Biologia, Bratislava, **61**/5: 541—546, 2006
Section Zoology
DOI: 10.2478/s11756-006-0088-7

Influence of trophic status and conductivity on zooplankton composition in lakes and ponds of Torres del Paine National Park (Chile)

Doris Soto[1] & Patricio De los Rios[2]*

[1] *Universidad Austral de Chile, Laboratorio de Ecologia Acuatica, Casilla 1327, Puerto Montt, Chile*
[2] *Universidad Catolica de Temuco, Departamento de Ciencias Biologicas y Quimicas, Casilla 15-D, Temuco, Chile; e-mail: prios@uct.cl*[1]*, patorios@msn.com*[2]

Abstract: The Torres del Paine National Park is located in the southern Chilean Patagonia. This park has numerous and heterogeneous lakes and ponds with different trophic status and zooplankton composition. The aim of this study was to analyze the influence of trophic status and conductivity on zooplankton assemblages in lakes and ponds within the Torres del Paine National Park. The water bodies described in the present study were previously classified in three groups. The first group consisted of large, deep and oligotrophic lakes with fish populations, low zooplankton species diversity and high predominance of calanoid copepods of small body size. The second group contained small mesotrophic lakes with fish populations and relatively high predominance of small sized daphnids. The third group consisted of fishless ponds of different trophic status, wide conductivity gradient and with zooplankton species of relatively large body size. The results show that Daphnids abundance was directly related to chlorophyll-*a* concentration and inversely associated with conductivity. Calanoids abundance was also directly associated with conductivity.

Key words: Lakes, oligotrophic, mesotrophic, conductivity, zooplankton, daphnids, calanoids, Chile.

Introduction

The lakes in the southern part of South America have been described as oligotrophic (Soto, 2002; Modenutti et al., 1998a, b). There are numerous natural freshwater bodies south to 46° S, however, their characteristics are almost unknown due to difficulties of access. Some of these sites are located in the Torres del Paine National Park, Chilean Patagonia (Soto et al., 1994). This park contains a large set of lakes and ponds of different size, age and trophic status. These lakes have the advantage of low human impact (Soto et al., 1994). In contrast to North American water bodies, the zooplankton of Southern South American lakes has been characterized by low daphnid abundance (Gillooly & Dodson, 2000) and low number of species (Soto & Zuniga, 1991). The low daphnid abundance can be explained, in particular, by oligotrophy of the water bodies (Soto & Zuniga, 1991). Within the Torres del Paine National Park, there are large lakes with fishes, especially salmonids and galaxids (*Galaxias* spp.), small lakes with populations of galaxids as well as small ponds without fishes (Soto et al., 1994). Salmonids are mainly benthivorous and predate on macroinvertebrates, whereas galaxids predate on microinvertebrates and zooplankton (Soto & Campos, 1995; Soto & Zuniga, 1991). Conductivity was found to be low ($< 500\ \mu\text{S cm}^{-1}$) in large lakes, and high ($> 4000\ \mu\text{S cm}^{-1}$) in some ponds without fishes (Soto et al., 1994). In the present study, we investigated the effects of trophic status and conductivity on zooplankton assemblage in water bodies of the Torres del Paine National Park.

Material and methods

The Torres del Paine National Park is located in S Chile (50°55′ S, 73°05′ W). The park covers approximately 242,240 ha and was declared a Biosphere Reserve by the United Nations. Within the park, there is a large diversity of landscapes, glaciers, valleys, snowcaps, lakes and ponds (Soto et al., 1994). The climate within the park is subpolar, cold and dry, with less than 700 mm of precipitation a year. In October and November, the park is exposed to strong winds of approximately 100 km h^{-1} (Soto et al., 1994).

The data on trophic status, depth, area and conductivity in the lakes were obtained from Soto et al. (1994). Zooplankton samples were collected during September 1988,

---

* Corresponding author

Table 1. Zooplankton assemblages of study sites in Torres del Paine National Park.

