

A NULL MODEL FOR EXPLAIN CRUSTACEAN ZOOPLANKTON SPECIES ASSOCIATIONS IN CENTRAL AND SOUTHERN PATAGONIAN INLAND WATERS.

UN MODELO NULO PARA EXPLICAR LAS ASOCIACIONES DE ESPECIES DE CRUSTÁCEOS
ZOOPLANCTÓNICOS EN AGUAS INTERIORES DE LA PATAGONIA CENTRAL Y SUR.

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ABSTRACT

The zooplankton assemblages in water bodies of central and southern Chilean Patagonia, is characterized by high endemism and a relative low species richness, the main regulator factor would be the conductivity and trophic status of their habitats. The aim of the present study was analyze published and unpublished information about crustacean zooplankton in central and southern Chilean Patagonian lakes and ponds (44 - 53° S). To these data was applied the species/genera ratio, and also, a null model analysis for species co-occurrence, based in a presence-absence species matrix, for determine the existence of random factors as regulator factors of species associations. Finally, it was applied a Jaccard Index for determine potential similarities in species associations for site. The results revealed low species number in large and deep lakes, whereas in small shallow permanent and ephemeral ponds had high species number, and low values in the species genera/ratio. The results of null model revealed the absence of random factors as regulators of species associations for two of three simulations, and the results of Jaccard Index denoted the existence of three main groups based in the species associations of sites. These results agree with ecological information for southern Patagonia. Ecological and biogeographical topics are discussed.

Key words: zooplankton, *Boeckella*, *Branchinecta*, *Daphnia*, lakes, ponds, null model.

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RESUMEN

Los ensambles zooplanctónicos en cuerpos de agua de la zona centro y sur de la Patagonia chilena se caracterizan por su alto endemismo y un relativo bajo número de especies, lo cual se debería principalmente a la oligotrofia y niveles de conductividad de estos ambientes. El objetivo del presente trabajo consistió en analizar información publicada y sin publicar sobre crustáceos zooplanctónicos en lagos y lagunas de la zona central y sur de la Patagonia (44 - 53° S). A estos datos se les estimó la razón especies/género, y se aplicó un modelo nulo basado en co-ocurrencia de especies mediante una matriz de presencia y ausencia de especies, con la intención de determinar ausencia de factores reguladores de las asociaciones de especies. Dentro de este mismo contexto, se aplicó un índice de Jaccard para determinar potenciales similitudes entre las asociaciones de especies por sitio.

Los resultados revelaron que hubo un bajo número de especies en lagos grandes y profundos, mientras que en lagunas pequeñas someras, ya sea temporales o permanentes, hubo un alto número de especies, y un bajo valor de la razón especies/género. Los resultados del modelo nulo revelaron la ausencia de factores aleatorios como reguladores de las asociaciones de especies en dos de tres simulaciones. Los resultados del índice de Jaccard indicaron la existencia de grupos marcados de sitios sobre la base de las especies reportadas en cada uno. Estos resultados concordarían con información ecológica para el sur de la Patagonia. Se discutieron tópicos de ecología y biogeografía.

Palabras clave: zooplancton, *Boeckella*, *Branchinecta*, *Daphnia*, lagos, lagunas, modelo nulo.

INTRODUCTION

The zooplankton assemblages in lakes and ponds in central and southern Patagonia (44 – 53° S), has different patterns, due the heterogeneity of water bodies, based in studies of water bodies of Torres del Paine National Park, we have first low species richness in oligotrophic large and deep lakes, and second high species richness in small lakes and shallow ponds (Soto 1990, De los Ríos 2003¹, Soto & De los Ríos 2006). The studies for water bodies of Torres del Paine National Park, denoted that the zooplankton species associations are regulated by conductivity and the trophic status (Soto & De los Ríos 2006). This pattern is similar with descriptions for lakes and ponds in Argentinean Patagonia (Modenutti *et al.* 1998), and with descriptions of New Zealand lakes and ponds (Jeppensen *et al.* 1997, 2000). These observations are markedly opposed to Europa and North America, that have high number of species, that is directly associated with surface (Dodson 1992), and with marked dominance of daphnids cladocerans (Gillooly & Dodson 2000).

