*Hydrobiologia* **387/388:** 259–265, 1998.
*E. Wurdak, R. Wallace & H. Segers (eds), Rotifera VIII: A Comparative Approach.*



# Planktonic rotifers of Samborombón River Basin (Argentina)

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*Key words:* Rotifera, species composition, La Plata estuary basin, salinity, river

## Abstract

The rotifer fauna of the river Samborombón and its tributaries (La Plata river basin) was analysed, and 47 species of monogonont rotifers were identified. Results indicate that differences in salinity and ion composition between waters of the main river and that of its tributaries account for differences in the species composition.

## Introduction

The La Plata River system, including the upper Paraná–Paraguay, middle Paraná–Paraguay and Uruguay (Welcome, 1985) is one of the most important hydrological basins of South America. The system has floodplains composed of lakes and low gradient channels with variations caused mainly by changes in water level. As a consequence, physical and chemical parameters exhibit strong variations and thus modify the composition of aquatic communities. Several studies report changes in zooplankton community structure related to the physical and chemical characteristics of this system (Bonecker & Lansac-Toha, 1996; Bonecker et al., 1994; José de Paggi, 1978, 1983; Martinez & Frutos, 1986; Paggi & José de Paggi, 1990), but they refer mainly to the upper and middle sections of the rivers Paraná and Paraguay. Thus, rivers flowing into the Rio de la Plata estuary are not well investigated. In previous studies (Modenutti, 1991; Modenutti & Claps, 1988) the planktonic and periphytic rotifers of the inner estuary tributaries were analysed. Here I report the spatial and temporal distribution of planktonic rotifers of the Samborombón river and its tributaries located in the Pampasic region that flow into the outer Rio de La Plata estuary.

## Study area and sampling sites

The Samborombón river lies in the depressed Pampa, in Buenos Aires province (Frenguelli, 1950). Its basin lies NW–SE and drains 5090 km$^2$. The main river course is approximately 140 km long. It is a plain river (Solari & Claps, 1996) and its gentle gradient (0.13 m km$^{-1}$) produces flooded areas, especially along the middle and lower course. Its flow is regulated by rainfall (923 mm year $^{-1}$), with great floods in spring, while in summer it is fed only by underground waters.

Ten sampling stations were established (Figure 1). Five of these were fixed on the river Samborombón from its headwaters in Brandsen to its mouth in La Plata River estuary (main course stations called El, E2, E3, E4 and E5). The hydrophytes *Potamogeton striatus* Ruiz et Pavón and *Chara* sp were found in headwaters, and *Salicornia ambigua* Michaus and *Spartina* sp in backwaters. The other five stations were located on tributaries: San Vicente, San Carlos, Manantiales, Dulce, and Saladillo (E6, E7, E8, E9, E10). These streams were colonized by different macrophytes, *Althernanthera* sp in San Vicente Stream, *Schoenoplectus californicus* (Meyer) Steud in Dulce, San Carlos, Manantiales and Saladillo Streams, *Scirpus americanus* and *Sagittaria* sp in San Carlos Stream and *Ludwigia* sp in Dulce Stream.

## Methods

Samples were taken for each season in November 19, February 11, May 18, and August 10, 1987 corresponding to spring, summer, autumn, and winter, respectively. I took duplicate plankton samples from the middle course of the river channels, by filtering 50 l through a 30-$\mu$m mesh net. Samples were fixed with 4% formaldehyde. Water temperature, trans-

