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Redescription and distribution of *Mastigodiaptomus montezumae* (Copepoda, Calanoida, Diaptomidae) in Mexico

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Abstract

Mastigodiaptomus montezumae is redescribed on the basis of material from several localities in Mexico. It is characterized by an asymmetrical fifth pediger in both sexes. It appears to be restricted to central Mexico, where it is quite common. It is associated with *M. albuquerquensis* and occasionally with *L. siciloides* and *Leptodiaptomus novamexicanus*.

Introduction

Reid (1990) cites only 11 calanoid species for Mexico, mostly from old reports. Of these, *Mastigodiaptomus montezumae* Brehm, 1955 is common species in the centre of the country, but its original description lacks detail, and the type has been lost. It was described from a place called Potosi, apparently mine water disposal pond in the state of Hidalgo (Gerhard, 1986); however, it is not possible to ascertain the position of this site from the original paper. The genus, restricted to Central and North America, is characterized in the males by a spinous process on segments 13, 14, and 15 of the right antennule, and in the female by a posterolaterally directed spine on the basal segment of leg 5.

Material and methods

Samples were collected using 50–54 μm plankton nets, fixed in 5–6% formaline and 70% ethanol. A stereomicroscope and compound microscope were used for identification. A camera lucida was used for drawings. SEM microphotographs of *M. montezumae* were also used. The material examined was deposited in the Museo de Zoologia, catalog number 2, 4, 5, 10, 14, 17, 19, 22, 87, 88, UNAM Iztacala, and at the Instituto Nacional de Pesquisas da Amazonia.

Material examined

Numerous males and females from the following localities:

Aguascalientes State. Cebolletas pond (21 ° 48′N, 102 ° 38′W., Jan. 28, 1990), collected by Marcelo Silva Briano.

Durango State. Arturo Bernal y Viborillas pool (24 ° 27′N, 104 ° 20′W., Nov. 20, 1985), collected by Dr Alejandro Maeda Martínez, Hortencia Obregón Barbosa.

Guanajuato State. Begonias dam (20 ° 53′N, 100 ° 49′W., Sept., 1988), collected by Dr E. Díaz Pardo.

Mexico State. La Herradura pond, and several reservoirs between 19 °15′–20 °15′N and 90 °10′–100 °15′W: La Goleta (Feb. 16, 1990), Danxho (May 17, 1986) and Macua (June 19, 1991), collected by Manuel Elías Gutierrez, Felipe de Jesús Crúz López.

Sinaloa State. La Posta pond (25 ° 12′N, 107 ° 47′W., Nov. 20, 1985), collected by Dr Alejandro Maeda Martínez, Hortencia Obregón Barbosa.

Redescription of male

Mean length (± SD) and range, excluding caudal setae: 1.43 ± 0.05 mm (1.52–1.3 mm), $n = 20$.

Cephalothorax, in dorsal view, widest at first pediger (Figures 2, 26). Rostral points acute, with expanded base on right side (Figures 6, 27). Mouth parts as in female. Suture between fourth and fifth pedigers dorsally complete.

Right antennule, with socketed spines on segments 8 and 12 (Figure 24). Spine on segment 10 about half as long as that on segment 11, both curved. Spine on segment 13 large, perpendicular to axis of antennule. Spines on segments 14 and 15 large, but more slender than on segment 13. Antepenultimate segment (Figure 25) with short outcurved process and narrow hyaline membrane. Fleeces occur on segments 17, 18 and 19. Left antennule as in female.

Antenna as in female.

Leg 1–4 (P_1–P_4) as in female.