On this view point the zooplankton assemblages are not random, this is that the regulator factors are deterministic. The absence of regulator factors, this is random distribution in species co-occurrence is the basis of null models, one of these models, used presence and absence of species for determine the absence of deterministic factors as regulator of species co-occurrence (Gotelli 2000, 2001, Abelha *et al.* 2006; Rodríguez-Fernández *et al.* 2006; Segurado & Figueredo 2007). These null models are more robust in comparison with deterministic models (Gotelli 2000, 2001). The aim of the present study is apply a null model analysis based in a presence-absence species matrix for determine the absence regulator factors for explain species associations in zooplankton of central and southern Patagonian lakes and ponds.

MATERIAL AND METHODS

Information for species associations in central and southern Patagonian lakes and ponds was obtained from literature (Villalobos 1999², De los

¹ De los Ríos, 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: 1-107. (PhD. Thesis, Austral University of Chile, Valdivia).

² Villalobos, L. 1999. Determinación de capacidad de carga y balance de fósforo y nitrógeno de los lagos Riesco, Los Palos y Laguna Escondida en la XI región. Informe Técnico, Fondo de Investigación Pesquera, Chile FIP-IT/97-39.

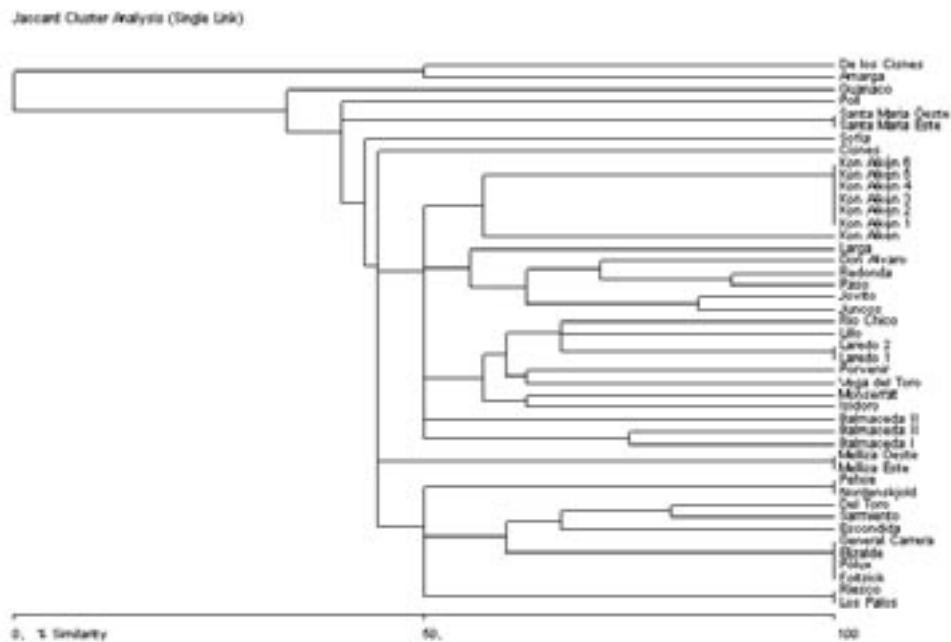


Fig. 1: Dendrogram of Jaccard index for studied sites.

Ríos 2005, Soto & De los Ríos 2006, De los Ríos & Soto 2007, De los Ríos *et al.*, in press-1³, Rogers *et al.* In press⁴), also, information obtained in field works in October 2001, October 2006 and April 2007 was included. For field work, the zooplankton was collected using horizontal hauls in shallow ponds, whereas in small lakes, and large and deep lakes, the zooplankton was collected by vertical hauls from a boat, for both procedures, were used an Apstein net of 20 cm diameter and 100 μ m mesh size. Zooplankton specimens were fixed with absolute ethanol, and identified with specialized literature (Araya & Zúñiga 1985, Reid 1985, Bayly 1992a,b, Paggi 1999, De los Ríos & Zúñiga 2000, Brtěk & Mura 2000). To this information was applied for each site the species/genera ratio (Gotelli 2000, 2001).