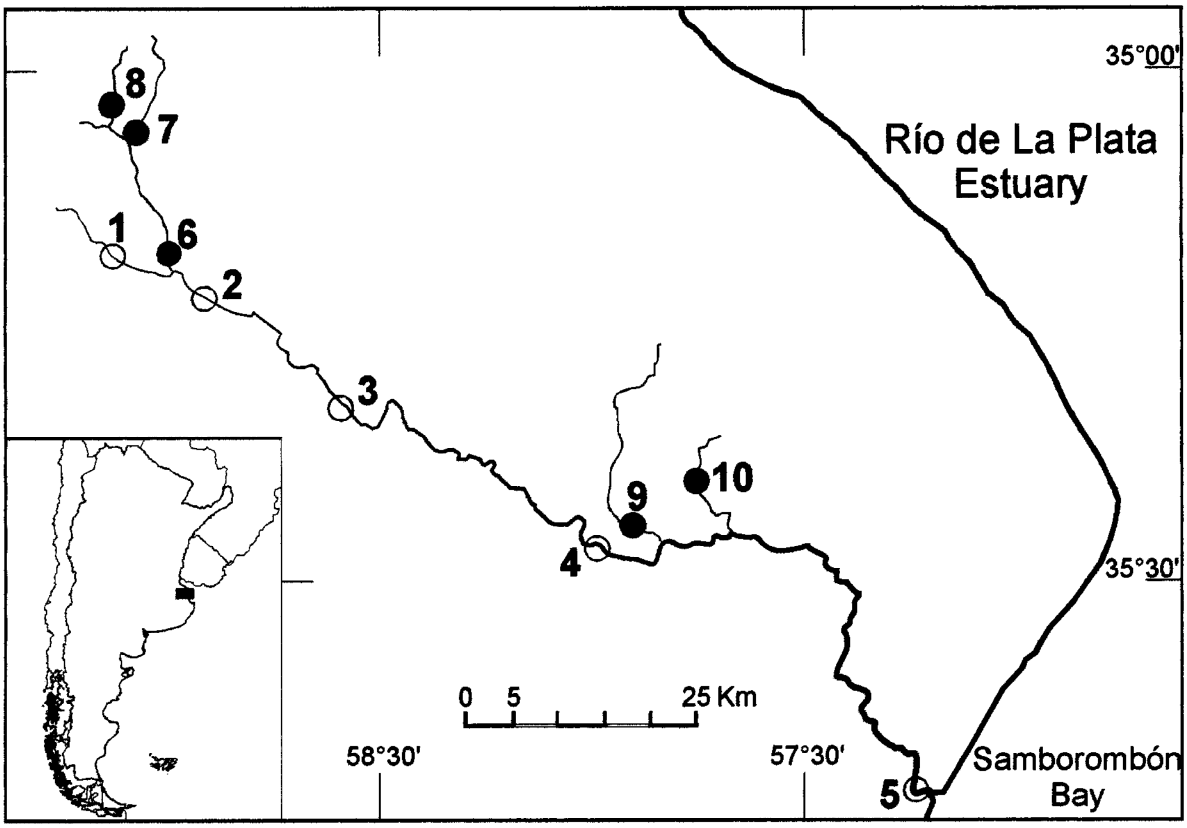


*Figure 1.* Map of the studied area. References: 1–5, main course sampling stations in the Samborombón River; 6–9, Tributary streams sampling stations; 6, San Vicente stream; 7, San Carlos stream; 8, Manantiales stream; 9, Dulce stream; 10, Saladillo stream.

parency, pH, conductivity, ion concentrations and dissolved oxygen were measured for each sample (Laboratorio de Química, Instituto de Limnología, La Plata, Argentina). Zooplankton was counted in a 1-ml Sedgwick–Rafter chamber under compound microscope. Biovolumes for rotifers were calculated using the formulas by Ruttner-Kolisko (1977). Presence/absence data were analysed using the percent of dissimilarity distance index and grouped by the average linkage method.

## Results

Results showed that the physical and chemical parameters varied between the main river course and its tributaries (Table 1). Conductivity and pH values were much higher in the main course than in the tributaries. In both cases, the large variations in these values are related to factors affecting salt content. Conductivity values were highly variable between the four sampling dates during the course of the year. Maximum fluctuations occurred in E5, located at the river mouth in the La Plata estuary. These variations reflect effects of rainfal, runoff, and high tides from the outer estuary.

Ion content concentration, mainly $Na^+$ and $Cl^-$, also showed a marked increase towards the river mouth (Solari & Claps, 1996). These differences could be clarified through the analysis of the weight ratios Na/(Na + Ca) and Cl/(Cl + $HCO_3$) relative to total dissolved salts (Gibbs, 1970). The relationships indicate that the main river and its tributaries are controlled by distinct processes (Figure 2). According to Gibbs' classification, the evaporation-fractional, crystallization process controls the main Samborombón course; while rock dominance controls its tributaries. Dissolved oxygen concentration and transparency did not show great differences between the main river and tributary stations. San Vicente (E6) had an oxygen concentration lower than the other sampling stations, which, in summer, even decreased to undetectable levels (Table 1). Water temperature was similar at all

