Article

Diversity and abundance of rotifers during an annual cycle in the reservoir Valerio Trujano (Tepecoacuilco, Guerrero, Mexico)

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Abstract

We analyzed the diversity and density of monogonont rotifers collected from 10 sites, 5 in the littoral zone and 5 in the pelagic zone, during a 1-year period from March 2010 to April 2011 in the reservoir Valerio Trujano, altitude 820 m a.s.l. (Tepecoacuilco de Trujano, State of Guerrero, Mexico). We also measured physicochemical variables such as temperature, pH, hardness, nitrates, and phosphates. The rotifers were identified to species level and quantified using a Sedgwick-Rafter chamber. We found 62 species belonging to 28 genera and 19 families, representing 22% of total species reported for Mexico. The most abundant species were *Brachionus caudatus*, *B. falcatus*, *Horaëlla thomassoni*, *Filinia longiseta*, *Conochilus dossuarius*, and *Keratella cochlearis*. The highest rotifer densities were those of *B. caudatus* (around 300 ind. L^{-1}) in June and July. The common phytoplankton genera were *Pediastrum*, *Cosmarium*, *Closterium*, *Nitzschia*, *Suriella*, *Microcystis*, *Oscillatoria*, and *Merismopedia*. The species diversity of Rotifera in the reservoir ranged from 1.3 to 3.2 in both the littoral and the pelagic regions. The saprobic index varied from 1.2 to 2 in the pelagic and 1.4 to 2.1 in the littoral region of the reservoir. Nutrient levels and indicator species (*Brachionus* and *Trichocerca*) showed that the reservoir, which was nitrogen rather than phosphorus limited, is eutrophic and moderately polluted by organic matter.

Key words: eutrophication, Monogononta, phytoplankton, saprobic index, species diversity

Introduction

Epicontinental waterbodies in Mexico include about 14,000 reservoirs with a combined storage capacity of approximately 150 × 10^9 m^3 (De la Lanza and García-Calderon 2002). The reservoir Valerio Trujano located in the State of Guerrero (Mexico) has a capacity of 39.5 × 10^6 m^3. The reservoir water is used for irrigation and human consumption for 3 nearby municipalities. The reservoir supported a high density of edible fish until the invasion of the exotic and inedible suckermouth catfish (*Hypostomus plecostomus*). Although this reservoir was built in 1964, to date there are no published records on the zooplankton of this waterbody.

Management of aquatic resources depends heavily on long-term records of limnological variables, including the plankton composition (Gulati et al. 1990). This feature is lacking in several waterbodies in tropical countries, including Mexico. The specific composition of zooplankton is an excellent approach to characterize the trophic status and water quality of aquatic systems and to deduce the structure of aquatic communities, which are often dominated by rotifers and crustaceans (Conde-Porcuna et al. 2004).

Rotifers play a key role in food chains in freshwater ecosystems. They are a link between primary producers (phytoplankton) and secondary consumers and also transfer energy from bacteria and detritus to higher trophic levels (Wallace et al. 2006). Several indices use the density and diversity of rotifers as indicators of the trophic status and saprobic level in wetlands, lakes, and reservoirs (Sládeček 1983, Lougheed and Chow-Fraser 2002).

Although studies on the diversity of rotifers from Mexican waterbodies began a century ago, serious work

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began only recently (Sarma et al. 1996). Nevertheless, recent work has been based mostly on point collections in the Mexican states of Aguascalientes, Michoacan, and Yucatan (Rico-Martínez and Silva-Briano 1993, Sarma and Elías-Gutiérrez 1997, 1998). Among the different states of the Mexican Republic, Guerrero has received the least attention with reference to rotifer diversity; we found only one published record (Robles and Esqueda 2008) that reports 25 species and an unpublished report that adds 6 different taxa to the list. Our study is the first analysis of the rotifer fauna in a reservoir in Guerrero over a period of a full year. Here we present information on the diversity of monogonont rotifers over a 1-year period (Mar 2010–Feb 2011) in the reservoir Valerio Trujano, located in the municipality of Tepecuacuilco, Guerrero.

Materials and methods

The reservoir Valerio Trujano is built on the Rio Tepecoacuilco (18°18′N, 99°28′W) located at an altitude of 820 m a.s.l. The climate is warm and humid with summer rainfall but with a low overall humidity. The average temperature varies throughout the year from 23 °C in the coldest months (Dec–Jan) to about 30 °C in the hottest months (May–Jun). The average annual temperature is 23.4 °C, and the average annual rainfall is 1023 mm.

Zooplankton samples were taken every month for a year from March 2010 to February 2011 at 10 selected sites (Fig. 1). From each site, 80 L of reservoir water were collected at a depth of 20–30 cm and filtered through a 50 μm pore size plankton net. Samples were concentrated to 250 mL and fixed immediately in 10% formalin. Zooplankton samples were then transported to the laboratory where both quantitative and qualitative analyses were conducted.

