

Rotifers from high altitude crater-lakes at Nevado de Toluca Volcano, Mexico.

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ABSTRACT

A survey on the high-altitude lakes El Sol and La Luna located in the crater of the volcano Nevado de Toluca, was carried out for rotifer fauna. Samples were taken with a mesh of 60 μm from the littoral and limnetic zones of both lagoons in 1994. Results include 34 specific taxa representing 10 families and 16 genera. In total 11 species are new records to the fauna of Mexico viz. *Aspelta lestes*, *Cephalodella tenuiseta*, *Dicranophorus forcipatus*, *Lecane inopinata*, *Lecane scutata*, *Lepadella rhomboides*, *Notommata glyphura*, *Taphrocampa annulosa*, *Testudinella emarginula*, *Trichocerca bidens* and *Trichocerca collaris*. The fauna found emphasizes the transition between nearctics and neotropics of the Mexican altiplano.

Key words: Rotifer, Mexico, high-mountain lakes, tropical, new record.

RESUMEN

En este trabajo se realizó un análisis de la fauna de rotíferos en los lagos El Sol y La Luna, localizadas en el cráter del volcán Nevado de Toluca. Las muestras fueron tomadas de la zona litoral y limnética de cada lago con una malla de 60 μm , durante 1994. Los resultados incluyen 34 taxa a nivel de especie, representando 10 familias y 16 géneros. En total 11 especies se constituyen en ampliaciones de ámbito hacia México y son: *Aspelta lestes*, *Cephalodella tenuiseta*, *Dicranophorus forcipatus*, *Lecane inopinata*, *Lecane scutata*, *Lepadella rhomboides*, *Notommata glyphura*, *Taphrocampa annulosa*, *Testudinella emarginula*, *Trichocerca bidens* and *Trichocerca collaris*. La fauna encontrada enfatiza la posición del altiplano mexicano como una zona de transición entre las regiones neártica y neotropical.

Palabras clave: Rotíferos, México, lagos alpinos, tropical, nuevos registros.

INTRODUCTION

The central part of Mexico is characterized as volcanic zone which in several cases originated from crater-lakes, for example the nine axalapascos in Puebla, seven luminarias in Guanajuato and the two lakes in the crater of volcano Nevado de Toluca near the city of Toluca. Rotifers from these types of localities remain unknown and the scarce analysis of the Mexican rotifers deals with other types of water bodies such as big lakes or reservoirs (see Table 1). All these studies result in about 150 taxa from

Mexico, but a high percentage of them needs confirmation, because these are only taxonomic lists and no material was deposited nor drawings were made for comparison. The present work adds some information to Mexican rotifer fauna, particularly on crater-lakes.

STUDY AREA

La Luna and El Sol lakes are located at 19°06'13" N, 99°45'20" W, in the interior of the crater basin of the

Nevado de Toluca Volcano, at 4690 m above the sea level. Main limnological variables at the time of the collections are resumed in Table 2. A good account of the limnological data from El Sol is given in Banderas *et al.* (1991). Both systems are endorreic basins with no direct connection, under strong winds throughout the year.

MATERIAL AND METHODS

Samples from El Sol were taken during January, February and June of 1994. La Luna was visited only in February and April of the same year. Rotifers were collected using 60 μm conical plankton net with a mouth opening of 30 cm and 50 cm length, attached to a handle. At least 100 l of water were filtered from each of the systems in the littoral zone. In the limnetic zone a surface and bottom samples were collected. The latter sample was obtained with a Van Dorn bottle of 2.5 l capacity and there were filtered 15 l. All the samples were preserved in 5% formalin. Rotifers were isolated from samples using capillary tubes under a stere-

omicroscope. Trophi were isolated by dissolving tissues using dilute (8%) NaOCl. All figures were drawn using a camera lucida attached to a Nikon Labophot-2 microscope. Species determination was made with recent taxonomic literature (Koste, 1978; Koste and Shiel, 1987, 1989, 1991; Segers, 1995a,b). Classification followed here is after Koste (1978).

RESULTS AND DISCUSSION

This report includes 34 species representing 10 families and 16 genera. A list of species is presented in Table 3. In total 11 species are new to Mexican fauna (Figs. 1 and 2):

Lepadella rhomboides (Gosse). Cosmopolitan species previously unknown from Mexico. Lorica sub-ovoid with a dorsal sclerotization forming a flat plate; in cross section rhomboidal shape. Anterior margin in ventral side "V" shaped. Foot with three pseudosegments and toes longer than the last pseudosegment.