Site	Location Lat (S), Long (W)	Percentage of daphnid abundance	Number of species	Zooplankton biomass (μg L^{-1})*	Daphnidae (ind. L^{-1})	Cladocera (ind. L^{-1})	Calanoida (ind. L^{-1})	Cyclopoida (ind. L^{-1})	Total zooplankton (ind. L^{-1})
Large lakes with fish									
Del Toro	51°12′ 72°38′	0.00	7	16	0.00	0.00	1.40	0.21	1.60
Sarmiento	51°03′ 72°37′	0.00	6	24	0.00	0.80	8.30	0.30	9.40
Nordenskjold	51°01′ 72°56′	0.00	4	8	0.00	0.00	0.70	0.01	0.71
Pehoe	51°07′ 72°56′	0.00	4	6	0.00	0.00	0.80	0.00	0.80
Small lakes with fish									
Melliza Este	51°03′ 72°57′	39.41	14	182	6.70	0.60	8.40	1.30	17.00
Melliza Oeste	51°03′ 72°57′	10.84	15	158	2.20	1.80	14.10	2.20	20.30
Fishless ponds									
Juncos	51°01′ 72°52′	53.32	16	1230	33.60	0.20	27.10	2.11	63.01
Jovito	51°02′ 72°54′	2.70	14	885	0.61	0.40	20.50	1.11	22.62
Paso	51°02′ 72°55′	82.87	16	215	64.41	0.30	12.10	0.91	77.72
Redonda	51°01′ 72°52′	2.19	13	618	0.80	0.02	35.70	0.00	36.52
Larga	51°01′ 72°52′	3.40	10	250	0.71	0.70	19.50	0.00	20.91
Cisnes	51°01′ 72°52′	0.69	9	10900	2.40	0.10	346.90	0.00	349.40

Note: * Data obtained from Soto et al. (1994). The other data were obtained during the present study.

January, May and October 1989, and January 1990, because these periods had optimal weather for field work (Soto et al., 1994). Zooplankton in deep lakes was collected by vertical hauls of 50 m with an Apstein net of 80 μm of mesh size. In small lakes and shallow ponds, zooplankton was collected by filtration to 80 μm of known volume (60–80 L). This method was used for small lakes and ponds, because in these water bodies there is a permanent mixing of the water column due to strong winds (Soto, 2002). Zooplankton specimens were identified according to Araya & Zuniga (1985) and Bayly (1992). Finally, the data used were analyzed by correlation analyses prior to a principal component analysis (PCA) using the Xlstat software (www.addinsoft.com).

Results

We classified the studied lakes in three main groups. The first group comprised large, deep and oligotrophic lakes with fish populations (Del Toro, Sarmiento, Pehoe and Nordenskjold lakes), characterized by low to moderate conductivity, low zooplankton biomass, and high abundance of calanoids (Tab. 1). The second group contained small lakes with fishes (Melliza Este, Melliza Oeste lakes), characterized by mesotrophy, moderate conductivity and zooplankton biomass, and relatively high daphnid abundance (Tab. 1). The third group consisted of small and shallow ponds without fishes, with moderate to high conductivity, meso- to eutrophic, high zooplankton biomass; in many of these water bodies calanoid copepods dominated (Tab. 1).

Zooplankton assemblages differed in the studied groups of water bodies. In large lakes, zooplankton was characterized by the presence of relative small sized copepods, such as *Boeckella gracilipes* and *Tropocyclops prasinus* (Tab. 2). Small lakes with fishes were characterized by moderate zooplankton abundance and biomass. The species found there were *Boeckella gracilipes*, *B. michaelseni* and *Ceriodaphnia dubia;* they were characteristic of a relatively small body size (Tab. 2). Finally, in fishless ponds the zooplankton was characterized by the presence of species with large body size, such as *Boeckella popei*, *Daphnia dadayana* and *Parabroteas sarsi* (Tab. 2).

