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Taxonomy and distribution of Macrothricidae (Crustacea: Anomopoda) in southeastern Mexico, northern Guatemala and Belize

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Resumen. A partir de un estudio efectuado en numerosos cuerpos de agua dulceacuícolas temporales y permanentes (lagunas, lagos, cenotes, humedales y charcos) desde 1995 al 2001 en la región sur-sureste de México, norte de Guatemala y Belice, se estableció la presencia de ocho especies de macrotrícidos. La mayoría de los taxa tiene afinidades subtropicales-pantropicales (50%), el resto es circuntropical (37.5%) y probablemente 12.5% endémico. *Macrothrix elegans* fue la especie más común en esta región. *Grimaldina* cf. *brazzai* y *Guernella* cf. *raphaelis* presentan características locales y difieren de las poblaciones africanas. *Macrothrix spinosa* se encuentra en una situación similar. *Onchobunops tuberculatus* y *Macrothrix marthae* tienen una distribución restringida, esta última posiblemente es endémica. *Macrothrix paulensis* y *Streblocerus pygmaeus* fueron registrados por primera vez en México y se describen con detalle. Se estima que la fauna de macrotrícidos conocida hasta ahora representa el 66.67% del máximo teórico para esta región, de acuerdo a la ecuación de Clench. Finalmente se propone una clave para los macrotrícidos de la región.

Palabras clave: Cladocera, Macrotrícidos, México, América Central, taxonomía, distribución, fauna.

Abstract. A survey conducted in numerous temporal and permanent freshwater systems (lagoons, lakes, sinkholes, wetlands, puddles) since 1995 to 2001 in southeastern Mexico, northern Guatemala and Belize, established the occurrence of eight macrothricid species. Half of the taxa are subtropical-pantropical (50%), others are circumtropical (37.5%) and 12.5% are possible endemics. *Macrothrix elegans* is the most common species in the studied region. *Grimaldina* cf. *brazzai* and *Guernella* cf. *raphaelis* constitute taxa with local characteristics and different from African populations. *Macrothrix spinosa* is in a situation similar to the former species. *Onchobunops tuberculatus* and *Macrothrix marthae* are species with restricted distribution, the latter is probably an endemic of southern Mexico. *Macrothrix*

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paulensis and *Streblocerus pygmaeus* are recorded by the first time, and described in detail. We estimate that the macrothricid fauna represents 66.67% of the theoretical maximum for this region, according to Clench´s equation. Finally, a key for macrothricids of this region is proposed.

Key words: Cladocera, Macrothricidae, Mexico, Central America, taxonomy, distribution, fauna.

Introduction

The Macrothricidae are a morphologically heterogeneous group of freshwater cladocerans. Although they exhibit widespread distribution (Smirnov 1992), some authors have recently demonstrated a restricted distribution for certain taxa (Frey 1988; Silva-Briano 1998). Today, the taxonomy of this family has been improved, but not finished. The taxonomical status of many species is vague, due to the existence of several species complexes (morphologically variable at species level), and the lack of a standard system to describe them (Korovchinsky 1996). For example, in the American continent most of the taxa have been synonymized with the existing ones described from Europe. However in Mexico and South America a new fauna has been recently found with some possible endemics (Paggi 1987, Smirnov *et al.* 1995, Ciros-Pérez & Elías-Gutiérrez 1997a, Silva-Briano *et al.* 1999, Elías-Gutiérrez & Smirnov 2000). Studies on cladocera from Mexico have produced discoveries of biogeographical interest, i.e. it has been demonstrated that Nearctic and Neotropical fauna are mixed here (Elías-Gutiérrez *et al.* 1999). The tropical lowlands of southeastern Mexico and Central America, with a high biological diversity, have not been studied at all. In this work, we studied the distribution and taxonomy of Macrothricids from southeast Mexico, northern Guatemala and Belize.

Study area

The surveys were conducted in 200 water bodies from southeastern Mexico, northern Guatemala (Peten and Alta Verapaz) and Belize (Mayan mountains). The water bodies in this area are numerous and diverse, including temporary pools, permanent lagoons, wetlands, lakes and sinkholes (called in spanish cenotes). All sites are located at altitudes below 600 m.

Material and methods

The samples were collected from the littoral zone of all water bodies, with a conical net (50 μm mesh size with a 1.5 m long metal handle). The net was passed through

macrophytes and all near-shore substrates; all materials were preserved with a 4% sugar-formalin mixture (Haney & Hall 1973). The sampling was carried out intermittently during 1995-2001. Specimens were dissected under a stereomicroscope and identified by using a compound microscope and standard literature (e.g. Smirnov 1992, Silva-Briano 1998); original descriptions were prepared when it was necessary. Drawings were made with a camera lucida attached to a Nikon compound microscope. Scanning electron microscope photographs (SEM) were used to study the fine structural details with the aim of clarifying the status of the species. This material is deposited at the reference collection (ECOCH-Z) held in the Zooplancton laboratory of El Colegio de la Frontera Sur, Chetumal, México.

A numerical identification system for different setae on the thoracic limbs proposed by Kotov (2000, 2002) for chydorids was used, keeping in mind a basic similarity of limbs in Chydoridae and Macrothricidae. A short description of the taxa found in this survey (including a description of *Streblocerus pygmaeus* and *Macrothrix paulensis*) from Mexico, Guatemala and Belize, is provided. Also, a key for Mexican species of *Macrothrix* is proposed.

Abbreviations used in text and all figures:

AI, Antenna I; AII, Antenna II. Trunk limbs I-V: EN, endopodite; EP, epipodite; EX, exopodite; FC, filtratory comb of plumose setae; GT, gnathobase. Limb I: R, receptor; EH, ejector hooks; E1, E2, E3, endites 1-3; F, forks; IDL, inner distal lobe, or endite four; ODL, outer distal lobe, or exopodite. Limb II: DCS, densely ciliated seta; SCA, scales; SC, scrapers of endopodite. Limb III: EE, External endite; IE, Internal endite. Limb V: P, papillae; PEP, pre-epipodite.

Finally, the theoretical maximum number of macrothricid species was estimated according to the species accumulation curve of Clench (1979):

$$S = Se\frac{N}{K+N}$$

Where S is the total accumulated number of species, N is the total number of samples, Se is the theoretical number of species in the area, and K is an adjustable constant, related to "collectability". This function calculates the probability of finding a different species, based in the sampling effort, represented here by the number of samples. The theoretical values were compared with the real ones.

Results

In general, the studied systems are still well conserved (UICN 1992) ranging from very shallow to deep (0.2-60 m). In the following part, a brief description is provided of the taxa found.

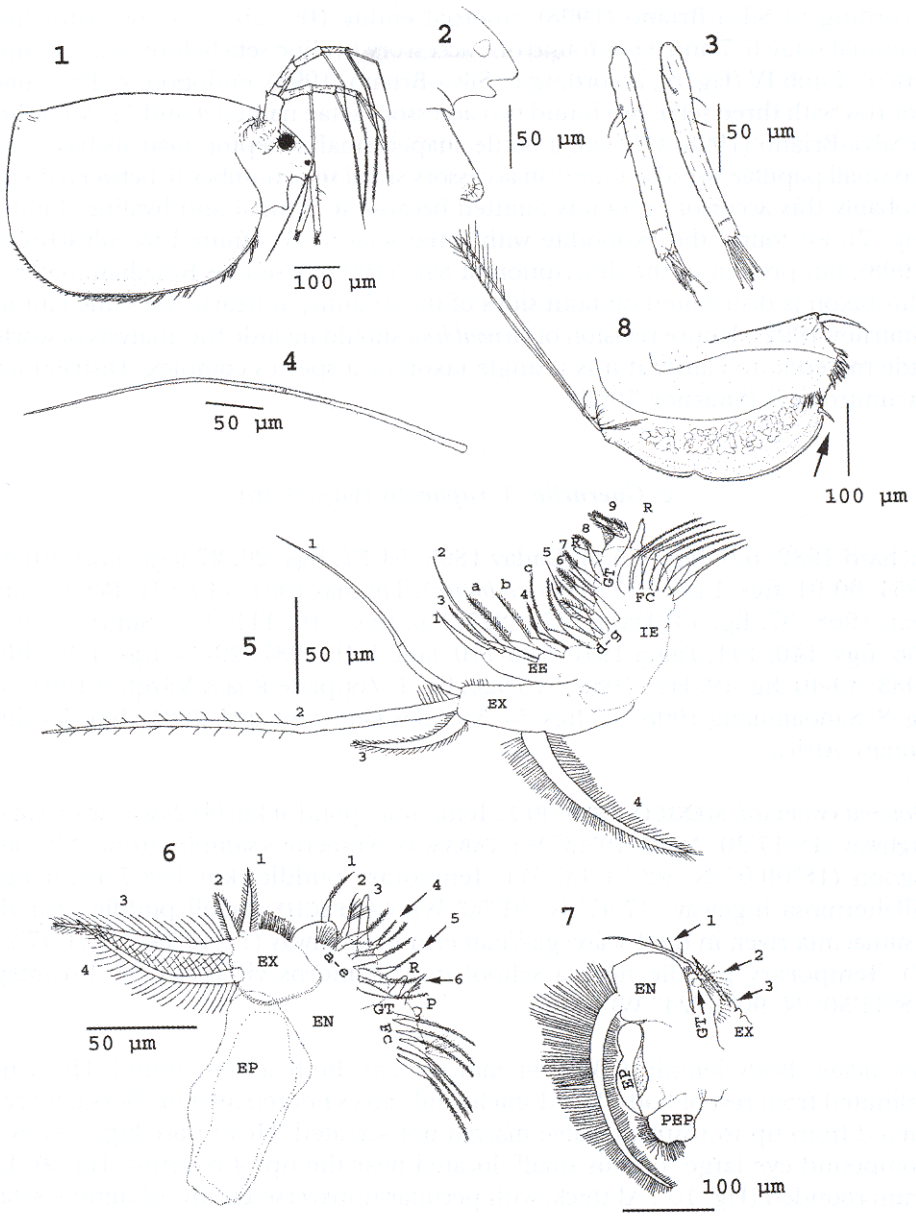
1. ***Grimaldina*** cf. ***brazzai*** (Figures 1-8)

Richard 1982: 2-6, figs. 1-3; Daday 1901: 40-41, fig. 18; Sars 1901: 28-31, pl. V; Daday 1905: 192-193; 1910: 130-139, lam. VII, fig. 26; Birge 1918: 711, fig. 1106; Rahm 1956: 248-250; Harding 1957: 70; Brooks 1959: 628-629, figs. 27, 62; Thomas 1961: 121-122; De Ferrato 1966: 4-3, lam. II, fig. 5; Rey & Saint-Jean 1968: 97, fig. 13; Fryer 1974: 236-238, figs.128-129; Smirnov 1976: 155-156, figs. 137-140; Idris 1983: 39, fig. 18; Brandorff *et al.* 1982: 103, fig. 79. Type locality: Congo, Africa.