Table 1. Taxonomic studies on rotifers from Mexican waters.

| LOCALITIES | NUMBER OF TAXA | AUTHOR(S) |
|---|----------------|------------------------------------|
| Lago de San Cristobal, near Mexico City | 1 | Harring and Myers, 1926 |
| Xocimilco and Chapultepec, D.F. | 10 | Sámano, 1931 |
| Near Chapala, Jal.; Río Lerma near Lerma city, Mex.; | | |
| Río Salto, Cd. Valles, SLP. and Texcoco Lake, Mex. | 62 | Ahlstrom, 1932 |
| Pátzcuaro lake, Mich. | 4 | Brehm, 1932 |
| Córdoba, Ver., Xochimilco and Texcoco, Mex. | 47 | Carlín-Nilson, 1935 |
| 4 Ponds near Actopan, Hgo. | 13 | Sámano, 1936 |
| Ejutla, Oaxaca, Ixtepec all from Oaxaca State | 6 | Hoffman and Sámano, 1938a |
| El Infiernillo, Ver. | 8 | Hoffmann and Sámano, 1938b |
| Pátzcuaro lake and a compilation from various sources | 122 | Osorio-Tafall 1942 |
| Pátzcuaro lake, Mich. | 4 | Brehm, 1942 |
| 7 localities in or around Mexico city | 35 | Vilaclara and Sladeczek, 1989 |
| Alzate dam, near Toluca, Mex. | 7 | Suárez, <i>et al.</i> , 1991 |
| Temporary pool near Aguascalientes city | 11 | Silva-Briano and Segers, 1992 |
| 30 localities from all the country | 96 | Rico and Silva-Briano, 1993 |
| Alzate dam, near Toluca, Mex. | 7 | Suárez, <i>et al.</i> , 1993 |
| Small reservoir near Palo Alto, Ags. | 6 | Kuticova and Silva-Briano, 1995 |
| Dessertic zone near Guyamas, Son. | 1 | Örstan, 1995 |
| El Niágara, Ags. | 9 | Flores-Tena and Silva-Briano, 1995 |

Lecane inopinata (Harring and Myers). Previously recorded in America from Brazil (Segers and Sarma, 1993); Colombia (Hauer, 1956) and USA (Harring and Myers, 1926). Lorica broadly rounded with anterior margin straight and two small pointed corners in antero-lateral side. Toes short, incompletely fused.

Lecane scutata (Harring and Myers). Species similar to *L. furcata* but with different arrangement of claws. Originally described from North USA, in Wisconsin and Laurentian Great Lakes. Also found in Austria, Germany, Hungary, Poland, Romania, Yugoslavia, Russia and Sweden. From Asia, it was found in Korea and India. Possibly cosmopolitan "but real distribution remains unknown, because of confusion with related taxa" (Segers, 1995b).

Cephalodella tenuiseta (Burn). First described from North America; it also has been recorded in Europe (Koste, 1978) and Australia (Koste and Shiel, 1991). Body elongate with long toes. In contracted specimens, the distal part of the toe narrower. Mastax large in lateral view, fulcrum wid-

ened posteriorly and towards base. Manubrium rod-like and curved. No eyes present.

Taphrocampa annulosa Gosse. Also a cosmopolitan species normally periphytic. Body soft, worm-like in con-

Table 2.- Selected physical and chemical variables at the time of collections

| Variable | Lakes | |
|-------------------------|-----------|-----------|
| | El Sol | La Luna |
| Maximum Depth (m) | 10.7 | 9.15 |
| Temperature (°C) | 7-11 | 9-11 |
| Secchi Transparency (m) | 3.7 | 9.15 |
| Dissolved Oxygen (mg/l) | 6-7.2 | 4.4-7.8 |
| pH | 5.01-6.39 | 5.22-5.74 |
| Alkalinity (mg/l) | 3-6 | 4-5 |
| Conductivity (µS) | 21-30 | 15-30 |

Table 3. Taxa of rotifers found in El Sol and La Luna. * Are new records to mexican fauna

