ZOOPLANKTON SPATIAL AND SEASONAL DISTRIBUTION IN THE TIBAGI RIVER (PARANÁ STATE, BRAZIL)

RUBENS MENDES LOPES[1]

LOPES, R.M. ZOOPLANKTON SPATIAL AND SEASONAL DISTRIBUTION IN THE TIBAGI RIVER (PARANÁ STATE, BRAZIL). **Semina**: Ci. Biol./Saúde, Londrina, v. 14, n. 2, p. 95-102, June 1993.

ABSTRACT: *The zooplankton composition and distribution of the Tibagi River (Paraná, Brazil) were studied from April 1990 to February 1991. The long stretch between the headwaters and the Londrina region was characterized by a tipical drift community (potamoplankton), dominated by chydorids, cyclopoids, rotifers and testate amoebae. Rotifers were poorly represented in the unpollutted riverhead but were numerically important in the other locations. Low densities of copepods and cladocerans were recorded in the Telêmaco Borba area, where a large industrial complex is settled. The lower reaches (Sertanópolis area) presented semi-lentic characteristics, with a dominance of pelagic species of rotifers, cladocerans and copepods.*

KEY-WORDS: *Zooplankton, Limnology, Distribution, Copepoda, Cladocera, Rotifera, Arcellinida.*

1 – INTRODUCTION

Rivers and reservois have been used for multiple purposes in Brazil, including energy production, irrigation, waste disposal and recreation. The evaluation of potential and actual impacts caused by such activities depends on a thoroughly knowledge of the biotic and abiotic processes in these aquatic ecosystems. Nevertheless, relatively few qualitative and quantitative data are available about the biological communities of lotic environments in Brazil. This include investigations on freshwater zooplankton, which have been nearly restricted to reservoirs, river floodplains and, to a lesser extent, natural lakes (ARCIFA, 1984; ARCIFA et al. 1992; BRANDORFF, 1976; KOSTE, 1972; MATSUMURA-TUNDISI, 1986; MATSUMURA-TUNDISI **et al.** 1984;

1 - Centro de Estudos do Mar, Universidade Federal do Paraná - Av. Beira Mar, s/n. Pontal do Sul, PR, CEP 83255-000, Brazil. Telefone: (041) 455-1333, Fax: (041) 455-1105

1990; REID & ESTEVES, 1984; ROBERTSON & HARDY, 1984; ROCHA **et al.**, 1982; SENDACZ & KUBO, 1982; among others).

The present short contribution deals with the composition and distribution of the major zooplankton taxa in the Tibagi River, which belongs to the Paraná River basin. Additional detailed information on each taxonomical group will be published elsewhere.

2 – MATERIAL AND METHODS

The Tibagi River (Figure 1) crosses the Paraná State in Southern Brazil for approximately 550 km, emptying in the Paranapanema River. MAACK (1981) gives a detailed geographical description of this river basin.

Prior to the present study, the Tibagi River was divided into four homogeneous geographic areas by a hierarchical clustering analysis, performed on selected environmental parameters (BARRELLA, 1992; BARRELLA **et al.** 1990). One collecting station of limnological data was positioned in each area. Two stations were located in the second area (Telêmaco Borba), upstream and downstream of large industrial complex. Additional stations were occupied at the headwaters and near the river mouth (Figure 1). Codes for the stations are as follows:

A: Ponta Grossa (headwaters)
B: Ipiranga
C: Telêmaco Borba (upstream the industrial area)
D: Telêmaco Borba (downstream the industrial area)
E: Sapopema
F: Londrina
G: Sertanópolis (ca. 40 km from the river mouth)

Sampling was performed during four periods of the year, from April 1990 to February 1991. The water collected by a suction pump (between 50 and 400 l) was filtered through a 68 μm plankton net and the retained material was preserved in 4% buffered formalin. All samples were taken at the subsurface layer (ca. 20 cm depth), in the middle of the river. At stations D, E, F and G, additional collectings were carried out next to the left and right margins. For these locations, mean values of the three points sampled were calculated. Macrophytes were present only at station G. The organisms were identified and counted in the laboratory under a Wild M8 stereomicroscope of 100x magnification.