Leg 5 (P_5) asymmetric. Right side slightly expanded posteriorly, with slender spine directed posteriorly and smaller spine at base. Left side rounded, with two small spines (Figures 2, 4). Right leg 5 (Figures 22, 28). Basipod 1 with large posterior mammiform projection ending in strong, blunt spine. Inner margin of basipod 2 straight, except with large lobular projection proximally. Right distal corner reinforced with lamella just below insertion of lateral seta. Exopod 1 irregularly shaped, with distolateral corners produced and reinforced with lamellae, particularly on right side. Exopod 2 more than twice as long as wide, curved, outer margin convex, inner margin concave, with two thin semicircular transverse lamellae on proximal posterior surface, and fine longitudinal 'Y'-shaped ridge runnings from left semicircular lamella to base of claw. Stout lateral spine smooth, inserted at distal third of outer margin. Terminal claw longer than exopod, broadly curved inward and smooth. Endopod of one article (Figure 22), with row of hairs on oblique tip. Left leg 5 (Figures 22, 29) with stout spine inserted at distolateral corner of basipod 1. Basipod 2 about twice as long as wide, margins nearly straight, with seta at distal quarter of lateral margin. Exopod long, of two articles. Article 1 with two separate proximal and distal inner pads, proximal pad hairy, distal one naked. Article 2 with two separated pads, proximal one hairy, distal one with short spinules, at the base of which originates short slender smooth proximal process. Distal process with right distal margin serrate (Figures 23, 29). Endopod of one segment with row of hair like setae on oblique tip.

Abdomen; (Urosome) 5 segments, not including caudal rami. Genital segment with short spine at right distal corner (Figures 2, 4). Right side of fourth segment slightly expanded laterally and posteriorly. Inner margins of caudal rami hairy, outer ones smooth. Right caudal ramus with small cuticular process on ventral side, near base of inner setae (Figures 2, 4).

Redescription of female

Mean length (± SD) and range, excluding caudal setae 1.59 ± 0.08 mm (1.72–1.36 mm), $n = 20$.