| | La Luna | El Sol | | La Luna | El Sol |
|---|---------|--------|--|---------|--------|
| Family Brachionidae | | | <i>Cephalodella panarista</i> Myers, 1924 | | X |
| <i>Brachionus bidentatus</i> Anderson, 1889 | | X | <i>Cephalodella tenuiseta</i> Herring and Myers, 1924* | X | |
| <i>Kellicottia bostoniensis</i> (Rousselet, 1908) | | X | <i>Notommata glyphura</i> Wulfert, 1935* | | X |
| <i>Keratella tropica</i> (Apstein, 1907) | | X | <i>Taphrocampa annulosa</i> Gosse, 1851* | | X |
| Family Trichotriidae | | | Family Trichocercidae | | |
| <i>Trichotria tetractis</i> (Ehrenberg, 1830) | | X | <i>Trichocerca bidens</i> (Lucks, 1912)* | X | |
| Family Colurellidae | | | <i>Trichocerca bicristata</i> (Gosse, 1887) | | X |
| <i>Colurella colurus</i> (Ehrenberg, 1830) | | X | <i>Trichocerca collaris</i> (Rousselet, 1896)* | | X |
| <i>Lepadella acuminata</i> (Ehrenberg, 1834) | X | | <i>Trichocerca similis</i> (Wierzejski, 1893) | X | |
| <i>Lepadella ovalis</i> (O.F. Müller, 1786) | X | | <i>Trichocerca tigris</i> (O.F. Müller, 1786) | X | |
| <i>Lepadella patella</i> (O.F. Müller, 1786) | X | | Family Synchaetidae | | |
| <i>Lepadella quinquecostata</i> (Lucks, 1912) | | X | <i>Polyarthra vulgaris</i> Carlin, 1943 | | X |
| <i>Lepadella rhomboides</i> (Gosse, 1886)* | X | | <i>Synchaeta oblonga</i> Ehrenberg, 1831 | | X |
| Family Lecanidae | | | Family Dicranophoridae | | |
| <i>Lecane bulla</i> (Gosse, 1815) | | X | <i>Aspelta lestes</i> Harring and Myers, 1928* | | X |
| <i>Lecane closterocerca</i> (Schmarda, 1859) | | X | <i>Dicranophorus forcipatus</i> (O.F. Müller, 1786)* | | X |
| <i>Lecane flexilis</i> (Gosse, 1886) | | X | <i>Dicranophorus grandis</i> (Ehrenberg, 1832) | X | |
| <i>Lecane inopinata</i> Harring and Myers, 1926* | X | | Family Testudinellidae | | |
| <i>Lecane lunaris</i> (Ehrenberg, 1832) | | X | <i>Testudinella emarginula</i> (Stenroos, 1898)* | | X |
| <i>Lecane scutata</i> (Harring and Myers, 1926)* | | X | Family Conochilidae | | |
| <i>Lecane tenuiseta</i> Harring, 1914 | | X | <i>Conochillus unicornis</i> (Rousselet, 1892) | | X |
| Family Notommatidae | | | | | |
| <i>Cephalodella gibba</i> (Ehrenberg, 1838) | | X | Total number of species | 10 | 25 |
| <i>Cephalodella hoodi</i> (Gosse, 1896) | | X | | | |

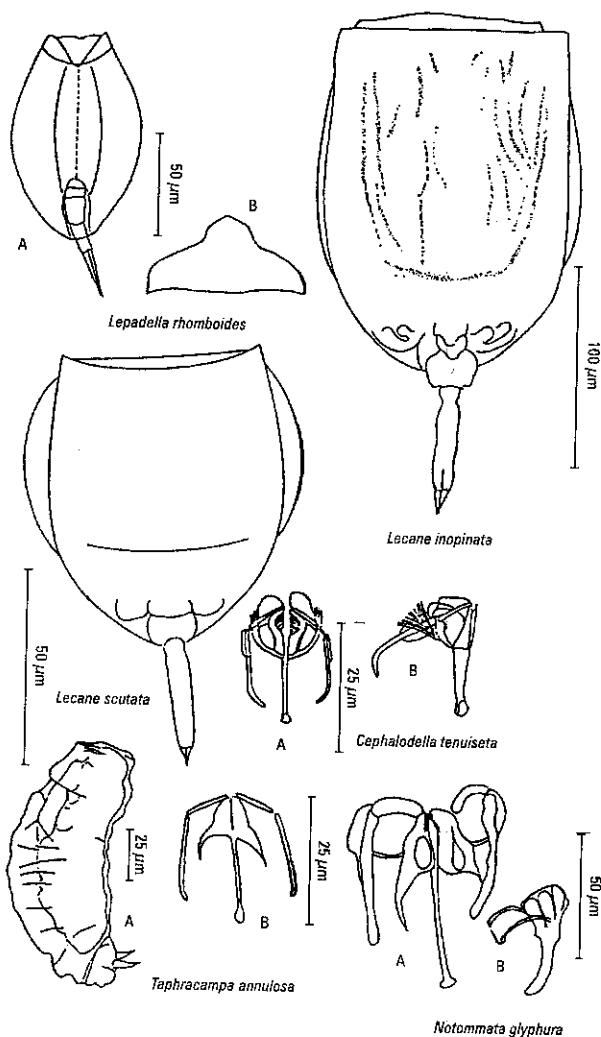


Figure 1. *Lepadella rhomboides* A) Dorsal view B) Cross section. *Lecane inopinata*, ventral view. *Lecane scutata*, ventral view. Trophi of *Cephalodella tenuiseta* A) Dorsal view B) Lateral view. *Taphracampa annulosa* A) Habitus, lateral view B) Trophi. Trophi of *Notommata glyphura* A) Dorsal B) Lateral view of the manubrium.

tracted specimens, trunk annulated. Morphology differs widely in preserved condition. Two short toes. Mastax virgate with long and slender fulcrum and rami with large and pointed alula.

