Macroinvertebrate communities structure in different environments of the Taim Hydrological System in the state of Rio Grande do Sul, Brazil.

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ABSTRACT: Macroinvertebrate communities structure in different environments of the Taim Hydrological System in the state of Rio Grande do Sul, Brazil. The structure and functional feeding groups of the benthic macroinvertebrate communities, from wetlands and freshwater lakes within the Taim Hydrological System, in the southern coastal zone of the state of Rio Grande do Sul - Brazil, were studied. Macroinvertebrates were collected during three sampling campaigns in summer of 2000 and winter and autumn of 2001, at seven sampling points in lakes Flores, Nicola and Jacaré and in North, Central and South areas in Mangueira Lake and at Mangueira Lake/ Taim wetland interface. The taxa composition and the community structure showed a large diversity of habitats in the system. The ANOVA test indicated that mean densities of invertebrate community and family richness was significantly higher in north and south Mangueira Lake sampling stations. The cluster analysis, based on average density values (ind/m²) and macroinvertebrate composition, defined 4 groups. Group 1, with samples from the Central Mangueira station, which distinguished itself from the other groups by the predominance of Cumacea and Oligochaeta. Group 2 was formed by sampling stations from Taim Wetlands' inner lakes, Nicola and Jacaré, presenting lower average individual densities and family richness. Group 3 joined the Lake Mangueira/Taim Wetland interface and the North Lake Mangueira sampling stations, which are characterized by the presence of Tanaidae and Corophiidae. Group 4 was formed by Flores Lake and South Mangueira Lake sampling stations, which were characterized by a greater abundance of Hidrobiidae. Functional groups composition of benthic macroinvertebrates was characterized by a predominance of gathering collectors in the sample stations that composed the groups 1, 2 and 3 and by a predominance of scrapers in the points that formed the group 4.
Key-words: macroinvertebrates, structure, functional feeding groups, wetlands, Taim Hydrological System, South Brazil.

RESUMO: Estrutura das comunidades de macroinvertebrados em diferentes ambientes do Sistema Hidrológico do Taim, Rio Grande do Sul, Brasil. O presente trabalho estuda a estrutura e os grupos tróficos funcionais de macroinvertebrados bentônicos de um conjunto de lagos na área do Sistema Hidrológico do Taim, na parte sul da região costeira do estado do Rio Grande do Sul – Brasil. Os macroinvertebrados foram coletados durante três campanhas no verão de 2000 e no inverno e outono de 2001, em uma estação amostral nos lagos: Flores, Nicola e Jacaré, nas áreas norte, central e sul da Lagoa Mangueira e na interface da Lagoa Mangueira com o subsistema do Banhado do Taim. A composição dos táxons e a estrutura das comunidades mostraram diferenças entre as estações amostrais do sistema. Os resultados do teste ANOVA indicaram que as densidades médias da comunidade de macroinvertebrados e a riqueza de famílias foram significativamente altas nas partes norte e sul da Lagoa Mangueira. A análise de agrupamento baseada nas médias de densidade (ind/m²) e composição de macroinvertebrados definiram 4 grupos. Grupo 1, constituído pela estação amostral Mangueira centro, se distinguiu dos demais grupos pela predominância de Cumacea e Oligochaeta. Grupo 2, formado pelas estações dos lagos internos do Banhado do Taim, Nicola e Jacaré, que apresentaram baixas densidades médias de indivíduos e baixa riqueza de famílias. Grupo 3, reuniu a estação de interface Lagoa Mangueira/ Banhado do Taim e a da Lagoa Mangueira norte, que foram caracterizadas pela presença de Tanaidae e Corophiidae. Grupo 4, formado pelas estações amostrais do Lagoa Flores e

da parte sul da Lagoa Mangueira, as quais foram caracterizadas por uma grande abundância de Hidrobiidae. A composição dos grupos funcionais de macroinvertebrados bentônicos foi caracterizada pela predominância de coletores de depósito nas estações amostrais que compuseram os grupos 1, 2 e 3 e pela predominância de raspadores nas estações que formaram o grupo 4.
Palavras-chave: macroinvertebrados, estrutura, grupos tróficos funcionais, terras úmidas, Sistema Hidrológico do Taim, sul do Brasil.