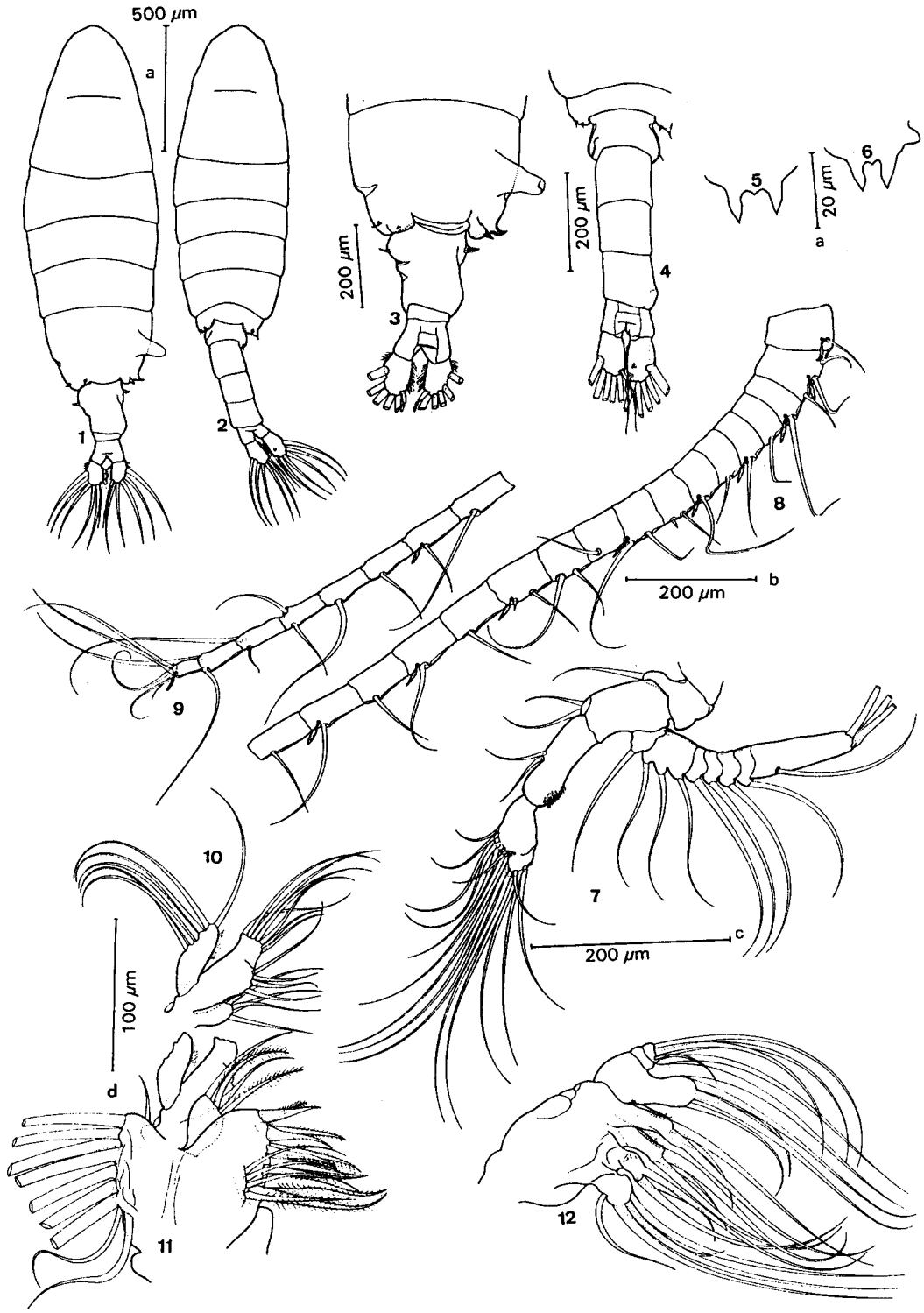
Cephalothorax, in dorsal view, widest at first pediger (Figures 1, 30). Rostral points acute below frontal organ (Figure 5). Gnathal lobe of mandible with pointed apical and subapical teeth. Chitinized triangle between base of apical and subapical teeth. Four medial teeth, all bicuspidate. Three basal teeth, two ventralmost bicuspidate, dorsalmost tooth tricuspidate (Figures 13, 14). Maxillula, maxilla and maxilliped as in Figures 10, 11, 12 and 15. Suture between fourth and fifth pedigers incomplete dorsally (Figures 1, 3). Fifth pediger occasionally with large, dorsal conical process directed laterally and to the right. Almost all specimens of all populations have this process. Fifth pediger asymmetrical (Figures 1, 3). Left side short, rounded, divided into two lobes, each with one small spine. Right side slightly produced laterally, bilobed, each lobe bearing an latero-dorsally spine (Figure 3). Spine on first lobe more anteriorly directed than second one.

Antennule, last 4 segments extending beyond caudal rami, their armature as in Figures 8 and 9.