3 – RESULTS

3.1 – Zooplankton composition

Comparatively, the Sertanópolis area (station G) presented a distinct zooplankton community, composed by limnetic species. Among them, the most frequent and abundant were: **Keratella cochlearis** Gosse 1851, **K. americana** Carlin 1943, **Conochilus unicornis** Rousselet 1892, **Conochilus dossuarius** (Hudson, 1875), **Trichocerca capucina** Wierzejski & Zacharias 1893, **Brachionus** spp, **Ploesoma truncatum** (Levander, 1894) and **Polyarthra** spp (rotifers); **Ceriodaphnia cornuta** Sars 1885, **Bosminopsis deitersi** Richard 1895, **Bosmina hagmani** Stingelin 1904, **Moina minuta** Hansen 1899 and **Diaphanosoma birgei** Körinek 1981 (cladocerans); **Mesocyclops meridianus** (Kiefer, 1926), **Thermocyclops minutus** (Lowndes, 1934), **Thermocyclops decipiens** (Kiefer, 1929) and **Notodiaptomus iheringi** (Wright, 1935) (copepods). Physical and chemical data confirmed the occurrence of semi-lentic conditions at station G during the period of study (YABE & LOPES, 1992). This was due to the influence of the Capivara dam in Paranapanema River (see Figure 1).

Conversely, stations A-F were characterized by a potamoplankton, i.e., a drift community composed by litoral and sediment-living species. Among these, the predominant were **Acroperus harpae** (Baird 1834), **Alona** spp, **Ilyocryptus** spp and **Bosminopsis** sp (cladocerans); **Tropocyclops prasinus** (Fischer, 1860), **Paracyclops fimbriatus** (Fischer, 1853) and **Eucyclops serrulatus** (Fischer, 1851) (copepods); **Brachionus falcatus** Zacharias 1898, **Lecane** spp, **Keratella** spp and Bdelloidea (rotifers); **Arcella dentata** Ehrenberg 1838, **A. discoides** Ehrenberg 1838, **Centropyxis aculeata** Stein 1859, **Difflugia** spp and **Lesquereusia spiralis** Ehrenberg 1838 (testate amoebae). In addition, insect larvae of chironomids, culicids, trichopterans and ephemeropterans also occurred in high frequencies. Other taxa which appeared in this section of the river were oligochaetes, nematodes, ostracodes, water mites, and stray specimens of tardigrades.

3.2 – Spatial and temporal variations

Figure 2 shows the zooplankton seasonal distribution at station G (Sertanópolis). During April, very high densities were recorded for the three dominant groups. A numerical decrease occurred in August, followed by a relatively small increase during the November and February periods. Rotifers outranked both copepods and cladocerans, excepting in February.

A very dynamic picture was observed in the lotic reaches (Figure 3). On the whole, higher abundances were recorded in the April/May and November periods. Cladocerans and copepods dominated in April/May with the exception of station D, where rotifers reached greater densities. During the following periods, testate amoebae and rotifers were the dominant taxa. Cyclopoid copepods, insect larvae and, to a lesser degree, oligochaetes (included in the category "others") sometimes occurred in representative numbers. Cladocerans were relatively scarse in August, November and February, and furthermore never appeared at stations C and D. In a similar manner, copepods were generally found at very low numbers in these locations.