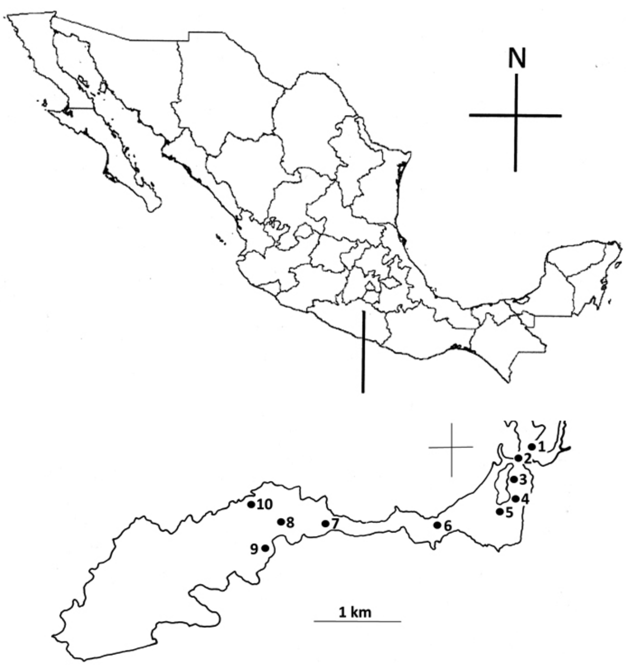

Fig 1. Sampling stations in the Valerio Trujado Reservoir. Stations 1–5: littoral samples; Stations 6–10: pelagic samples. (a) Mexico; (b) sampling area.

We estimated selected physicochemical variables at one site in the littoral region (site 1) and one in the pelagic region (site 8). The water depth in the littoral site was 30–50 cm and 4–6 m in the pelagic. Although the maximum depth of the reservoir is ~40 m at the deepest point close to the dam, the mean depth was <15 m during the study period, mainly due to low rainfall and irrigation. We measured temperature, pH, dissolved oxygen (YSI 55), and nitrate and phosphate levels (YSI 9500).

The dominant phytoplankton taxa were identified to genus level following Ortega (1984). Rotifers were identified to species level when possible using Koste (1978). Rotifer abundance was determined using a Sedgewick-Rafter chamber and an inverted microscope (Nikon Eclipse TS 100).

The diversity of rotifers was calculated using the diversity index of Shannon-Wiener (Krebs 1993):

$$H' = -\sum p_i \log_2 p_i,$$

where H' is the index of species diversity, and p is the proportion of individuals of the ith species.

Multifactorial analysis was conducted using Canoco for Windows 4.5. We conducted these analyses on the physicochemical variables tested in the study, which were dissolved oxygen, temperature, pH, hardness, and nitrate and phosphate concentrations. We included monthly values for the entire 1-year study duration, but we conducted the analyses individually for the shallow littoral and pelagic regions of the reservoir. Species occurring <5 times were excluded from the study.

Saprobic indices (S) were calculated using the formula proposed by Pantle and Buck (1955) and the trophic state of the reservoir using ratios based on the number of *Brachionus* to *Trichocerca* species (B/T ratios; Sládeček 1983):

$$S = \Sigma\,(s.h)/\,\Sigma h,$$

where S is the Pantle and Buck (1955) saprobic index, s is the valence of each rotifer (Sládeček 1983), h is the relative frequency (1 = uncommon, 3 = common, and 5 = abundant), and S is the saprobic index based on the following ranking scale: 1.0–1.5 = oligosaprobic, 1.6–2.5 = β-mesosaprobic, 2.6–3.5= α-mesosaprobic, and 3.6 ≥ 4.4 = polysaprobic.

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Results

The genera of phytoplankton commonly found in the reservoir Valerio Trujano were *Pediastrum*, *Cosmarium*, *Closterium*, *Nitzchia*, and *Suriella*. Cyanobacteria belonging to the genera *Microcystis*, *Oscillatoria*, and *Merismopedia* were present in higher densities during the warm summer months. In all we observed 64 species of rotifers in the reservoir during the study period (Table 1). Considering all the study sites and the sampling duration, we observed 17 and 15 species of Brachionidae and Lecanidae, respectively, 8 of which were found exclusively in the pelagic zone and 8 exclusively in the littoral zone; the remaining species were distributed in both regions. In the littoral collections we found *Brachionus havanaensis*, *B. rubens*, *Lecane decipiens*, *L. hornemanni*, *L. ludwigii*, *L. lunaris*, *L. nana*, and *L. ungulata*, and in the pelagic zone we found *Keratella lenzi*, *Dipleuchlanis propatula*, *Lecane closterocerca*, *L. crepida*, *Notommata pachyura*, *Eosphora najas*, *Pompholyx sulcata*, and *Cupelopagis vorax*. The family Asplanchnidae was frequently represented by A*splanchna brightwellii* and *A. priodonta*, and in mixed live samples we occasionally observed the rare species *A. tropica*.