Introduction

Benthic macroinvertebrates are an important component of aquatic environments taking part in ecosystem processes. They play an essential role in the food chain, productivity, nutrient cycling, and decomposition. Living on and in the sediments or associated with macrophytes, the benthonic communities can exhibit different composition and functional structure as answer to biological and physicochemical variables at multiple spacial scales.

Macroinvertebrates are directly influenced by substrate type, average sediment grain size, benthic organic matter abundance, macrophytic bed composition and structure, water nutrients, dissolved oxygen level, and depth (Downing, 1991; Szalay & Resh, 1996; Würdig et al., 1998, Shieh et al., 1999 and Stewart et al., 2000). Because the environmental heterogeneity, these variables can change in the distincts areas of lakes, wetlands and streams and determining changes in the structure and distritution of macrobenthos.

Most natural ecosystems exhibit extreme heterogeneity in environmental conditions and biotic communities at multiple spacial scales, ranging from microhabitats to whole landscapes and ecoregions (Heino et al., 2004). Knowledge of the interplay between ecological scale and aquatic community composition and function are needed to detect and interpret more effectively changes in biodiversity, thus improving our awareness of ecosystem response, resistance and resilience to natural and human-induced perturbation (Johnson et al., 2004).

The present study is part of the Brazilian Program for a Long –Term Ecological Research (MCT/CNPq), site 7. The objective of this study is to investigate the invertebrate macrofauna composition and structure along the Taim Hydrological System, verifying the distribution patterns of macroinvertebrate functional feeding groups in the sampled areas, comparing the lacustrine ecosystems and transicional environments in the Taim wetland.

Study area

The Taim Hydrological System with an area of 2,254km² is located in the southern coastal zone of Rio Grande do Sul – Brazil, and makes a chain of aquatic areas characterized by wetlands and shallow freshwater lakes (Motta Marques et al., 2002). It represents an area with a great diversity of habitats, where in the northern part Flores Lake and the Taim Wetlands are covered with extensive macrophytic banks. Lakes Nicola and Jacaré are small freshwater bodies associated with the Taim Wetlands. Mangueira Lake makes up a vast extension of free waters located in the southern region of the Taim Wetlands. The northern part of this lake establishes an important interface with the wetlands, interacting in the hydrodynamic processes of the system.

Villanueva et al. (1998) recognize three subsystems: the North Subsystem, formed by Lake Caiubá, Lake Flores, and the Maçarico Wetland, which is Lake Flores influent; the Wetland Subsystem, made up of Nicola Lake, Jacaré Lake, and the Taim Wetlands; and the South Subsystem, formed by Mangueira Lake and its contributing basin. The South and Wetland Subsystems communicate by the lake-wetland interface through diffuse flow and by a channel along the federal route, BR 471. From a hydrological perspective, North Subsystem's influence on the Wetland Subsystem is minimal. Water flow in the wetland is characterized by low surface velocities due to the presence of a great quantity of macrophytes. Lakes Flores, Nicola, and Jacaré are characterized by small surface areas corresponding to 11.30km², 2.58km², and 1.45km², respectively. Average depths are around 1.68m, 1.10m and 1.57m, respectively. Lake Mangueira has a surface area of 802 km² and an average depth of 2.49m (Fig. 1).