The comparison of the dataset gathered is useful to test the hypothesis that species reported are non randomly associated. For this, we use the “C score” index (Stone & Roberts 1990), which determines the co-occurrence based on presence (1)-absence (2) matrices for a zooplankton species in the sample. Following Gotelli (2000) and Tiho

& Johens (2007) the presence/absence matrix was analysed as follows: (a) fixed-fixed: In this algorithm, the row and the column sums of the original matrix are preserved. Thus each random community contains the same number of species as the original community (fixed column), and each species occurs with the same frequency as in the original community (fixed row). In this instance, it is not prone to type I errors (falsely rejecting the null hypothesis) and has a good power for detecting non-randomness (Gotelli 2000, Tiho & Johens 2006). (b) fixed-equiprobable: In this simulation, only the row sums are fixed, whereas the columns are treated as equiprobable. This null model treats all the samples (columns) as equally suitable for all species (Tiho & Johens 2006, Gotelli 2000). (c) fixed-proportional in this algorithm, the species occurrence totals are maintained as in the original community, and the probability that a species occurs in a sample (= column) is proportional to the column total for that sample (Gotelli 2000, Tiho & Johens 2006, Tondoh 2007). Data were analysed with Ecosim program version 7.0 (Gotelli & Entsminger 2001). Finally, it was applied a Jaccard index for determine the similarities between studied sites (Gotelli & Graves 1996, Frutos 1998), this analysis was applied using the software Biodiversity Pro.

³ De los Ríos *et al.* In press-1. *Branchinecta gaini* (Daday, 1910) (Branchiopoda, Anostraca) as a bioindicator of oligotrophic and low conductivity shallow ponds in southern Chilean Patagonia. *Crustaceana*.

⁴ Rogers *et al.* In press. The fairy shrimp (Crustacea, Branchiopoda, Anostraca) of Chile. *Journal Crustacean Biology*.

TABLE 1. Geographical location, surface, maximum depth, number of species and species – genera ratio for studied sites.