*Table 1.* Mean values of the physical and chemical parameters of the river Samborombón and its tributaries

| | Main Course | | | | | Tributaries | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Conductivity ($\mu$S cm$^{-1}$)** | | | | | | | | | | |
| Mean | 3673 | 3023 | 3493 | 4292 | 4485 | 1026 | 1530 | 594 | 602 | 561 |
| Minimum | 1003 | 545 | 1230 | 729 | 655 | 604 | 750 | 282 | 500 | 255 |
| Maximum | 7689 | 5141 | 7689 | 8800 | 15750 | 1286 | 2400 | 1218 | 809 | 809 |
| **pH** | | | | | | | | | | |
| Mean | 8.35 | 8.45 | 8.64 | 8.53 | 8.30 | 7.70 | 7.78 | 7.67 | 7.72 | 7.74 |
| Minimum | 8.18 | 8.14 | 8.20 | 8.20 | 8.18 | 7.47 | 7.50 | 7.35 | 7.68 | 7.65 |
| Maximum | 8.50 | 8.72 | 8.96 | 8.74 | 8.36 | 7.90 | 8.30 | 7.86 | 7.76 | 7.94 |
| **Oxygen (mg l$^{-1}$)** | | | | | | | | | | |
| Mean | 7.70 | 7.70 | 7.90 | 7.20 | 7.30 | 3.80 | 5.70 | 6.50 | 7.00 | 7.50 |
| Minimum | 5.60 | 6.60 | 6.60 | 4.10 | 4.70 | 0.00 | 3.80 | 5.00 | 4.40 | 3.00 |
| Maximum | 9.00 | 10.00 | 9.60 | 9.40 | 9.40 | 6.00 | 7.40 | 7.40 | 9.10 | 9.00 |
| **Transparency (cm) Secchi disc** | | | | | | | | | | |
| Mean | 17 | 18 | 21 | 20 | 18 | 14 | 14 | 17 | 19 | 15 |
| Minimum | 15 | 15 | 18 | 15 | 10 | 10 | 10 | 10 | 12 | 12 |
| Maximum | 19 | 20 | 30 | 30 | 32 | 20 | 20 | 42 | 20 | 20 |

References as in Figure 1.

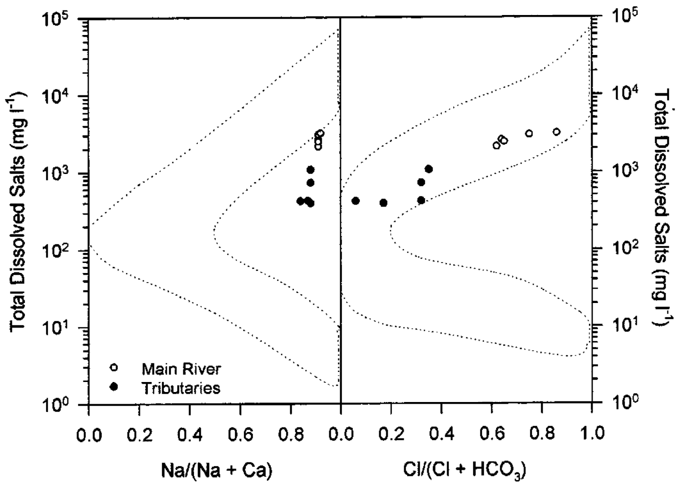


*Figure 2.* Relationship between total dissolved solids and Na/(Na + Ca) and Cl/(Cl + $HCO_3$) weight ratios for the river Samborombón and its tributaries.

sampling stations, averaging 13°C in autumn, 11°C in winter and 25°C in spring and summer.

In total, 47 taxa of monogonont rotifers were found (Tables 2 and 3). Bdelloids were present in the samples but could not be identified. Rotifers were the most important zooplankton group representing 57.3% of the total zooplankton species diversity. The family Brachionidae was represented by the highest number of species (16) followed by Lecanidae with nine species. The total number of rotifer species found in one sampling station varied from 18 to 29 (Figure 3a). In the main river, E4 was the site with the lowest number of species (Figure 3a). At the mouth of the river, E5, rotifers were absent in summer (Figure 3b). The summer plankton samples from this station were dominated by estuarine crustaceans such as the calanoid *Acartia tonsa* Dana and nauplii of the barnacle *Balanus*. In the tributaries, only E6 (San Vicente) did not contain rotifers in the autumn samples (Figure 3b), and only a few ciliates and two species of testate rhizopods were found in these samples.