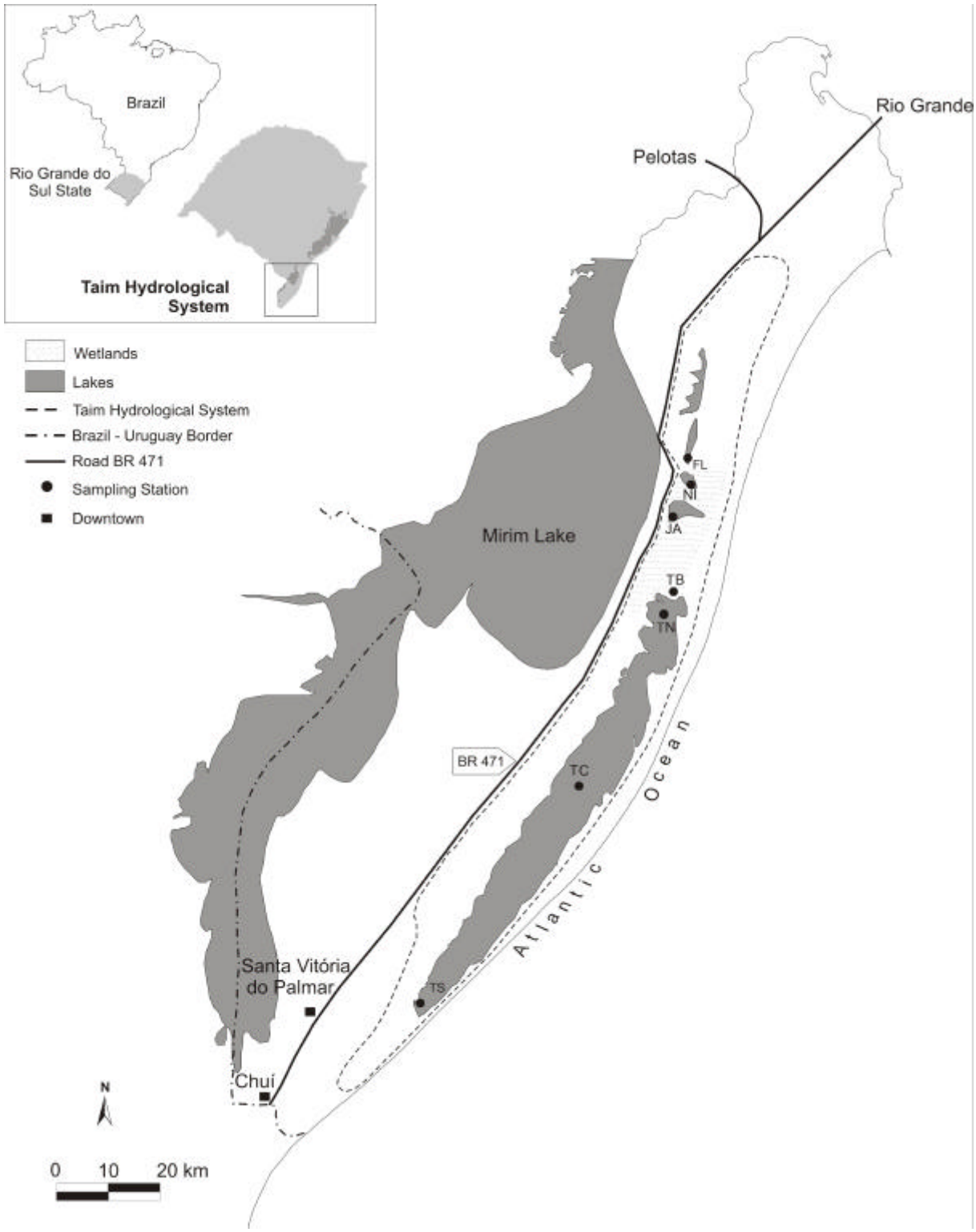


Figure 1: Study area, sampling points location, in the Taim Hydrological System, southern coast of Rio Grande do Sul, Brasil. FL= Lake Flores, NI= Lake Nicola, JA= Lake Jacaré, TB= Lake Mangueira-Banhado Taim, TN= Lake Mangueira-north, TC= Lake Mangueira-center, TS= Lake Mangueira-south.