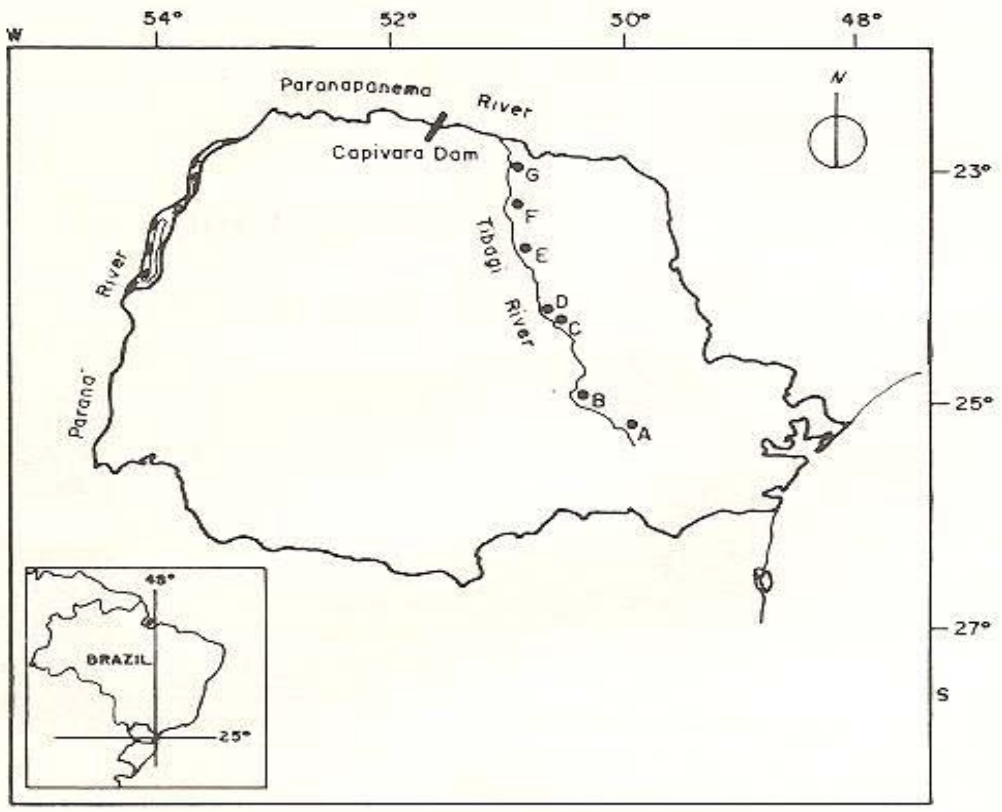

FIGURE 1: Map of the Paraná State, Southern Brazil, showing the positioning of the sampling stations in the Tibagi River.

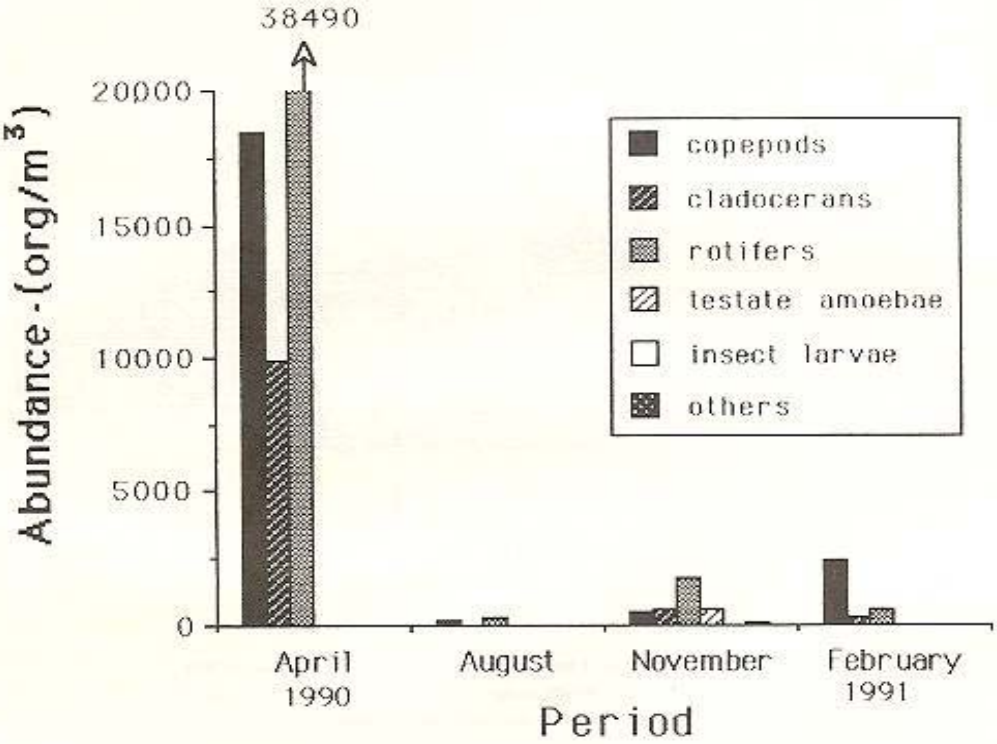

FIGURE 2: Seasonal variation of zooplankton abundance at Sertanópolis area (station G) in the Tibagi River.