Throughout the year, *Brachionus caudatus*, *Filinia longiseta*, *B. falcatus*, *Conochilus dossuarius*, *Horaëlla thomassoni*, and *Keratella cochlearis* were dominant (Fig. 2). The seasonal variations in the abundance of these rotifers indicated differences between the pelagic and littoral sites (Fig. 3). Both *B. caudatus* and *B. falcatus* occurred in the summer, but *B. caudatus* was more abundant in the littoral zone while *B. falcatus* was more abundant in the pelagic zone. *Keratella cochlearis* did not reach high densities except during the winter months in the pelagic region. In comparison, *Filinia longiseta* was more abundant in the littoral during May to July. *Conochilus dossuarius* was fairly abundant throughout the year, more so in the pelagic than in the littoral region. *Wolga spinifera* and *Horaëlla thomassoni* are rare taxa not commonly found in Mexican waterbodies. *Wolga spinifera* was fairly evenly distributed, both in the littoral and the pelagic regions; *H. thomassoni* was more abundant in the littoral throughout the year but only during the spring in the pelagic region of this reservoir (Fig. 3).

We found 8 species exclusively in the pelagic zone and 8 exclusively in the littoral, while the remaining species were distributed in both regions. The littoral sites, located upstream, also had higher species diversity than the pelagic sites, located about 4 km downstream. The species diversity in the reservoir ranged between 1.3 to 3.2 in both the littoral and the pelagic regions, but the diversity patterns were distinctly different. Diversity was generally higher in the littoral zone from July to February and generally lower for the pelagic zone from March to July (Fig. 4). The saprobic indices ranged from 1.2 to 2.0 in the pelagic and 1.4 to 2.1 in the littoral region; overall the reservoir seemed to be β-meso-saprobic. We recorded 11 species of *Brachionus* (B) and 17 species in the family Brachionidae and only 3 species of *Trichocerca* (T). Thus the B:T ratio was 3.66, indicating a eutrophic condition in the reservoir.

A summary of the physicochemical variables (Table 2) showed water temperature ranged from 20.5 to 31 °C and was highest during March to September, more so in the littoral than in the pelagic zone of the reservoir. The pH ranged from 5.8 to 8.6 and was more frequently acidic in the winter than in the summer. The dissolved oxygen levels ranged between 3.5 to 12.5 mg L^{-1} and were lower in the littoral than the pelagic waters. The water hardness ranged from 80 to 237 mg L^{-1} and was greater from November to July and lowest during August to October. In general, the water was moderately hard to hard and was very hard only during the month of June. The conductivity was always <0.5 mS cm^{-1} with no significant differences between the pelagic and littoral zones of the reservoir. The reservoir had high levels of phosphates (0.5–4 mg L^{-1}), which occasionally reached peaks of 10–20 mg L^{-1} in the pelagic region. The nitrate concentrations were generally <0.5 mg L^{-1} except on one occasion in August when it was 4 mg L^{-1} in the pelagic zone.

Most of the rotifer species formed clusters (Fig. 5a and b) with relation to high temperature and pH in the pelagic zone, while the distribution in relation to the physicochemical variables in the littoral was more even. Among the rare taxa, *Horaëlla thomassoni* was found under conditions of high temperature and high concentrations of nitrates and *Wolga spinifera* under high phosphate concentrations but at lower temperature. In both the pelagic and littoral zones, *Filinia longiseta* was found in alkaline pH conditions. In the pelagic region, moderately hard water conditions supported a greater cluster of species.

Discussion

Over the past 2 decades, studies have been conducted on the rotifer fauna in Mexico, especially in the central part of the country (Rico-Martínez and Silva-Briano 1993, Sarma and Elías-Gutiérrez 1998), but published information on rotifer diversity is available only for 22 states (Sarma et al. 1996). Guerrero is a state with abundant freshwater resources but with little published information on its zooplankton diversity. Previous studies on the rotifer fauna in Mexico often recorded numerous taxa; for instance, Rico-Martínez and Silva-Briano (1993) and Sarma and Elías-Gutiérrez (1998) reported 96 and 123 species, respectively, but these studies were based on surveys conducted in several waterbodies.