Material and methods

Data collection

Benthic macrofauna sampling was carried out in the summer of 2000 (December), autumn 2001 (March), and winter 2001 (June), at 7 sampling points in Lakes Flores (FL), Nicola (NI), Jacaré (JA), North, Central, and South Mangueira, (TN, TC, and TS), and at the Mangueira Lake /Taim Wetland interface (TB), as displayed in Figure 1. At each area, three samples were collected for the macroinvertebrates using an Ekman Bottom Grab (wildco, 6'x6', standard). Samples were fixed in a 10% formaldehyde solution buffered with sodium borate. Then they were rinsed through a 0.250mm mesh sieve and macrofauna was preserved in 70% alcohol. Sorting and separation were carried out under a stereomicroscope. The organisms were identified at family level and when possible some groups were identified in tribes, genus or species or even morphotypes by means of taxonomic keys: Brinkhurst & Marchese (1989), Epler (2001), McCafferty (1981) and Trivinho-Strixino & Strixino (1995).

During the macrofauna sampling, simultaneous water samples were collected using a Van Dorn bottle. Water samples field handling and laboratory measures of suspended solids, chlorides, chemical oxygen demand and chlorophyll followed ASPHA (1995). Measurements of total nitrogen and total phosphorous followed Mackereth et al. (1978).

Water column depth and water transparency were measured using a depth sensor and a Secchi disc, respectively. The water pH, temperature, salinity, and dissolved oxygen were measured in the field using a YSI 6600 multiprobe.

Data analyses

Individuals' average density (ind/m^2) and relative abundance (%) was carried out based on a bottom-grab area of 332 cm^2. Richness (S), diversity (H') and equitability (J) were calculated for the number of families present in the sampling areas, employing the statistics program PRIMER version 5.2.9. (Clarke & Warwick, 2001). The Shannon-Weaver (H') diversity index is calculed with natural logarithm (nl), and employing the statistics program PRIMER version 5.2.9.

Variance analysis (ANOVA) was applied between the sample points and seasons, taking into consideration the macrofauna mean density transformed by log (x+1), Richness family (S), Shannon-Wiener diversity (H') and Pielou equitability (J). The test of Scheffé was applied when significant differences were detected ($p<0.05$), by STATISTIC ® program 5.0 version.

Statistical treatment was carried out using the average individuals density (ind/m^2) undergoing a logarithmic transformation. The Bray-Curtis dissimilarity measure was chosen for determining the presence or absence of families in the study area, as well as their quantitative extension (Legendre & Legendre, 1998). The hierarchical grouping analysis through the Unweighted Pair Group Method with Arithmetic Mean (UPGMA) was carried out for the distribution analysis of the benthos macrofauna, with the help of the statistical program PRIMER version 5.2.9. (Clarke & Warwick, 2001). From the groups obtained in the Cluster analysis were calculated the percentual of functional feeding groups of the community of benthic macroinvertebrates.

Results

Environmental variables

Physical and chemical parameters were recorded at the 7 sampling points in the Taim Hydrological System during autumn 2001(March) and winter 2001(June). In summer of 2000 only biotic data was collected. Temperatures during the autumn fluctuated around 23°C, dropping to 12°C in winter. Dissolved oxygen values remained high, with saturation over 80% at all collection points and pH remained above 7. In autumn, conductivity registered the higher values, whereas suspended solids, chlorides, and chlorophyll a were higher in winter throughout the entire system (Tab. I). Wind direction in the region was predominantly SSE in autumn and ENE in winter. The water column was higher in winter 2001, with average values around 2.5 m while in the autumn was around 2m. According Volkmer-Ribeiro et al. (2006) sampling stations sediment varied from mud to sand (Tab. II).

The macrofauna structure

The benthic macrofauna in the Taim Hydrological System is represented by

Table I: Environmental characteristics at the sampling stations in the Taim Hydrological System – RS in Autumn (March) and Winter (June) 2001.