In the lakes studied, direct relationships were established between (1) surface and maximum depth, (2) conductivity and chlorophyll-*a* and nutrients concentrations. Nitrogen concentration was directly related to chlorophyll-*a* and soluble reactive phosphorus concentrations and conductivity (Tab. 3). Total zooplankton abundance, biomass and calanoid abundance were directly related to conductivity, chlorophyll-*a,* soluble reactive phosphorus and nitrogen concentrations (Tab. 4). Other important direct relationships observed were between (1) percentage of daphnid abundance and nitrogen concentration, (2) zooplankton biomass and total zooplankton abundance, (3) daphnid abundance and percentage of daphnid abundance, (4) calanoid abundance and total zooplankton abundance and zooplankton biomass, (5) cyclopoid abundance and species diversity and cladoceran abundance, (6) number of species and percentage of daphnid abundance. Only one negative relationship was found, i.e., between number of species and maximum depth of the lakes (Tab. 3).

Evaluation of the variables revealed that conductivity, chlorophyll-*a* and nitrate concentrations, total zooplankton abundance, zooplankton biomass and calanoids abundance were important for the first axis, whereas the most important variable for the second axis were depth, number of species, percentage of daphnid abundance, daphnid and cyclopoid abundances (Tab. 3, Fig. 1). PCA analysis revealed the existence of two main groups of lakes: the first group comprised deep oligotrophic lakes with fishes, low zooplankton biomass and high calanoids abundance in their zooplankton assemblages (Tab. 1, Fig. 1). The second group comprised

Table 2. Zooplankton species and minimum and maximum values of total length (TL) for species detected in the studied sites in Torres del Paine National Park.

Crustacea	LT (mm)	Sites
Copepoda		
Centropagidae		
Parabroteas sarsi (Daday, 1901)	5.0–7.0	10–12
Boeckella popei (Mrazek, 1901)	2.0–3.0	5–12
B. gracilipes (Daday, 1901)	0.8–1.0	1–4
B. michaelseni (Mrazek, 1901)	0.8–1.2	1–4
B. meteoris (Brehm, 1935)	1.5–2.0	12
B. poopoensis (Marsh, 1906)	2.0–3.0	12
Cyclopidae		
Mesocyclops longisetus araucanus (Löffler, 1962)	1.0–1.6	1–6
Tropocyclops prasinus prasinus (Fisher, 1860)	0.6–0.8	1–4, 7, 8
Acanthocyclops vernalis (Fisher, 1853)	1.0–2.0	5–12
Cladocera		
Daphnidae		
Daphnia commutata (Ekmann 1900)	1.5–2.0	5–11
D. sarsi (Daday, 1902)	1.5–2.0	5–10
D. dadayana (Paggi, 1999)	3.0–5.0	12
Ceriodaphnia dubia (Richard, 1894)	0.8–1.0	5–10
Bosminidae		
Bosmina (*Neobosmina*) *chilensis* (Daday, 1902)	0.6–0.8	1, 3–12
Chydoridae		
Chydorus sphaericus (O. F. Müller, 1785)	0.5–0.6	5–11
Alona sp. (Baird, 1850)	0.6–0.8	6–11
Rotifera		
Brachionidae	0.4	*
Lecanidae	0.4	*
Trichocercidae	0.4–0.6	**
Aspinahnidea	0.4	**

Key. Sites: 1 – Del Toro; 2 – Sarmiento; 3 – Norsdenkjold; 4 – Pehoe; 5 – Melliza Este; 5 – Melliza Oeste; 6 – Juncos; 7 – Jovito; 8 – Redonda; 9 – Larga; 10 – Cisnes. * Presence reported at all studied sites; ** Presence reported in small lakes and shallow ponds (sites 5 to 12).

Table 3. Data of correlation coefficients of the parameters studied in the present paper. The data in bold represent significant correlations ($P < 0.05$).