Material examined. **MEXICO.** VERACRUZ: Temporary pond km 90.2 Acayucan-Tinaja highway (18°17'30" N, 95°46'43" W). TABASCO: Numerous samples of Matillas lagoon (17°53'45.8" N, 92°31'19.6" W) and El Pajonal lagoon (18°00'40" N: 92°51' 8" W). Temporary puddle, km 138.7 Escárcega-Villahermosa highway (17°47' N: 91°50' W). CAMPECHE: Temporary puddle close to a school in Matamoros village, near Escárcega (18°35'50" N, 90°38'24" W). Several puddles near Palizada village (18°07'01.7" N, 91°07'03.3" W; 18°04'45.4" N, 92°01'32.0" W; 18°03'06.0" N: 91°55'01.5" W). **BELIZE**: Small puddle near La Democracia town (17°21'53.9" N: 88°32'20.7" W), and near Zoological garden (17°24'23" N: 88°24'00" W).

Description. Body length: 0.60-0.70 mm (n=9). Body semi-quadrangular in lateral view, posterior margin convex. Ventral margin with small and fine serrations on edge of valve, and small spines (Fig. 1). Head shield well defined, cephalic pore not visible. Compound eye located close to margin, ocellus small, located near tip of rostrum. Labrum unsegmented (Fig. 2). AI rod-like with transverse rows of minute spikes interiorly. Apex with small and strong spines. Nine aesthetascs of different length (Fig. 3). AII with spines 0-1-0-1/0-0-1, setae 0-0-1-3/1-1-3. Largest seta bisegmented, bilaterally setulated at its distal segment (Fig. 4). Postabdomen wide in lateral view, unique among macrothricids. Preanal zone without heel. Dorsal margin bilobed, finely serrated at the edge (Fig. 8). Largest seta with long distal segment. A group of denticles at distal side of anal aperture, and a solitary larger tooth at posterior side of the anal aperture (see arrow in Fig. 8). Claw big, with two basal spines, one of them minute.

Comments. Grimaldina brazzai has been previously recorded from Africa, Australia, Asia, New Guinea, Central and South America (Smirnov 1992). This taxon was recorded before from the state of Tabasco (Elías-Gutiérrez *et al.* 1999). A significant part of our material was found here. A comparison of Mexican and Guatemalan material revealed no differences among them. A comparison of Mexican material with descriptions of this taxon by Silva-Briano (1998) from Mozambique and Brazil showed some differences in trunk limbs III, IV and V, *i.e.* the presence of accessory setae on different limbs, while the rest of the characters were similar. The accessory setae found in the present material are as follows: Limb III (Fig. 5),



Figs. 1-8. *Grimaldina* cf. *brazzai*, 1. Habitus of a parthenogenetic female. 2. Labrum. 3. Antenna I (ventral side, left and right). 4. Longest seta on antenna II. 5. Limb III with rows of setae on exopodite and endopodites. 6. Limb IV. 7. Limb V. 8. Postabdomen (arrow points to solitary teeth near the anus).

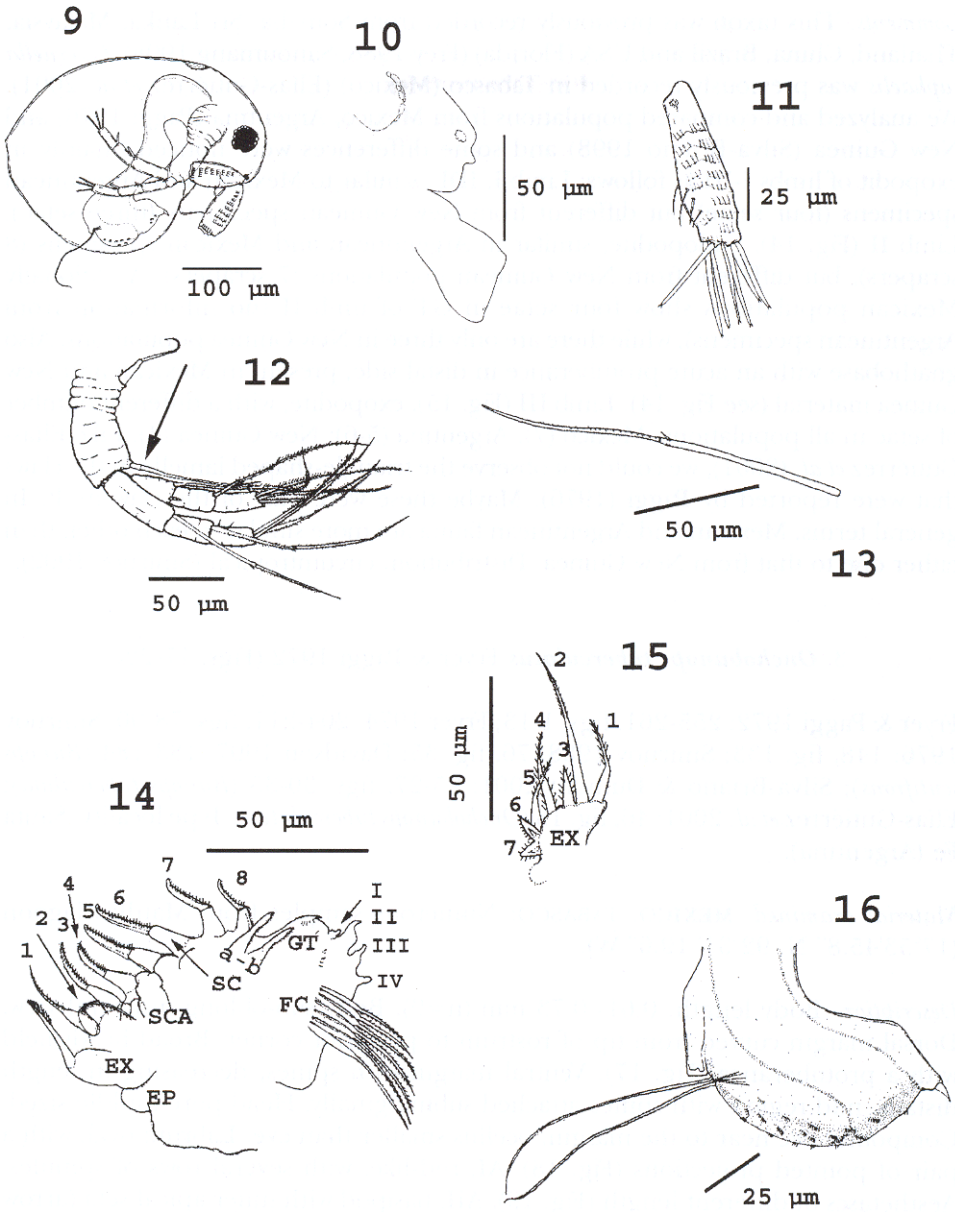
according to Silva-Briano (1998), internal endite (IE), anterior row with three marginal setae 6, 7 and 8 (we found one accessory hyaline seta before seta 6, named seta 5). Limb IV (Fig. 6), according to Silva-Briano (1998), endopodite (EN), anterior row with three setae (we found two accessory setae named 4 and 5). According to Silva-Briano (1998) GT with a bottle shaped small receptor, near its basis, and two small papillae (we also found an accessory small seta, number 6, between them). Probably this accessory seta was omitted because it is small and hyaline. Limb V (Fig. 7), we found the exopodite with three setae (1-3) omitted by Silva-Briano (1998), but present in the description of Sars (1900) based on Brazilian material. This taxon is distributed on both sides of the Atlantic, at nearly the same latitude (Smirnov 1992). Future revision of *Grimaldina* should include the analysis of world-wide material, to clarify if it is a single taxon or a species complex. Distribution: circumtropical (Smirnov 1992).

2. ***Guernella*** cf. ***raphaelis*** (Figs. 9-16)

Richard 1982: 6-9, figs. 4,5,6); Daday 1898: 54-57, figs. 26, 27 (*ceylonica*); Brehm 1951: 90-91, figs. 1 g-s; 1953: 336 (*ceylonica*); Thomas 1961: 119-121; Rey & Saint-Jean 1968: 97, fig. 14; Fryer 1974: 227-230, figs. 110, 111, 112; Smirnov 1976: 156, figs. 140, 141; Paggi 1976: 105-110, lam. I, II; 1987: 29-36, figs. 1-14; Idris 1983: 39-40, fig. 19: Frey 1988: 516 520, fig. 1; Zoppi de Roa & Vázquez 1991: 55, fig. 8. Sanoamuang 1998: 51, figs. 51-53. Elías-Gutiérrez *et al.* 2001. Type locality: Congo, Africa.

Material examined. **MEXICO.** VERACRUZ: Temporary pond at km 90.2 Acayucan-Tinaja highway (18°17'30" N: 95°46'43" W). TABASCO: Numerous samples from El Pajonal lagoon (18°00'0" N: 92°51'48" W). Temporary puddle, km 138.7 Escárcega-Villahermosa highway (17°47' N: 91°50' W). CAMPECHE: Small puddle near the Usumacinta river, in the Escárcega-Villahermosa highway (17°50'44" N: 91°47'25" W). Temporary puddle near a school in Matamoros village, near Escárcega (18°35'50" N: 90°38'24" W).

Description. Body length: 0.39-0.44 mm (n=15). Body almost round. Head not delimited from rest of body. Head shield and valves not reticulated. Dorsal margin curved from tip to rostrum, valve margin not serrated. Head pore big, and oval. Compound eye large, ocellus small, located near the tip of rostrum (Fig. 9). Labrum rounded (Fig. 10). AI thick, with peculiar transverse groups of minute setae. Seven aesthetascs, all similar in length (Fig. 11). AII, basipod with inner apical seta very long (see arrow in Fig. 12). Swimming setae 0-1-1-3/1-1-3; spines 0-1-0-1/0-0-1 (Fig. 12). Largest seta bisegmented, bilaterally setulated at distal segment (Fig. 13). Postabdomen widely oval (Fig. 16).



