus *Hesperocyclops* based on the characteristic structure of the female P_4 endopod, notwithstanding the absence of the outer seta (exopod) on the basipodite of the antenna and the different armature of P_5 (the distal seta of P_5 in the new species is the shortest known for the genus) (figs. 14–18). These features as well as the remarkable expansions on Basp 2 of P_1 and P_4 and the shortness of the apical spine on the endopodite of female P_4 are diagnostic characteristics that separate *H. venezuelanus* n. sp. from all its congeners.

Discussion. – Herbst (1984) established the genus *Hesperocyclops*, with the species *H. improvisus*, to accomodate cyclopids from ground waters of West Indies close to *Apocyclops* Lindberg, but with reduced, 1-segmented female endopodite of P_4 and different morphology of P_5, genital somite and anal operculum.

From the same region, one year later, Pesce (1985) described the species *Metacyclops* (*Apocyclops*) *stocki*, successively removed to the genus *Hesperocyclops* (da Rocha & Gonzaga de Carvalho Bjornberg, 1987; Petkovski, 1988).

To date, *Hesperocyclops* is represented by five species from West Indies and South America. The only West Indian species is *H. improvisus* [= *Metacyclops* (*Apocyclops*) *stocki*], from phreatic (wells) and spring waters of Guadeloupe, Antigua, Aruba and Barbuda; the South American species are: *H. inauditus* Dussart & Frutos, 1986, from the hyporheic of Paraná Medio (Argentina); *H. herbsti* da Rocha & Gonzaga de Carvalho Bjornberg, 1987, from semiterrestrial habitats. São Paulo (Brasil); *H. pescei* Petkovski, 1988, from cave waters of Cueva del Alto Grande (Colombia) and *H. venezuelanus* n. sp., from ground waters (a well in North Venezuela).

Our recent reexamination of type-material of

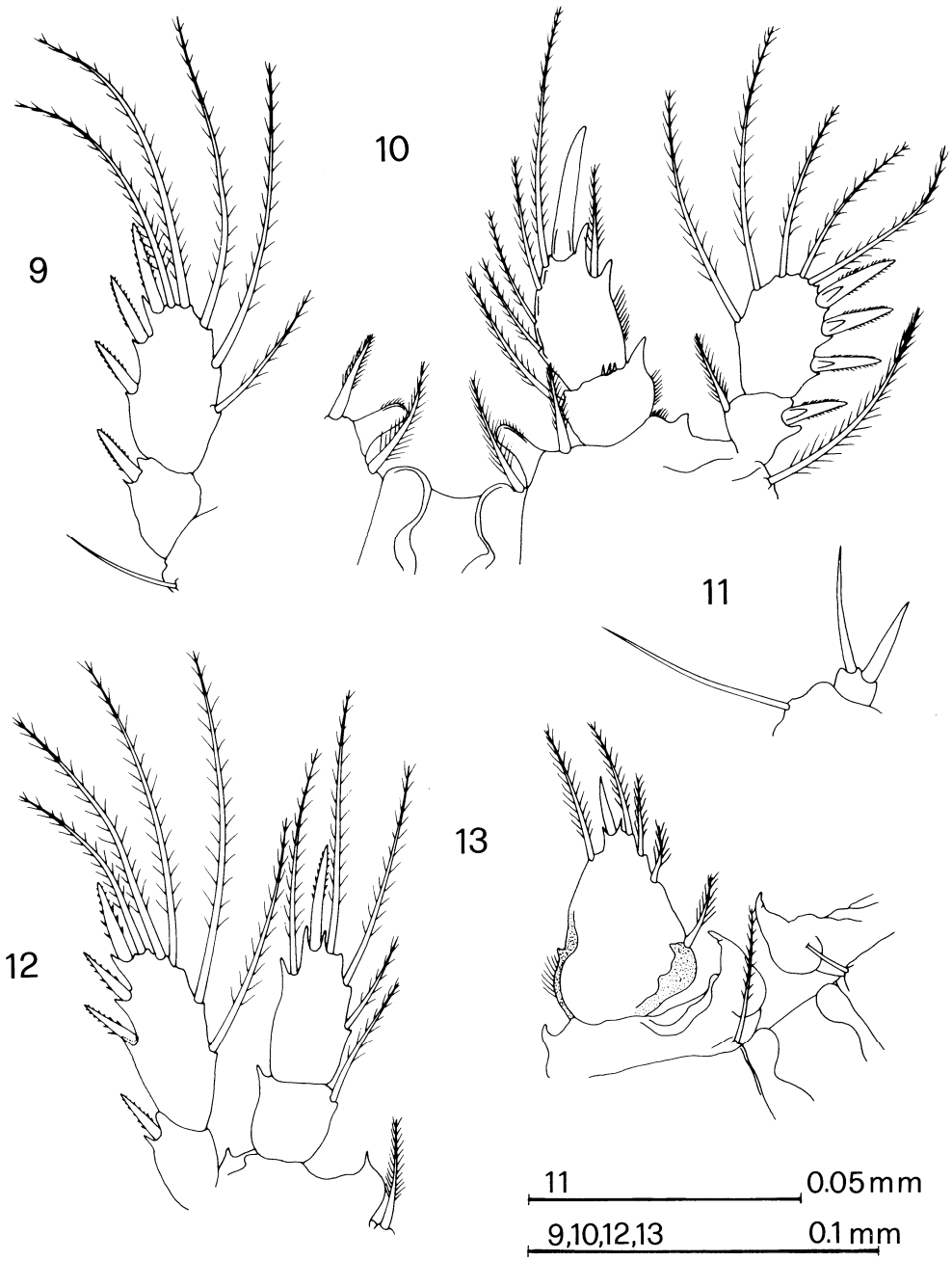

Fig. 9–13. Hesperocyclops venezuelanus n. sp. 9–11, 13: female; 12: male. (9) exopodite of P_4; (10) P_1; (11) P_5; (12) P_4; (13) endopodite of P_4.

