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Two new species of *Eucyclops* Claus (Copepoda: Cyclopoida) from the Chihuahuan Desert with a redescription of *E. pseudoensifer* Dussart

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Abstract

Two new species of the freshwater copepod genus *Eucyclops* are described from two sites in the Chihuahuan Desert (CHD), which includes parts of northern Mexico and southern United States. *Eucyclops cuatrocienegas* **sp. nov.** is distinguished by having a short inner spiniform seta on the fifth leg, relatively short caudal rami, and a partially naked spine of the fourth endopod, among other characters. The finding of *E. cuatrocienegas* in Cuatro Ciénegas, an area in the CHD that is known for harbouring the highest number of endemic aquatic species in North America, suggests that these habitats could yield other endemic forms. The other new species resembles the Neotropical *E. pseudoensifer* Dussart, 1984 but differs in having a shorter basipodal spine of the first leg, shorter outer terminal spiniform caudal seta, a different length ratio of inner/outer spines of leg 4 third endopodal segment, and a different pattern of the serra on the caudal rami. *Eucyclops pseudoensifer*, originally collected from a high altitude lake in the Andean system of western Venezuela, is here redescribed from female and male type specimens. The description of *E. chihuahuensis* **sp. nov.** recognizes both the subtle but consistent differences of this population and its environmental isolation in this arid region. The North American records of *E. pseudoensifer* should be revised in the light of these findings in order to determine the real distributional ranges of these species.

Key words: taxonomy, arid systems, new species, crustacean freshwater zooplankton

Introduction

Among the freshwater cyclopoid copepods, the genus *Eucyclops* Claus, 1893 is one of the most diverse; there are more than 135 nominal species and subspecies known to date (Dussart and Defaye 2001, 2006). However, the taxonomic knowledge of the genus is far from complete; the taxonomy of the group is plagued by incomplete species descriptions and by records based on cursory observations (Ishida 1997; Alekseev *et al.*2006). The main source of such confusion was the incomplete description of the type species of the genus: *Eucyclops serrulatus* (Fischer, 1851). Alekseev *et al.* (2006) redescribed the species based on an upgraded set of morphological and genetic characters and contributed much to solve this basic taxonomic problem. This species, however, shows a high intraspecific morphological variability and was long regarded as a cosmopolitan form. This notion hampered the recognition of cryptic forms with restricted distributional ranges. The taxonomical confusion also extends to *E. agilis* (Koch, 1838), a widespread species (Yeatman 1959; Reid 1992) the name of which recently has been deemed as invalid (Alekseev *et al.* 2006). The American records of both *E. agilis* and *E. serrulatus* are, in general, assignable to the currently valid species *E. pectinifer* (Dussart and Defaye 2006).

The bi-national environmental system known as the Chihuahuan Desert (CHD) includes states of northern Mexico and southern United States. It is considered to be one of high priority for conservation and regional development among the hydrological basins of North America. The CHD comprises many arid and semi-arid

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areas with different hydrological basins and a variety of limnological conditions. Some of these areas are protected to varying degrees. One of the more interesting and studied areas is the valley of Cuatro Ciénegas, in the central sector of the Mexican State of Coahuila. This area is well known for its high levels of endemism of aquatic species, including microbes (Souza *et al.* 2006), molluscs (Hershler 1985), crustaceans (Contreras-Balderas 1978; Cole 1984), and fishes (Minckley 1984). It was designated as an "Area for the Protection of Flora and Fauna" (Gómez-Pompa and Dirzo 1995). Specimens of an undescribed species of *Eucyclops* were collected in 2006 during a zooplankton survey carried out in Cuatro Ciénegas. In a preliminary analysis, these copepods were tentatively identified as *E*. cf. *agilis*. The re-examination of these individuals was motivated by the uncertainty of the taxonomic status of some of the American records of this species (Alekseev *et al.* 2006, Dussart and Defaye 2006) and differences observed in some of the structures with taxonomical relevance within the genus (Reid 1985, 1992). A second species of this genus, tentatively identified as *E. pseudoensifer* Dussart, 1984 was collected from Presa Chihuahua, located near the city of Chihuahua, in northern Mexico; this reservoir is also part of the CHD environmental system. A morphological analysis of these specimens and a comparison with the type specimens from Venezuela revealed subtle but consistent differences that were considered to be enough to separate a new species. In this work both new taxa are described and illustrated following the current criteria for the taxonomic study of eucyclopine copepods (Alekseev 2000). *Eucyclops pseudoensifer* is redescribed based on the type specimens.

Material and methods

The zooplankton fauna of different types of freshwater systems of arid and semi-arid areas of northern Mexico and southwestern United States was surveyed over several years by researchers of the University of Texas at El Paso and Ripon College, Wisconsin. As part of the general survey of the CHD aquatic systems, zooplankton samples were obtained in July 2006 from different habitats of Cuatro Ciénegas, including springs, natural lakes, and ponds. Other CHD localities sampled include a large reservoir, the Presa Chihuahua, visited in April, 2006. The biological material was then fixed and preserved in 70% ethanol for long-term preservation. Adult specimens of the cyclopoid copepod genus *Eucyclops* Claus, 1893 were recorded from these two sites. Copepods were sorted out from the entire original samples and maintained in 70% ethanol with a drop of glycerine. Specimens were dissected and examined following the techniques described by Williamson and Reid (2001) and Reid (2003). All dissected specimens were mounted in semi-permanent slides with glycerine sealed with Entellan® or nail varnish. Drawings were prepared with the aid of a camera lucida mounted on an E-200 Nikon compound microscope. The specimens were deposited in the zooplankton collection at El Colegio de la Frontera Sur (ECO-CHZ), in Chetumal, Mexico.

Taxonomy

Order Cyclopoida Rafinesque, 1815

Family Cyclopidae Rafinesque, 1815

Subfamily Eucyclopinae Kiefer, 1927

Genus *Eucyclops* Claus, 1893

***Eucyclops cuatrocienegas* sp. nov.**
(Figs 1–4)

Material examined. Holotype. Adult female, dissected, mounted in glycerine sealed with Entellan, deposited in the zooplankton collection of ECOSUR (ECOCH-Z) (ECO-CHZ- 03586), collected from Poza Tortugas, a pond in the northern sector of the state of Coahuila, Mexico (26º 55.887'N; 102º 07.482 W), July 7, 2006; coll. Elizabeth Walsh and colleagues. Allotype. One dissected male, same date, site, and collector, mounted in glycerine, slide sealed with Entellan® (ECO-CHZ-03588). Paratypes. Five undissected adult females (ECO-CHZ-03587), same date, site, and collector, ethanol-preserved. Additional, non-paratype specimens and original zooplankton sample in the laboratory of E. Walsh, University of Texas at El Paso.

Type locality. Poza Tortugas, Cuatro Ciénegas, Coahuila, Mexico (26º 55.887'N; 102º 07.482 W), elevation 725 m. Shallow (~ 1 m deep) poza (pond with vertical walls) near Poza Azul. Poza Tortugas was a natural, small pond that was enlarged by previous owners for recreational swimming about 16 years ago. The pond is no longer used for swimming but is a site where visitors are shown features and fauna of Cuatro Cienegas from an observation deck. It is surrounded by grasses (spikerush, common reed, cordgrass, brittlegrass) and hairsedge. Aquatic vegetation includes stonewort and the dotleaf waterlilly. Physical parameters at the time of collection: water temperature 28.6°; pH 7.96; conductivity 1.69 milliS/cm; TDS 1.099 mg/L.

Etymology. The species name is a noun in apposition that makes reference to Cuatro Ciénegas, the Mexican protected area from which this species was collected.

Description. FEMALE (Fig. 1A): Total body length = 0.818 ± 0.039 mm (n= 6) from anterior end of cephalothorax to posterior margin of caudal rami. Body elongate, cephalothorax relatively long, widest at midlength of cephalosome in dorsal view; lateral margins of pedigers 3 and 4 straight, slightly produced posteriorly. Cephalothorax length = 0.45 ± 0.08 mm (n= 15), representing 66 % of total body length. Dorsal surface smooth, antennules reaching anterior margin of first pediger. Rostrum strong, wide, with rows of spinules on lateral surfaces of rostral base converging near anteriormost end. Urosome, excluding caudal rami, representing 31% of body length.

Antennule (Fig. 1B): 12-segmented, armament per segment as follows (s= seta, ae= aesthetasc): 1(8s + rows of spinules on proximal and distal position), 2(3s), 3(2s), 4(5s), 5(2s), 6(2s+ 1 spine), 7(2s), 8(3s), 9(2s), 10(2), 11(2s), 12(7s+1ae). Hyaline, smooth, slender membrane on segments 10–12.

Antenna (Fig. 2D): 4-segmented, basis with several rows of spinules on caudal surface. Largest spinules on subdistal clusters, near insertion point of 2 anterodistal setae. Basis with long exopodal pinnate seta. Second segment with 1 short external seta and subdistal row of spinules. Third segment with 8 setae; inner margin with row of spinules from proximal 1/3 increasing size distally. Fourth segment with 5 terminal and 2 subterminal setae.

Labrum: Distal margin curved, with 11–12 rounded teeth. Two ventral plates in area where 2 groups of short spinules are medially conjoined.

Mandible (Figs 2B, C): Gnathobase with strongly chitinized teeth; 4 ventral teeth bicuspidal, blunt, 3 dorsal ones acute. Palp with 2 long plumose setae and 1 naked seta of about half the length of the other two, row of 6–8 spinules on ventral surface.

Maxillule (Fig. 2E): Praecoxal arthrite armed with 6 setae and spines. Palp with 3 setae on proximal article; distal article with 3 subequal setae.

Maxilla (Fig. 2F): 5-segmented, praecoxa and coxa separated; precoxal endite protuberant, armed with 2 plumose setae, caudal surface naked. Coxa with single seta on middle inner margin. Proximal basipodal endite well developed, with 2 apical setae. Claw-like basal endite with 12–15 stout teeth, row of fine spinules on distal 1/3 of outer margin, plus short, slender seta on frontal side. Endopod 2-segmented, proximal segment with 2 long setae, distal segment with 3 stout setae.

Maxilliped (Fig. 2G): 4-segmented. Coxa with 3 short pinnate setae; row of spinules on surface of coxa. Basis with 2 pinnate setae, with row of long spinules near insertion of basipodal setae. Endopod 2-segmented, first segment with wide-based, stout seta; row of 6–8 long spinules along distal margin of segment. Second endopod armed with strong spiniform seta and 2 distal setae.

Leg 1 (Fig. 3A): Coupler with curved rows of 7–10 spinules on each side plus distal row of short spinules between pair of rounded chitinized projections. Coxa with strong coxal seta; row of spinules on outer proximal surface and row of 4–6 hair-like elements along outer margin. Basis with slender outer seta; inner margin with spinules and row of short hair-like elements on insertion point of strong, pinnate basipodal seta reaching beyond distal margin of second endopodal segment. Endopod and exopod 3-segmented. Armature as in Table 1.