	Area	Depth	Conductivity	Chl-*a*	SRP	N-NO$_3$	NS	% DA	TI	ZB	DPA	CLA	CAA	CYA
Area	1	**0.800**	−0.229	−0.333	−0.334	−0.280	−0.468	−0.296	−0.233	−0.193	−0.234	−0.186	−0.196	−0.281
Depth		1	−0.338	−0.492	−0.501	−0.466	**−0.795**	−0.427	−0.374	−0.295	−0.348	−0.178	−0.297	−0.418
Conductivity			1	**0.796**	**0.791**	**0.915**	−0.027	−0.153	**0.966**	**0.984**	−0.087	−0.155	**0.987**	−0.230
Chl-*a*				1	0.541	**0.828**	0.294	0.315	**0.896**	**0.820**	0.361	−0.091	**0.823**	−0.007
SRP					1	**0.696**	0.109	−0.080	**0.684**	**0.680**	−0.019	−0.004	**0.691**	−0.209
N-NO$_3$						1	0.262	0.097	**0.935**	**0.925**	0.139	−0.134	**0.910**	0.055
NS							1	**0.665**	0.084	−0.034	0.556	0.359	−0.040	**0.749**
% DA								1	0.036	−0.142	**0.943**	0.013	−0.161	0.532
TI									1	**0.979**	0.115	−0.199	**0.978**	−0.139
ZB										1	−0.075	−0.203	**0.997**	−0.194
DPA											1	−0.094	−0.092	0.375
CLA												1	−0.179	**0.579**
CAA													1	−0.226

Key: NS – number of species; % DA – percentage of daphnids abundance; TI – total abundance; ZB – zooplankton biomass; DPA – daphnids abundance; CLA – small cladocerans abundance; CAA – calanoids abundance; CYA – cyclopoids abundance.

small lakes with fishes and most of the fishless ponds. All these lakes had moderate conductivity and were mesotrophic, but their zooplankton assemblages were variable, either with a high percentage of daphnid abundance (Paso, Juncos, Melliza Este and Melliza Oeste), or with a relatively low percentage of daphnid abundance (Redonda, Larga and Jovito) (Tab. 1, Fig. 1). Finally, the Cisnes pond was a unique site, characterized by a high conductivity, high chlorophyll-*a* and nutrients concentrations, and high calanoid abundance, zooplankton biomass and total numbers of zooplankton individuals (Tabs 1, 2, Fig. 1).

Discussion

The studied water bodies in the Torres del Paine National Park are heterogeneous in their trophic status, morphometrics and zooplankton assemblages (Fig. 1).

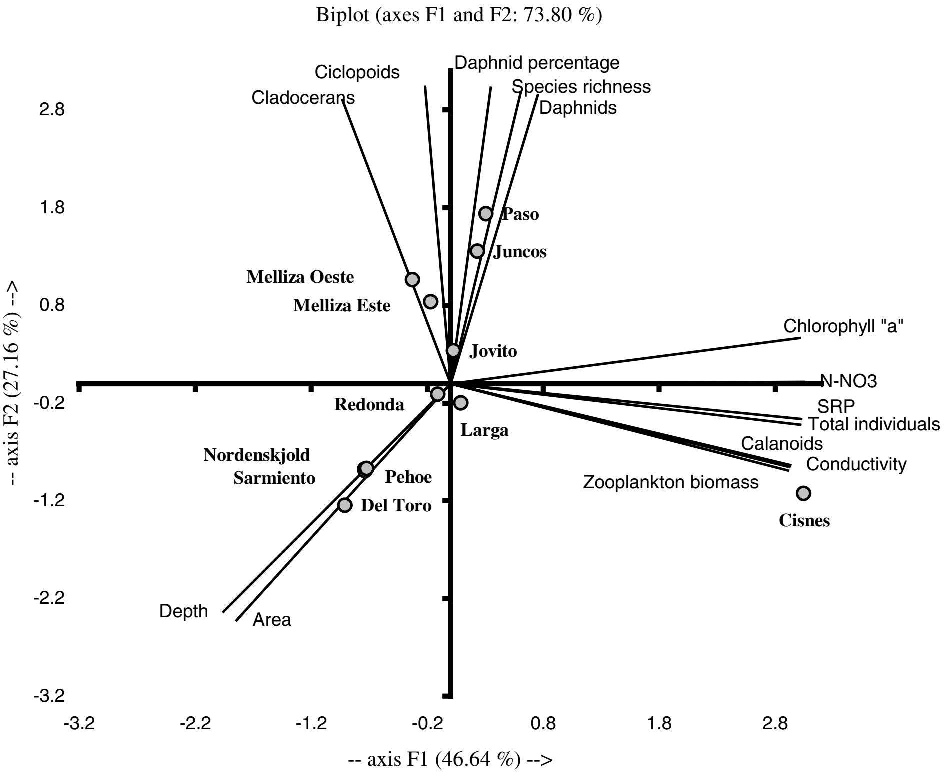

Fig. 1. Results of PCA for the studied sites (in bold).