Name	Kind of site	Geographical location	Surface (km ²)	Depth (m)	Number of species	S/G	Reference
Los Palos	Small lake	45° 19' S – 72° 42' W	5,0	59	4	1,00	Villalobos (1999) ²
Foitzick	Small lake	45° 38' S – 72° 05' W	1,0	2	3	1,00	De los Ríos, field works 2001
Pólux	Small lake	45° 40' S – 71° 52' W	9,0	No data	4	1,00	De los Ríos, field works 2001
Riesco	Lake	45° 46' S – 72° 20' W	147,0	130	4	1,00	Villalobos (1999) ²
Elizalde	Lake	45° 47' S – 72° 11' W	30,0	130	4	1,00	De los Ríos & Soto (2007)
Escondida	Small lake	45° 49' S – 72° 40' W	7,0	43	5	1,00	Villalobos (1999) ²
Balmaceda I	Permanent pond	45° 53' S - 71°40' W	< 0,1	1	5	1,25	De los Ríos, field works 2001
Balmaceda II	Ephemeral pond	45° 53' S - 71°40' W	< 0,1	1	8	1,60	De los Ríos, field works 2001
Balmaceda II	Ephemeral pond	45° 53' S - 71°40' W	< 0,1	1	8	1,60	De los Ríos, field works 2001
General Carrera	Lake	46° 18' S – 71° 56' W	1892,0	410	4	1,00	De los Ríos, field works 2001
Amarga	Permanent pond	50° 29' S – 72°45' W	6,0	3	1	1,00	Campos et al (1996)
Isidoro	Permanent pond	50° 57' S – 72°53' W	< 0,1	2	6	1,20	De los Ríos (2005)
Juncos	Permanent pond	51° 01' S – 72° 52' W	< 0,1	3	6	1,20	Soto & De los Ríos (2006)
Jovito	Permanent pond	51° 01' S – 72° 54' W	< 0,1	3	6	1,20	Soto & De los Ríos (2006)
Paso	Permanent pond	51° 01' S – 72° 55' W	< 0,1	3	7	1,40	Soto & De los Ríos (2006)
Redonda	Permanent pond	51° 01' S – 72° 52' W	< 0,1	3	8	1,33	Soto & De los Ríos (2006)
Larga	Permanent pond	51° 01' S – 72° 52' W	0,1	5	6	1,00	Soto & De los Ríos (2006)
Cisnes	Permanent pond	51° 01' S – 72° 52' W	< 0,1	1	7	1,40	Soto & De los Ríos (2006)
Don Alvaro	Permanent pond	51° 01' S – 72° 52' W	< 0,1	2	7	1,40	De los Ríos (2005)
Guanaco	Permanent pond	51° 01' S – 72° 50' W	< 0,1	2	7	1,40	De los Ríos (2005)
Melliza Este	Small lake	51° 03' S – 72° 57' W	0,1	16	9	1,80	Soto & De los Ríos (2006)
Melliza Oeste	Small lake	51° 03' S – 72° 57' W	0,1	25	9	1,80	Soto & De los Ríos (2006)
Sarmiento	Lake	51° 03' S – 72° 37' W	86,0	114	4	1,33	Soto & De los Ríos (2006)
Nordenskjold	Lake	51° 07' S – 72° 56' W	25,0	104	4	1,33	Soto & De los Ríos (2006)
Pehoe	Lake	51° 07' S – 72° 56' W	15,0	200	4	1,33	Soto & De los Ríos (2006)
Monserrat	Permanent pond	51° 07' S – 72° 47' W	< 0,1	2	7	1,75	De los Ríos (2005)
Vega del Toro	Ephemeral pond	51° 07' S – 71° 40' W	< 0,1	1	8	1,33	De los Ríos (2005)
Del Toro	Lake	51° 12' S – 72° 38' W	196,0	154	5	1,25	Soto & De los Ríos (2006)
Sofia	Small lake	51° 30' S – 72° 40' W	9,0	40	4	1,00	Cañete (1999)
Kon Aikén	Ephemeral pond	52° 50' S – 71° 10' W	< 0,1	1	7	1,17	De los Ríos (2005)
Kon Aikén I	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Kon Aikén II	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Kon Aikén III	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Kon Aikén IV	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Kon Aikén V	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Kon Aikén VI	Ephemeral pond	52° 51' S - 70° 55' W	< 0,1	1	4	1,00	De los Ríos, field works, 2006
Laredo I	Permanent pond	52° 57' S - 70° 49' W	< 0,1	1	3	1,00	De los Ríos, field works, 2006
Laredo II	Permanent pond	52° 57' S - 70° 49' W	< 0,1	1	3	1,00	De los Ríos, field works, 2006
Río Chico	Permanent pond	53° 06' S - 70° 53' W	< 0,1	1	3	1,00	De los Ríos, field works, 2006
De los Cisnes	Permanent pond	53° 14' S – 70° 00' W	6,0	2	2	1,00	De los Ríos (2005)
Porvenir	Permanent pond	53° 17' S – 70°19' W	< 0,1	1	5	1,00	De los Ríos (2005)
Lillo	Permanent pond	53° 21' S - 70°19' W	< 0,1	1	2	1,00	De los Ríos, field works, 2007
Santa María Este	Ephemeral pond	53° 22' S - 70°20' W	< 0,1	1	2	1,00	De los Ríos, field works, 2007
Santa María Oeste	Ephemeral pond	53° 22' S - 70°20' W	< 0,1	1	2	1,00	De los Ríos, field works, 2007
Poll	Permanent pond	53° 23' S - 70°19' W	< 0,1	1	2	1,00	De los Ríos, field works, 2007