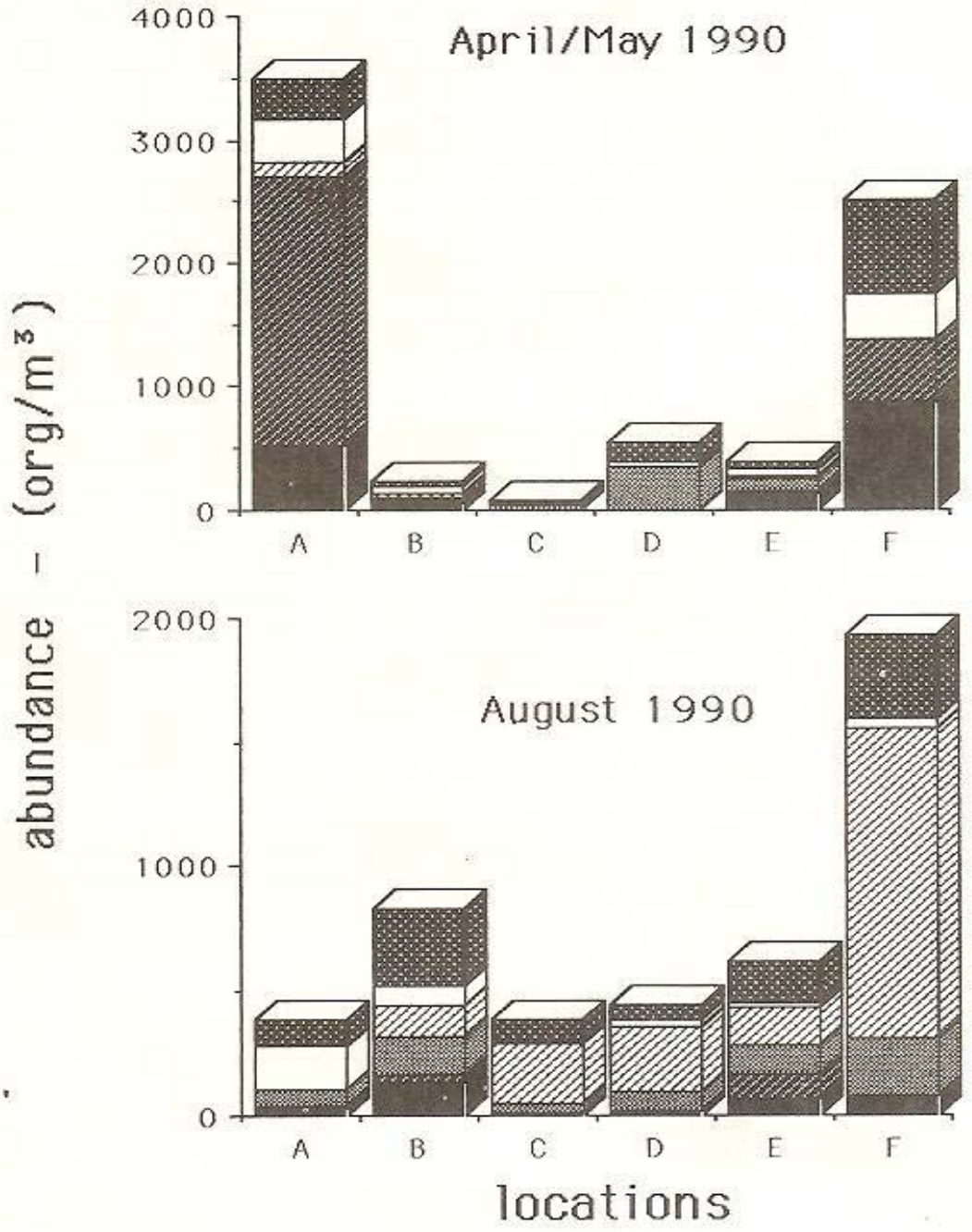

FIGURE 3: Spatial and seasonal variation of the zooplankton abundance in the lotic environments of the Tibagi River. Note the different scales. Symbols as in Figure 2.