Table 4. Percentage of contribution of different variables to PCA.

	F1	F2
Area	2.451	7.278
Depth	4.715	11.544
Conductivity	13.966	1.951
Chlorophyll-a	12.331	0.511
SRP	9.270	0.229
N-NO$_3$	13.926	0.001
Number of species	0.806	21.164
Percentage of daphnids abundance	0.140	17.988
Total individuals abundance	14.455	0.494
Zooplankton biomass	13.669	2.017
Daphnids abundance	0.326	13.471
Cladocerans abundance	0.248	4.135
Calanoids abundance	13.646	2.205
Cyclopoids abundance	0.051	17.011

The deep lakes are similar to Araucanian lakes, because the large lakes of Torres del Paine are oligotrophic with relatively low zooplankton biomass, low number of species and notorious calanoid dominance (Tab. 1, Fig. 1) (CAMPOS, 1984; SOTO & ZUNIGA, 1991; CAMPOS et al., 1994a, b; WÖLFL, 1996; DADAY, 1902b). In spite of the relatively high nutrient concentration, the large and deep lakes have a large mixing depth of approximately 75 m (CAMPOS et al., 1994a, b; SOTO, 2002) which causes a low chlorophyll-a concentration (SOTO, 2002; DE LOS RIOS, 2003). Low chlorophyll-a concentrations can be regarded as a cause of high abundance of calanoids, as these taxa are tolerant to oligotrophic conditions (STERNER & HESSEN, 1994, Tab. 1). This scenario is similar to that observed in large and deep lakes of S Argentinean Patagonia, where calanoids graze mainly on ciliates, diatoms and phytoflagellates (MODENUTTI et al., 1998a, b; BALSEIRO et al., 2001). Oligotrophy could also explain the low species diversity in the studied lakes (SOTO & ZUNIGA, 1991; Tab. 1). These lakes are full of zooplanktivorous fishes, such as *Galaxias* spp., and introduced salmonids (SOTO et al., 1994). However, relatively few studies have suggested that calanoids are important prey for fish of the *Galaxias* genus that live in the littoral zones (MODENUTTI et al., 1998a, b). There is no information about wild diets of the salmonids in Chilean water bodies. Nevertheless, salmonids probably predate mainly on benthic macroinvertebrates in these water bodies (SOTO & CAMPOS, 1995). Small lakes with fishes are mesotrophic and are characteristic of high daphnid abundance (Tab. 1; Fig. 1) due to a low mixing depth (SOTO, 2002; DE LOS RIOS, 2003) that leads to high chlorophyll-a concentration (SOTO, 2002; DE LOS RIOS, 2003). Consequently, in conditions of increasing chlorophyll concentration, cladocerans would increase their abundance (VILLALOBOS, 2002) and, in comparison with oligotrophic sites, relatively more species would be possible (SOTO & ZUNIGA, 1991; DE LOS RIOS, 2003). Finally, a different situation can be observed in fishless ponds (Tab. 1), because in these water bodies with a relatively high number of species (Tab. 1, Menu-Marque et al., 2000; De los Rios 2005a, b; Modenutti et al., 1998a, b), the conductivity variation can be an important regulator of the structure of zooplankton assemblages, especially species diversity and number of species (Williams, 1998). In some of the water bodies, such as the ponds Paso and Juncos, high species diversity and high daphnid abundances were observed (Tab. 1). These were associated with high chlorophyll concentration and low or moderate conductivity (Tabs 1, 2, Fig. 1) and with similar results to the first studies of lakes of this type in S Patagonia (Ekman, 1900; Daday, 1902a, b). An opposite situation was observed in the other sites without fishes with moderate to high conductivity values, that had high calanoid dominance (Tabs 1, 2, Fig. 1).