RESULTS AND DISCUSSION

The results denoted low species richness in large and deep lakes, whereas in small lakes, shallow permanent and temporal ponds a high number of species were reported (Table 1). For large and deep lakes, and small lakes, the most representative species were *Boeckella gracilipes* (Daday, 1902), *B. michaelsoni* (Mrázek, 1901), *Daphnia pulex* (Scourfield, 1877), and *Ceriodaphnia dubia* (Richard, 1894) (Table 2). Whereas for shallow temporal and permanent pond the most representative species were *B. gracilipes*, *B. michaelsoni*, *B. poppei* (Mrázek, 1901), *Parabroteas sarsi* (Mrázek, 1901) and *D. dadayana* (Paggi, 1999) (Table 2), an important situation was reported in few shallow temporal ponds, that have the presence of *Branchinecta* genera (Table 2). Finally, also, the presence of brine shrimps *Artemia persimilis* (Piccinelli & Prosdocimi, 1968), were reported in two saline lakes (Table 2). The species observed in the present study, included some wide spread species such as *B. gracilipes*, *D. pulex* and *C. dubia*, and endemic species such as *B. poppei*, *P. sarsi* and *D. dadayana*, a particular situation is the presence of the halophilic calanoid copepod *B. poopoensis* (Marsh, 1906) (Table 2). The values of species genera ratio was low (Table 1), this is due probably to low species number. The results of null model analysis revealed the presence of regulator factors of species associations for fixed-fixed and fixed-proportional simulations, whereas for fixed-equiprobable simulations it denoted the absence of regulator factors, this is random distribution as cause of species association reported (Table 3). The results of Jaccard index denoted the existence of three main groups, a first group that joined large lakes and small lakes with few species number, a second group main joined with shallow ephemeral and permanent ponds with high species number, and a third group that included only Amarga and De los Cisnes lagoons, that are the hyper saline habitats of studied zone (Fig. 1). This results of Jaccard index support the results of null models, first the results of fixed-fixed and fixed-proportional simulations, that denote presence of regulator factors, agree with the results of Jaccard, where it is possible found different groups in according to species associations. Second, the results of fixed-equiprobable simulation that denote the absence of regulator factors for explain species

TABLE 2. Results of null model analysis for studied sites. "P" values lower than 0.05, denoted presence of non random factors as regulator of species association.

	Observed index	Mean index	Standard Effect Size	P
Fixed-Fixed	30,593	28,924	7,703	< 0,001
Fixed-Proportional	30,593	26,570	3,264	< 0,001
Fixed-Equiprobable	30,593	30,828	-0,870	0,192

associations, would be caused due the occurrence of determined species that were reported in many of the studied sites, in example *B. michaelsoni* or *B. poppei* (Table 2; De los Ríos *et al.*, In press-2⁵, In press-3⁶).

The results obtained in the present study that denoted the absence of species associations in both simulation of null models, would agree with descriptions for zooplankton assemblages in lakes and ponds of Torres del Paine National Park, that described the important role of conductivity and trophic status as main regulator of zooplankton assemblages (Soto & De los Ríos 2006). This description would be similar to Argentinean Patagonia (Campos *et al.* 1994a,b, Modenutti *et al.* 1998). The zooplankton assemblages in water bodies of Argentinean and Chilean Patagonia, is characterized by the high predominance of calanoids copepods (Soto & Zúñiga 1991, Modenutti *et al.* 1998, Soto & De los Ríos 2006, De los Ríos & Soto 2006). If we consider the importance of calanoids copepods in the zooplankton assemblages, there are two main groups, first, small and gracile species such as *B. gracilipes* and *B. michaelsoni*, that has been reported for large and deep lakes and small lakes and some times in shallow ponds (Bayly 1992a, Menu-Marque *et al.* 2000, Soto & De los Ríos 2006). The second group included large and stout species such as *B. brasiliensis* (Lubbock, 1855), *B. poppei* and *P. sarsi* that inhabits in small shallow permanent and temporal ponds (Bayly 1992a, Menu-Marque *et al.* 2000, Soto & De los Ríos 2006), this last pattern of zooplankton assemblage has been reported for sub-antarctic island (Hannson *et al.* 1996, Pugh *et al.* 2002, Dartnall 2005). If it is

⁵ De los Ríos, P., N. Rivera & M. Galindo (In press-2). The use of null models to explain zooplankton species associations in shallow water bodies of the Magallanes region, Chile. *Crustaceana*.