Environmental Variables	FL		NI		JA		TB		TN		TC		TS	
	Aut 01	Win 01	Aut 01	Win 01	Aut 01	Win 01	Aut 01	Win 01	Aut 01	Win 01	Aut 01	Win 01	Aut 01	Win 01
Depth (m)	2.8	3.5	1.1	2.1	1.9	2.5	2.3	2.5	2.2	2.8	2.1	2.4	2.3	2.51
Z_{SD} (m)	0.23	0.35	0.32	0.3	0.58	0.3	1.55	0.6	1.2	0.6	0.8	0.88	1.2	1.2
Temperature (°C)	24.44	13.6	24	13.31	24.17	13.55	22.81	10.99	23.13	11.78	23.5	14.81	22.42	14.12
Conductivity (mS/cm)	0.1	0.063	0.379	0.171	0.387	0.263	0.334	0.266	0.388	0.275	0.38	0.279	0.36	0.266
Saturated Oxygen (%)	100	105.1	82.9	108.2	81.7	100.9	93.5	103.8	99.8	106.3	99	105.4	99.1	106.6
pH	7.53	7.48	7.81	7.93	7.74	7.79	7.9	7.86	8.12	8.19	8.51	8.16	8.6	8.32
Total Solids (mg/L)	22.5	52.91	40	43.98	42	54.8	20	41.2	20.5	54.7	31.5	141.8	25	38.7
Total DQO (mg O_2 /L)	15.2	27	36.8	22	26.8	23	35.4	24	26.4	17	18.2	11	16.7	17
Total N (mg N /L)	0.189	0.4039	0.103	0.360	0.091	0.852	0.103	0.404	0.147	0.261	0.123	0.788	0.177	0.675
Total P (mg P /L)	0.06	0.069	0.049	0.042	0.0198	0.011	0.083	0.086	0.047	0.047	0.045	0.049	0.072	0.064
Chloride (mg Cl/L)	17.95	89.184	69.03	98.155	68.38	86.035	69.44	42.23	65.81	108.518	65.02	115.289	74.4	88.937
Chlorophyll a (ug/L)	0.9	5.1	0.3	4.5	0.2	7.5	0.6	7.7	2.1	7.3	0.9	6.7	0.3	8.1

*FL= Flores Lake, NI= Nicola Lake, JA= Jacaré Lake, TB= Mangueira Lake /Taim wetland, TN= North Mangueira Lake , TC= Central Mangueira Lake, TS=South Mangueira-Lake, Aut= autumn, Win= winter.

Table II: Sediment classification and organic matter percentage.

Sampling station	Textural Classification*	Organic matter %
NI	Mud with sand	27.70%
TB	Sand with mud	22.70%
FL	Sand with mud	9.95%
JA	Mud	40.90%
TC	Sand	0
TS	Sand	0
TN	Sand	12.90%

*From: Volkmer-Ribeiro et. al. 2006.

FL= Flores Lake, NI= Nicola Lake, JA= Jacaré Lake, TB= Mangueira Lake - Taim wetland, TN=North Mangueira Lake, TC= Central Mangueira Lake, TS=South Mangueira Lake.

forty two taxonomic groups, being Chironomidae the more rich in species (Tab.III). The most abundant taxons were represented by Crustacea (Corophiidae, 22%; Sphaeromatidae, 11%; Tanaidae, 11%; and Cumacea, 7%); by Mollusca (Hidrobiidae, 18% and Corbiculidae, 5%); by Insecta (Chironomidae, 9%) and Oligochaeta, 9%, corresponding to more than 90% of the macroinvertebrate community.

Macroinvertebrate community composition and abundance in the Taim system varied among the sampling areas. In Flores Lake, Hidrobiidae predominated; in Nicola Lake, Chironomidae and Tubificidae were most common; and in Jacaré Lake, Polymitarcyidae and Tubificidae were most found. The Mangueira Lake /Taim Wetland point was characterized by an alternation of families during the three

Table III: Composition and classification by functional groups of benthic macrofauna found in Taim Hydrological System lakes – RS.