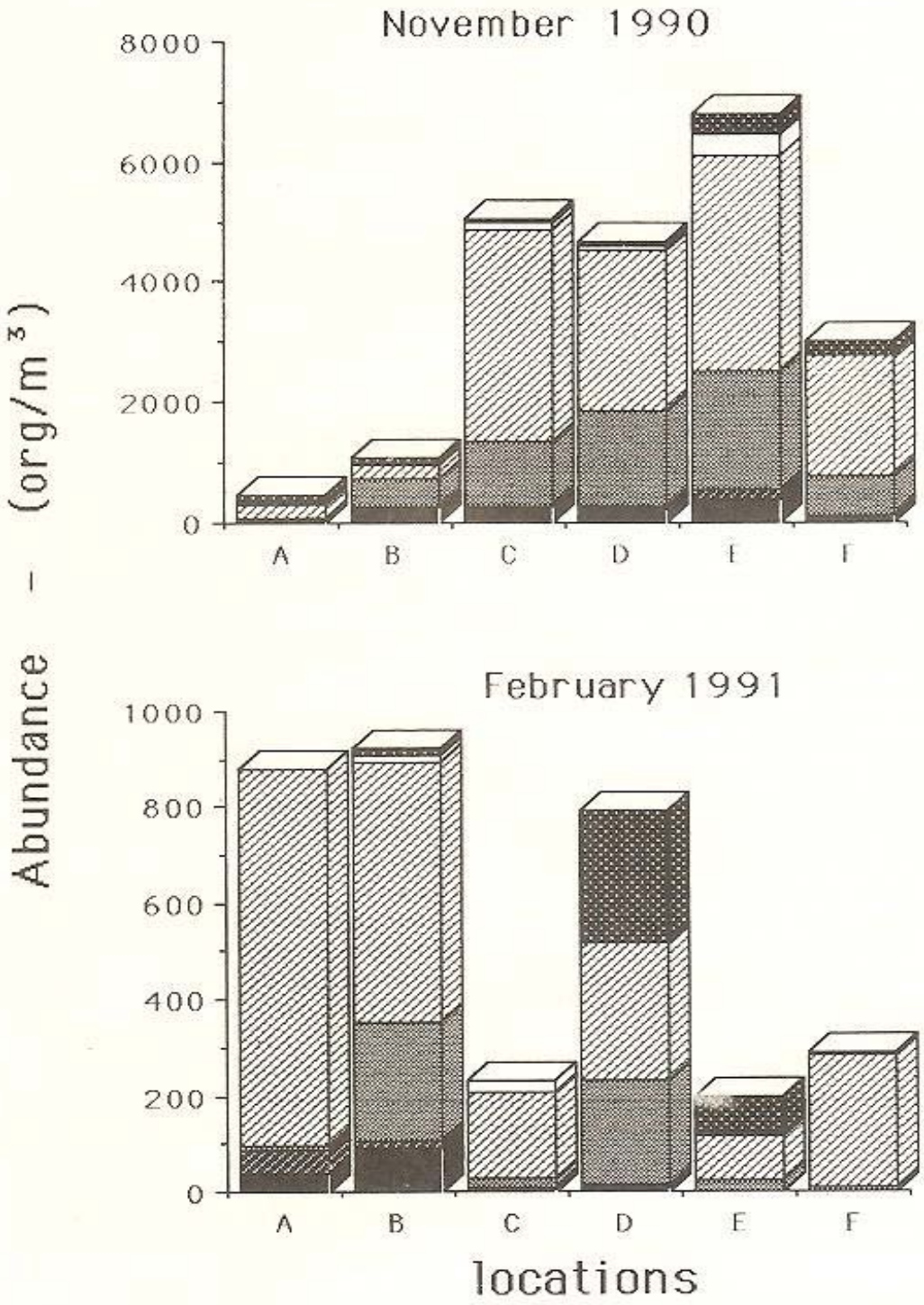

FIGURE 3: cont.

4 – DISCUSSION

The majority of the species recorded in this study have a wide geographic distribution in the tropical and subtropical lowlands of South America east of the Andes.

Many rotifers found in Tibagi River are cosmopolitan, including **Brachionus falcatus, Conochilus dossuarius, Keratella cochlearis** and **Lecane bulla** (Gosse 1886), while others have a neotropical distribution (DUMONT, 1983). The latter include **Brachionus dolabratus** Harring 1915 and **Brachionus patulus macracanthus** (Daday, 1905), among others. The cladoceran species of the Sertanópolis area are very common in reservoirs and floodplain lagoons of the Amazon and Paraná basins (JOSÉ DE PAGGI, 1981; LANSAC-TÔHA **et al.** in press; ROBERTSON & HARDY, 1984; SENDACZ & COSTA, 1991), which is also valid for the cyclopoids **Thermocyclops minutus, T. decipiens** and **Mesocyclops meridianus** (ARCIFA, 1984; PETKOVSKI, 1986; REID, 1989). On the other hand, freshwater calanoid copepods are generally restricted to a narrower range of latitudes, with a total absence of cosmopolitism and even pan-tropical species (DUSSART **et al.** 1984). Accordingly, MATSUMURA-TUNDISI (1986) suggested that the center of dispersion of **Notodiaptomus iheringi** is the southern region of Brazil, since it has been found in great number in reservoirs of São Paulo, Rio de Janeiro and Paraná States. The fauna encountered in the lotic environments has either a pan-tropical or a neotropical geographic distribution (DUSSART & DEFAYE, 1985; MONTÚ & GOEDEN, 1986; PAGGI, 1972; 1973).