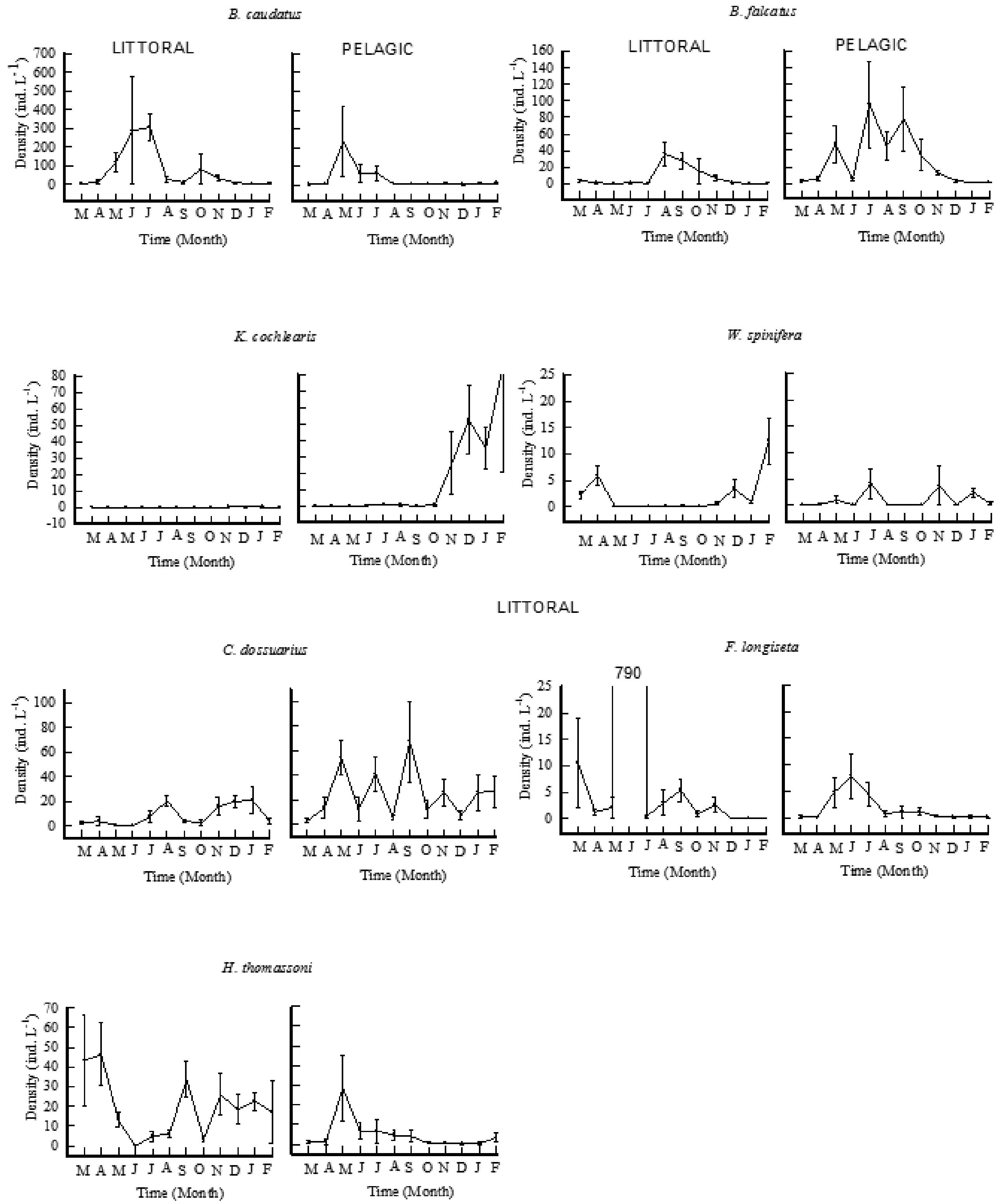

Fig 2. Seasonal abundance of dominant rotifers species from the Valerio Trujano Reservoir (Tepecoacuilco, Guerrero) during 2010–2011. Shown are mean ± SD of the densities recorded at 10 different sites, 5 in the littoral zone and 5 in the pelagic zone.

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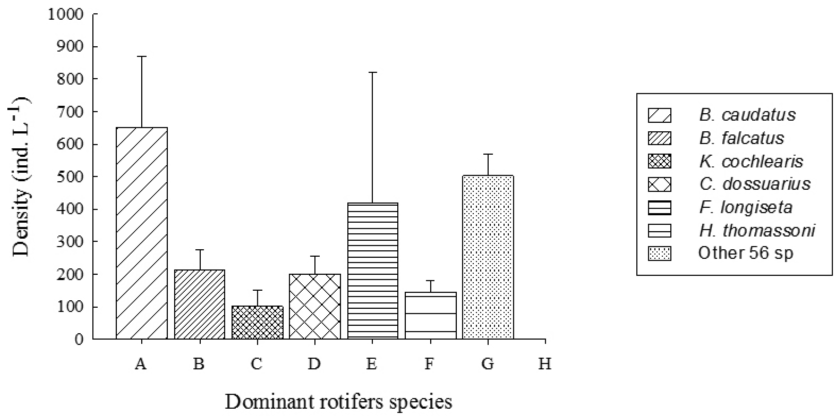

Fig 3. Total density of selected rotifers observed during this study. Shown are mean ± SD of the densities recorded at 10 different sites.