Figs. 9-16. *Guernella* cf. *raphaelis*, 9. Habitus of a parthenogenetic female. 10. Labrum. 11. Antenna I (ventral side, left). 12. Antenna II (arrow points to long seta on basipod). 13. Longest seta on AII. 14. Limb II. 15. Limb III. 16. Postabdomen, lateral.

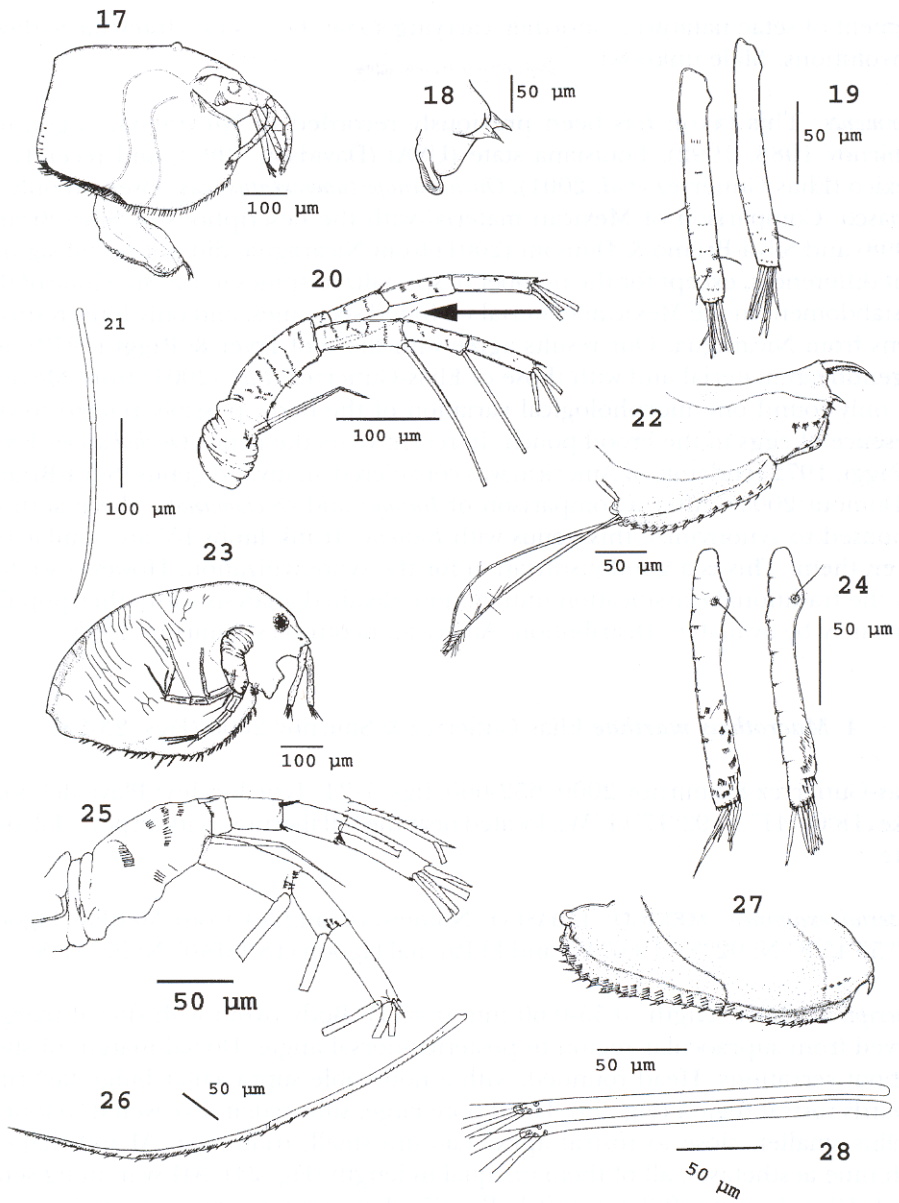
Comments. This taxon was previously recorded from Somalia, Sri Lanka, Malaysia, Thailand, China, Brazil and USA (Florida) (Frey 1988; Sanoumang 1998). *Guernella raphaelis* was previously recorded in Tabasco (Mexico) (Elías-Gutiérrez *et al.* 2001). We analyzed and compared populations from Mexico, Argentina (Paggi 1976) and New Guinea (Silva-Briano 1998) and some differences were noticed, mainly in exopodit of limbs I-III as follows: Limb I, IDL, similar to Mexican and Argentinean specimens (four setae) but different from New Guinean specimens (three setae). Limb II (Fig. 14), endopodite, similar in Argentinean and Mexican specimens (8 scrapers), but different from New Guinean populations (7 scrapers). Additionally Mexican populations show four setae in GT of limb II (no information from Argentinean specimens), while there are only three in New Guinea populations. Also gnathobase with an acute protuberance in distal side, present in Mexican and New Guinea material (see Fig. 14). Limb III (Fig. 15), exopodite, with a different number of setae in all populations: Mexico (7); Argentina (5-6); New Guinea (4). Like Elías-Gutiérrez *et al.* (2001), we could not observe the triangle-shaped lamella in the claws that were reported by Paggi (1976). Maybe these were part of the claw itself. In general terms, Mexican and Argentinean fauna are more similar to each other, than either one to that from New Guinea. Distribution: circumtropical (Smirnov 1992).

3. ***Onchobunops tuberculatus*** Fryer & Paggi 1972 (Figs. 17-22)

Fryer & Paggi 1972: 255-261, figs. 1-13; Fryer 1974: 204-211, figs. 78-90; Smirnov 1976: 148, fig. 133; Smirnov 1988: 76, fig. 35; Davidson 1997: 183-184 (*Bunops scutifrons*); Silva-Briano & Dumont 2001: 25-27, figs. 30-35 (*Bunops tuberculata*); Elías-Gutiérrez *et al.* 2001: 46, fig. 13 (*Onchobunops tuberculatus*). Type locality: Santa Fe (Argentina).

Material examined. **MEXICO.** TABASCO: Numerous samples from Matillas lagoon (17°53'45.8" N: 92°31' 19.6" W).

Description. Body length: 0.61- 0.73 mm (n=9). Body sub-oblong in lateral view. Dorsal margin curved from tip of rostrum to posterior corner. Broad headshield with a protuberance (Fig. 17). Ventral margin with spines, decreasing in length distally, mid region with spines attached submarginally. Head pore middle sized. Compound eye near to the margin, ocellus smaller than eye. Labrum oval, with a pair of pointed projections (Fig. 18). AI, rod-like, with several rows of spinules. Aesthetascs of different length (Fig. 19). AII, basipod with inner apical seta (arrow in Fig. 20). Swimming setae 0-0-0-3/1-1-3; spines 0-1-0-1/0-0-1 (Fig. 20). Largest seta, bisegmented, almost without setulation (Fig. 21). Postabdomen bilobed, anal lobe with spines, preanal lobe with groups of small setae, increasing in size proximally (Fig. 22). Claws with only a minute basal spine, with a lateral tooth. Distal



Figs. 17-22. *Onchobunups tuberculatus*, 17. Habitus of a parthenogenetic female. 18. Labrum. 19. Anntena I (dorsal and lateral side, left and right). 20. Antenna II (arrow points to distal seta on basipod). 21. Longest seta on Antenna II. 22. Postabdomen. Figs. 23-28. *Macrothrix marthae*, 23. Habitus of parthenogenetic female. 24. Antenna I (dorso-lateral side, left and right). 25. Antenna II. 26. Longest seta on Antenna II. 27. Postabdomen. 28. Seta natatoria.

segment of setae natatoriae shorther, carrying some short setae. Intestine without convolutions. Male unknown.

Comments. This taxon has been previously recorded in Nicaragua, Argentina (Smirnov 1988, 1992), Louisiana state (USA) (Davidson 1997), and recently in Mexico (Elías-Gutiérrez *et al.* 2001). *Onchobunops tuberculatus* was observed only in Tabasco. Comparison of Mexican material with the descriptions of Silva-Briano (1998) and Silva-Briano & Dumont (2001) from Nicaragua, did not reveal significant differences, except for the number of specialized spines in the anal lobe of the postabdomen. In the Mexican material we found six spines, and only four in specimens from Nicaragua. Our results agree with those of Fryer & Paggi (1972), for Argentinean material and with those of Elías-Gutiérrez *et al.* (2001) from Mexico. We only found one morphological variation of the body, possibly related to the presence of eggs in the brood pouch. In recent years the genus *Onchobunops* Fryer & Paggi, 1972 (endemic of America) was considered an invalid genus (Silva-Briano & Dumont 2001). After a comparison of *Bunops* and *Onchobunops*, these authors proposed to synonymize this genus with *Bunops*. Trunk limbs I-V are similar between them. This is a good justification for the synomynization. However we follow the traditional classification until a more detailed analysis with other populations may be available. Distribution: American neotropics (Smirnov 1992).

4. ***Macrothrix marthae*** Elías-Gutiérrez & Smirnov 2000 (Figs. 23-28)

Elías-Gutiérrez & Smirnov 2000: 652-660, figs. 1-24. Type locality: Playa del pozo Lake (18°00'41" N, 92°17'11" W), located near the Villahermosa city airport, Tabasco state.

Material examined. **MEXICO**: TABASCO. Numerous samples from Matillas lagoon (17°53'45.8" N: 92°31' 19.6" W) and El Pajonal lagoon (18°00'40" N: 92°51' 8" W).