TABLE 1. Armature of swimming legs 1–4 (spines in Roman numerals, setae in Arabic) of *Eucyclops cuatrocienegas* **sp. nov.**, *E. chihuahuensis* **sp. nov.**, and *E. pseudoensifer* Dussart, 1984. Sequence follows external to internal positions.

	coxa	basis	endopodite	exopodite
leg 1	0-1	1-I	0-;0-0;0-2	I-0;I-0; 0,3
leg 2	0-1	1-0	1-0;2-0;3,1,I,1	I-1;I-1;IV,1,4
leg 3	0-1	1-0	1-0;2-0;3,1,I,1	I-1;I-1;IV,1,4
leg 4	0-1	1-0	1-0;2-0;2,II,1	I-1;I-1;III,1,4

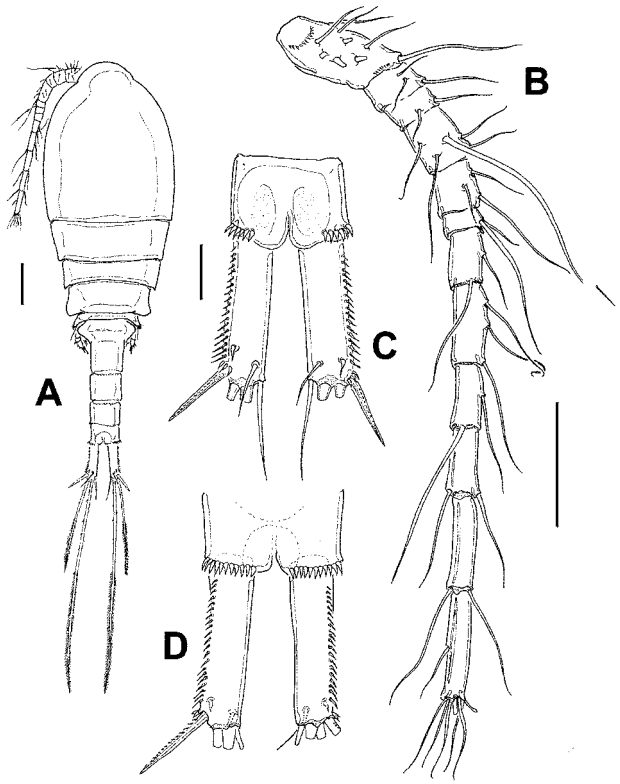

FIGURE 1. *Eucyclops cuatrocienegas* **sp. nov.**, adult female holotype from Cuatro Ciénegas, Coahuila, northern Mexico. A) habitus, dorsal view; B) antennule; C) caudal rami, dorsal view; D) same, ventral view. Scale bars A=100 μm, B–D=50 μm.

Leg 2 (Fig. 3B): Coupler with transverse row of 10–13 minute spinules; distal margin with 2 low, rounded projections. Coxa with strong inner coxal seta; outer margin with proximal row of spinules. Basis with slender basipodal seta on outer margin, inner margin with hair-like ornamentation. Distal margin with disto-medial expansion between insertion point of exopod and endopod. Endopod and exopod 3-segmented; first and second exopodal segments with distal row of spinules. Armature as in Table 1.

Leg 3 (Fig. 3C): Coupler with 2 frontal, transverse rows of 25–30 tiny spinules, distal margin with 2 low, rounded chitinized projections, naked. Coxa with strong inner coxal seta; outer margin with proximal row of spinules. Basis with seta on outer margin; row of spines at insertion point of seta. Endopod and exopod 3-segmented. Armature as in Table 1.

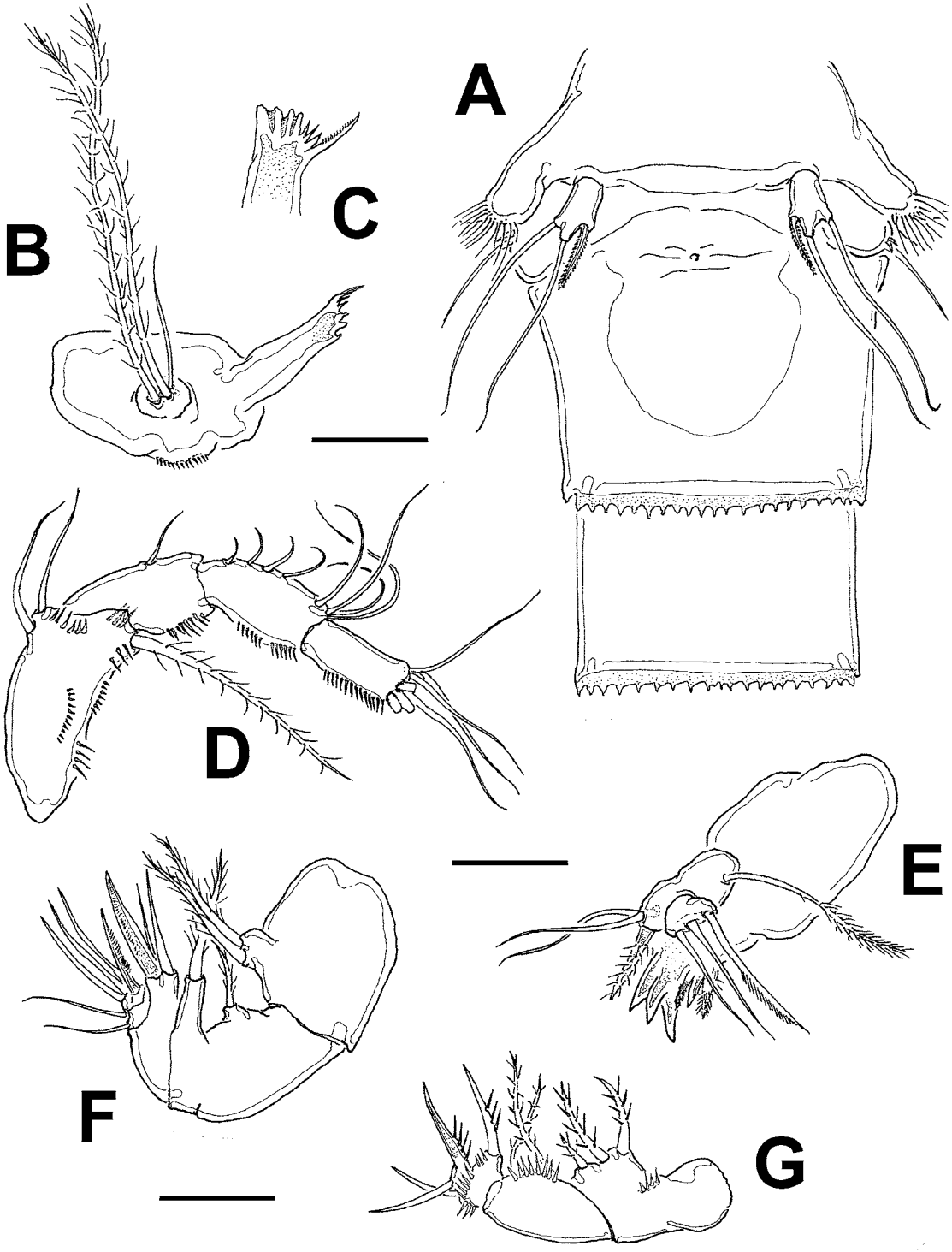

FIGURE 2. *Eucyclops cuatrocienegas* **sp. nov.**, adult female holotype from Cuatro Ciénegas, Coahuila, northern Mexico. A) fifth pedigerous and genital double somites, ventral view; B) mandible with palp; C) detail of gnathal blade; D) antenna; E) maxillule; F) maxilla; G) maxilliped. Scale bars A–G=50 μm.

Leg 4 (Fig. 3D): Coupler with medial row of 7–8 spinules on each side of plate; distal margin straight, armed with row of spinules. Coxa with strong inner coxal seta. Basis with slender basipodal seta and row of strong spines on outer margin. Endopod and exopod 3-segmented. Armature as in Table 1. Outer terminal endopodal spine finely pinnate along both margins; inner seta with spinules on outer margin only, inner margin smooth. Length ratio of inner/ outer terminal spines of Enp 3= 1.50–1.54. Length/width ratio of third

endopodal segment= 3.1. Insertion point of seta on outer margin of Enp 3= 58%. Length of inner endopodal spine/endopod 3= 1.1–1.3.

Leg 5 (Figs 2A, 3E): Consisting of article armed with 2 setae and 1 spiniform seta, middle seta as long as outer one; inner spiniform seta pinnate, slightly curved, short, as long as bearing segment.