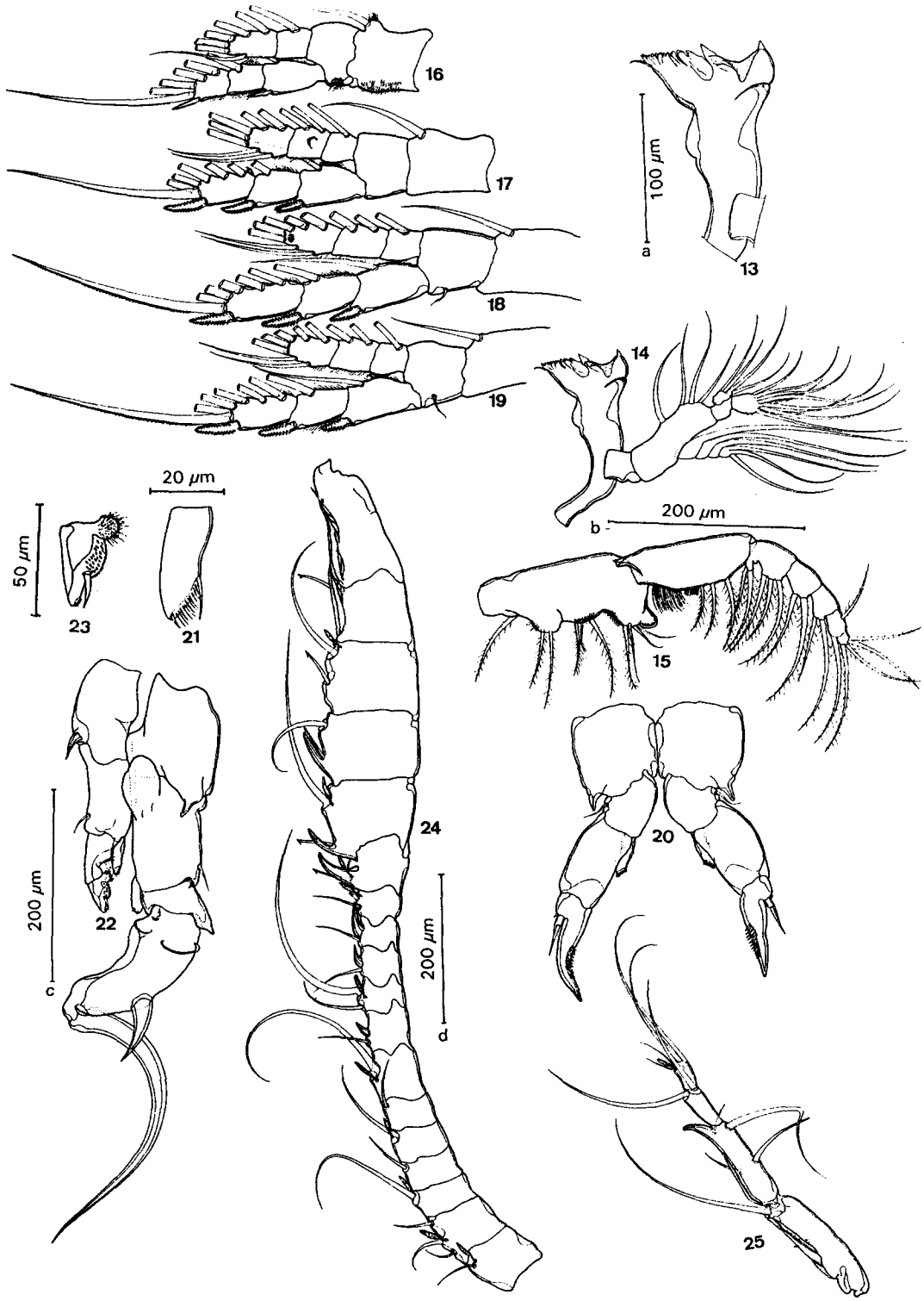
Antenna as in Figure 7.

Legs 1–4 (P_1-P_4) as in Figures 16–19; Schmeil's organ present on posterior surface of segment two of endopod of leg 2 (Figure 17). Legs 3 and 4 with small sensory setae on outer margin of basipod 2.