Description. Body length: 0.55-0.60 mm (n=11). Body ovoid with dorsal margin curved from supraocular region to posterior-dorsal angle. Dorsal margin of shell without serrations. Head rounded, with a noticeable supraocular bulge tapering towards rostral region (Fig. 23). Head pore large, subcircular. Eye well developed, ocellus smaller, close to rostral apex. Labrum small, triangular. AI rod-shaped, with nine aesthetascs, all of them unequal in length (Fig. 24). AII swimming setae 0-0-1-3/1-1-3, spines 0-2-1-1/ 0-0-1 (Fig. 25). Longest setae bisegmented, convex margin with fine spinules on proximal segment, last quarter with alternating stronger and finer spinules (Fig. 26). Postabdomen ovoid in lateral view, ventral margin almost convex, dorsal margin not bilobed (Fig. 27). Anal region bordered on both sides by dorsal stripe of needle-like spinules arranged in several transverse rows

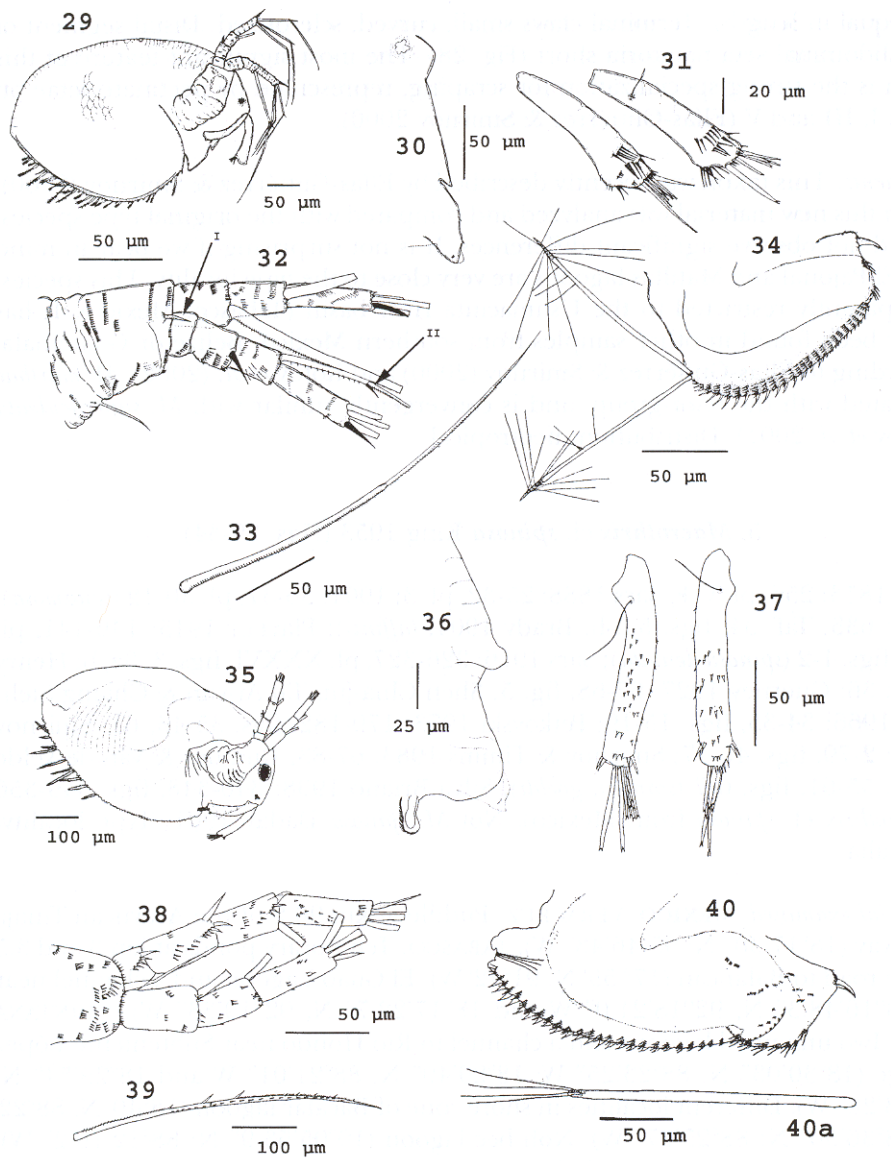
(subequal in length). Terminal claws small, curved, sclerotized. Distal segment of postabdominal seta natatoria short (Fig. 28). The most significant feature of this taxon is the strong specialization for scraping, represented by pectinate setae on limbs I, III and V (Elías-Gutiérrez & Smirnov 2000).

Comments. This taxon was recently described by Elías-Gutiérrez & Smirnov (2000). When this new material was analyzed and compared with the original type species, we did not observe significant differences. It is not surprising if we bear in mind that El Pajonal and Matillas lagoons are very close to the type locality. This species, is apparently restricted to the Usumacinta river basin (Tabasco, Mexico). It has never been found in other samples from southern Mexico, Belize or Guatemala. According to Elías-Gutiérrez & Smirnov (2000) and Kotov *et al.* (2002), *M. marthae* is related with the *rosea*-group, and is convergently similar with *M. superaculeata* (Kotov *et al.* 2001). Distribution: neotropical.

5. ***Macrothrix*** cf. ***spinosa*** King 1953 (Figs. 29-34)

King 1853: 256, pl. VIF; Sars 1888: 25-32, pl. 3; 1901: 36-37; pl. 30-12 (*squamosa*); 1904: 633, Taf. 34, figs. 5 a-b; Brady 1904, (*affinis*); Playfair 1915: 140-141, pl. VIII, figs. 1-2 (*spinosa dentata*); Sars 1916: 326-327, pl. XXXVI, figs. 3, 3a, b; Henry 1922: 36; Guerney 1927: 67-68, fig. 5; Shen Chia-jui, Tai Ai-yun & Chiang Sieh-chin 1966: 34-35, figs. 15-19; Petkovski 1973: 179-182, figs. 35-43, 61; Smirnov 1976: 2-79, figs. 40-47; Smirnov & Timms 1983: 67-83; Dumont & Van de Velde 1977: 55-61, figs. 6-7 (*spinosa, goeldi*); Silva-Briano 1998: 346-348, figs. 349-356 (*Macrothrix* cf. *spinosa* from Mexico). Not *M. spinosa* Daday 1901. Type locality: Australia.

Material examined. **MEXICO**. VERACRUZ: Puddle at km 90,2 of the Acayucan-Tinaja highway (18°17'30" N: 95°46'43" W). TABASCO: Temporary ponds at km 3 and 3.5 of the road to Balancan (17° 55' N: 91°42' W). El Guao Lagoon and a channel near it (18°16'48.3" N, 92°18'21.0" W and 18°17'22,7" N, 92°19'33" W). QUINTANA ROO: Two unnamed lagoons and a channel to Río Hondo near Subteniente López village (18°30'03" N: 88°23'25" W; 18°29'49" N: 88°21'01" W and 18°29'54" N: 88°23'28" W). Different localities in shore zone of Bacalar lagoon (18°40' N, 88°22' W, 18°36'50" N: 88°25'27" W). Noh bec lagoon (19°05'53.9" N: 88°12'19.2" W). **GUATEMALA**. Alta Verapaz: Small flow near Chajmaic bridge (15°43'15" N: 89°56'24" W). Puddle near Sayanche (16°26'49.9" N: 90°07'08.6" W. Pond near El Pato crossing roads (16°03'37.5" N: 90°10'51.2" W). Flooded wetland near Melchor de Mencos (17°01'37.4" N: 89°14'08.8" W).



Figs. 29-34. *Macrothrix spinosa*, 29. Habitus of parthenogenetic female. 30. Labrum. 31. Antenna I (dorsal side, left and right). 32. Antenna II (arrows I, and II point to a distal seta and a spine on largest seta, see explanation in text). 33. Longest seta on antenna II. 34. Postabdomen. Figs. 35-40. *Macrothrix elegans*, 35. Habitus of parthenogenetic female. 36. Labrum. 37. Antenna I (dorsal and ventral side, left and right). 38. Antenna II. 39. Longest seta on second antenna. 40. Postabdomen. 40a. Seta natatoria from postabdomen

Description. Body length: 0.39-0.44 mm (n=14). Body subovoid in lateral view, dorsal margin curved from tip of rostrum to posterior dorsal angle. With serrulations along dorsal margin of head and valves. Head-shield well reticulated (Fig. 29). Head pore small and oval. Labrum convex (Fig. 30). AI dilated distally, with 6-7 transverse rows of small spinules. Two subapical rows of strong spinules, 9 different aesthetascs of different length (Fig. 31). AII with a stout apical spine on outer surface (arrow I in Fig. 32), swimming setae 0-0-1-3/1-1-3; spines 0-1-0-1/ 0-0-1 (Fig. 32). A spinule on the boundary between proximal and distal segments of seta on 3rd segment of 4-segmented branch (arrow II in Fig. 32).Largest seta bisegmented, unilaterally armed with fine setules (Fig. 33). Postabdomen subovoid in lateral view. Ventral margin slightly convex with rows of spines. Preanal zone without heel. Anus bordered with several groups of stout spines. Terminal claw small, curved. Seta natatoria with long proximal segment, distal segment short, carrying large setae (Fig. 34).

Comments. This taxon was previously recorded in Africa, Australia, Asia, and across America (Smirnov 1992). It was found frequently in Mexican and Guatemalan material (figs. 1-6). *M. spinosa* has been reported in some studies from southeastern Mexico and northern Guatemala. Unfortunately these reports lack taxonomic explanations (Van de Velde *et al.* 1978; Suárez-Morales & Elías-Gutiérrez 1992). Comparison of Mexican material with descriptions by Silva-Briano (1998) from specimens collected in Aguascalientes (Mexico) did not reveal any significant differences. However, he concluded not to accept this taxon in *sensu stricto* for Mexican populations. To establish if this is a group of closely related species or a sole taxon, it should be studied material from other continents. Additionally, we compared Mexican, Guatemalan and Argentinean material, but no significant differences were found. Trunk limbs 1-5 were similar in all analyzed populations. This is only a provisional conclusion because the species is widely distributed. Distribution: Circumtropical (Smirnov 1992).