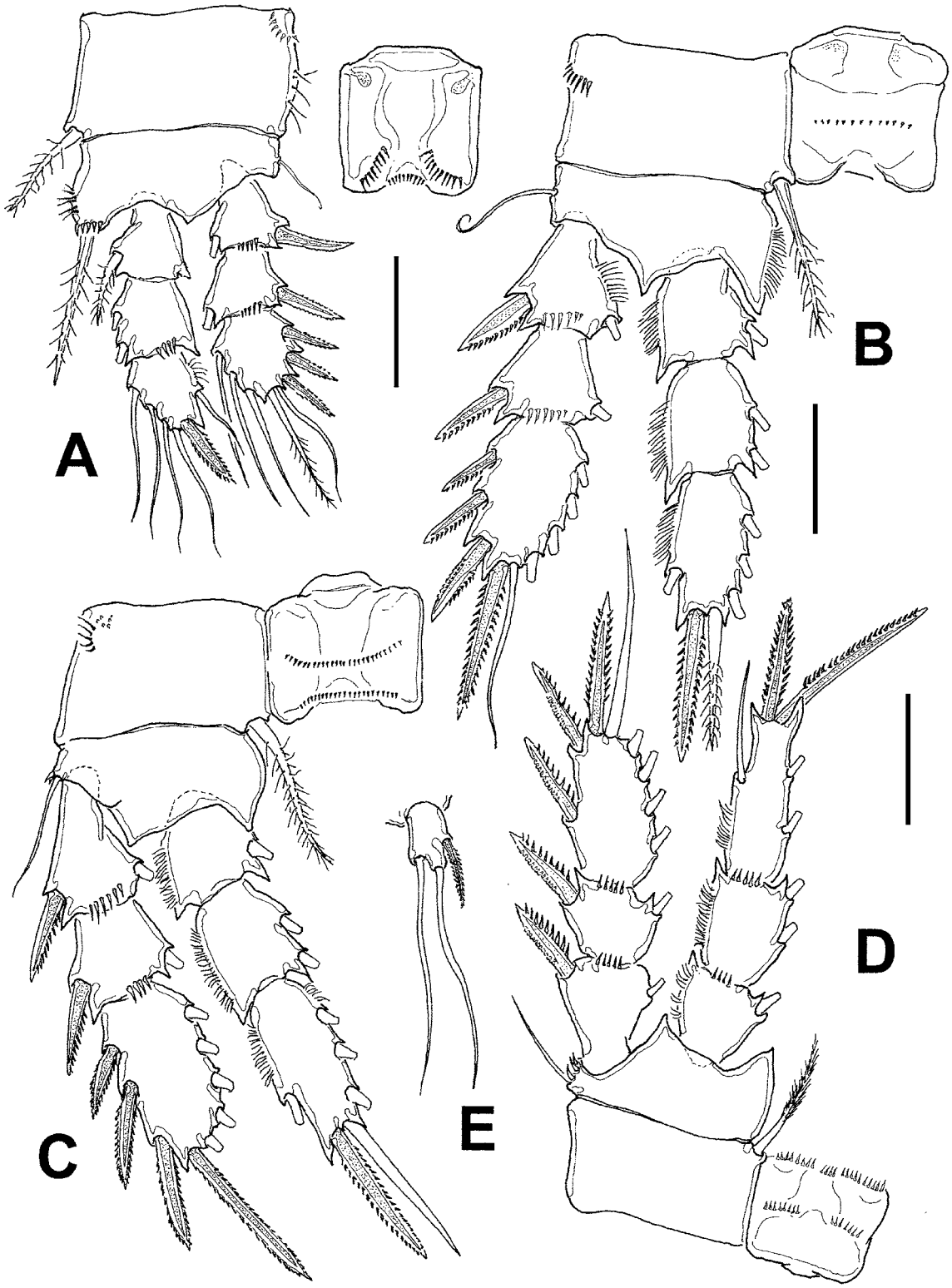

FIGURE 3. *Eucyclops cuatrocienegas* **sp. nov.**, adult female holotype from Cuatro Ciénegas, Coahuila, northern Mexico. A) leg 1 with coxal plate (separate), frontal view; B) leg 2 with coxal plate, frontal; C) leg 3 with coxal plate, frontal; D) leg 4 with coxal plate, frontal; E) leg 5. Scale bars A–E=50 μm.

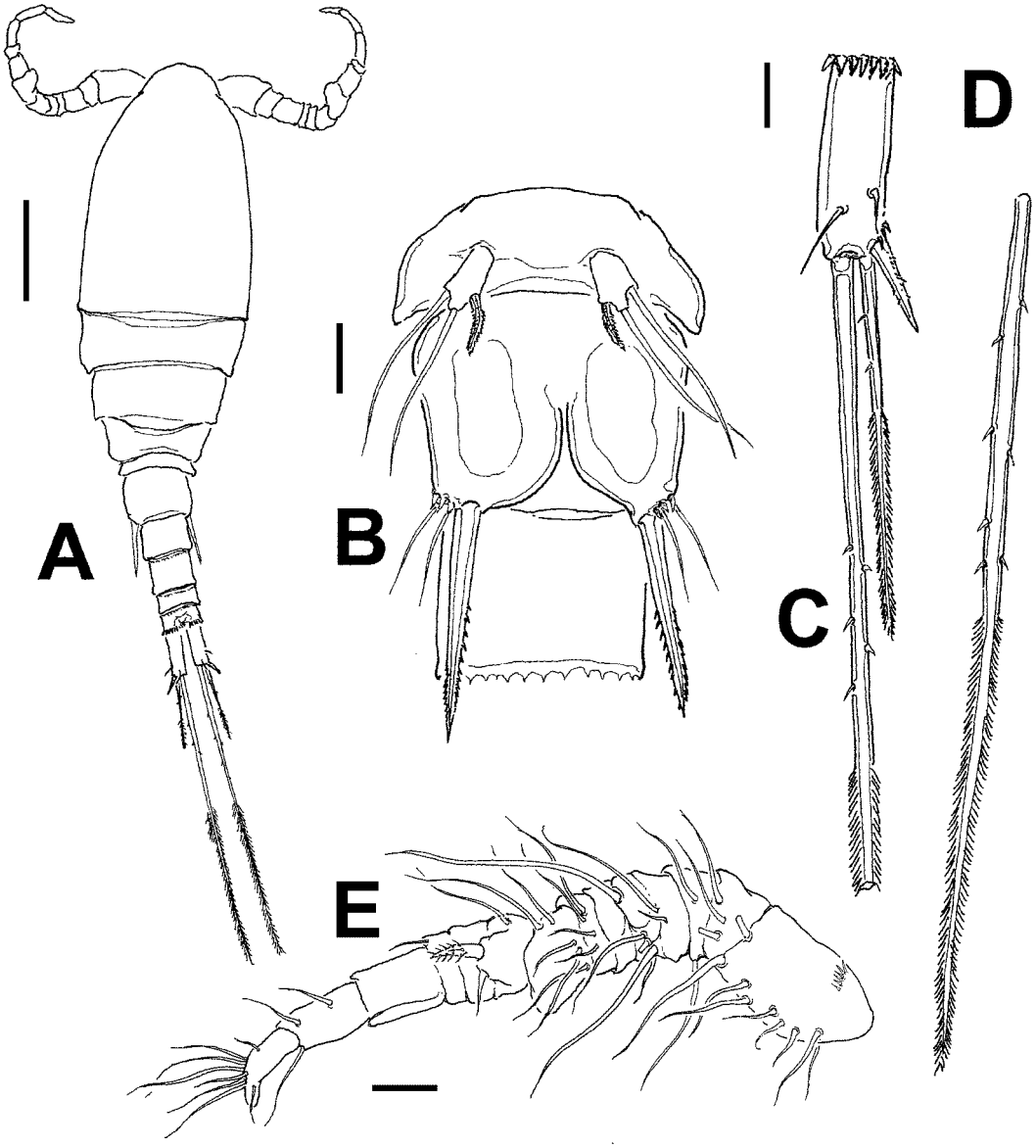

FIGURE 4. *Eucyclops cuatrocienegas* **sp. nov.**, adult male allotype from Cuatro Ciénegas, Coahuila, northern Mexico. A) habitus, dorsal view; B) fifth pedigerous and genital somites, ventral; C) right caudal ramus, dorsal view; D) inner terminal caudal seta showing ornamentation pattern. E) antennule. Scale bars A=100 μm, B–E=60 μm.

Vestigial leg 6 (Fig. 2A): Small, low plate near lateral margin of genital somite with laterally directed dorsal seta and tiny lateral spinules.

Urosome (Figs 1A, 2A): Urosome comprising fifth pedigerous somite, genital double somite and 3 free somites; posterior margin of genital double and postgenital somites serrate dorsally and ventrally. Fifth pediger armed with tuft of hair-like elements on outer distal margin. Genital somite representing 13.9–14.3 % of total body length; anterior half of genital somite expanded laterally forming subtriangular processes. Seminal receptacle wide, with short, rounded lateral arms; lateral channels curved. Posterior margin rounded, sac-like (Fig. 2A). Anal somite armed with row of spinules along posterior margin; ventral row covering only half of margin (Figs 1C, D).

Caudal rami (Figs 1 C, D): Rami relatively short, representing 8.5 % of total body length, 0.35 times as long as urosome. Length/width ratio= 3.1–3.4. Inner margin smooth. Outer margin armed with row of

spinules from proximal to distal margin; spines increasing in size distally, distalmost spines of saw relatively long. Lateral seta noticeably short, peg-like, thick at base, tapering into acute end; inserted subterminally near insertion point of lateralmost terminal spiniform seta. Lateralmost terminal seta 0.63 times as long as caudal ramus. Dorsal seta noticeably short, 0.42–0.47 times as long as caudal ramus. Inner terminal seta longest, about 2 times longer than outer terminal seta, armed with a few spinules along proximal half, followed by regular plumose pattern (Fig. 1A). Outer terminal setae with same ornamentation pattern, half their length with sparse spinulation, distal half with regular setulation.

MALE (Figs 4A–E): Body elongate, without hairs or pits on dorsal surface. Noticeably smaller, more slender than female. Total body length of allotype = 0.68 mm, cephalothorax length = 0.42 mm, representing almost 64% of total body length, urosome length = 0.26 mm. Body and appendages as in females except for sexual dimorphism.

Antennule (Fig. 4E): Geniculate, 14-segmented.

Vestigial leg 6: consisting of broad subquadrate plate with long medial stout spine reaching beyond succeeding posterior urosomite; cluster of spines on insertion of spine. Article with 2 outer seta subequal in length and breath. Spine twice as long as 2 lateral setae, reaching about proximal 1/3 of succeeding urosomite.

Urosome. 5-segmented, genital somite largest of urosome; relative lengths of urosomites as: 32.1: 24: 23.3: 13.3: 7.3=100. Ventral and dorsal surface of anal somite smooth; distal margin with continuous dorsoventral row of spines. Anal plate smooth. Caudal rami relatively shorter than in female, 2.8 times longer than wide (Fig. 4C), margins smooth. Inner and outer terminal caudal seta with ornamentation as in female (Fig. 4D). Innermost terminal seta relatively shorter than in female, 0.64 times as long as ramus.

Remarks. The specimens examined were assigned to the genus *Eucyclops* Claus, 1893 owing to their its possession of the combination of features defined by Reid (1985) and Dussart & Defaye (2001). One of the most useful characters used to separate some of the American species of *Eucyclops* is the length/width proportion of the caudal ramus; it can be long (more than 5.0 times longer than it is wide) as in *E. serrulatus* (Fischer, 1851), *E. pectinifer* (Cragin, 1883), *E. solitarius* Herbst, 1959 or *E. festivus* Lindberg, 1955, or relatively short, less than 4 times longer than it is wide (i.e., between 3.6–4 in *E. leptacanthus* Kiefer, 1956 and *E. serrulatus chilensis* Löffler, 1961, 3.5 in *E. conrowae* Reid, 1992, 3.2 in *E. ensifer* Kiefer, 1936, or 2–3 in *E. siolii* Herbst, 1962, *E. breviramatus* Löffler, 1963, and the Asian *E. dumonti* Alekseev, 2000). The length ratio of the caudal rami in the new species shows values around 3 (3.1–3.4).