The zooplankton community in the Sertanópolis area was composed by small-sized species, generally not exceeding 0.9 mm (data not shown). Nauplii and early copepodites comprised the bulk of the copepod populations, and furthermore very small rotifers dominated over crustaceans. It is possible that biotic factors, like phytoplankton composition and invertebrate or vertebrate predation, exert an important influence on the zooplankton size structure and therefore on the dominance of certain groups or species in this area.

The high densities of rotifers, cladocerans and copepods recorded at station G in April were within the range reported for other reservoirs of southeastern Brazil (ARCIFA **et al.** 1992; MATSUMURA-TUNDISI & OKANO, 1983; MATSUMURA-TUNDISI **et al.** 1990; SENDACZ **et al.** 1985). Unfortunately, the sampling frequency used in this study precludes any explanation of the contrasting figures obtained in the following periods.

The dominance of rotifers and testate amoebae has been well documented in lotic environments, including the Paraná River (LANSAC-TÔHA **et al.** in press; JOSÉ DE PAGGI, 1984). The testate amoebae species recorded in Tibagi River are mostly cosmopolitan. In Brazil, they were already found in the Pantanal wetland (HARDOIM & HECKMAN, 1992). There was no apparent correlation between the abundance of testate amoebae and other biotic and abiotic parameters. On the other hand, it is known that rotifers may be usefull biological indicators of eutrophication processes, as recently demonstrated for Brazilian reservoirs and estuarine areas (MATSUMURA-TUNDISI **et al.** 1990; NEUMANN-LEITÃO **et al.** 1992). Rotifers were nearly absent from the headwaters of Tibagi River, which are not submitted to pollution (YABE & LOPES, 1992). Inversely, rotifers were important components of the potamoplankton in the other locations.

The low numbers of crustaceans recorded in the Telêmaco Borba stations suggest additional pollution stress occurring in this area. However, stations C and D had similar faunistic composition and density, which might indicate a significative contribution of other sources of pollution, situated upstream the industrial complex.

Further experimental **in situ** and laboratory investigations are needed to answer these questions. Ecotoxicological studies on the effects of isolated or mixed chemical substances on planktonic populations and time-series analysis of distributional data, are strongly recommended procedures for future ecological assessments of water pollution impact in the Tibagi River.

LOPES, R.M. Distribuição Espacial e Sazonal do Zooplâncton no Rio Tibagi (Estado do Paraná, Brasil). **Semina:** Ci. Biol./Saúde, Londrina, v. 14, n. 2, p. 95-102, jun. 1993.

RESUMO: *A composição e a distribuição do zooplâncton do Rio Tibagi foram estudadas de Abril/1990 a Fevereiro/1991. O trecho entre as nascentes e a região de Londrina foi caracterizado pela ocorrência de uma típica comunidade de deriva (potamoplâncton), dominada por Chydoridae (Cladocera), Cyclopidae (Copepoda), Bdelloidea (Rotifera) e tecamebas. Os rotíferos foram pouco abundantes nas cabeceiras do rio, onde não existem fontes significativas de poluição, mas foram numericamente importantes nas demais localidades. Baixas densidades de copépodos e cladóceros foram registradas nas estações de coleta localizadas em Telêmaco Borba, uma área de intensa atividade industrial. O trecho inferior do rio (região de Sertanópolis) apresentou características semi-lênticas, evidenciadas pela dominância de espécies pelágicas de rotíferos, cladóceros e copépodos.*

PALAVRAS-CHAVE: *Zooplâncton, Limnologia, Distribuição, Copepoda, Cladocera, Rotifera, Arcellinida.*

REFERENCES

ARCIFA, M.S. Zooplankton composition of ten reservoirs in southern Brazil. *Hydrobiologia*, v. 113, p. 137-145, 1984.