6. ***Macrothrix elegans*** Sars 1901 (Figs. 35-40)

Sars 1901: 33-36, pl. 6, figs 1-9; Daday 1905: 194; Stingelin 1913: 615-616, figs 18-19 (*triserialis* var. *chevreuxi*); Delachaux 1919: 25-26 (*triserialis* var. *chevreuxi*); Brehm & Thomsen 1936: 213 (*triserialis*); Brehm 1937: 498 (*triserialis*); 1938: (*tenuicornis* var. *maxima*); 1939: 181 (*triserialis*); Harding 1955: 338-339, figs 34-36 (*triserialis*); Orghidan & Negrea 1973: 107-109, fig. 3 (*triserialis*); Van de Velde *et al.* 1978: 394 (*triserialis*); Infante 1980: 597-598, fig. 4 (*Echinisca triserialis*); Frey 1982: 179 (*elegans* and *triserialis*); Montú & Gloeden 1986: 31, figs 8 c-f; Valdivia Villar 1988: 293 (*Echinisca triserialis*); Ciros-Pérez & Elías-Gutiérrez 1996a: 298, figs 1-2 (*triserialis*); Elmoor-Loureiro 1998: 25 (*triserialis*); Dumont *et al.* 2002: 8-9, figs 65,

77-88 (*elegans*); Dumont *et al.* 2002: 8-9, figs 77-88 (cf. *triserialis* from Mexico). Type locality: Itatiba State, São Paulo, Brazil (according to lectotype). *Macrothrix elegans* was obtained in 1900 by artificial hatching mud from dried material (São Paulo, Itatiba, Iparanga (Brazil) and Argentina). Because Sars´s (1900) material was not specified accurately, Kotov *et al.* 2002 (in press) redescribed it, based on the author's type materials and selected a lectotype of *M. elegans* from Itatiba.

Material examined. **MEXICO.** VERACRUZ: Temporary pond at km 90,2 of the Acayucan-Tinaja highway (18°17' 30" N: 95°46'43" W). TABASCO: Temporary ponds at km 3 and 3.5 on the road to Balancan (17° 55' N: 91°42' W). Temporary puddle (Km 138.7) in the highway Escárcega-Villahermosa (17°47' N: 91°50' W). Small temporary puddle near the Usumacinta river, at Escárcega-Villahermosa highway (17°50'44" N: 91°47'25" W). El Espino lagoon (18°13'26.3" N: 92°19'18.6" W). Several puddles near Palizada village (18°07'01.7" N: 91°07'03.3" W; 18°04'45.4" N: 92°01'32.0" W & 18°03'06.0" N: 91°55'01.5" W). QUINTANA ROO: several lagoons and a channel to Río Hondo near Subteniente López village (18°30'03" N: 88°23'25" W; 18°29'49" N: 88°21'01" W and 18°29'54" N: 88°23'28" W). Xul-ha lagoon near Bacalar (18°34' N: 88°26' W). Temporary puddle in Huay-pix village (18°30' N: 88°26' W). Small river below Puente Milagros (18°31' N: 88°23' W). Different localities in shore zone of Bacalar lagoon (18°40' N: 88°22' W and 18°36'50" N: 88°25'27" W). Minicenote (Sinkhole) near El Padre lagoon (19°36'25" N: 87°59'21" W). YUCATÁN: Dzibalchatun sinkhole (21°05'30" N: 89°35'54" W). Two localities in the shore zone of Chichancanab lagoon (19°57' N: 88°44° W & 19°53'46.3" N: 88°46'00.4" W). **GUATEMALA**, Alta Verapaz: small ponds 5 km from and near Raxruja (15°49'26" N: 89°57'20" W). Pond near San Antonio Flores (15°49'26" N: 89°57'20" W). Petén Flores: series of samples in shore zone of lake Petén (16°55' N: 89°53' W; 16°55'44" N: 89°53'38" W; 16°55'35" N: 89°55'30" W; 16°55'30" N: 89°51'27" W; 16°59'34" N: 89°41'39" W; 16°56'00" N: 89°53'22" W). Small flow near Chajmaic bridge (15°43'15" N: 89°56'24" W). Puddle near Sayanche (16°26'49.9" N: 90°07'08.6" W). **BELIZE**: Small puddle near Spanish Lockout (17°13'54.1" N: 88°55'49.2" W). Small puddle near La Democracia (17°21'53.9" N: 88°32'20.7" W). Small puddle near Zoological garden (17°24'23" N: 88°24'00" W). **NICARAGUA:** Río Tipitapa. **ARGENTINA**: Santa Fe.

Description. Total length: 0.56- 0.71 mm (n=60). Body ovoid, elongate in lateral view. Dorsal margin finely serrated, with a shallow depression posterior to dorsal head pore. Surface of head and valves with striations (Fig. 35). Cephalic pore ovoid, relatively small, surrounded by a thick ring around it. Labrum wide, with series of small tubercles at apex (Fig. 36). AI rod-like, with 7-9 transverse lines of spinules, nine aesthetascs, two of them larger than the rest (Fig. 37). AII with spines 0-1-0-1/0-0-1, swimming setae 0-0-1-3/1-1-3. In most populations additional spines on second exopod segment are relatively small than true spines. In other populations

additional spines are large, with size of elements decreasing gradually into dorsal direction (Fig. 38). Largest seta with series of robust, sparse spinules in middle portion, and a fringe of short setules in basal and distal portions (Fig. 39). Postabdomen subovoid, with sculpture arranged in longitudinal lines on sides, preanal portion with heel and numerous rows of spines decreasing in size (Fig. 40). Terminal claw small, outer dorsal row of denticles on it consists only of "basal spine" and second denticle located distally. Postabdominal seta, with long proximal segment, very short distal segment, carrying some setae.

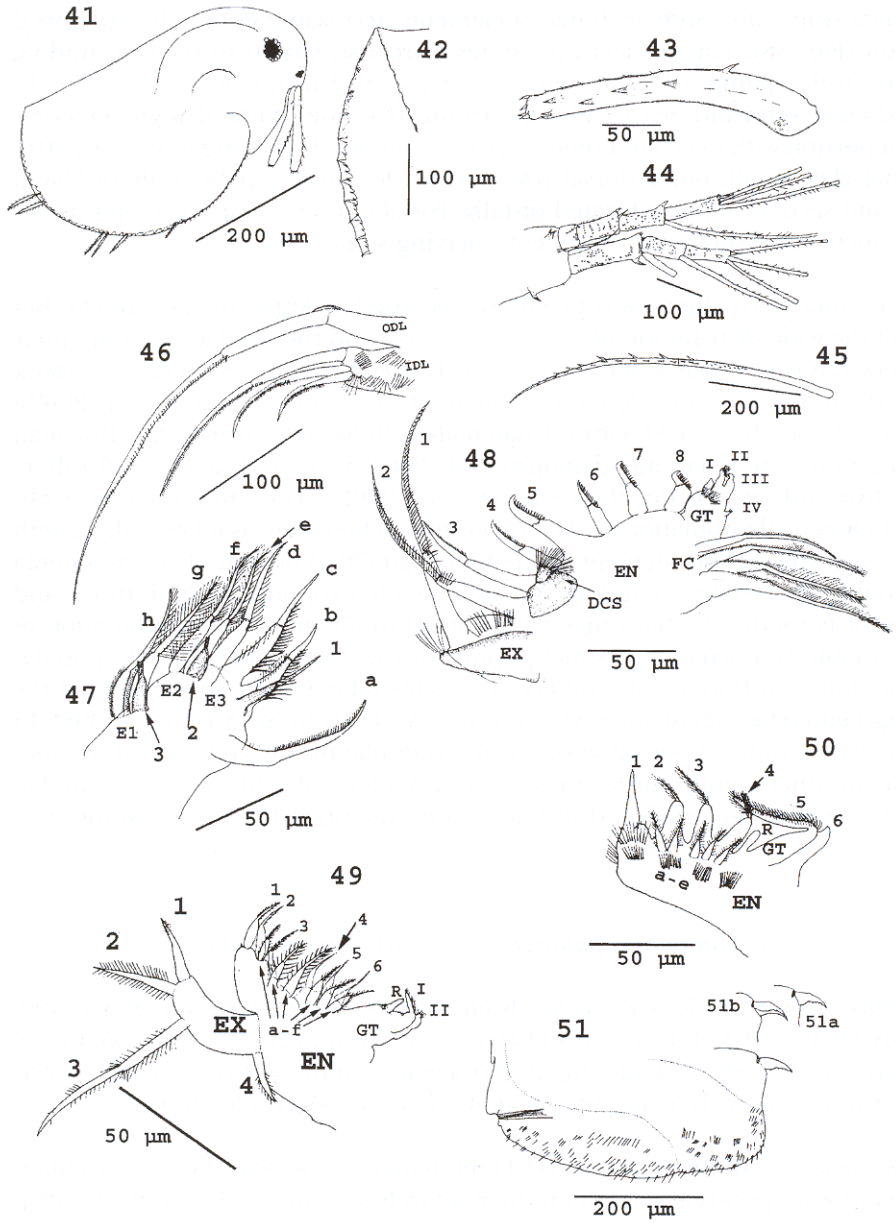
Comments. *Macrithrix elegans* was previously recorded in Argentina and Brazil. Because of the wide distribution of *triserialis*-like taxa and the similarity among their members, this species was synonymized with *M. triserialis* (Smirnov 1992). *Macrothrix superaculeata* also was considered a synonym of *M. elegans* (Dumont *et al.* 2002). However, the analysis of Mexican, Guatemalan, Belizean, Nicaraguan, Brazilian and Argentinan populations, demonstrated that it is a valid taxon, and differs clearly from others (for details see Kotov *et al.* 2002). The only differences observed between all populations of *M. elegans* studied here were as follows: the length of spines on the second segment of the four-segmented branch of the antennula was variable; the relative length of the third seta in exopodite of limb three, and the size of epipodite V, that ranged from small to gigantic. The combination of these variable characters in distinct populations was different. In some populations of Quintana Roo, we also observed a visible lobe in the first segment of the four-segmented branch of antenna, reported previously by Silva-Briano (1998). In general, we consider these variations as interpopulation variability of *M. elegans*, because all other significant features (*i.e.* morphology of limbs I-V) were similar. Now *M. elegans* is regarded as distributed from Argentina to Mexico (Kotov *et al.* 2002).

7. ***Macrothrix paulensis*** Sars 1901 (Figs. 41- 51)

Sars 1900: 4-27, pl. I, II (*Iheringula*); Brehm, 1938: 97-99, Abb. 3-4 (*Iheringula*); Smirnov 1976: 130-134, figs. 112-114 (*Echinisca*); Brandorff *et al.* 1982: 95, fig. 80 (*Echinisca*); Frey 1988: 520-522, fig. 2 (*Iheringula*); Zoppi de Roa & Vazquez 1991: 55, fig.8 (*Iheringula*). Type locality : neighborhood of São Paulo (Brazil).