Among the American species that share with the new species these characters (i.e., relatively short caudal rami, outer margin entirely spinulated) are: *E. delachauxi* (Kiefer, 1925), *E. conrowae*, *E. leptacanthus* Kiefer, 1956, *E. ensifer*, *E. pectinifer* (sensu Alekseev *et al.* 2006), *E. pseudoensifer* Dussart, 1984, *E. prionophorus* Kiefer, 1931, *E. bondi* Kiefer, 1934, *E. serrulatus chilensis*, and *E. torresphilippi* Suárez-Morales, 2004. The new species can be distinguished from this group of congeners by evaluating additional characters. In the new species the fifth leg has a relatively short inner spine, as long as the bearing segment (ratio: 1.0). This character diverges from the pattern found in other congeners in which this element is clearly longer than the segment; the comparative length ratios (spine/segment) are: 1.37 in *E. conrowae*, 1.78 in *E. ensifer*, 1.28 in *E. leptacanthus*, 1.2–1.3 in *E. pectinifer*, 2.6 in *E. prionophorus*, 4.5 in *E. pseudoensifer*, 1.7–2.1 in *E. serrulatus chilensis*, and 1.31 in *E. torresphilippi* Suárez-Morales, 2004 (Löffler 1961; Collado *et al.*1984; Reid 1985, 1992; Suárez-Morales 2004; Alekseev *et al.* 2006). Only in one other American species, *E. siolii*, is the inner spine is smaller than the fifth leg segment (Reid 1985). This character should be explored further in some of these species, particularly in those showing polymorphism such as *E. serrulatus* and *E. prionophorus* (see Alekseev *et al.* 2006). Conversely, the proportion of the outer and middle setae seems to be generally more stable in these species (see Alekseev *et al.* 2006, figs 6.1–7). In the new species these setae have the same length, thus diverging from most of these other congeners in which one of these setae is noticeably longer than the other, except for *E. ensifer*; however, in this species the inner spine is thick, dagger-like, thus differing from the slender, slightly curved spine of the new species.

Overall, the new species shows the closest resemblance with *E. pectinifer* (sensu Alekseev *et al.* 2006), but there are a number of important differences between the two species. *Eucyclops cuatrocienegas* **sp. nov.**

can be easily distinguished from *E. pectinifer* mainly by the proportion of the caudal rami; in the latter species the length/width proportion is consistently around 5 (Reid 1992; Alekseev *et al.* 2006), whereas it is clearly shorter in the new species (consistently less than 3.6). The dorsal seta is distinctly shorter in the new species, 0.36 times as long as ramus, vs 0.5 in *E. pectinifer.* The inner caudal seta is 0.5 times as long as ramus in *E. pectinifer* vs. a relatively longer seta (0.82) in the new species. Other differences include shorter antennules in the new species, reaching only halfway of the second pedigerous somite, whereas in *E. pectinifer* they reach beyond the third pedigerous somite (see Alekseev *et al.* 2006). The taxonomic value of the structure and ornamentation of the mouthparts has not been fully explored in the genus but some of the most complete, detailed descriptions allow a comparative analysis of some characters related to these appendages. The ornamentation of the antennular basis has been used as valuable discriminating characters in other genera (see Holynska 2006), and Alekseev *et al.* (2006) provided guidelines to evaluate these patterns in *Eucyclops*. A comparison of the characters of the mouthparts showed additional differences of *E. cuatrocienegas* with respect to *E. pectinifer*, including: 1) a weaker antennal ornamentation in *E. cuatrocienegas* **sp. nov.**; 2) in the new species the maxilliped has a stronger ornamentation on the basipod and on the first endopodal segment. In *E. pectinifer* the spinulation pattern of the coxal plate of leg 4 includes three rows of stout spines, whereas the pattern is reduced in *E. cuatrocienegas*, with only two rows of tiny spinules. In the new species the first coxal plate has a heavy ornamentation, with two frontal rows of slender spines and one distal row of spinules; the plate is smooth in *E. pectinifer* (Alekseev *et al.*2006, figs 17.14, 18.5).

The relative lengths and ornamentation of the distal spines of leg 4 endopodite are useful to separate some species of *Eucyclops* (Reid 1985, Table 2). In the new species, the inner/outer spine length ratio is 0.64–0.66 vs. a 0.60 ratio in *E. pectinifer* (see Alekseev *et al.* 2006, fig. 18.7). In *E. pectinifer* both elements are bipinnate, whereas the inner margin of the inner spine is smooth in *E. cuatrocienegas* **sp. nov.** This character is present in other American species of the genus, such as *E. solitarius*, *E. delachauxi*, and *E. demacedoi* Lindberg, 1907, all known only from South America (see Reid 1985). Also, in *E. cuatrocienegas* **sp. nov.** the insertion point of the outer seta of the third endopodal segment of leg 4 is at midlength (57%) of the segment vs. a more distal position in *E. pectinifer* (74%) (see Alekseev *et al.* 2006, fig. 18.8).

The medial spine of leg 6 of the male of *E. pectinifer* reaches beyond the proximal margin of the third urosomite (Alekseev *et al.* 2006, fig. 17.11), whereas in the new species this element is shorter, barely reaching the posterior margin of the second urosomite. The male caudal rami of *E. pectinifer* are relatively shorter than in the female (length/width ratio= 3.9); the same is true in the new species (l/w ratio=2.7). The innermost terminal caudal seta is clearly shorter in *E. cuatrocienegas* **sp. nov.** than in *E. pectinifer* (0.64 times as long as ramus vs 1.0 in *E. pectinifer*) (see Alekseev *et al.* 2006, fig. 17.10).

Eucyclops conrowae is another American species that has morphologic resemblance to *E. pectinifer* (see Reid 1992) and has some affinities with the new species too, mainly in having a relatively short caudal rami (length/width ratio=3.5); however it differs from *E. cuatrocienegas* **sp. nov.** in some important characters. *Eucyclops conrowae* has 1) relatively longer antenules, reaching posterior margin of pediger 2; 2) modified, sclerotized blunt setae on third endopodal segment of leg 4; 3) both terminal spines of leg 4 endopod are spinulate on both margins; 4) the inner spine of the fifth leg is clearly longer than the segment; 5) a set of lateralmost terminal caudal setae carried nearly at right angle to ramus; 6) dorsal seta 0.7 times as long as ramus; 7) anal somite relatively short, 0.35 times as long as caudal ramus; 8) medial spine of male leg 6 reaching beyond posterior margin of third urosomite. These characters are absent from or different in *E. cuatrocienegas* **sp. nov.** Another American form that has some resemblance with the new species is the Chilean subspecies *Eucyclops serrulatus chilensis* Löffler, 1961; both share several characters including a short dorsal seta, anal somite with spines along distal margin, a complete serra on the caudal rami, the outer and middle setae of the fifth leg are equally long, and the fourth leg has the same general structure (see Löffler 1961). Aside those mentioned before, the new species diverges in several other taxonomically relevant characters in *Eucyclops*, including a shorter caudal rami (length/width ratio= 3.1–3.4, vs 3.7–4.1 in *E. serrulatus chilensis*, although some specimens reported by Löffler have a ratio close to 3.5; however, additional specimens from the Patagonic region show a consistent range between 3.72 and 3.77 (Menu

Marque in litt.). There is also a different proportion of inner/outer spines of leg 4 third endopodal segment (1.50–1.54 in the new species vs. 1.2–1.4 in the subspecies *chilensis*) (Löffler 1961; Menu Marque in litt.), the distal ornamentation of the coxal plate of leg 4 (row of short spinules in the new species vs. single distal row of long hair-like elements in the form *chilensis*) (Löffler 1961; Menu Marque in litt.), the dorsal seta is clearly shorter in the new species (0.35 times as long as ramus) than in the form *chilensis* (0.52–0.65) (see Löffler 1961, figs 77, 81, 84). Further, one of the main characters of the new species is the short spine of the fifth leg, which is as long as the segment; in the subspecies *chilensis* this spine is consistently almost twice as long as the segment in different populations (see Löffler 1961, figs 78, 82, Menu Marque in litt.).

TABLE 2. Comparison of selected morphometric characters of adult females of some American species of *Eucyclops* Claus, 1893, including *E. cuatrocienegas* **sp. nov.** and *E. chihuahuensis* **sp. nov.** CR= caudal ramus; P4end3= fourth leg endopod, third segment; I=inner terminal spine of P4end3; O= outer terminal spine of P4end3; IS= spine of fifth legs; OS= outer seta of fifth legs; SC= Coverage of serra on external margin of caudal rami. Data from Kiefer (1925), Reid (1985, 1992), Grimaldo-Ortega *et al.*(1998), Dussart & Defaye (2001), and Suárez-Morales (2004).

Species	L/W CR	% SC	I/O L4EN3	I/ L4EN3	IS/OS P5
E. pectinifer	5–5.3	50–75	1.3	0.9	0.64–0.66
E. bondi	3.1–3.5	71	1.6–2	1.1–1.3	0.57–0.62
*E. delachauxi**	4.0	16–52	1.1	1.1	1.1
E. conrowae	3.5	77	1.5	1.2	0.54
E. festivus	6.0	68	1.1	1.1	1.4–1.7
*E. leptacanthus**	3.2–3.6	70–80	1.8	1.2–1.3	0.61–0.63
E. prionophorus	4–4.3	71	1.5	1.3–1.4	1.5–2.7
*E. pseudoensifer**	3–3.8	63–74	1.1	1.0–1.1	1.45
*E. silvestrii **	3.5	80–90	1.2	1.1	0.67
*E. solitarius**	6.5–8	73–90	1.2	0.85	1.5–1.6
E. torresphilipi	4.2–4.6	67	1.3–1.5	1.30	0.82
E. cuatrocienegas	3.1–3.4	90–95	1.5	1.1–1.3	0.27
E. chihuahuensis	4.3–4.6	80–85	1.6	1.33	1.0

(*) South American forms.

***Eucyclops pseudoensifer* Dussart, 1984**
(Figs 5–8)

Material examined. Paratype. Adult female, partially dissected, slide deposited in the Museum National d' Histoire Naturelle (MNHN Cp 2547), collected from Laguna Mucubají, Venezuela, a high altitude (3 600 m) lagoon in the Andean area near the city of Merida, western Venezuela, October 5, 1980; coll. Evelyn Zoppi. One partially dissected adult male, slide (NMHN Cp 2548), same date, site, and collector.

Redescription. FEMALE: Total body length of paratype = 0.773 mm from anterior end of cephalothorax to posterior margin of caudal rami. Body relatively robust, widest at midlength of cephalosome in dorsal view; lateral margins of pedigers 3 and 4 straight, produced posteriorly, pediger 4 covering pediger 5. Cephalothorax representing 66 % of total body length. Dorsal surface smooth, antennules short, not reaching anterior margin of first pediger. Urosome, excluding caudal rami, representing 31% of body length.

Antennule (Fig. 5A): 12-segmented, armament per segment as follows (s= seta, ae= aesthetasc): 1(8s), 2(4s), 3(2s), 4(5s), 5(2s), 6(2s+ 1 spine), 7(2s), 8(3s), 9(2s), 10(2), 11(2s+1ae), 12(7s). Hyaline, finely serrate membrane on segments 10–12.