Class	Order	Family	Genus or species	Functional Group
Oligochaeta	Tubificida	Naididae	Unidentified*	Gathering Collector
		Tubificidae	Unidentified *	Gathering Collector
		Enchytraidae	Unidentified *	Gathering Collector
Hirudínea	Rhynchobdellida	Glossiphonidae	Unidentified *	Predator
		Hirudinea morphotype A	Unidentified *	Predator
Turbellaria		Planariidae	Unidentified *	Predator
Bivalvea		Hyriidae	Diplodon sp.	Filterer
	Veneroida	Corbiculidae	Neocorbicula sp.	Filterer
			Corbicula fluminea Müller, 1774	Filterer
		Sphaeridae	Pisidium sp.	Scraper
Gastropoda	Mesogastropoda	Hidrobiidae	Heleobia sp.	Scraper
			Heleobia parchappii Orbigny, 1835	Scraper
		Chilinidae	Chilina fluminea parva Martens, 1868	Scraper
Crustacea	Amphipoda	Corophiidae	Leptocheirus sp.	Gathering Collector
	Tanidacea	Tanaidae	Sinelobus stanfordi Richardson, 1901	Gathering Collector
	Isopoda	Sphaeromatidae	Unidentified *	Gathering Collector
	Cumacea		Unidentified *	Gathering Collector
	Decapoda	Aeglidae	Aegla prado Schmith, 1942	Gathering Collector
Insecta	Diptera	Chironomidae	Procladius sp.	Shredder
			Djalmabatista pulcher Tennessen & Gottfried, 1983	Predator
			Coelotanypus sp.	Shredder
			Clinotanypus sp.	Shredder
			Ablabesmyia (Karelia) group	Shredder
			Aedokritus sp.	Gathering Collector
			Axarus sp.	Gathering Collector
			Chironomus sp.	Gathering Collector
			Polypedilum (Tripodura) group	Gathering Collector
			Harnischia sp.	Gathering Collector
			Saetheria sp.	Gathering Collector
			Eifeldia sp.	Gathering Collector
			Cladopelma sp.	Gathering Collector

Table III: Cont.

Class	Order	Family	Genus or species	Functional Group
Insecta	Diptera	Chironomidae	Cryptochironomus sp2 sensu Trivinho-Strixino & Strixino, 1995	Predator
			Glyptotendipes sp.	Gathering Collector
			Rheotanytarsus sp.	Filterer
			Caladomya sp.	Gathering Collector
			Lopescladius sp.	Shredder
			Nanocladius sp.	Shredder
	Ephemeroptera	Polymitarcyidae	Unidentified *	Gathering Collector
		Baetidae	Unidentified *	Gathering Collector
		Caenidae	Unidentified *	Gathering Collector
		Ephemeridae	Unidentified *	Gathering Collector
	Colembola		Unidentified *	Gathering Collector

collection periods, highlighting Tanaidae, Corophiidae, and Polymitarcyidae. In the northern point of Mangueira Lake, Corophiidae, Tanaidae, and Chironomidae predominated; in the central point, Cumacea, Oligochaeta, juvenile forms of Veneroida, and Sphaeromatidae were the most abundant; and in the southern point, Hidrobiidae and Sphaeromatidae composed the majority of the community (Tab. IV).

The average benthic macroinvertebrate density in the lakes at north of Mangueira Lake during the three study periods varied from 297 to 1,255 ind/m² (Tab. IV). The sampling point that represents the interface between the Taim Wetlands and Mangueira Lake had an average density of 1,633 ind/m² and Mangueira Lake registered the highest averages, varying from 5,297 to 7,547 ind/m² (Tab. IV).