Material analyzed: **MEXICO**. TABASCO: Three females (one adult & two juveniles) from temporary ponds at km 3.5 on the road to Balancan (17° 55' N: 91°42' W).

Description. Body length: 1.07 mm. In lateral view, dorsal margin almost straight in juvenile (Fig. 41). There is a depression on the dorsal margin between the head and rest of the body. Dorso-posterior corner noticeable (Fig. 42). A shallow de-



Figs. 41-51. *Macrothrix paulensis*, 41. Habitus of juvenile female. 42. Posterior margin of valve. 43. Anntena I (dorsal side, left). 44. Antenna II. 45. Long seta on antenna II. 46. IDL, ODL of limb I. 47. Limb I (endites 1-3). 48. Limb II. 49. Limb III with rows of seta on exopodite and endopodites. 50. Limb IV. 51. Postabdomen. 51a. Claw, outer side. 51b. Claw, inner side.

pression on the dorsal side between the head and rest of the body. Ventral side of the head even (Smirnov 1992). According to Brehm (1938), the dorsal margin of the valves is serrated.

Head with ventral side even. AI rod-like, with 6 strong spines along its side and four on base of it (Fig. 43). AII, setae 0-0-1-3/1-1-3, spines 0-2-1-1/0-1-1. Basipod with three strong spines near inner basipodal region, one of them bifurcated (Fig. 44). Largest antennal seta with strong spines in the middle segment, decreasing distally (Fig. 45).

Limb I (Fig. 46), ODL bearing a long apical seta, bisegmented, unilaterally setulated along distal part, and a small bilaterally setulated lateral seta. IDL with three setae of different length, all of them bisegmented, unilaterally setulated along their distal segment. Endite 3 with four setae (Fig. 47, marked as a,b,c and 1). Seta a long, curved, with short setules in one side; seta 1, the smallest, with long and strong setules at middle part; seta b and c similar in length, stout, bisegmented, with transverse rows of setules, the inferior row with strong setae. Endite 2 with three setae (d, e and f), bisegmented whith dense setulation at their distal segment; seate d and f with short setules basally. Endite 1 with two long setae (g and h), with fine, long, bilateral setulation, with short setules basally. Forks on endites 1 and 2 broad at base. Fork on endite 1 (marked with number 3), left part acute, right part with two teeth. Fork on endite 2 (marked with number 2), left part acute, right part with two teeth.

Limb II (Fig. 48). Exopodite elongated but apparently without setae. Endopodite with eight scrapers. Scraper 1, long with broad basis, bisegmented, finely setulated at its distal segment. Scraper 2 shorter than 1, bisegmented, distal segment unilaterally setulated. Scraper 3 shorter than 2, bisegmented, with strong teeth at its distal segment. Scrapers 4 and 5 similar in length, bisegmented, with teeth in distal segment. Scrapers 6, 7 and 8 small, bisegmented, with teeth similar in length (7 slightly longer than 6 and 8). GT with four setae; seta I long and thick, naked. Seta II with fine and long setules at its tip; seta 3 hooked; seta 4 between GT and FC, with a tuft of setules at its tip. Filter comb composed of four long setae, not segmented, and bilaterally setulated. There is a lobe carrying a stout conical seta densely ciliated on its distal portion (DCS), located at the external surface on the endopodite, near the insertion of scrapers 3 and 4.

Limb III (Fig. 49). Exopodite with four setae (1-4). Outermost seta (1) not segmented, bilaterally setulated at distal part. Seta 2 shorter than 1, not segmented, bilaterally setulated, hyaline. Seta 3, the longest, not segmented, bilaterally setulated at its distal part, hyaline. Seta 4, smaller, hyaline, not segmented, setulated from the middle to the tip. Endopodite, with two anterior rows of setae, outer one with three setae. Seta 1 and 2 with the base dilated, distal part narrow, with a line of setules. Seta 3 shorter, also with setules at its distal portion. Inner row of three setae (4, 5 and 6), all of them similar in length and naked. Posterior row with six setulated setae (a-f), with b and c elements longer and with stronger setulae on them. Gnathobase with one receptor (R), and two setae at the top (I and II).

Limb IV (Figure 50). Exopodite not seen in dissected animals (most probably lost during dissection). Endopodite: with two rows of setae. Anterior row with four setae (1-4) and a receptor. Seta 1 broad at base, unsegmented and naked. Setae 2, 3 and 4 similar in length, bisegmented, with dense cluster of setules at their tip. A small finger-like receceptor (R) after seta 4. Posterior row with five setae (a-e) bilaterally setulated at their distal part. Gnathobase with a setose seta (5) and a finger-like projection at the proximal end.

Postabdomen (Fig. 51) quadrangular, with setae along its dorsal and distal side, however the Thailand material differs from the typical species because it has a more oval postabdomen. Dorsal side covered over the whole length with small spines and four long spines standing on both sides of the anus (small in juvenile stages). The dorsal outline is concave. Claw with four spines (outer side) and a small protuberance on middle convex side (Figs. 51a and 51b).

Comments. Unfortunately, we obtained only three specimens of *M. paulensis* (the only parthenogenethic female is deformed). Our material agrees with the description from Brazil (Sars 1900) and Venezuela (Zoppi de Roa & Vazquez 1991), where AI has 6 strong spines on margin and 4 on the base. Also AII in specimens from Mexico is similar to those of Venezuela, Brazil and Thailand because they have two spines on the second segment of 4-segmented branch of antenna. The claw in Mexican material has 4 basal spines (outer side) and a small protuberance on the distal convex part of the postabdominal claw, like the Venezuelan material. Distribution: this species is known from Venezuela, Brazil, Florida (Smirnov 1992), Australia and Thailand (Sanoamuang 1998).

8. ***Streblocerus pygmaeus*** Sars 1901 (Figs. 52-64).

Sars 1901: 38-39, pl. V, fig. 13-17; Birge 1918: 709, fig. 1103; Brooks 1959: 627, figs. 27, 59; Idris 1983: 41-42, fig. 20; Brandorff *et al.* 1982: 103, figs. 71-73. Type locality: neighborhood of São Paulo (Brazil).

Material examined. **MEXICO**: TABASCO. Temporary ponds at km 3 and 3.5 on the road to Balancan (17°55' N: 91°42' W). **BELIZE**: Small puddle (17°24'21" N: 88°28'29" W).

Description. Body length: 0.23-0.28 mm (n=9). Body globular in lateral view. Dorsal outline of head and valves squamose, and arched. Dorso posterior corner of valves rounded, not noticeable (Fig. 52).Ventral margin with serrations along the edge, and long spines increasing in size distally. Surface of shell sculptured, with conspicuous scale-like ridges. Lower edge of valves with spinules and setae (Fig. 53).

Head large, in lateral view with a slight depression in rostral region (Fig. 65, 66). Dorsal margin squamose. Head pore not visible, but a well developed depres-

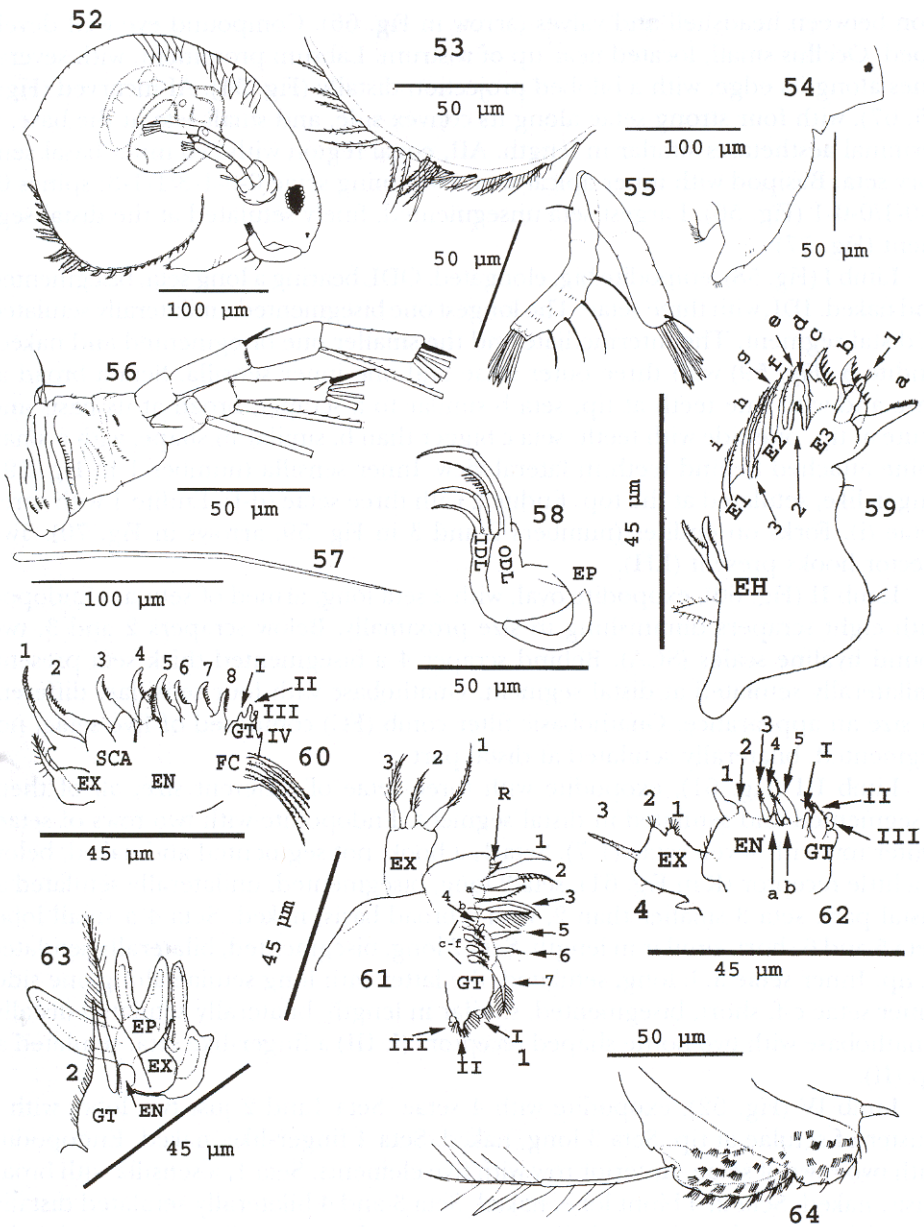
sion between headshell and valves (arrow in Fig. 66). Compound eye well developed. Ocellus small, located near tip of rostrum. Labrum prominent, with several lines along its edge, with a bilobed projection distally (Fig. 54). AI incurved (Figs. 55, 67), with four strong setae along its convex side, and small seta at the base, 9 terminal aesthetascs similar in length. AII, coxal region with two inner basal sensory seta. Basipod with inner apical seta. Swimming setae 0-0-1-3/1-1-3; spines 0-1-0-1/0-0-1 (Fig. 56). Largest seta unsegmented, finely setulated at the distal segment (Fig. 57).