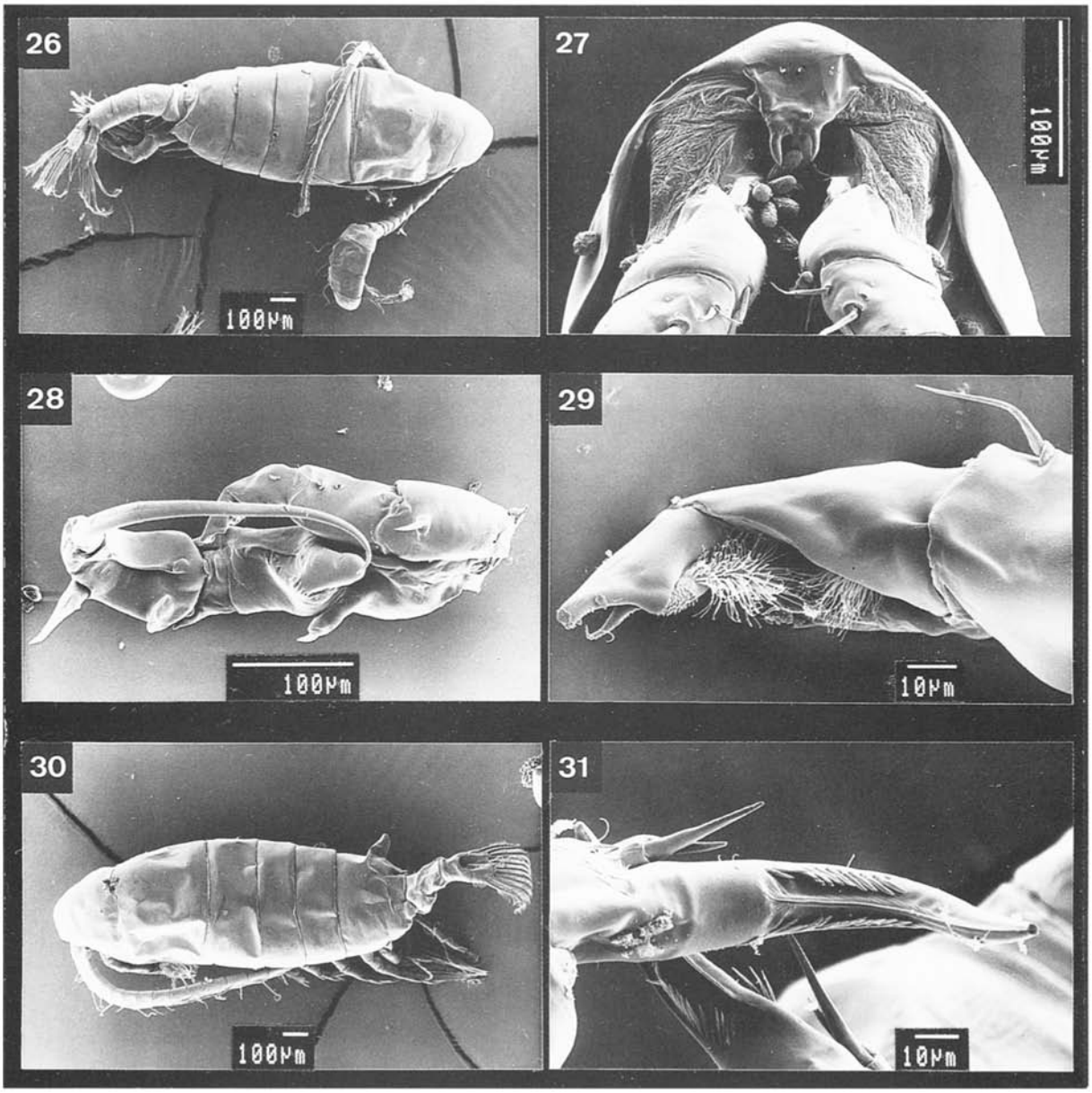
Leg 5 (P_5) (Figure 20); first basal segment with relatively large, conical, posterolaterally-directed blunt spine. Inner margin of second basal segment about 2–3 times as long as outer margin, bearing a seta. Exopod 1 about two times longer than broad. Exopod 2 with short outer spine. Exopod 3 with two terminal spines, medial about twice as long as lateral. Terminal claws asymmetric, left claw longer and more concave than right one, which is shorter and straight. Claws with row of 12 spines in middle of inner margin (Fig-



Figures 1–12. Mastigodiaptomus montezumae: 1, female, habitus, dorsal; 2, male, habitus, dorsal; 3, female, pedigers 4 and 5 and urosome, dorsal; 4, male pedigers 4 and 5 and urosome, dorsal; 5, female, rostrum; 6, male rostrum; 7, female, antenna. Scale a, Figures 1, 2; scale b, Figures 5, 6.
Mastigodiaptomus montezumae: female; 8, 9, right antennule; 10, 11 maxillula; 12, maxilla. Scale a, Figures 8, 9; scale b, Figures 10, 11, 12.