⁶ De los Ríos, P., P. Acevedo, R. Rivera & G. Roa (In press-3). Comunidades de crustáceos litorales de humedales del norte de la Patagonia chilena (38° S): rol potencial de la exposición a la radiación ultravioleta. En: Efecto de los cambios globales en la diversidad. Programa CYTED Red 406RT0285.

TABLE 3. Presence-absence species matrix for studied sites.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Copepoda, Calanoida																
<i>Boeckella brasiliensis</i> (Lubbock, 1855)																
<i>B. brevicaudata</i> (Brady, 1875)								X								
<i>B. gracilipes</i> (Daday, 1902)	X			X		X	X		X							
<i>B. meteoris</i> (Kiefer, 1928)																
<i>B. michaelseni</i> (Mrázek, 1901)		X	X		X					X		X	X	X		
<i>B. poopoensis</i> (Marsh, 1906)																
<i>B. poppei</i> (Mrázek, 1901)							X	X	X			X				
<i>Parabroteas sarsi</i> (Mrázek, 1901)	X			X			X	X	X							
Copepoda, Cyclopoida																
<i>Acantocyclops vernalis</i> (Fisher, 1853)						X										
<i>Mesocyclops longisetus</i> (Thiebaud, 1914)																
<i>Tropocyclops prasinus</i> (Fisher, 1960)	X	X	X	X	X	X				X						
<i>Microcyclops</i> sp.																
Unidentified cyclopoida							X	X	X			X	X	X		
Unidentified harpacticoida																
Branchiopoda, Anostraca																
<i>Artemia persimilis</i> (Piccinelli & Prosdocimi, 1968)											X					
<i>Branchinecta gaini</i> (Daday, 1902)																
<i>B. granulosa</i> (Daday, 1902).																
<i>B. vuriloche</i> (Cohen, 1985)							X	X	X							
Branchiopoda, Cladocera																
<i>Daphnia ambigua</i> (Scourfield, 1967)									X							
<i>D. dadayana</i> (Paggi, 1999)							X		X			X				
<i>D. obtusa</i> (Kurz, 1874)													X	X		
<i>D. pulex</i> (Scourfield, 1877)							X						X	X		
<i>Ceriodaphnia dubia</i> (Richard, 1894)						X										
<i>Neobosmina chilensis</i> (Daday, 1902)	X	X	X	X	X	X				X				X		
<i>Chydurus sphaericus</i> (O.F. Müller, 1785)																
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Copepoda, Calanoida																
<i>Boeckella brasiliensis</i> (Lubbock, 1855)												X				
<i>B. brevicaudata</i> (Brady, 1875)																X
<i>B. gracilipes</i> (Daday, 1902)	X	X			X		X	X	X					X	X	
<i>B. meteoris</i> (Kiefer, 1928)				X												
<i>B. michaelseni</i> (Mrázek, 1901)							X	X	X	X	X	X	X	X		
<i>B. poopoensis</i> (Marsh, 1906)				X		X										
<i>B. poppei</i> (Mrázek, 1901)	X	X	X			X						X	X			X
<i>Parabroteas sarsi</i> (Mrázek, 1901)		X	X	X									X			X
Copepoda, Cyclopoida																
<i>Acantocyclops vernalis</i> (Fisher, 1853)							X	X								
<i>Mesocyclops longisetus</i> (Thiebaud, 1914)							X	X	X	X	X			X		
<i>Tropocyclops prasinus</i> (Fisher, 1960)									X					X		
<i>Microcyclops</i> sp.			X													
Unidentified cyclopoida	X	X		X								X	X		X	X
Unidentified harpacticoida																
Branchiopoda, Anostraca																
<i>Artemia persimilis</i> (Piccinelli & Prosdocimi, 1968)																
<i>Branchinecta gaini</i> (Daday, 1902)																X
<i>B. granulosa</i> (Daday, 1902).													X			
<i>B. vuriloche</i> (Cohen, 1985)																
Branchiopoda, Cladocera																
<i>Daphnia ambigua</i> (Scourfield, 1967)																
<i>D. dadayana</i> (Paggi, 1999)				X								X	X			X
<i>D. obtusa</i> (Kurz, 1874)	X	X	X		X											
<i>D. pulex</i> (Scourfield, 1877)	X	X			X		X	X					X			
<i>Ceriodaphnia dubia</i> (Richard, 1894)							X	X				X				
<i>Neobosmina chilensis</i> (Daday, 1902)	X	X	X	X	X		X	X	X						X	X
<i>Chydurus sphaericus</i> (O.F. Müller, 1785)	X	X	X		X		X	X				X	X			