Limb I (Fig. 58), epipodite big, elongated. ODL bearing a long seta, bisegmented and naked. IDL with three setae. The longest one bisegmented, unilaterally setulated at distal segment. The intermediate and the smaller one bisegmented and naked. Endite 3 (Fig. 59) with three outer setae and one inner sensilla. Seta a broad at base and with fine teeth at tip; seta b similar to a scraper, broad at its basis and acute at tip, one side with teeth; seta c bigger than b, similar in shape, with a small spine attached behind teeth in lateral view. Inner sensilla (number 1 in Fig. 59), finger-like, setulated at the top. Endite 2 with three setae (d-f). Endite 1 with three setae (i). Forks on endites (numbers 2 and 3 in Fig. 59, arrows in Fig. 70). Two ejector hooks present (EH).

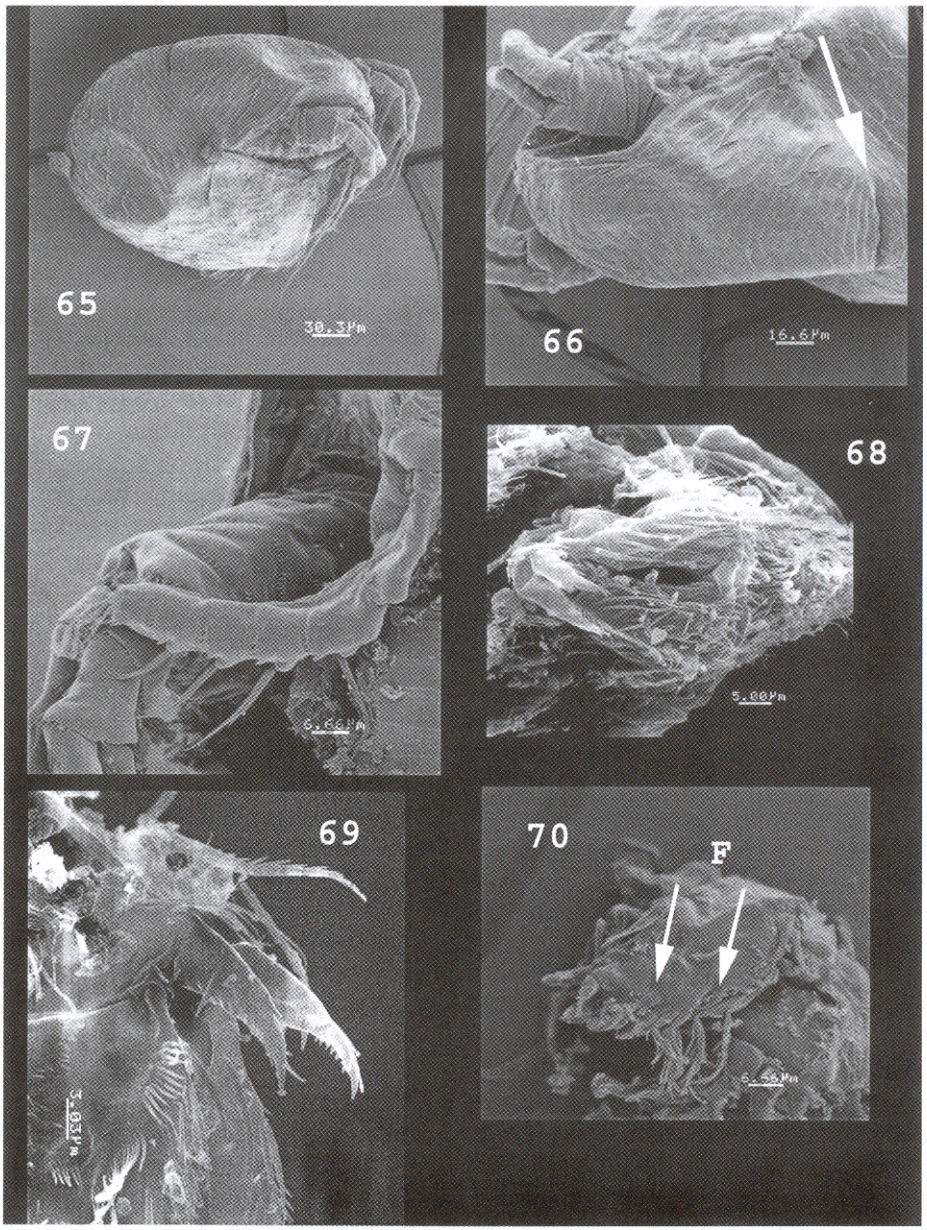
Limb II (Fig. 60), exopodite oval, with a seta long, armed of setulae. Endopod with eight scrapers diminishing in size proximally. Below scrapers 2 and 3, two round hyaline scales (SCA). Behind scraper 4 a bisegmented thick seta present, unilaterally setulated at distal segment. Gnathobase with four sensillae, different in size an appearance. Gnathobasic filter comb (FC) composed of five setae, not segmented, bilaterally setulated at distal part.

Limb III (Fig. 61), exopodite with three setae of different size, all of them bisegmented and setulated in distal segment. Endopodite with two rows of setae. Outer row with seven setae (1-7). Seta 1, a hook, not segmented and naked, below it a little receptor (R in Fig. 61); seta 2 long, bisegmented, unilaterally setulated at distal part; seta 3 smaller than 2, with a broad basis, naked. Seta 4 a small lobe. Seta 5 and 6 short, similar in length. Seta 7 long, bisegmented, bilaterally setulated at tip. Inner setae a, b long, setulated, the latter with long setulae along one side. Inner setae c-f, short, bisegmented, similar in length, bilaterally setulated distally. Gnathobase with two bottle shaped receptors (I, III) a finger-like seta, setulated at tip (II).

Limb IV (Fig. 62), exopodite with 4 setae. Seta 1and 2 just two lobes with a cluster of setulae at tip. Seta 3 long, naked. Seta 4 finger-like, naked. Endopodite with two rows of setae. Anterior row with five elements. Seta 1, a sensilla with broad basis, naked. Seta 2, a blunt lobe, naked. Seta 3 and 4 bilaterally setulated distally. Seta 5 broad at basis, naked. Posterior row with two small setae, naked (a-b). Gnathobase with three elements, a bottle-shaped sensilla, unsegmented and naked (I). Number II, a seta with broad basis, bisegmented, unilaterally setulated at distal part, and two small papillae (III).



Figs. 52-64. *Streblocerus pygmaeus*, 52. Habitus of parthenogenetic female. 53. Detail of valve. 54. Labrum. 55. Antenna I (lateral and dorsal side, left and right). 56. Antenna II. 57. Longest seta on antenna II. 58. IDL, ODL of limb I. 59. Limb I (endites 1-3). 60. Limb II. 61. Limb III. 62. Limb IV. 63. Limb V. 64. Postabdomen.



Figs. 65-70. SEM photographs of *Streblocerus pygmaeus* 65. Habitus, lateral view. 66. Dorsal view of headshield (arrow points to depression between headshield and valves). 67. AI, lateral view. 68. Postabdomen, dorsal side. 69. Postabdominal claws. 70. Limb I (arrows point to forks, F)

Limb V (Fig. 63), exopodite with one seta, not segmented, acute and naked. Epipodite with five lobes. Endopodite with one setae, not segmented, bilaterally setulated from basis to tip, one side with long setulae, and a naked lobe. Gnathobase with one seta, long, not segmented, bilaterally setulated from basis to tip.

Postabdomen: (Figs. 64, 68) short in lateral view, bilobed. Preanal zone without heel, margin bearing setae, these setae form distinct groups. Seta natatoria bisegmented, bilaterally setulated with long distal segment. Claws minutely denticulate throughout their whole length, and a larger tooth in lateral side. A minute spine on basis of claw (Fig. 69).

Comments. This is a small species, described from southern Brazil (Sars 1901), also known from Louisiana (southern USA) (Birge 1910), and China (Chiang Sich-chin & Du Nan-shan 1979). In general *Streblocerus pygmaeus* from Mexico agres with the original description of Sars (1901) and Brandorff *et al.* (1982). According to Smirnov (1992), in the preanal margin, the setae form distinct groups. In populations from Mexico, and populations analyzed by Sars (1901) from the neighborhood of São Paulo they are present. But in populations from the River Nhamundá they do not form distinct groups. Male unknown.

Discussion

Eight taxa were found, three of them are new records for México (*Macrothrix elegans*, *M. paulensis* and *Streblocerus pygmaeus*), three for Guatemala, and two taxa are recorded the first time in Belize. This is probably not a final figure, and more species will be discovered, according to Clench´s (1979) equation. The predicted value of "potential" species from this region is 12 ($r^2 = 0.94$), so the eight species found here represent 66.67 % of the expected maximum. Five species approximately remain to be discovered, but a considerable effort of sampling should be carried out (see Fig. 71).

Macrothrix elegans was present in many analyzed sites from southeastern Mexico, northern Guatemala and Belize. We agree with Kotov *et al.* (2002), considering *M. elegans* as one of the most common species in the neotropics, from Argentina to Mexico.

Grimaldina cf. *brazzai* and *Guernella* cf. *raphaelis* from Central America presented some differences with African and Asian populations. Further studies should be conducted to establish the main regional differences of these taxa. Most important part is the lack of sexual females and males, as occurs with *M. spinosa*, a species widely distributed in the tropics, but relatively unstudied as yet. An example of a more complete description is that of Ciros-Pérez & Elías-Gutiérrez (1997b) that described all adult elements of the life cycle for the rare *Spinalona anophtalma*, and Kotov *et al.* (2002) for *M. elegans*.