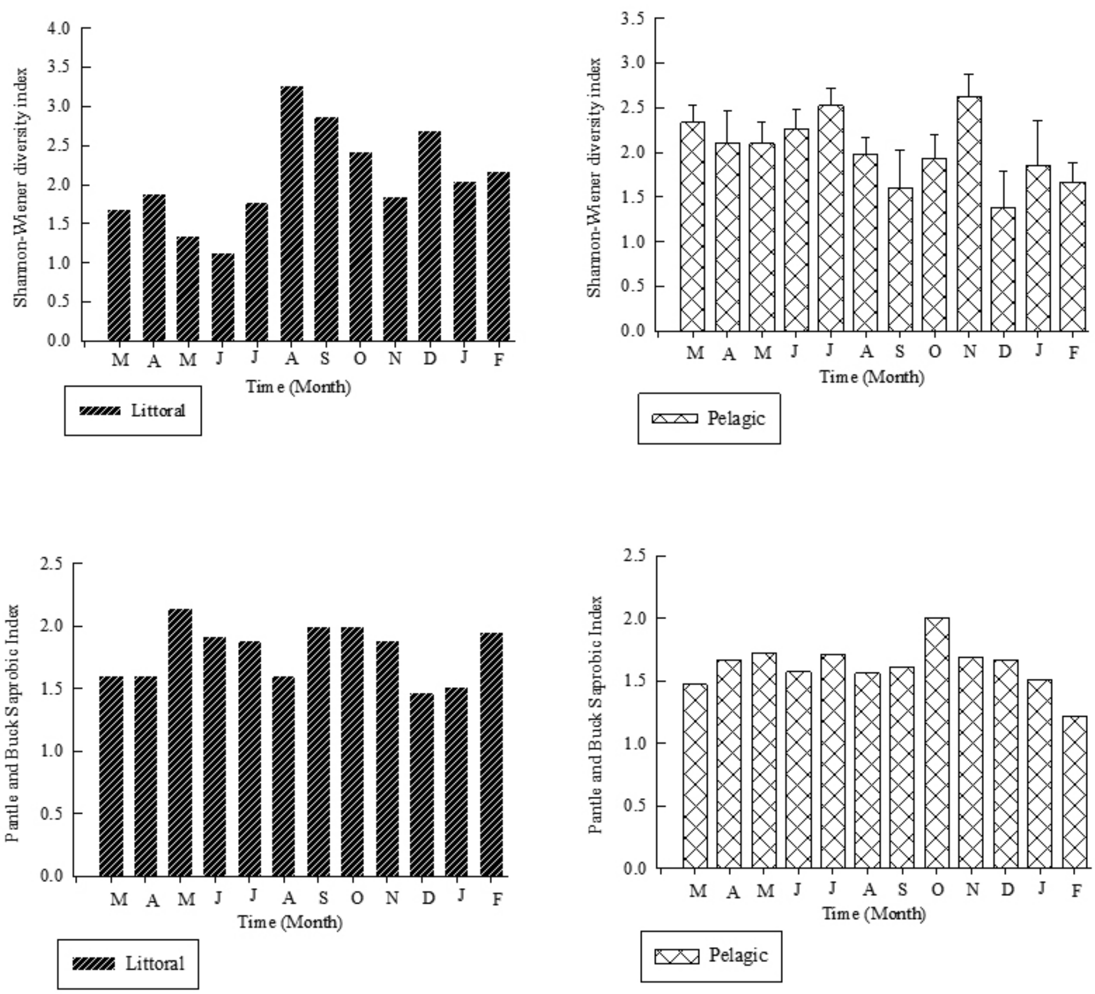

Fig 4. Average seasonal variations in the Shannon-Wiener diversity index and the Pantle and Buck Saprobic Index at the littoral and pelagic stations over a period of 1 year.

Table 1. Distribution of the rotifer species found throughout the year in the littoral and pelagic regions of the reservoir Valerio Trujano.