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Copepoda, Calanoida															
<i>Boeckella brasiliensis</i> (Lubbock, 1855)															
<i>B. brevicaudata</i> (Brady, 1875)															
<i>B. gracilipes</i> (Daday, 1902)															
<i>B. meteoris</i> (Kiefer, 1928)															
<i>B. michaelsoni</i> (Mrázek, 1901)															
<i>B. poopoensis</i> (Marsh, 1906)															
<i>B. poppei</i> (Mrázek, 1901)	X	X	X	X	X	X	X	X	X		X	X	X	X	
<i>Parabroteas sarsi</i> (Mrázek, 1901)	X	X	X	X	X	X					X				
Copepoda, Cyclopoida															
<i>Acantocyclops vernalis</i> (Fisher, 1853)															
<i>Mesocyclops longisetus</i> (Thiebaud, 1914)															
<i>Tropocyclops prasinus</i> (Fisher, 1960)															
<i>Microcyclops</i> sp.										X					
Unidentified cyclopoida											X		X	X	X
Unidentified harpacticoida											X				
Branchiopoda, Anostraca															
<i>Artemia persimilis</i> (Piccinelli & Prosdocimi 1968)											X				
<i>Branchinecta gaini</i> (Daday, 1902)	X	X	X	X	X	X									
<i>B. granulosa</i> (Daday, 1902).															
<i>B. vurioloche</i> (Cohen, 1985)															
Branchiopoda, Cladocera															
<i>Daphnia ambigua</i> (Scourfield, 1967)															
<i>D. dadayana</i> (Paggi, 1999)	X	X	X	X	X	X	X	X	X		X	X			X
<i>D. obtusa</i> (Kurz, 1874)															
<i>D. pulex</i> (Scourfield, 1877)															
<i>Ceriodaphnia dubia</i> (Richard, 1894)															
<i>Neobosmina chilensis</i> (Daday, 1902)															
<i>Chydorus sphaericus</i> (O.F. Müller, 1785)							X	X			X				

considered this habitat heterogeneity it is possible denote the presence of bio-indicator species such as fairy shrimps, that would be indicators of low conductivity and oligotrophic water bodies (De los Ríos & Rivera 2007), also, other important species is *A. persimilis* that inhabits at hipersaline water bodies (Campos *et al.* 1996).

The role of salinity as determining the zooplankton structure has been reported for lakes and ponds of northern Chilean and surrounding zones, that denoted the existence of two main species, first *B. poopoensis* that inhabits at salinity lower than 90 g/l, and second species is *A. franciscana* (Kellog, 1906) that inhabit at salinity upper than 90 g/l (Hurlbert *et al.* 1984, 1986, Williams *et al.* 1995, De los Ríos & Crespo 2004, De los Ríos 2005, De los Ríos & Contreras 2005). Nevertheless, in Altiplanic water bodies both species are practically exclusive component in zooplankton assemblages, this is a different situation, because the low salinity observed in southern Patagonian plains, allow the existence of a relative high species number at low conductivity waters (Soto & De los Ríos 2006). Also many of the studied sites are very near, and

this condition would explain the existence of similar species in many close sites (Menu-Marque *et al.* 2000, Soto & De los Ríos 2006). This last condition would explain the result of fixed-equiprobable simulation that denoted the existence of regulator factors for explain species association in studied sites (Table 3). The obtained results need confirmation, with more ecological studies for understand the zooplankton community ecology of Patagonian water bodies.

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