*Table 2.* List of rotifer species and their presence in the river Samborombón and its tributaries sampling stations

| | Main Course | | | | | Tributaries | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| *Anuraeopsis fissa* (Gosse) | | | | | | | | | Sp | |
| *Asplanchna (A.) brightwelli* (Gosse) | | | Su | | Sp | | | | | |
| *Brachionus angularis* Gosse | | | SpSu | SpSu | Sp | Su | Su | Sp | | SpSu |
| *B. bidentata* Anderson | | | | | Sp | Sp | | | | Sp |
| *B. budapestinensis* Daday | Su | | Su | | | | | | | Sp |
| *B. calyciflorus* Pallas | SuW | SpSuW | SpSu | SpSuW | W | SpSuW | Su | | | Sp |
| *B. caudatus astrogenitus* Ahlstrom | | | | | Sp | | | | | |
| *B. caudatus insuetus* Ahlstrom | SpSu | SpSu | SpSu | Sp | | Su | Su | | | SpSu |
| *B. patulus* (Müller) | | | | | | Su | | | SuW | W |
| *B. plicatilis* (Müller) | Su | Su | Su | SpSu | | | | | | |
| *B. quadridentatus* Hermann | Sp | SpSuA | Sp | | AW | SpW | | SpSuW | | |
| *B. urceolaris nilsoni* (Ahlstrom) | | Su | | SpW | | | | | | |
| *B. urceolaris urceolaris* Müller | Sp | SpSu | SpSu | | Su | | Su | | | |
| *Cephalodella* sp 1 | Sp | SpSuW | SuAW | | | SpSu | SpSu | SpA | SuAW | AW |
| *Cephalodella* sp 2 | Sp | Sp | | | | W | | | W | |
| *Colurella uncinata* (Müller) | SpSuA | SpA | SpAW | A | SpAW | Sp | | SuW | SpW | W |
| *Epiphanes senta* (Müller) | | | W | | | W | | | | |
| *Euchlanis dilatata* Ehr. | | | | | | Su | Sp | | A | |
| *Filinia longiseta* (Ehr.) | SuW | SpSu | SpSu | SpSu | SpAW | SuW | Su | Su | W | SpSuW |
| *Gastropus* sp | | W | | | | | | | W | W |
| *Hexarthra fennica* (Levander) | Su | SuA | Su | SpSu | | Su | | Su | | |
| *Horaëlla thomassoni* Koste | | | | | | | | | Sp | Sp |
| *Keratella cochlearis* (Gosse) | | | | | Sp | | | Su | A | |
| *K. lenzi* (Hauer) | W | | | | AW | W | W | W | Su | W |
| *K. tropica* (Apstein) | SuW | W | | A | SpAW | W | | W | SpAW | W |
| *Lecane (L.) hastata* (Murray) | | | | | | | Sp | | SpA | SuA |
| *L. (L.) luna* (Moller) | | Sp | | | | | | | | |
| *Lecane (L.)* sp | | A | | | | Su | SpSu | Su | | A |
| *Lecane (M.) bulla* Gosse | SpA | | Sp | A | | Su | | W | Sp | A |
| *L. (M.) closterocerca* Schmarda | | | | | W | | | | | W |
| *L. (M.) cornuta* (Müller) | | | | A | A | | | Sp | SuW | A |
| *L. (M.) hamata* (Stokes) | AW | A | | | A | | | | W | A |
| *L. (M.) lunaris* (Ehr.) | | | | | | | | | | W |
| *L. (M.) pyriformis* (Daday) | W | A | | | A | | | W | W | |
| *Lepadella ovalis* (Müller) | W | AW | A | | | W | SpW | SpW | SpW | AW |
| *Lophocaris salpina* (Ehr.) | A | | | | Sp | | | | | Su |
| *Mytilina ventralis* (Ehr.) | | | | | | | | | Sp | W |
| *Notholca acuminata* (Ehr.) | AW | AW | W | AW | W | | W | W | W | |
| *N. squamula* (Müller) | | W | | W | W | | | | | |
| *Platyas quadricornis* (Ehr.) | W | | | | Sp | | | | | |
| *Polyarthra vulgaris* Carlin | SuW | SuAW | SpSuA | A | SpAW | SuW | SuW | SpSuW | SpSuAW | SpSuW |
| *Pompholyx sulcata* Hudson | SuW | | | | SpA | | | Su | Su | |
| *Synchaeta* sp | W | W | W | W | AW | | AW | AW | AW | W |
| *Testudinella patina* (Hermann) | W | Sp | | | SpA | | Sp | W | A | W |
| *Trichocerca (T.) rattus* (Müller) | Su | SpSuAW | SuA | A | AW | SuW | SuW | SpSuAW | SpSuAW | SpW |
| *Trichotria pocillum* (Müller) | | | | | | | | | | W |
| *Wolga spinifera* Western | | | A | A | | | | SpW | A | |

References: Sampling stations as in Figure 1. Seasons: Sp, Spring; Su, Summer; A, Autumn; W, Winter.