Notommata glyphura Wulfert. Large non-loricate predatory species. Toes two, short and slender. Trophi virgate for sucking the contents of prey. Alula of rami strongly pointed, asymmetrical. Pleural stubs present, fulcrum long, distal end wide. Anterior end of rami moderately serrated. Common littoral species (Koste, 1978).

Trichocerca collaris (Rousselet). Cosmopolitan species from acidic waters. Body elongate with narrow anterior part

and without spines. Toes long and equal, straight. No dorsal keel.

Trichocerca bidens (Lucks). A well characterized species, with two teeth in anterior end of contracted specimens. Toes long, curved and well developed. Trophi virgate and asymmetric. Left manubrium L-shaped

Aspelta lestes Haring and Myers. Previously recorded from Europe (Koste, 1978) and North America (Haring and Myers, 1928). Mastax asymmetric with ramus, uncus and manubria with one side more developed. Ramus anteriorly pointed. Manubria long. Fulcrum short and slender.

Dicranophorus forcipatus (O.F. Müller). Cosmopolitan species from clear waters with well developed teeth on the rami, alulae wide, and fulcrum short. Uncus tooth shaped and manubria long with a wide and rounded anterior end. Epypharynx long and slender, usually loosely bound to the trophi.

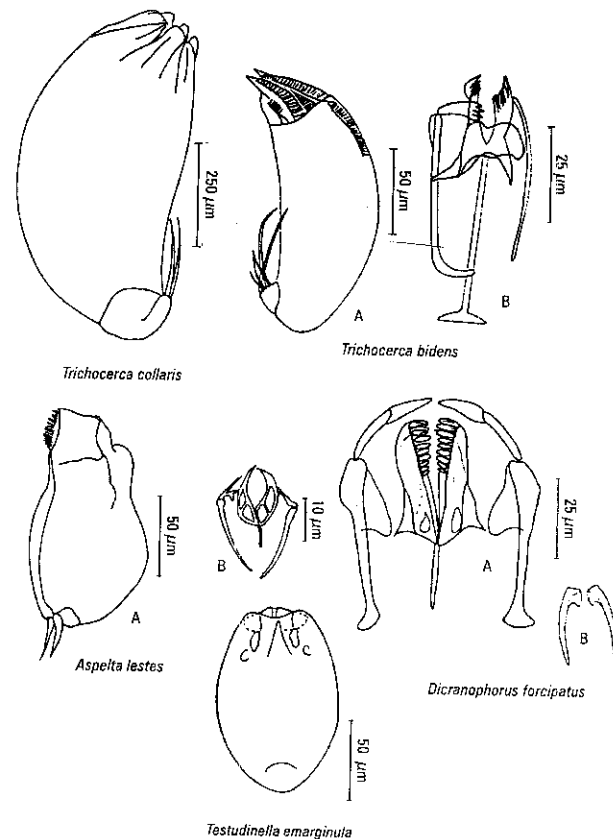


Figure 2. *Trichocerca collaris*, habitus in lateral view. *Trichocerca bidens* A) Habitus in lateral view B) Trophi. *Aspelta lestes* A) Habitus in lateral view B) Trophi. Trophi of *Dicranophorus forcipatus* A) Dorsal view B) Epipharynx. *Testudinella emarginula*, ventral view.

Testudinella emarginula (Stenroos). Formerly synonymized with *Testudinella incisa* by Koste (1978), but is now recognized as a distinct species (Koste and Tobias, 1987). Body oval with lateral margins converging. Strongly dorsoventrally compressed. Foot opening slit-like. A tropical species found in Africa (Koste and Tobias, 1987) and India (Sarma, 1988).

From the total number of species 32% are new records. All but two species are considered cosmopolitan. *Lecane inopinata* is considered tropicopolitan (Segers, 1995a) and *Kellicottia bostoniensis* is typical for North America. The new records are from the littoral region. Both lakes are different in rotifer composition for reasons not known, although physical and chemical parameters are more or less similar. This study indicates the possibility of the existence of higher rotifer species diversity in Mexican waters than previously thought, since it was found 34 species in limited sampling from two acidic, high altitude and endorreic lakes. Here the environmental conditions may reduce the possibility of rotifer colonization.

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