Antenna (Fig. 6A): 4-segmented, basis with several rows of spinules on caudal surface; largest spinules near insertion of exopodal seta. Basis with exopodal seta. Second segment with one short external seta and subdistal row of spinules. Third segment with 9 setae; inner margin with row of hair-like elements. Fourth segment with 7 setae. Mouthparts as in *E. conrowae* (Reid 1992).

Leg 1 (Figs 6B, 7B): Coupler with curved rows of 7–10 spinules on each side. Coxa with strong inner coxal seta; row of spinules on outer proximal surface. Basis with slender outer seta; inner margin with row of long hair-like elements; spinules on insertion of strong, pinnate basipodal seta reaching distal margin of third endopodal segment. Endopod and exopod 3-segmented. Armature as in Table 1.

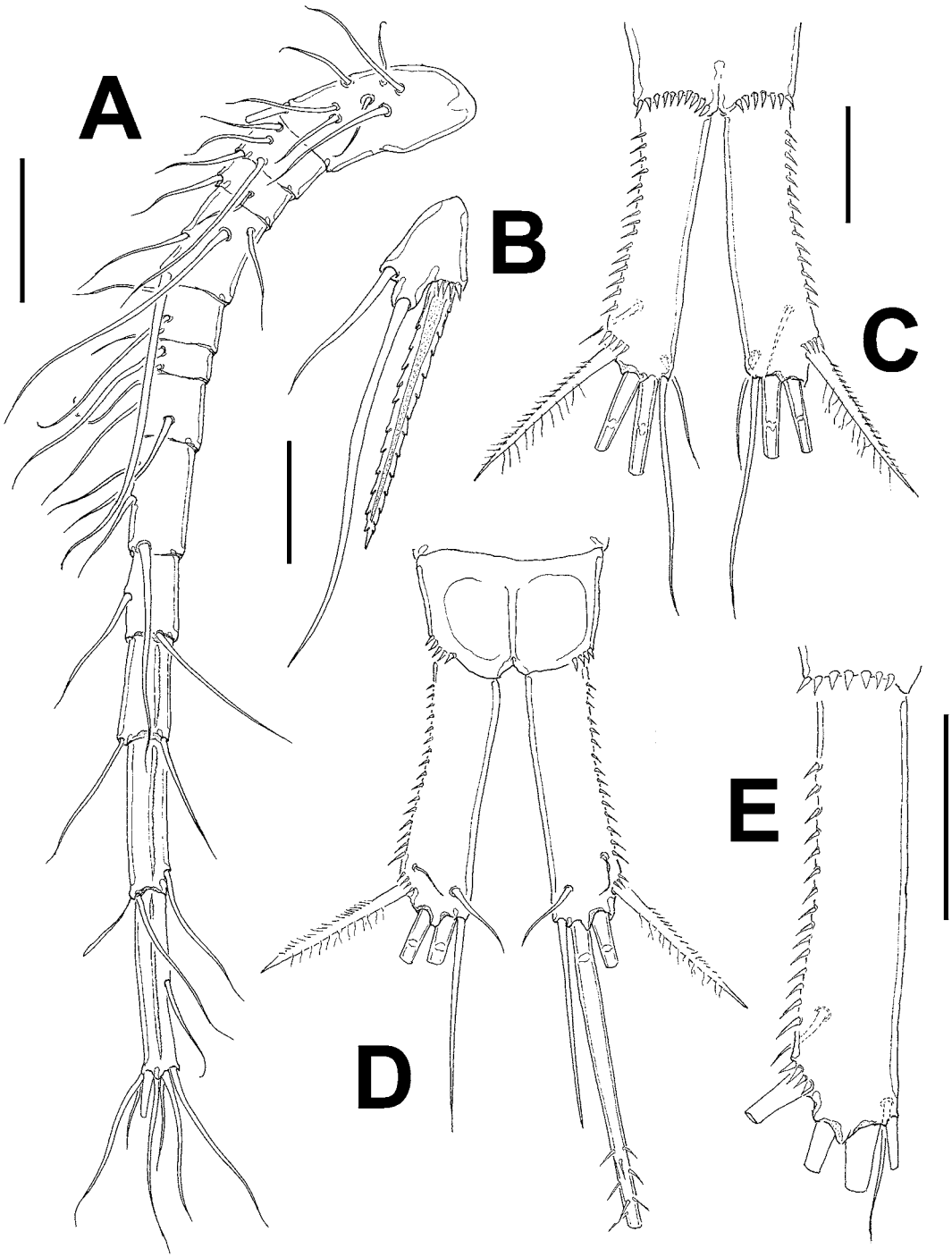

FIGURE 5. *Eucyclops pseudoensifer* Dussart, 1984, adult female paratype (MNHN-2547) from Laguna Mucubajì, Venezuela. A) antennule; B) leg 5; C) caudal rami, ventral view; D) same, dorsal view; holotype female, E) right caudal rami, ventral view. E from D. Defaye's drawing of the holotype specimen (in litt.). Scale bars A=50 μm, B= 25 μm, C–E=50 μm.

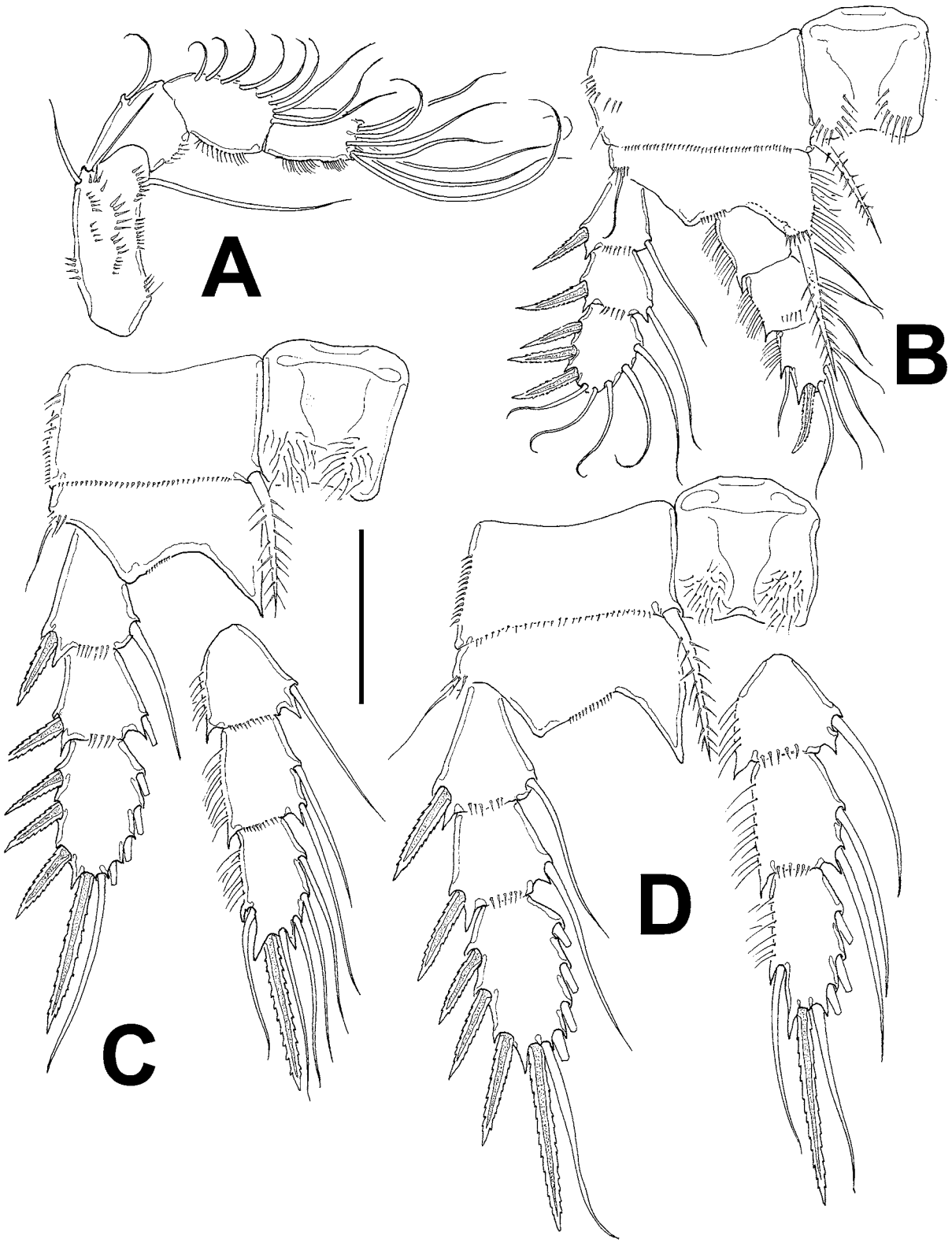

FIGURE 6. *Eucyclops pseudoensifer* Dussart, 1984, adult female paratype (MNHN-2547) from Laguna Mucubajì, Venezuela. A) antenna; B) leg 1; C) leg 2; D) leg 3. Scale bars A–D=50 µm.