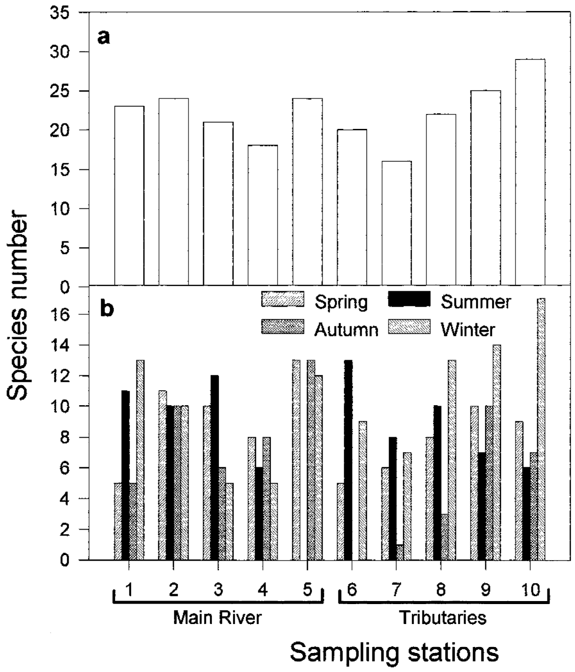


*Figure 3.* Number of rotifer species found in the Samborombón sub-basin. (a) Total number; (b) seasonal variation in species number. References as in Figure 1.

*Table 3.* Comparison of number of species of planktonic rotifers between inner estuary and outer estuary Rio de la Plata tributaries and pampasic lentic water bodies of Buenos Aires province

| Categories | Outer estuary tributaries[1] | Inner estuary tributaries[2] | Lobos pond[3] | Chascornús system [4] |
|---|---|---|---|---|
| Total rotifers | 47 | 59 | 38 | 39 |
| Brachionidae | 22 | 18 | 17 | 16 |
| Lecanidae | 9 | 14 | 4 | 6 |
| Total zooplankton | 82 | 123 | 71 | 74 |
| % of rotifers | 57.3 | 47.9 | 53.5 | 52.7 |

Data: 1, This study; 2, Modenutti (1991) and Modenutti & Claps (1988); 3, Boltovskoy et al. (1990); 4, Ringuelet et al. (1967).

Total rotifer density was higher in the main course than in the tributaries (Figure 4a). Remarkably, a few species are responsable for the high spring and summer densities. *B. calyciflorus* made up 90% of total rotifer biovolume at E3 during spring, while in E4 *B. plicatilis* and *Hexarthra fennica* dominated the summer zooplankton (Figure 4b, c). The latter two species were not found in E5 or in the tributary streams.

Rotifer species composition varied with season. In the Samborombón basin, rotifers can be classified according to temperature as perennial, summer

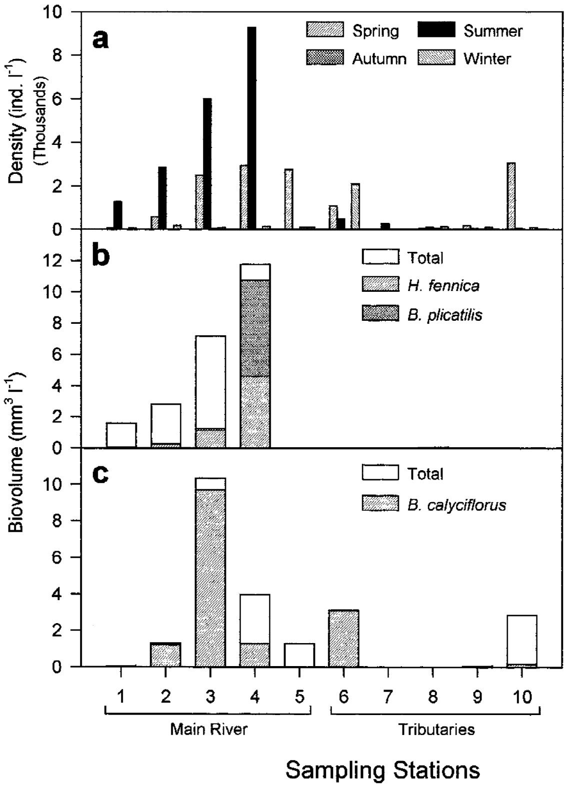


*Figure 4.* (a) Seasonal variation of the rotifer density in the Samborombón sub-basin. (b) Total rotifer and dominant species biovolume in summer. (c) Total rotifer and dominant species biovolume in spring. References as in Figure 1.