The results obtained demonstrate an important impact of chlorophyll-*a* concentration on daphnid abundance (Fig. 1) as found by De los Rios & Soto (2005) and Sterner & Hessen (1994). Conductivity also had a key role (Fig. 1), as indicated by the high mineral concentrations, and might be inversely associated with daphnid representation and number of species (De los Rios, 2005b; De los Rios & Crespo, 2004; Fig. 1). Our results also agree with early data of Ekman (1900) and Daday (1902a), and recent descriptions from S Argentina (Adamowicz et al., 2004) who reported the presence of permanent high daphnid abundances in S Patagonia shallow ponds. The pattern, where conductivity and high mineral contents are key regulators of zooplankton assemblages (Fig. 1), is similar to water bodies of Andes Mts of N Chile (Campos et al., 1996; De los Rios & Crespo, 2004; De los Rios, 2005b).

Acknowledgements

The field work on the present study was conducted with the support of grant No. 817-88 of Found for Science and Technology (FONDECYT-Chile). We express our gratitude to L. Zuniga for logistic help, and to H. Campos, who died in 1998 during the field work, and whose contribution to the present study was very important. This publication is dedicated to the memory of H. Campos, and his pioneer research on Chilean limnology. The study was partly supported by projects IAI (Enhanced ultraviolet B radiation in natural ecosystems as an added perturbation due to ozone depletion), CONICYT (Scholarship supporting doctoral thesis), the Direction Research and Development (DID-UACH D2001-11) of the Austral University of Chile, and the General Research Direction of the Catholic University of Temuco. Finally, we express our gratitude to F. Rodriguez for his valuable assistance in statistical procedures.

References

Adamowicz, S.J., Hebert, P.D.N. & Marinone, M.C. 2004. Species diversity and endemism in the *Daphnia* of Argentina: a genetic investigation. Zool. J. Linn. Soc. **140:** 171–205.

Araya, J.M. & Zuñiga, L.R. 1985. Manual taxonómico del zooplancton lacustre de Chile. Copepods. Boletín Limnológico, Universidad Austral de Chile, Valdivia 8, 169 pp.

Balseiro, E.G., Modenutti, B.E. & Queimaliños, C.P. 2001. Feeding of *Boeckella gracilipes* (Copepoda, Calanoida) on ciliates and phytoflagellates in an ultraoligotrophic Andean lake. J. Plankon Res. **23:** 849–857.

Bayly, I.A.E. 1992. Fusion of the genera *Boeckella* and *Pseudoboeckella* (Copepoda) and revision of their species from South America and sub-Antartic islands. Rev. Chil. Hist. Nat. **65:** 17–63.

Campos, H. 1984. Limnological study of Araucanian lakes (Chile). Verh. Int. Verein. Theor. Angew. Limnol. **22:** 1319–1327.

Campos, H., Soto, D., Parra, O., Steffen, W. & Agüero, G. 1996. Limnological studies of Amarga Lagoon, Chile: a saline lake in Patagonian South America. Int. J. Sal. Lake Res. **4:** 301–314.

Campos, H., Soto, D., Steffen, W., Agüero, G., Parra, O. & Zúñiga, L. 1994a. Limnological studies of Lake del Toro (Chile) morphometry, physics, chemistry and plankton. Arch. Hydrobiol., Suppl. **99:** 199–215.

Campos, H., Soto, D., Steffen, W., Parra, O., Agüero, G. & Zúñiga, L. 1994b. Limnological studies of Lake Sarmiento (Chile): A subsaline lake from Chilean Patagonian. Arch. Hydrobiol., Suppl. **99:** 217–234.

Daday, E. von. 1902a. Mikroskopische Süsswassertiere aus Patagonien, gesammelt von Dr. Filippo Sylvestri. Természetrajzi Füzetek, Budapest **25:** 201–310.

Daday, E. von. 1902b. Beiträge zur Kenntniss der Süsswasser-Mikrofauna von Chile. Természetrajzi Füzetek, Budapest **25:** 436–447.