	Littoral					Pelagic				
Species	1	2	3	4	5	1	2	3	4	5
Family Epiphanidae										
Epiphanes brachionus (Ehrenberg, 1837)	x	—	—	—	—	—	—	—	—	x
Family Brachionidae										
Anuraeopsis fissa (Gosse, 1851)	x	x	—	x	x	—	—	x	x	—
Brachionus angularis (Gosse, 1851)	x	x	x	x	x	—	—	x	x	x
B. bidentatus Anderson, 1889	x	x	x	x	x	—	x	x	x	x
B. budapestinensis (Daday, 1885)	x	x	x	x	x	—	—	—	—	x
B. calyciflorus Pallas, 1766	x	x	x	x	x	x	x	x	x	x
B. caudatus Barrois & Daday, 1894	x	x	x	x	x	x	x	x	x	x
B. falcatus Zacharias, 1898	x	x	x	x	x	x	x	x	x	x
B. havanaensis Rousselet, 1911	—	—	—	x	—	—	—	—	—	—
B. variabilis (Hcmpie, 1896)	—	x	—	—	—	x	—	—	—	—
B. quadridentatus (Hermann, 1783)	x	x	x	x	x	x	x	x	x	x
B. rubens (Ehrenberg, 1838)	—	—	x	x	—	—	—	—	—	—
B. urceolaris (O.F. Müller, 1773)	x	x	x	x	x	x	—	—	x	x
Kellicotia bostoniensis (Rousselet, 1908)	x	—	—	—	—	x	x	x	—	—
Keratella americana Carlin, 1943	x	x	x	—	x	x	x	x	x	x
K. cochlearis (Gosse, 1851)	x	x	x	x	x	x	x	x	x	x
K. lenzi (Haue, 1953)	—	—	—	—	—	—	—	x	x	—
Platyias quadricornis (Ehrenberg, 1832)	x	x	x	x	x	x	x	x	x	x
Family Euchlanidae										
Dipleuchlanis propatula (Gosse, 1886)	—	—	—	—	—	—	—	x	—	—
Euchlanis dilatata Ehrenberg, 1832	x	x	x	—	—	x	—	—	—	x
Family Trichotriidae										
Trichotria tetractis (Ehrenberg, 1830)	—	x	x	x	—	x	—	x	—	—
Wolga spinifera (Western, 1894)	x	x	x	x	x	x	x	x	x	x
Familiy Colurellidae										
Lepadella rhomboides (Gosse, 1886)	x	x	x	x	x	x	x	x	x	x
Family Lecanidae										
Lecane bulla (Gosse, 1851)	x	—	x	x	x	—	x	x	—	x
L. closterocerca (Schmarda, 1859)	—	—	—	—	—	—	—	x	—	—
L. crepida Harring, 1914	—	—	—	—	—	—	x	—	—	—
L. curvicornis (Murray, 1913)	x	x	x	x	x	x	—	x	—	—
L. decipiens (Murray, 1913)	—	—	x	—	—	—	—	—	—	—
L. hastata (Murray, 1913)	x	x	x	x	x	x	—	—	—	x
L. hornemanni (Ehrenberg, 1834)	—	—	x	—	x	—	—	—	—	—
L. ludwigii (Eckstein, 1883)	x	—	x	x	x	—	—	—	—	—
L. luna (O.F. Müller, 1776)	x	x	x	x	x	—	—	x	—	x

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L. lunaris (Ehrenberg, 1832)	x	x	—	x	x	—	—	—	—	—
L. nana (Murray, 1913)	—	—	—	x	—	—	—	—	—	—
L. papuana (Murray, 1913)	x	x	x	x	x	x	x	x	x	x
L. pyriformis (Daday, 1905)	—	x	x	—	x	—	—	—	x	—
L. stenroosi (Meissner, 1908)	—	x	x	x	—	x	x	—	x	—
L. ungulata (Gosse, 1887)	—	—	—	x	—	—	—	—	—	—
Family Notommatidae										
Cephalodella gibba (Ehrenberg, 1838)	x	x	x	x	x	x	x	x	x	x
C. misgurnus Wulfert, 1937	x	x	x	x	x	x	—	—	—	—
Notommata pachyura (Gosse, 1886)	—	—	—	—	—	—	x	—	—	—
Eosphora najas Ehrenberg, 1830	—	—	—	—	—	—	—	—	—	x
Family Trichocercidae										
Trichocerca elongata (Gosse, 1886)	x	x	x	x	x	x	x	x	x	—
T. dixonnuttalli Jennings, 1903	—	—	x	x	x	—	—	—	x	—
T. similis (Wierzejski, 1893)	—	x	—	—	x	x	x	x	x	x
Family Synchaetidae										
Polyarthra dolichoptera Idelson, 1925	x	x	x	x	x	x	x	x	x	x
P. vulgaris Carlin, 1943	x	x	x	x	x	x	x	x	x	x
Ploesoma hudsoni (Imhof, 1891)	x	—	—	—	—	—	—	x	—	x
Family Asplanchnidae										
Asplanchna brightwellii (Gosse, 1850)	x	—	—	—	x	x	—	x	x	x
A. priodonta (Gosse, 1850)	—	—	—	—	x	—	—	—	x	—
Family Dicranophoridae										
Dicranophorus caudatus (Ehrenberg, 1834)	—	—	x	x	—	—	—	—	x	—
D. forcipatus (O.F. Müller, 1786)	x	—	—	x	x	—	—	x	x	—
Family Testudinellidae										
Pompholyx sulcata Hudson, 1885	—	—	—	—	—	—	—	—	—	x
Testudinella patina (Hermann, 1783)	x	x	x	x	x	—	x	x	x	x
Family Flosculariidae										
Sinantherina sp.	x	x	—	—	x	x	—	—	x	—
Family Conochilidae										
Conochilus dossuarius (Hudson, 1875)	x	x	x	x	x	x	x	x	x	x
Family Hexarthridae										
Hexarthra mira (Hudson, 1871)	x	x	—	x	x	x	x	x	x	x
Family Filiniidae										
Filinia longiseta (Ehrenberg, 1834)	x	x	x	x	x	x	x	x	x	x
F. opoliensis (Zacharias, 1898)	x	x	x	x	x	x	x	x	x	x
F. terminalis (Plate, 1886)	x	x	x	x	x	x	x	x	x	x
Family Trochosphaerldae										
Horaëlla thomassoni Koste, 1973	x	x	x	x	x	x	x	x	x	x
Family Atrochidae										
Cupelopagis vorax (Leidy, 1857)	—	—	—	—	—	—	—	—	—	x

Table 2. Physicochemical variables over the sampling period (2010–2011). All measurements were taken at site 1 of the littoral region (L) and site 8 of the pelagic region (P).