ARCIFA, M.S.; GOMES, E.A.T.; MESCHIATTI, A.J. Composition and fluctuations of the zooplankton of a tropical Brazilian reservoir. *Hydrobiologia*, v. 123, p. 479-495, 1992.

BARRELA, W. *A Terra gasta, a questão do meio ambiente*. São Paulo: Educ, 1992. p. 111-144; Princípios básicos da metodologia aplicada em estudos ambientais.

BARRELA, W.; NAKAJIMA, J.N.; VIEIRA, A.O.S.; SILVA, S.M. *Caracterização macro-ambiental para estudos da Bacia do Rio Tibagi (PR)*. In: CONGRESSO DA SOCIEDADE BOTÂNICA DE SÃO PAULO, 8, Campinas, 1990. *Resumos*, p. 43.

BRANDORFF, G.O. The geographic distribution of the Diaptomidae in South America (Crustacea, Copepoda). *Rev. Brasil. Biol.* v. 36, p. 613-627, 1976.

DUMONT, H.J. Biogeography of rotifers. *Hydrobiologia*, v. 104, p. 19-30, 1983.

DUSSART, B.H.; DEFAYE, D. *Répertoire mondial des Copépodes Cyclopoides*. Paris: Bordeaus; CNRS, 1985. p. 1-236.

DUSSART, B.H. FERNANDO, C.H.; MATSUMURA-TUNDISI, T.; SHIEL, R.J. A review of systematics, distribution and ecology of tropical freshwater zooplankton. *Hydrobiologia*, v. 113, p. 77-91, 1984.

HARDOIM, E.L.; HECKMAN, C.W. *Variações sazonais na atividade de testaceas (Sarcodina: Testacea) em corpos d'água no Pantanal de Poconé - Mato Grosso - Brasil*. In: CONGRESSO BRASILEIRO DE LIMNOLOGIA, 4, Manaus, 1992. *Resumos...* p. 93.

JOSÉ DE PAGGI, S. Variaciones temporales y distribución horizontal del zooplancton en alguns cauces secundarios del Rio Paraná Medio. *Stud. Neotrop. Fauna Environ.*, v. 16, p. 185-199, 1981.

JOSÉ DE PAGGI, S. Estudios limnologicos en la sección transversal del tramo medio del Rio Paraná. *Rev. Asoc. Cienc. Nat. Litoral*, v. 15, p. 135-155, 1984.

KOSTE, W. Rotatorien aus gewassern amazoniens. *Amazoniana*, v. 3, p. 258-505, 1972.

LANSAC-TÔHA, F.A.; LIMA, A.F.; THOMAZ, S.M.; ROBERTO, M.C. Zooplâncton de uma planície de inundação do Rio Paraná. II. Variação sazonal e influência dos níveis fluviométricos sobre a comunidade. *Acta Limnol. Bras.*, v. 6, 1993. (in press).

MAACK, R. *Geografia física do Estado do Paraná*. Rio de Janeiro: José Olympio Editora, 1981. 450p.

MATSUMURA-TUNDISI, T. Latitudinal distribution of Calanoida copepods in freshwater aquatic systems of Brazil. *Rev. Brasil. Biol.*, v. 46, p. 527-553, 1986.

MATSUMURA-TUNDISI, T.; OKANO, W.Y. Seasonal fluctuations of Copepod populations in Lake Dom Helvécio (Parque Florestal, Rio Doce, Minas Gerais, Brazil. *Hydrobiologia*, v. 16, p. 35-39, 1983.

MATSUMURA-TUNDISI, T.; TUNDISI, J.G.; TAVARES, L.S. Diel migration and vertical distribution of Cladocera in Lake Dom Helvécio (Minas Gerais, Brazil). *Hydrobiologia*, v. 113, p. 299-306, 1984.

MATSUMURA-TUNDISI,T.;NEUMANN-LEITÃO,O.S.;AGUENA,L.S.; MIYAHARA, J. Eutrofização da represa de Barra Bonita: estrutura e organização da comunidade de Rotifera. *Rev. Brasil. Biol.*, v. 50, p. 923-935, 1990.