De los Rios, P. 2003. Efectos de las disponibilidades de recursos energéticos, estructurales y de protección sobre la distribución y abundancia de copépodos y cladóceros zooplanctónicos lacustres chilenos. PhD Thesis, Austral University of Chile, Science Faculty, Valdivia, 107 pp.

De los Rios, P. 2005a. Survival or pigmented freshwater zooplankton exposed to artificial ultraviolet radiation and two concentrations of dissolved organic carbon. Pol. J. Ecol. **53:** 113–116.

De los Rios, P. 2005b. Richness and distribution of zooplanktonic crustacean species in Chilean altiplanic and southern Patagonia ponds. Pol. J. Env. Stud. **14:** 817–822

De los Ríos, P. & Crespo, J. 2004. Salinity effects on *Boeckella poopoensis* abundances in Chilean Andean lakes (Copepoda, Calanoida). Crustaceana **77:** 245–253.

De los Rios, P. & Soto, D. 2005. Survival of two species of crustacean zooplankton under two chlorophyll concentrations and protection from or exposure to natural ultraviolet radiation. Crustaceana **78:** 163–169.

Ekman, S. 1900. Cladoceren aus Patagonien, gesammelt von der schwedischen Expedition nach Patagonien 1899. Zool. Jahrb. Abt. Syst., Geogr. Biol. Tiere **14:** 62–84.

Gillooly, J.F. & Dodson, S.I. 2000. Latitudinal patterns in the size distribution and seasonal dynamics of new world, freshwater cladocerans. Limnol. Oceanogr. **45:** 22–30.

Menu-Marque S., Morrone, J.J. & Locascio de Mitrovich, C. 2000. Distributional pattern of the South American species of *Boeckella* (Copepoda: Centropagidae): a track analysis. J. Crust. Biol. **20:** 262–272.

Modenutti, B.E., Balseiro, E.G., Queimaliños, C.P., Suarez, D.A., Dieguez, M.C. & Albariño, R.J. 1998a. Structure and dynamics of food webs in Andean lakes. Lakes and Reservoirs: Res. Manag. **3:** 179–186.

Modenutti, B.E., Balseiro, E.G., Dieguez, M.C., Queimaliños, C.P. & Albariño, R.J. 1998b. Heterogeneity of freshwater Patagonian ecosystems. Ecol. Austral **8:** 155–165.

Soto, D. 2002. Oligotrophic patterns in southern Chile lakes: the relevance of nutrients and mixing depth. Rev. Chil. Hist. Nat. **75:** 377–393.

Soto, D. & Campos, H. 1995. Los lagos oligotróficos del bosque templado húmedo del sur de Chile, pp. 134–148. In: Armesto, J., Khalin, M. & Villagrán, M. (eds) Ecología del bosque Chileno, Editorial Universitaria, Santiago de Chile.

Soto, D., Campos, H., Steffen, W., Parra, O. & Zúñiga, L. 1994. The Torres del Paine lake district (Chilean Patagonia): A case of potentially N-limited lakes and ponds. Arch. Hydrobiol. **99:** 181–197.

Soto, D. & Zúñiga, L. 1991. Zooplankton assemblages of Chilean temperate lakes: a comparison with North American counterparts. Rev. Chil. Hist. Nat. **64:** 569–581.

Sterner, R.W. & Hessen, D.O. 1994. Algal nutrient limitation and nutrition of aquatic herbivores. Ann. Rev. Ecol. Syst. **25:** 1–29.

Villalobos, L. 2002. Comparison of the filtration structures in South American Daphnia. Arch. Hydrobiol. **154:** 647–663.

Williams, W.D. 1998. Salinity as a determinant of the structure of biological communities in salt lakes. Hydrobiologia **381:** 191–201,

Wölfl, S. 1996. Untersuchungen zur Zooplanktonstruktur einschliesslich der mikrobiellen Gruppen unter besonderer Berücksichtigung der mixotrophen Cilliaten in zwei südchilenischen Andenfubseen. Universität Konstanz, Hartung-Gorre Verlag, Deutschland, 242 pp.

Received June 21, 2005
Accepted December 13, 2005