Figures 13–25. Mastigodiaptomus montezumae: female; 13, gnathobase of mandible; 14, mandible; 15, maxilliped; 16, leg 1, anterior; 17, leg 2, anterior; 18, leg 3, anterior; 19, leg 4, anterior. Scale a, Figure 13; scale b, Figures 14–19.
Mastigodiaptomus montezumae: female; 20, leg 5, anterior; 21, last segment of endopodite of leg 5. Male; 22, leg 5, anterior; 23, exopod 2 of left leg 5; 24–25, right antennule. Scale a, Figure 21; scale b, Figures 20, 22; scale c, Figure 23; scale d, Figures 24, 25.



Figures 26–31. SEM microphotographs of *Mastigodiaptomus montezumae*. 26–29 Male: 26, dorsal; 27, rostral points; 28, fifth leg; 29, detail of left side leg. 30–31 Female: 30, dorsal; 31, detail of exopod and terminal claw.

ure 31). Pore present on tip of end claw, with a canal on anterior surface (Figure 31). Endopod of two segments, distal margin bearing 2 spines on either side of row of spinules (Figure 21).

Abdomen (Urosome); three segments, not including caudal rami (Figures 1, 3). Genital segment large, asymmetrical, more than half as long as urosome. Anterior portion of genital segment slightly produced on the left side with laterally directed spine on both sides. Posterior portion of genital segment slightly produced on right side. Medial and lateral margins of caudal rami hairy (Figures 1, 3).

Differential diagnosis

M. montezumae is close to *M. albuquerquensis* (Brehm, 1955), but can be distinguished from it in both sexes, as follows.