MONTÚ, M.; GOEDEN, I.M. Atlas dos Cladocera e Copepoda (Crustacea) do estuário da Lagoa dos Patos (Rio Grande, Brasil). *Neritica*, v. 1, n. 2, p. 1-134, 1986.

NEUMANN-LEITÃO, S.; PARANAGUÁ, M.N.; VALENTIN, J.L. The planktonic rotifers of the estuarine lagunar complex of Suape (Pernambuco, Brazil). *Hydrobiologia*, v. 232, p. 133-143, 1992.

PAGGI, J.C. Contribucion al conocimiento de la fauna de cladoceros dulceacuicolas argentinos. *Physis* (Sec. B), v. 32, p. 105-114, 1973.

PAGGI, J.C. Nota sistematica acerca de algunos cladoceros del genero *Chydorus* Leach 1843, de la Republica Argentina. *Physis* (Sec. B), v. 31, p. 223-236, 1972.

PETKOVSKI, T.K. Zur taxonomie des genus *Mesocyclops* G.O. Sars 1914 (Crustacea, Copepoda Cyclopoida) in der Neotropis. *Acta Mus. maced. sci. nat.* v. 18, p. 47-49, 1986.

REID, J.W. The distribution of species of the genus *Thermocyclops* (Copepoda, Cyclopoida) in the western hemisphere, with description of *T. parvus*, new species. *Hydrobiologia*, v. 175, p. 149-174, 1989.

REID, J.W.; ESTEVES, F.A. Considerações ecológicas e biogeográficas sobre a fauna de copépodos (Crustacea) planctônicos e bentônicos de 14 lagoas costeiras do Estado do Rio de Janeiro. In: LACERDA, L.D.; ARAÚJO, D.S.D.; CERQUEIRA, R.; TURCQ, B. (orgs.), *Restingas*: origem, estrutura, processos. Niterói: Univ. Federal Fluminense, 1984. p. 305-326.

ROBERTSON, B.A.; HARDY, E.R. Zooplankton of Amazonian lakes and rivers. In: SIOLI, H. (ed.). *The Amazon, limnology and landscape ecology of a mighty tropical river and its basin*. New York: Dr. W. Junk, 1984. p. 337-352.

ROCHA, O.; MATSUMURA-TUNDISI, T.; TUNDISI, J.G. Seasonal fluctuation of **Argyrodiaptomus furcatus** populations in Lobo Reservoir (São Carlos, SP-Brasil). *Trop. Ecol.*, v. 23, p. 134-150, 1982.

SENDACZ, S.; COSTA, S.S.M. Caracterização do zooplâncton do Rio Acre e Lagos Lua Nova, Novo Andirá e Amapá (Amazônia, Brasil). *Rev. Brasil. Biol.*, v. 51, p. 463-470, 1991.

SENDACZ, S.; KUBO, E. Copepoda (Calanoida e Cyclopoida) de reservatórios do Estado de São Paulo. *Bol. Inst. Pesca*, v. 9, p. 51-89, 1982.

SENDACZ, S.; KUBO, E.; CESTAROLLI, M.A. Limnologia de reservatórios do sudeste do Estado de São Paulo. *Bol. Inst. Pesca*, v. 12, p. 187-207, 1985.

YABE, M.J.S.; LOPES, R.M. *Análise de parâmetros limnológicos da Bacia do Rio Tibagi (PR)*. In: CONGRESSO BRASILEIRO DE LIMNOLOGIA, 4, Manaus, 1992. *Resumos...* p. 180.

Recebido para publicação em 13/11/1992

ACKNOWLEDGEMENTS

This work is part of a large research project carried out through a joint effort of the State University of Londrina and the COPATi – Consortium for the Environmental Protection of the Tibagi River – with the collaboration of the Klabin Industries. I thank Dr. Moacyr Medri (project general co-ordinator), Sirlei T. Bennemann (co-ordinator of the Limnology working group) and Claudio Müller (head, during the study period, of the Dept. of Animal and Plant Biology) for their technical and academic support. I am also indebted to numberless colleagues of the State University of Londrina, who participated in the laboratory and field tasks. Ms. Joseane Balan da Silva gave an invaluable help with zooplankton sampling and counting. Finally, I would like to acknowledge Dr. Susana Sendacz, Dr. Carlos E.F. Rocha (University of São Paulo) and Dr. Juan C. Paggi (National Institute of Limnology, Argentina), for their assistance and suggestions.