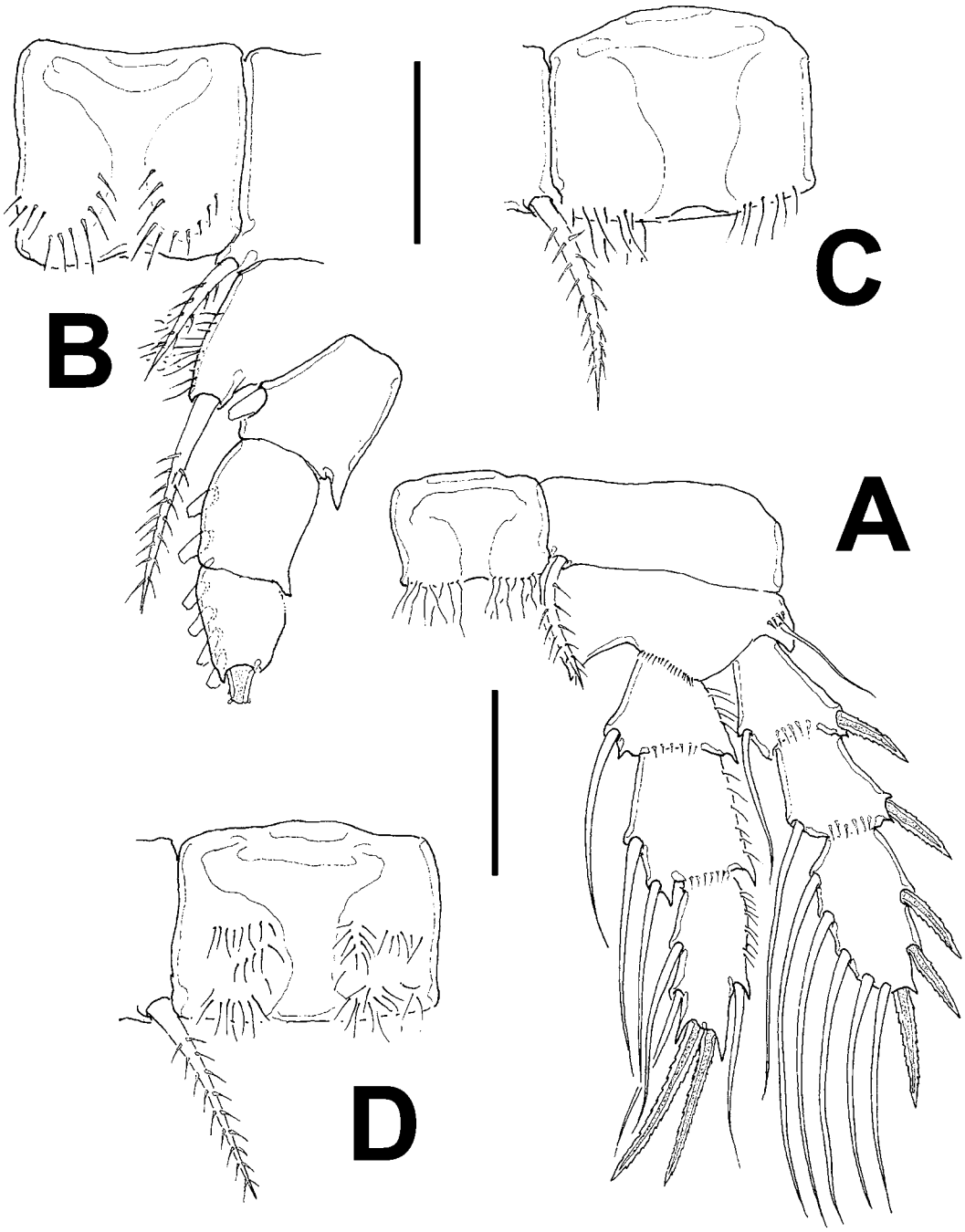

FIGURE 7. *Eucyclops pseudoensifer* Dussart, 1984, A adult female paratype (MNHN-2547) from Laguna Mucubajì, Venezuela. B-D from D. Defaye's drawings of the holotype specimen (MNHN-Cp663) (in litt.).A) leg 4; B) leg 1, coupler and inner margin of coxa and basipod; C) leg 4, ornamentation of coupler; D) leg 3, same. Scale bars A=50 μm, B–D= 25 μm.

Leg 2 (Fig. 6C): Coupler pilose, with clusters of long hair-like elements; distal margin with two low, rounded projections. Coxa with strong inner coxal seta; outer margin with rows of spinules. Basis with slender, short basipodal seta not reaching distal margin of first exopodal segment. Distal margin with disto-medial expansion between insertion point of exopod and endopod; row of spinules near insertion of endopod. Endopod and exopod 3-segmented. Armature as in Table 1.

Leg 3 (Fig. 6D, 7D): Coupler pilose, with clusters of 8–10 hair-like elements. Coxa with strong inner coxal seta. Basis with slender basipodal seta; row of spinules on insertion point of seta. Endopod and exopod 3-segmented. Armature as in Table 1.

Leg 4 (Fig. 7A, C): Coupler with distal rows of 8–10 long hair-like elements. Coxa with strong, relatively short inner coxal seta, barely reaching distal margin of basipodal segment. Basis with slender basipodal seta on outer margin. Inner and outer spines of terminal endopodal segment serrate along both margins. Endopod and exopod 3-segmented. Armature as in Table 1. Length ratio of inner/outer terminal spine of Enp 3= 1.1. Length/width ratio of third endopodal segment= 2.2. Insertion point of outer seta of Enp 3= 67%. Length of inner endopodal spine/endopod 3= 1.1.

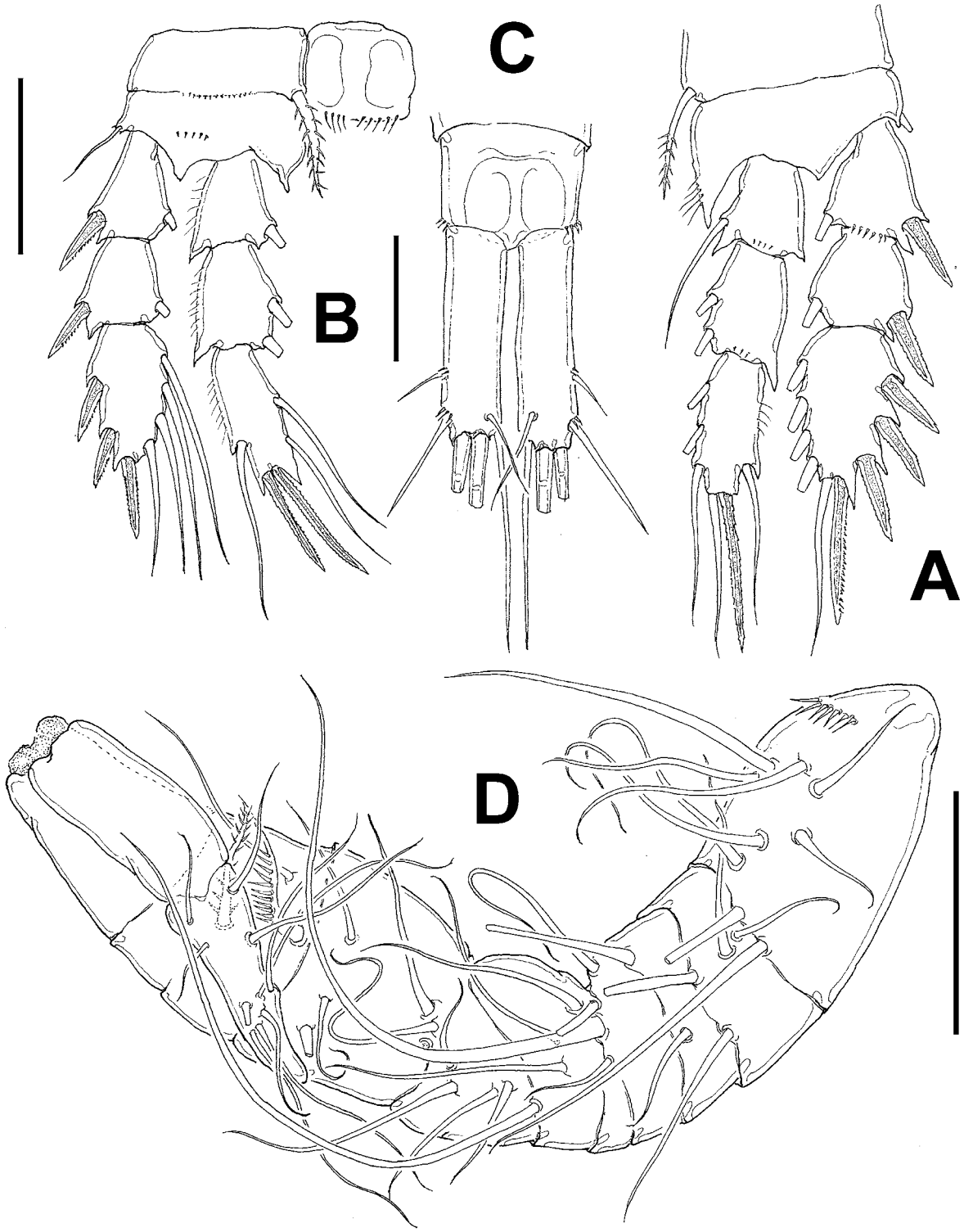

FIGURE 8. *Eucyclops pseudoensifer* Dussart, 1984, adult male paratype (MNHN-2548) from Laguna Mucubajì, Venezuela. A) leg 3; B) leg 4; C) caudal rami, dorsal view; D) geniculate antennule. Scale bars A–D=50 µm.

Leg 5 (Fig. 5B): Consisting of article armed with 2 regular setae and 1 spine, middle seta more than twice as long as outer one; spine coarsely serrate, clearly longer than outer seta. Inner spiniform seta 2.4 times as long as bearing segment.

Vestigial leg 6: Small, low plate near lateral margin of genital somite with 2 laterally directed setae and stout, pinnate spine.

Urosome (Figs 5C, D): Formed by 5 somites, genital double somite and 3 free somites. Genital double somite representing 11.5 % of total body length (excluding caudal rami); somite smooth on ventral and dorsal surfaces; posterior margins of genital and 2 succeeding somites smooth. Seminal receptacle wide, with short, rounded lateral arms. Anal somite with row of spinules at insertion points of caudal rami; row on ventral margin complete, only 1/3 of dorsal margin with spinules.

Caudal rami (Figs 5 C-E): Rami representing 11.5 % of total body length and about 0.5 times as long as urosome. Length/width ratio= 4.3. Inner margin smooth. Outer margin armed with row of short spinules arranged in a relatively loose pattern increasing in size distally. Lateralmost terminal spiniform seta relatively long, 0.63–0.68 times as long and 2.6 as wide as caudal ramus. Dorsal seta 0.3 times as long as caudal ramus. Inner medialmost terminal seta longest, about twice as long as outer terminal seta, proximal part smooth, followed by sparse pinnate pattern. Outer terminal setae with same ornamentation pattern. Innermost terminal seta 0.81 times as long as ramus.

MALE: Body elongate, without hairs or pits on dorsal surface. Noticeably smaller, more slender than female. Total body length of allotype = 0.68 mm, cephalothorax representing almost 64% of total body length, urosome length = 0.26 mm. Appendages as in females except for sexual dimorphism. Legs 3 and 4 as in female, except for absence of spinules on outer margin of coxa on leg 3 and shorter hair-like elements on coupler of leg 4 (Figs 8A, B).

Antennule (Fig. 8D): Geniculate, 14-segmented.

Vestigial leg 6: consisting of broad subquadrate plate with long medial stout spine reaching beyond succeeding posterior urosomite; cluster of spines present on insertion point of spine. Article with 2 outer seta subequal in length and breath. Spine twice as long as 2 lateral setae, reaching about proximal 1/3 of succeeding urosomite.

Urosome: 5-segmented, genital somite largest of urosome. Ventral and dorsal surface of anal somite smooth; distal margin with ventral row of spinules, only ¼ of dorsal margin with spinules. Anal plate smooth. Caudal rami relatively shorter than in female, 3.9 times longer than wide (Fig. 8C), margins smooth. Innermost terminal seta relatively longer than in female, 0.94 times as long as ramus.

***Eucyclops chihuahuensis* sp. nov.**
(Figs 9, 10)

Material examined. Holotype. Adult female, dissected, mounted in glycerine sealed with Entellan, deposited in the zooplankton collection of ECOSUR (ECO-CHZ- 3589), collected from Presa Chihuahua, a reservoir near the city of Chihuahua, northern Mexico (28°34.540 N; 106°09. 932 W), July 7, 2006; coll. Elizabeth Walsh and colleagues. Paratypes. One undissected adult female, mounted in glycerine, slide sealed with Entellan (ECO-CHZ-3590), same date, site, and collector. Four undissected adult females, ethanol-preserved (ECO-CHZ-3590), same locality and date. Additional, non-paratype specimens and original zooplankton sample in the laboratory of E. Walsh, University of Texas at El Paso.