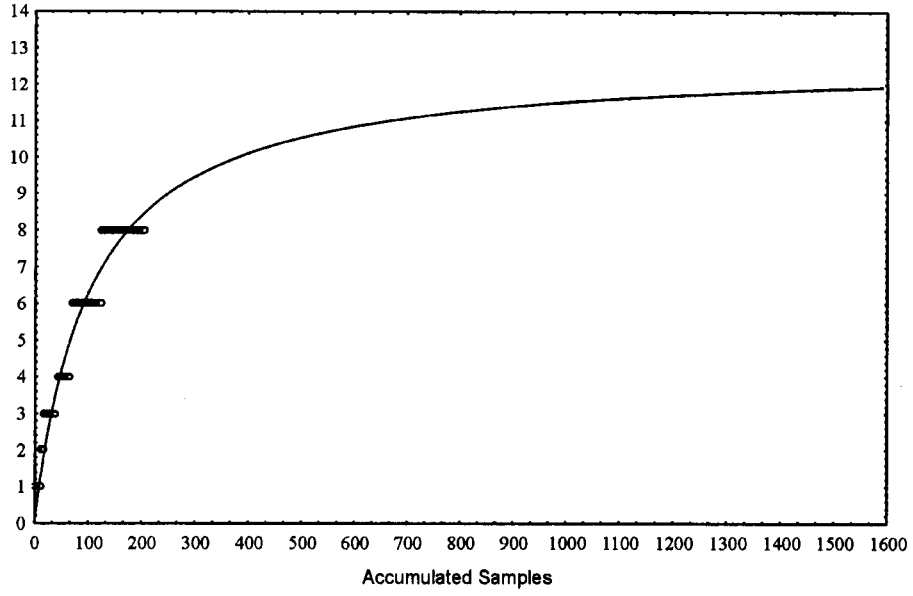


Fig. 71. Sampling effort vs. number of species, according to Clench's equation. The continuous line represents fitted values.

Other rare taxa described in this study are *Macrothrix paulensis* and *Streblocerus pygmaeus*, both with apparently specific requirements to survive, because they were found in limited localities and in small numbers, although we cannot conclude about the variability of *M. paulensis* population from Mexico with the rest of America, Asia and Australia. However, it should be considered, according to the preliminary analysis of Frey (1988) on different populations of *M. paulensis* and *G.* cf. *raphaelis*, based on the length-frequency distribution with material from Florida, the Congo and Sri Lanka, that these macrothricids seem to be different. Maybe they represent groups of closely related species, as has been demonstrated for other macrothricids and chydorids (Kotov *et al.* 2002).

Previous investigations in Mexico rendered 12 known species of Macrothricids (Elías-Gutiérrez *et al.* 2001; Dumont *et al.* 2002; Silva-Briano *et al.* 1999). After this study, the Mexican fauna of this family rises to 15 species and 5 genera. These numbers are comparable to those reported from South and North America, with 17 and 12 species respectively (Green 1981; Villalobos-Hiriart *et al.* 1993). On the other hand, *Streblocerus pygmaeus* from Guatemala and Belize, represents a new record for Central America and the Caribbean, increasing this list to 10 known species (Van de Velde *et al.* 1978; Frey 1982; Collado *et al.* 1984; Smirnov 1988; Villalobos-Hiriart *et al.* 1993).

Recently, the family Macrothricidae has been re-arranged in two subfamilies and 10 genera (Dumont & Silva-Briano 1998). The larger number of species is

found in the genera *Macrothrix*, with 40 (50%). *Grimaldina*, *Guernella*, *Streblocerus* and *Onchobunops* are monotypical, but as it was discussed, some of them could be species-groups. Knowledge of this family is improving rapidly, and the number of species known has increased since 1996, mainly from some regions of Mexico, where at least five species have been described, and at least two more have been reinstated (Ciros Pérez *et al.* 1996b; Ciros-Pérez & Elías-Gutiérrez 1997a; Silva-Briano *et al.* 1999; Elías-Gutiérrez & Smirnov 2000; Kotov *et al.* 2002 in press).

Four of the 8 taxa reported here are subtropical-pantropical (*Macrothrix elegans*, *M. paulensis*, *Onchobunops tuberculatus*, *Streblocerus pygmaeus*), 37.5 % circumtropical (*Grimaldina brazzai*, *Guernella raphaelis* and *Macrothrix spinosa*), and 12.5% probably endemics (*Macrothrix marthae*) (Smirnov 1992; Elías-Gutiérrez & Smirnov 2000).

The cladoceran fauna from the lowlands of Mexico, Guatemala and Belize, apparently is similar at the generic level (although different at the specific level) to that in South America and Central Mexico, and quite different from North America (Green 1981; Frey 1982; Villalobos-Hiriart *et al.* 1993). For example, in the central highlands of Mexico (2 000 m or more above sea level), the macrothricids are represented by *M. smirnovi*, *M. mexicanus*, *M. sierrafriatensis* and *M. agsensis* (Ciros-Pérez *et al.* 1996b; Ciros-Pérez & Elías-Gutiérrez 1997a; Silva-Briano *et al.* 1999; Dumont *et al.* 2002). Most of them are endemic, or have a restricted distribution in these highlands. Others are just found in lowlands, such as *M. elegans* (Kotov *et al.* 2002), *M. paulensis* and *M. marthae* (Elías-Gutiérrez & Smirnov 2000). It seems that an altitudinal gradient plays a significant role determining the diversity of this group, mainly due to microclimatic changes (Mosiño & García 1974). Species from tropical lowlands are replaced at high altitudes by more temperate ones (Green 1981). It is possible that the species from both types of environments do not mix, constituting characteristic assemblages and no transitional fauna has been found until now. According to Elías-Gutiérrez *et al.* (1999), the real geographical barrier for the fauna of cladocera with nearctic and neotropical representatives, are the Western Mountain Chain (Sierra Madre Occidental) and the Eastern Mountain Chain (Sierra Madre Oriental), running parallel to the Pacific and Gulf coasts of Mexico, splitting the coastal plains from the inland regions, where both sides of this chains represent different climatic conditions, and act as barriers to freshwater habitats. This could explain the differences in fauna, but further studies considering other cladocera and more ample surveys should be carried out, before a final conclusion is proposed.

Conclusions

The fauna of the lowlands of Mexico, Guatemala and Belize is closely related, and similar to the South American fauna. Apparently, this fauna is restricted to these regions, and is different from the fauna of the Mexican highlands. The problem of

species with wide distribution, requires special attention, and although we find differences in micro-characters, the study of each species should include the analysis of material from all over the world, including the type localities. The main problem is that in many cases this material is not available or is in bad state of preservation. Finally, the high number of new species described from Mexico (some of them from specific environments), suggests that many unknown taxa remain undiscovered, mainly in temporary pools and puddles.

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Key for the Mexican species of Macrothricidae. Includes all recorded species

1a.- Intestine convoluted. Postabdomen with preanal margin bearing fine setae, no strong spines; these setae form distinct groups.....***Streblocerus pygmaeus*** Sars 1901
1b. Intestine without convolutions.....2

2a.- With a dorsal outgrowth in the headshield as a bulge. Labrum with a pair of pointed projections.....***Onchobunops tuberculatus*** Fryer & Paggi 1972
2b.- Dorsal part of headshield without a dorsal outgrowth, only cephalic pore present.....3
3a.- Postabdomen without anal teeth. Small animals (less than 0.45 mm). Antenna I short and wide with peculiar ornamentation, like scales.....***Guernella*** cf. ***raphaelis***
3b.- Postabdomen with anal teeth 4
4a.- Postabdomen with a solitary large anal tooth at the proximal side of the anal aperture. Proximal part of postabdomen very thin, with two lines of small anal spines..... .....***Grimaldina*** cf. ***brazzai***
4b.- Postabdomen without a solitary large anal tooth. Wide throughout..... .....*Macrothrix* Baird 1843.....5
5a- With a dorsal tooth in headshield, variable in size from very big to a small denticle. Basipodite of antenna II, with a papilla covered by several spines..... ..... *Macrothrix mexicanus* Ciros-Pérez, Silva-Briano & Elías-Gutiérrez 1996 (**)
5b.- Without dorsal tooth in headshield, basipodite of antenna II without papillae with denticles, only sensory setae present 6
6a.- Limb II with one lobe carrying a stout conical outgrowth densely ciliated, located between scrapers 4 and 5.....*Macrothrix smirnovi* Ciros-Pérez & Elías-Gutiérrez 1997 (**).
6b.- Limb II without a conical lobe, but may present other kind of outgrowths.....7

7a.-Setae of limbs I, II and II bearing a well-developed pecten, the one in limb III visible seen without dissection of limb...***Macrothrix marthae*** Elías-Gutiérrez & Smirnov 2000
7b.-Setae in limbs I, II and III without well developed pectens 8
8a.-With at least five strong spines along antenna.....***Macrothrix paulensis*** Sars 1900
8b.-Antenna I with spinules or other ornamentation, but never with strong spines along its length 9
9a.- Distal segment of seta natatoria from very long to long 10
9b.- Distal segment of seta natatoria from very short to short 11
10a.-Antenna I dilated distally, no serration on dorsal margin of headshield.....
.....***Macrothrix hirsuticornis*** group (***)
10b.-Antenna I not dilating distally, with serration on dorsal margin of headshield
..... ***Macrothrix agsensis*** Dumont, Silva-Briano & Babu 2002
11a.-Valves covered by scales, giving a squamose appearance .....
.....***Macrothrix spinosa*** King 1853
11b.-Valves not squamose, with lines or other type of ornamentation 12
12a.- AI dilated distally, with fine serrations at long dorsal margin of valve .....
.....***Macrothrix sierrafriatiensis*** Silva-Briano, Nguyen & Dumont 1999 (*)
12b.- Antenna I rod like, not dilated distally, rod like.....13
13a.- Second segment of four-segmented branch of antennna II with a series of addi tional spines, always decreasing in size in dorsal direction.....***M. elegans*** Sars 1901
13b.- Second segment of four-segmented branch of antenna II with no additional spines. (This European species require confirmation in Mexico).....***M. rosea*** Liévin 1886

(*) Probably restricted to highlands of Central Mexico
(**) Probably restricted to lowlands of Mexico
(***) This is a group of species. Still deserves study. Type locality in Great Britain, but has been described from all over the world.

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