Month	Point	Temp (°C)	pH	Dissolved oxygen (mg L^{-1})	Hardness (mg L^{-1})	Nitrates (mg L^{-1})	Phosphates (mg L^{-1})
Mar	L	22	7.5	7.4	102.4	0.02	1
	P	28	7.5	5.8	91.2	0.68	6
Apr	L	29	6.5	14.3	138.6	0.56	4
	P	28	7.5	5.7	133.2	0.68	6
May	L	27	7.3	4	—	0.02	5
	P	27	6.8	6	113	0.09	5
Jun	L	25	8.6	8.5	274	0.06	7
	P	22	7.5	3.5	210	0.08	6
Jul	L	28	6.9	1.5	114	0.05	1
	P	29	7.5	5	104	0.14	10
Aug	L	27	6.7	3.5	90	0.88	5
	P	28	7.2	5.5	96	4.4	0.8
Sep	L	27	6.6	3	66	0.13	9
	P	31	6.7	7.5	80	0.08	3
Oct	L	22	7.1	3	110	0.13	6
	P	23	6.5	5	86	0.1	3
Nov	L	24	7.1	8	116	0.07	5
	P	24	7.2	5	118	0.19	4
Dec	L	24	6.2	8	134	0.7	2
	P	21	5.3	6	112	0.95	21
Jan	L	24	6.6	7	112	0.23	1
	P	20.5	6.4	6.5	98	0.34	1
Feb	L	24	7.4	5	136	0.55	4
	P	24	6.4	7.5	102	0.44	14

Few studies report the rotifer richness in large reservoirs. In our study we recorded 64 species, which is higher than previous records of rotifers from other reservoirs. For instance, from Valle de Bravo, a large drinking water reservoir, <30 species of rotifers have been recorded (Ramírez-García et al. 2002, Nandini et al. 2008, Jiménez-Contreras et al. 2009). In other reservoirs (e.g., Ignacio Allende) <40 species of rotifers have been recorded (López-López and Serna-Hernández 1999). At the Alzate dam in the State of Mexico only 7 species of rotifers were recorded (Suárez-Morales 1993), and in a later study from the same site only 15 species of rotifers were recorded (Sarma and Elías-Gutiérrez 1997). The diversity of rotifer species recorded in this work is thus far above the range previously recorded from other reservoirs in Mexico.

The most common families among rotifers in Mexican waterbodies are Brachionidae and Lecanidae (Sarma et al. 2009); we found 17 and 15 members, respectively, in this study. The rare taxa recorded here include *Horaëlla thomassoni* and *Wolga spinifera*, previously recorded from the State of Morelos and State of Mexico in Central Mexico (Sarma and Elías-Gutiérrez 1997, Granados-Ramírez and Álvarez-Del Angel 2003, Parra et al. 2006). To our knowledge, this is the first study on the seasonal diversity of these taxa. *Wolga spinifera* was equally distributed in the littoral and pelagic zones while *H. thomassoni* was more abundant in the littoral zone from October to March. Both these genera are tropical and have been recorded in crater lakes in Uganda and India (Koste 1978, Kizito et al. 1993, Somani and Pejaver 2003). *Conochilus* was not common in our study, although it is common in reservoirs. For example, Nandini et al. (2008) recorded this genus in the reservoir Valle de Bravo. *C. dossuarius* is also likely common in Mexican

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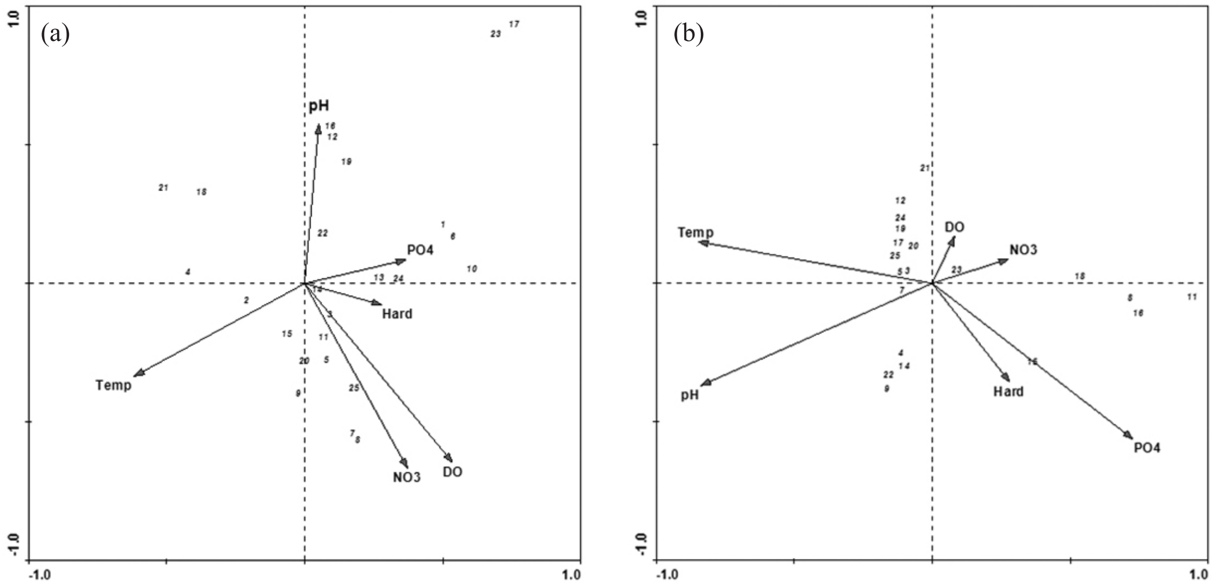