and winter species. Most of the *Brachionus* species and *Hexarthra fennica* were found in spring and summer at water temperatures ranging from 20 to 28°C. Ruttner-Kolisko (1974) also identifies these species to be thermophilic. *Notholca acuminata* and *Synchaeta* sp were recorded during autumn and winter at temperatures below 15°C. *N. squamula* was found only in winter at temperatures below 13°C. Other rotifers, e.g., *Polyarthra vulgaris*, *Keratella tropica* and *Keratella cochlearis*, showed no preferences; they are considered to be perennial species with eurythermal behaviour.

On the basis of the dendrogram, the 10 sampling stations can be divided into main river (El, E2, E3 and E4) and tributary (E6, E7, E8 and E9) groups. In addition to these, two isolated stations E5 (main river mouth) and E10 (Saladillo stream) can be recognized (Figure 5). Each group can be described in terms of its limnological characteristics (Table 1, Figure 2). This analysis, based on rotifer species composition, showed

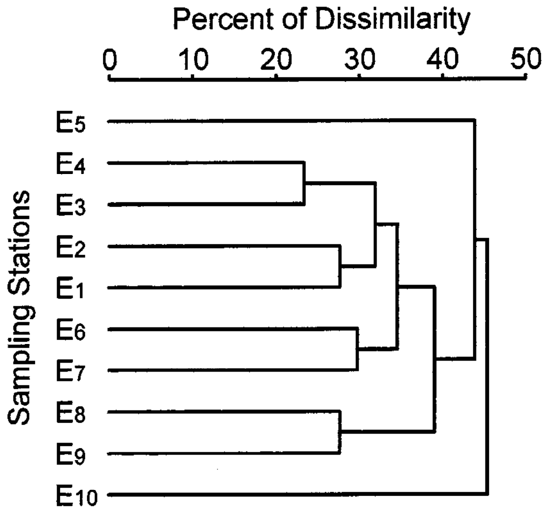


*Figure 5.* Dendrogram of the Samborombón sub-basin resulting from the rotifer species presence–absence distance matrix and grouped through an average linkage method. References as in Figure 1.

that the assemblages were sensitive to the different characteristics of the basin.

## Discussion

Rotifer composition can be related to conductivity, since salinity is a chemical limitation of rotifer communities (Ruttner-Kolisko, 1971, 1974). The Samborombón river represents a complex salinity gradient as fluctuations in salinity can occur over short time periods because of diluting effects of rain and the influence of high tides from the outer La Plata estuary. These factors were more evident at the river mouth. The rotifers found at E5 (a variable and saline station) probably represent an ephemeral freshwater association scoured from tributaries and headwaters. This assumption is supported by the absence of species associated with inland saline waters such as *Brachionus plicatilis* and *Hexarthra fennica*, which were found at the main river stations El, E2, E3 and E4, all with high conductivity values (Table 1). These two species tolerate high salinity but are probably sensitive to the fluctuating salinity of estuaries (Green, 1993, 1995) as was observed at E5. In Argentina, *Hexarthra fennica* has been recorded in alkaline waters (José de Paggi, 1990) and in Patagonian water bodies with high contents of chloride (Kuczynski, 1987) while large populations of *Brachionus plicatilis* are restricted to saline waters (José de Paggi, 1990).

Rotifers are opportunistic organisms whose densities reflect temporal variations related to environmental conditions (Allan, 1976). Rotifer densities were higher in the middle section of the Samborombón river (E3 and E4; Figure 4a). In this section, a good development of planktonic and benthic algae also was recorded, due to greater availability of nutrients, slower stream velocity and minimal variations in water level (Solari & Claps, 1996). Thus, rotifer populations can attain high densities. On the other hand, the low rotifer densities and the high number of species registered in the tributaries (Figures 3b and 4a) would indicate unstable conditions for planktonic rotifers. These streams are probably influenced greatly by any precipitation that cause large changes in flow. Consequently, rotifers do not reach high population densities there. This particular feature also was revealed by the cluster analysis (Figure 5) where tributaries are separated from the main river stations.

## Acknowledgments

I thank Lic. Victor Conzonno for providing me the chemical data of Samborombón river and Dr M.C. Claps and Dr Lía Solari for their amusing help in field work.

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