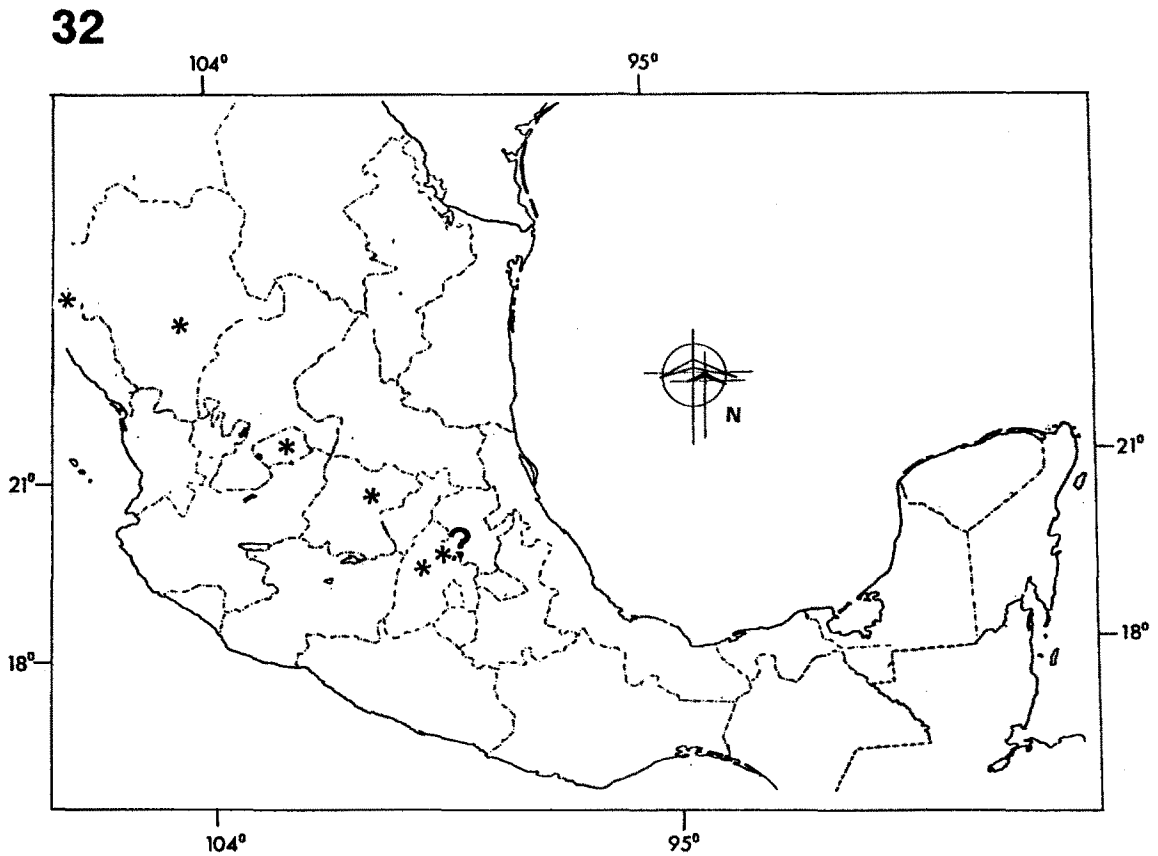


Figure 32. Map of central Mexico. * Localities where *M. montezumae* has been found. ? Possible type locality in original description.

Female. Fifth pediger asymmetrical; left side with two lobes, each with a small spine; right side protruded also into two lobes, the first with a spine directed anteriorly; conical process, when present always directed (latero-dorsally) to the right. Genital segment of abdomen asymmetric, with right side slightly produced in distal part. In *M. albuquerquensis*, the conical protuberance on the fifth pediger is located medially, between the fourth and fifth pediger, and is directed dorsally. It also lacks the protuberant extension on the distal right margin of the genital segment.

Male. Fifth pediger asymmetric, its right side more expanded, with two spines. Leg 5, right leg basipod 1 with mammiform projection ending in a blunt spine. Inner margin of basipod 2 with lobe-like projection, but in *M. albuquerquensis* such a projection is absent. However, *M. albuquerquensis patzcuarensis* Kiefer, 1938 shows one lobe-like projection similar to *M. montezumae*. Exopod 2 of *M. montezumae* with two semicircles of lamella and fine 'Y' shaped ridge running from left semicircle to base of claw. Right antennule similar to *M. albuquerquensis*, but this species has a 'butterfly'-like membraneous sclerotization (the best diagnostic feature) on the right basipod of the fifth leg; the right exopod 2 has a long stout lateral spine; the ornamentation of this segment is also different and lacks the 'Y'-shaped ridge and the two lamellar semicircles present in *M. montezumae*.

Discussion

Mastigodiaptomus montezumae has bien found in ponds and reservoir in the mountainous high-altitude neovolcanic axis of central Mexico and Aguascalientes (Figure 32). In all sampling sites, it was co-existings with *Mastigodiaptomus albuquerquensis*. In the neovolcanic axis, it also co-occurred with *Leptodiaptomus novamexicanus*, and in Aguascalientes with *L. siciloides*. Always *M. montezumae* was the largest

species. *M. albuquerquensis* the second largest, and *L. novamexicanus* the smallest. It seems that *M. montezumae* has a small distribution area, restricted to the central and north of Mexico, but more extensive studies are needed to confirm this.

From a morphological point of view, it is noteworthy that the claw of the exopodite of the female P5 bears a pore at its tip, and a conveyor canal along its inner surface, like in several species of the genus *Phyllodiaptomus*. It will be of interest to document, in future studies, how widespread such structures are among freshwater calanoids (see Dumont & Reddy, 1993; Reddy, 1994.)

Remarks

Physical-chemical conditions in the habitats of *M. montezumae*

Temperature (° C)	11–25
Transparency (cm)	10–40
Dissolved oxygen (mg l^{-1})	1.4–11.9
pH	6.6–9
Alkalinity (mg l^{-1})	9–160
Hardness: Ca+Mg (mg l^{-1})	35.9–138

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