Type locality. Presa Chihuahua, Chihuahua, Mexico (28°34.540 N; 106°09. 932 W), a man-made reservoir located 12 km from the city of Chihuahua, Mexico.

Etymology. The name of this species makes reference to the reservoir and the arid environmental system from which this species was collected. The name is an adjective for place, using the Latin suffix "-ensis".

Description. FEMALE (Fig. 9A): Total body length = 0.640 ± 0.043 mm (n= 6) from anterior end of cephalothorax to posterior margin of caudal rami. Body as in *E. pseudoensifer* Dussart, 1984.

Antennule (Fig. 9B): As in *E. pseudoensifer* except for absence of proximal row of spinules on first segment, one seta less on segment 2 and 6, and last segment 1.15 times as long as penultimate one.

Antenna (Fig. 9C): As in *E. pseudoensifer* except for lighter ornamentation of caudal surface of basipod.

Mouthparts including mandible, maxillule, maxilla, and maxillipeds as in *E. conrowae* (Reid 1992) except for mandibles armed with only 6 blunt bicuspidal teeth.

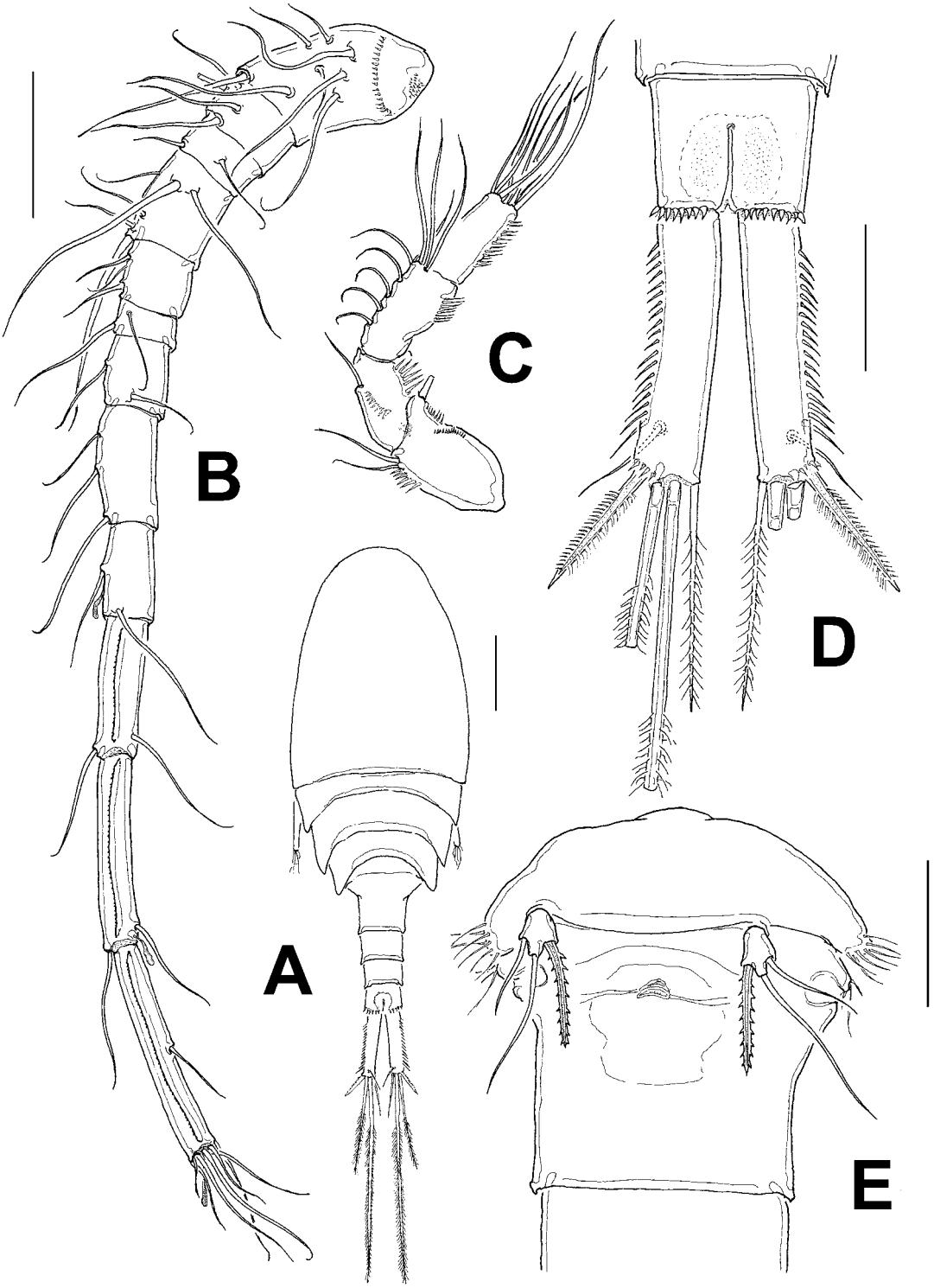

FIGURE 9. *Eucyclops chihuahuensis* **sp. nov.**, adult female holotype from Presa Chihuahua, northern Mexico. A) habitus, dorsal view; B) antennule; C) antenna; D) caudal rami and anal somite, ventral view; E) genital double and fifth pedigerous somites, ventral view. Scale bars A=100 μm, B–D=50 μm.

Leg 1 (Fig. 10A): As in *E. pseudoensifer* except for coupler with curved rows of 5–8 spinules on medial surface plus rows of long hair-like elements on distal margin (Fig. 6E), coxa with rows of spinules on outer proximal surface, medial row of 6–8 spinules plus subdistal row of 4–6 short hair-like elements along outer margin. Basis with long, pinnate spiniform basipodal seta reaching distal margin of second endopodal segment.

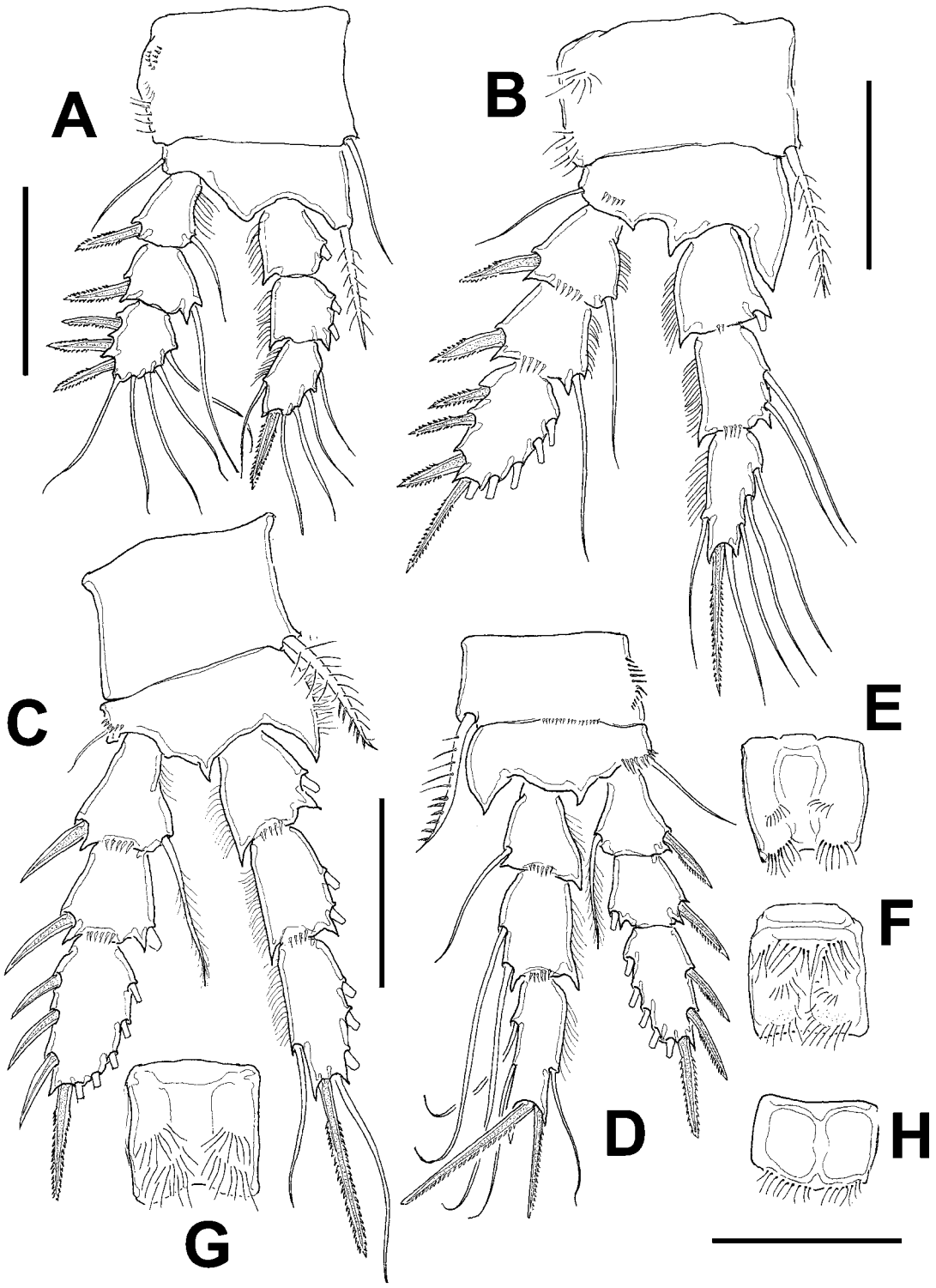

FIGURE 10. *Eucyclops chihuahuensis* **sp. nov.**, adult female holotype from Presa Chihuahua, northern Mexico. A) leg 1; B) leg 2; C) leg 2; D) leg 4; E) coxal plate of leg 1; F) coxal plate of leg 1; G) coxal plate of leg 3; H) coxal plate of leg 4. Scale bars A–G=50 μm. All appendages shown in frontal view.

Leg 2 (Fig. 10B): As in *E. pseudoensifer* except for coupler strongly pilose, with transverse clusters of long hair-like elements on anterior, medial and distal surfaces (Fig. 6F), coxa with outer margin ornamented with proximal and subdistal rows of long hair-like elements. Basis with slender basipodal seta on outer margin reaching beyond distal margin of first exopodal segment.

Leg 3 (Fig. 10C): As in *E. pseudoensifer* except for coupler with 2 transverse rows of 8–10 long hair-like elements.