Fig 5. Canonical Correspondence Analysis between rotifers and environmental variables in the (a) littoral and (b) pelagic regions. Abbreviations of environmental variables are: temperature (Temp); pH, dissolved oxygen (DO), hardness (Hard), nitrates (NO3), and phosphates (PO_4). The species included are: 1. *B. angularis*; 2. *B. bidentatus*; 3. *B. calyciflorus*; 4. *B. caudatus*; 5. *B. falcatus*; 6. *B.quadridentatus*; 7. *K. americana*; 8. *K. cochlearis*; 9. *P. quadricornis*; 10. *W. spinifera*; 11. *L. rhomboides*; 12. *L. bulla*; 13. *L. hastata*; 14. *L. papuana*; 15. *C. gibba*; 16. *T. elongata*; 17. *P. dolichoptera*; 18. *P. vulgaris*; 19. *T. patina*; 20. *C. dossuarius*; 21. *H. mira*; 22. *F. longiseta*; 23. *F. opoliensis*; 24. *F. terminalis*; 25. *H. thomassoni*.

waterbodies (Torres-Orozco and Zanatta 1998) but is easily overlooked because of its small size and distortion during preservation (Koste 1978).

The species diversity of Rotifera in the reservoir Valerio Trujano varied between 1.2 and 3.3 and was within the range recorded in several other reservoirs (Ramírez-García et al. 2002, Nandini et al. 2008, Jiménez-Contreras et al. 2009); however, this index alone does not reflect the true state of the rotifer richness and diversity. For instance, the species diversity is just as high or higher in Valle de Bravo, which has less than half the number of rotifers reported here; therefore, both richness and diversity indices should be considered in faunistic surveys.

The low depth of the reservoir also likely played an important role in the greater richness of rotifers; several shallow waterbodies in Mexico have a large number of rotifer species (Sarma and Elías-Gutiérrez 1998, Nandini et al. 2005, Enríquez-García et al. 2009). A study from the shallow wetland Chimaliapan by García-García et al. (2012) reported as many as 74 species of rotifers and a high Shannon-Wiener diversity index of about 5.0. The spatiotemporal variability of physicochemical variables and the high number of microhabitats due to the presence of submerged and emergent vegetation provide refuge against predators to rotifers, thereby increasing the species richness (Duggan et al. 1998).

The reservoir Valerio Trujano receives runoff from the surrounding agricultural fields and has a high density of fish, both of which contribute to increasing eutrophic conditions in the reservoir (Harper 1992, Godlewska and Świerzowski 2003). The levels of nitrates and phosphates are similar to those found in a few other reservoirs in Mexico (De la Lanza and García-Calderon 2002) and indicate eutrophic conditions (Harper 1992). Eutrophic conditions are also evident from the high number of brachionids observed in our analyses; this genus is often common in eutrophic waterbodies (Koste 1978). The B/T ratio in Valerio Trujano was 3.3 (11 species of *Brachionus* and 3 of *Trichocerca*; Table 1), which is also an indicator of the eutrophic conditions (Sládeček 1983). Our canonical correlation analyses (CCA) also indicates that most taxa are ordinated based on the level of nutrients, more so in the pelagic than the littoral zone.

Trophic level is an indicator of enrichment of a water body with nutrients, particularly nitrogen and phosphorus, while saprobity refers to the decomposition of organic matter. Several algal studies relate high nutrient levels to the pollution load in waterbodies (Dokulil 2003). Eutrophic waterbodies are not always highly saprobic; high quality water may be eutrophic but with low pollutant loads (Kwandrans et al. 1998). In our study we observed that the reservoir Valerio Trujano is eutrophic but oligo- to meso-saprobic. Compared to algal studies, few analyses use rotifers as indicators of water quality. The database of information on the taxonomy of rotifers and as indicators of saprobic levels warrants further research.

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