both *H. improvisus* and *Metacyclops* (*Apocyclops*) *stocki* clearly indicates that the two species are synonymous, the latter being a junior synonym of *H. improvisus*. Moreover, our study of some paratypes of *H. improvisus* pointed out that this species has a 5-segmented Mx_2, as suggested by da Rocha & Gonzaga de Carvalho Bjornberg (1987) (Herbst figured this appendage as 4-segmented); the examination of a paratype of *H. inauditus* revealed, as well, that this species is provided with outer seta on

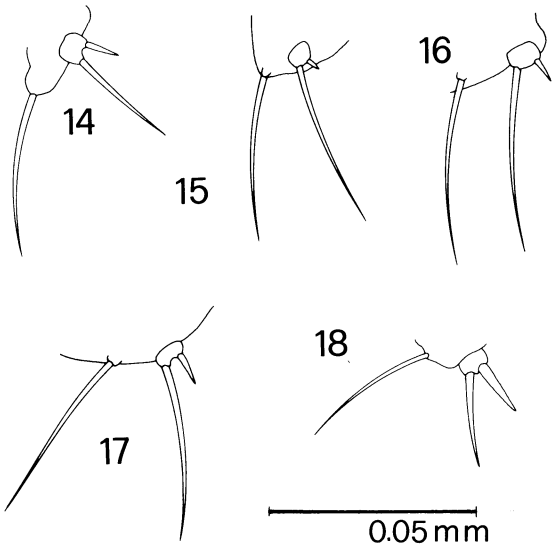

Fig. 14–18. P_5 in the genus *Hesperocyclops*. (14) *H. improvisus*; (15) *H. pescei*; (16) *H. inauditus*; (17) *H. herbsti*; (18) *H. venezuelanus* n. sp.

Basp A2 (Dussart & Frutos did not describe or figure A_2).

According to the above considerations, the diagnosis of the genus *Hesperocyclops* is emended as follows:

Hesperocyclops Herbst, 1984
Type species: *Hesperocyclops improvisus* Herbst, 1984

Female. – Prosome elongated, abdomen reduced, genital segment short, wider than long, anal operculum well developed. Caudal rami short, inner apical seta shorter than the corresponding outer one. A_1, 11-segmented. A_2 with (*H. improvisus*, *H. herbsti*, *H. inauditus*, *H. pescei*) or without (*H. venezuelanus*) vestigial exopodite. P_1–P_3 with both endopodite and exopodite 2-segmented, P_4 with 2-segmented exopodite and 1-segmented endopodite. Spine formula of Exp2 of P_1–P_4: 3.4.4.3 (*H. improvisus*) or 3.4.3.3 (South American species, except males of *H. inauditus* with spine formula 3.4.4.3). Basp 2 P_1 with inner corner expanded into a rounded protuberance. Setae on inner margin of endopodite of P_4 short. Distal segment of P_5 wider than long.

Fig. 19. Distribution of the species of the genus *Hesperocyclops*. (1) *H. improvisus*; (2) *H. inauditus*; (3) *H. herbsti*; (4) *H. pescei*; (5) *H. venezuelanus* n. sp.

Male.– Habitus similar to female. Both exopodite and endopodite of P_1–P_4 with 2 segments. Distal segment of P_5 slightly shorter than in female. P_6 consisting of chitinous lamella bearing 2 setae. Other characteristics as in female.

Key to females of species of *Hesperocyclops*

1 – Spine formula of Exp2 of P_1–P_4: 3443 . *H. improvisus* [= *Metacyclops* (*Apocyclops*) *stocki*] (West Indies)
– Spine formula of Exp2 of P_1–P_4: 3443 2
2 – Basp A2 with outer seta (exopodite) 3
– Basp A2 without outer seta (exopodite) ..... *H. venezuelanus* (Venezuela)
3 – Apical spine of the P_4 endopodite much shorter than ar-

ticle; distal setae much longer than spine .... *H. herbsti* (Brasil)
- Apical spine of the P_4 endopodite about half as long as article; distal setae slightly overreaching spine 4

4 - Anal operculum well developed, semicircular ... *H. inauditus* (Argentina)
- Anal operculum faintly rounded ..... *H. pescei* (Colombia)

Acknowledgements

We are much indebted to Prof. J.H. Stock and Dr. L. Botosaneanu (Amsterdam) for the loan of material. Furthermore, we are most grateful to Prof. B. Dussart, Prof. H.V. Herbst and Dr. F. da Rocha for offering paratypes of *H. inauditus*, *H. improvisus* and *H. herbsti*, respectively, as well as for their useful suggestions.

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First version received: 4 August 1992
Second version received: 16 September 1992