Leg 4 (Fig. 10D): As in *E. pseudoensifer* except for longer coxal seta, reaching well beyond distal margin of basipodite, coxa ornamented with outer row of long spinules. Outer and inner terminal endopodal spines finely serrate along outer margin only; inner margins smooth. Length ratio of inner/outer terminal spines of Enp 3= 1.5. Length/width ratio of third endopodal segment= 2.4. Insertion point of outer seta of Enp 3= 66%. Length of inner endopodal spine/endopod 3= 1.3.

Leg 5 (Fig. 9E): As in *E. pseudoensifer* except for outer seta as long as or slightly shorter than inner spine.

Vestigial leg 6 (Fig. 9E): As in *E. pseudoensifer.*

Urosome (Figs 9A, E): As in *E. pseudoensifer* except for genital double somite representing 12.2–12.8 % of total body length.

Caudal rami (Fig. 9D): As in *E. pseudoensifer* except for rami representing 14.5 % of total body length. Length/width ratio= 4.3–4.5. Outer margin armed with row of slender spinules arranged in tight pattern increasing in size distally. Lateralmost terminal spiniform seta relatively long, 0.50 times as long and 3.1 as wide as caudal ramus. Dorsal seta 0.43–0.45 times as long as caudal ramus. Inner medialmost terminal seta longest, proximal half smooth, followed by regular plumose pattern. Innermost terminal seta 0.85 times as long as ramus.

MALE: Unknown.

Remarks. The new species is similar in general proportions, habitus, and structure of the leg 5 to the general morphological pattern of *E. pseudoensifer* Dussart, 1984 (see Dussart 1984). Following Reid's (1985) work on the Neotropical *Eucyclops* Claus, this new species keys out to the South American *E. silvestrii* (Brian, 1927), both species share some important characters such as: length/width ratio of the caudal rami around 4.0, outer margin of caudal rami mostly serrate, short dorsal seta, outer spiniform caudal seta more than two times as wide as ramus, spine of the fifth leg as long as outer seta, last antenular segment longer than penultimate one. The new species differs from *E. silvestrii* in several characters including: the relative length of the last antennular segment (1.3 in *E. chihuahuensis* **sp. nov.** vs. more than 1.5 in *E. silvestrii*) (see Reid 1985), the length of the middle seta of the fifth leg is twice as long as the outer seta in the new species, whereas both elements are equally long in *E. silvestrii* (see Reid 1985, fig. 128). The serration pattern of the caudal rami is different in both species, elements are smaller and more numerous in *E. silvestrii* (see Reid 1985, fig. 127) than in the new species, in which the distal spinules of the serra are elongate, the length/width ratio of the caudal rami is less than 4.0 in *E. silvestrii*, thus differing from the figure in the new species (4.3–4.6). Additional morphometric differences between these species are presented in the Table 2.

This species has, of course, a strong resemblance with *E. pseudoensifer* Dussart, 1984 because of the similar body proportions, lateral margins of the thoracic somites 2–4 produced posteriorly and overlapping the succeeding somites, the length/width ratio of the caudal rami, the relative lengths of the caudal setae, and the general structure of the fifth leg (see Table 2). There are, however, several subtle differences between these two species. Among the most conspicuous is the structure of the serra on the caudal rami; in *E. pseudoensifer* it is formed by stout, relatively short spinules arranged in a loose pattern (see Figs 5C-E; Dussart 1984, fig. 14), whereas the elements in the new species are clearly slender, longer, arranged in a tighter pattern, and more numerous. The outer terminal spiniform caudal seta is clearly shorter in the new species, 0.50 times as long as ramus vs. 0.63-0.67 in *E. pseudoensifer* (see Figs 5C-E; Dussart 1984). Also, the length of the antennules differs in both species; they are clearly shorter in *E. pseudoensifer* (see Dussart 1984 fig. 14), even stretched backwards it barely reaches the middle of the first thoracic somite, whereas in the new species it reaches the posterior margin of the third thoracic somite (Fig. 9A). The inner basipodal spine of the first leg is shorter in the new species than in *E. pseudoensifer*; in *E. chihuahuensis* it barely reaches the distal margin of

the second exopodal segment, whereas it stretches to the distal margin of the third segment in *E. pseudoensifer* (see Figs 6B, 7B; Dussart 1984). The length ratio of the inner/outer spines of the fourth leg endopod differs in these species, 1.5 in the new species vs. 1.1 in *E. pseudoensifer* (see Figs 7A, 8B). Also different is the length ratio of the inner spine/ third endopodal segment: 1.3 in the new species, 1.1 in *E. pseudoensifer.* In the fifth leg the outer seta is as long as the inner spine in *E. chihuahuensis* and it is about 50% shorter in *E. pseudoensifer* (see Fig. 5B, Table 1). The body size of these species differs slightly, females: 0.64 mm in *E. chihuahuensis* vs. 0.77 in *E. pseudoensifer.*

Discussion

The knowledge of the diversity of the genus *Eucyclops* Claus, 1893 in the Americas is still growing (Suárez-Morales 2004) but it is also relatively low when compared with Europe and Asia (Dussart and Defaye 2006). The most diverse continental array of species currently known occurs in South America, where many species with a restricted distribution have been described as a result of early explorations of Brazil and the work of researchers such as K. Lindberg, F. Kiefer, and H. Herbst (see Reid 1985). Overall, there are about 13 species and several subspecies known in South America. Some of them were described as subspecies of *E. serrulatus* (Fischer, 1851) and these forms could represent separate species.

Eucyclops cuatrocienegas **sp. nov.** has some affinity with *E. pectinifer* (Cragin, 1883), a widespread species that has been able to colonize rapidly and efficiently many environments; also, it has similarities with the North American *E. conrowae* (Reid 1992), and even with some South American forms, as described. Alekseev *et al.* (2006) recognized that independent evolution in disjunct refugia is possible for ancestors of species of *Eucyclops*. Because of their ability to rapidly invade new habitats, they could have spread in the New World and recolonize post-glacial environments. The CHD system was influenced by the last glaciation (Metcalfe *et al.* 2002) with alternate wet conditions and deeper, more extensive bodies of water followed by periods of desiccation and deflation, thus favouring local events of isolation in the region. Dispersal of a common *E. pectinifer*-like ancestor from North America could have been possible during post-glacial periods; these forms could have been stranded in these isolated systems and undergone speciation.

The Cuatro Cienegas Valley has been considered as a postglacial refuge for many aquatic species and this has been deemed as a factor favouring local endemism (but see Minkley and Jackson 2008). It has the greatest number of endemic species of any place in North America (Stein *et al.* 2000). Much of its biotic diversity is associated with a diverse array of aquatic environments with variable limnologic conditions over very small spatial scales; this type of isolation has been shown to be sufficient for cyclopoid copepod speciation (see Fiers *et al.* 1996; Suárez-Morales *et al.* 2004).

From the earliest studies by Cole (1984), the crustacean fauna of Cuatro Cienegas was promising in terms of endemicity and discovery of new species; however, copepods remained largely unknown in the area. The works by Zamudio-Valdéz and Reid (1990) and Zamudio-Valdéz (1991) represented a significant contribution to the local listings of Copepoda; most of these results have not been acknowledged in recent accounts of the aquatic fauna from Cuatro Cienegas (see Dinger *et al.* 2005). In the first survey a new, apparently endemic harpacticoid, *Leptocaris stromatolicolus* Reid & Zamudio-Valdéz, 1990, was described; in the second work Zamudio-Valdéz (1991) recorded 18 species of Copepoda. Among these species, he found male and female specimens that were assigned to *E. serrulatus*; these specimens were collected from a creek related to Poza Tortugas, the type locality. From the illustrations by Zamudio-Valdéz (1991), these specimens are tentatively assigned to *E. cuatrocienegas* **sp. nov.** mainly because of the proportion of the caudal rami (3.3) (Zamudio-Valdéz 1991, fig. 65), which is similar to that described in *E. cuatrocienegas* (3.1–3.4) and diverges from *E. pectinifer* (5.0) (Alekseev *et al.* 2006). Most other characters, including the size range (0.71–0.84 mm), the relatively short inner spine and equally long medial and outer setae of the fifth leg, and the short innermost terminal caudal seta in the male (0.53 times as long as ramus: Zamudio-Valdéz 1991, fig. 67) are coincident with this opinion. There are, however, some differences in the armature of the female caudal rami: the relative

length of the terminal outer spiniform caudal seta (0.63 of ramus in our specimens vs. 0.75 in Zamudio-Valdéz 1991), the relative length of the dorsal seta differs in both groups (0.57 of ramus in Zamudio-Valdéz vs 0.42–0.47 in our specimens), in the length and proportion of setal elements of the male fifth leg, and in the length of the spine of the male sixth leg (shorter, not reaching the posterior end of succeeding urosomite) (Zamudio-Valdéz 1991 fig. 68).

Because of the biogeographic conditions of the system in which this species was found it is possible that *E. cuatrocienegas* is endemic in Cuatro Ciénegas. The copepod fauna of this valley and that of the entire Chihuahuan Desert system deserves further study to fully investigate the potential for discovery of new species, endemism and adaptation to these isolated and unique aquatic systems.

The number of species recorded from Central America, Mexico, and the Caribbean region has been relatively low, only seven species and one subspecies were listed by Reid (1990), but the accounts have grown recently with new records and a new species from southeast Mexico (Suárez-Morales *et al.*1996; Suárez-Morales 2004). Currently, 12 species of *Eucyclops* are known from Mexico: *E. bondi* Kiefer, 1934, *E. conrowae* Reid, 1992, *E. festivus* Lindberg, 1955, *E. prionophorus* Kiefer, 1931, *E. leptacanthus* Kiefer, 1956, *E.* cf. *bondi* Reid, 1992, *E. pectinifer* (Cragin, 1883) (as *E. serrulatus* (Fischer, 1851), *E. agilis* (Koch, 1838), and *E.* cf. *serrulatus*), *E. pseudoensifer* Dussart, 1984, *E.* cf. *solitarius* Herbst, 1959, *E. torresphilippi* Suárez-Morales, 2004, *E. cuatrocienegas*, and *E. chihuahuensis* (Grimaldo-Ortega *et al.*1998; Suárez-Morales *et al.*1996; Suárez-Morales & Reid 1998; Suárez-Morales *et al.*2000; Gutiérrez-Aguirre & Suárez-Morales 2001; Suárez-Morales 2004; this survey). In light of the elements provided in this work, it is clear that North American records of *E. pseudoensifer* should be checked to reveal if they correspond to this species or to *E. chihuahuensis*. The isolation and environmental divergence of the type locality of *E. pseudoensifer*, a high altitude lake in the Andean mountain system of Venezuela, and of the type locality of *E. chihuahuensis*, in the desert of Chihuahua, seem to provide additional support to consider these two as different species.

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