Comparing the average benthic organism density values during the three sampling periods in the Taim system, as well as family richness, a tendency toward higher densities and family richness was observed in the points situated at Mangueira Lake. The diversity index did not exhibit any great alterations throughout the system, though higher value was observed at the Mangueira Lake /Taim Wetland interface. The results of ANOVA test indicated that mean densities of invertebrate community and family richness was significantly higher in north and south Mangueira Lake sampling stations. Among seasons there was no significant differences, but the interaction results among sample points and seasons were significant (Tab.VI).

The cluster analysis considering the average density values (ind/m²) and benthic macroinvertebrate composition defined 4 groups (Fig. 2). Group 1 united samples from the Central Mangueira station (TC), which distinguished itself from the other groups by the abundance of crustacean families (Cumacea 43% and Sphaeromatidae 15%). Group 2 was formed by sampling stations from the interior lakes of the Taim Wetland, Nicola Lake (NI) and Jacaré Lake (JA), and had in common a greater abundance of Polymitarcyidae, Tubificidae and Chironomidae, which represented 69% of the community. Furthermore, the two lakes presented lower average individual densities in comparison to the other groups, with 297 and 316 ind/m², respectively (Tab. IV).

Group 3 united the Mangueira Lake / Taim Wetland interface (TB) and the North Mangueira Lake (TN) sampling stations, which presented differentiated average individual densities, 1,630 and 7,547 ind/m², respectively. Nonetheless, they were similar in regards to invertebrate composition with a predominance of Corophiidae (18 and 51%, respectively) and

Table IV: Average total density values (ind/m²) and relative abundance (%) of the benthic macroinvertebrate community in the Taim Hydrological System, southern coastal region of Rio Grande do Sul.

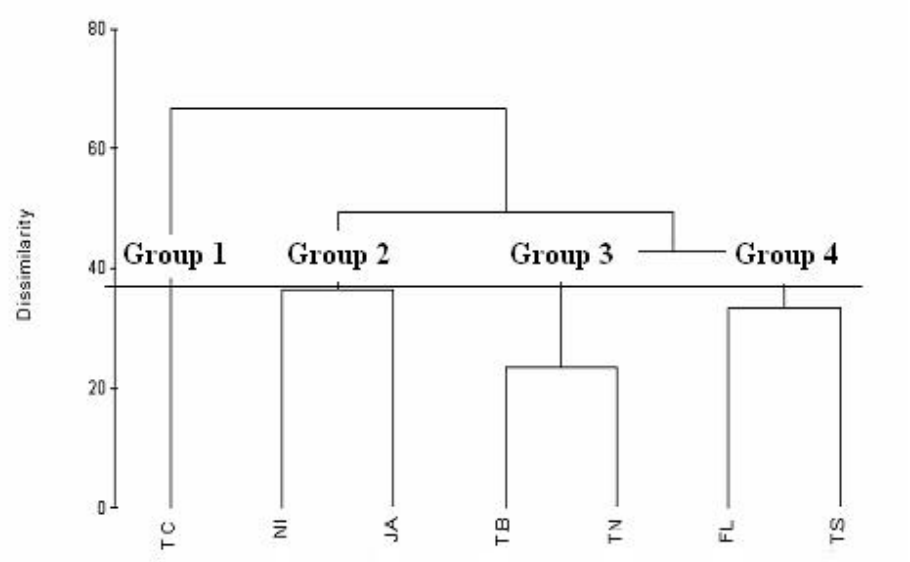
Taxons	FL		NI		JA		TB		TN		TC		TS	
	Ind/m²	%	Ind/m²	%	Ind/m²	%	Ind/m²	%	Ind/m²	%	Ind/m²	%	Ind/m²	%
Oligochaeta morphot.A	10	1	-	-	-	-	-	-	-	-	647	**21***	10	-
Naididae	81	6	14	5	5	2	10	1	-	-	34	1	81	2
Tubificidae	105	8	72	**24***	62	**20***	105	6	105	1	43	1	259	5
Enchytraidae	29	2	-	-	-	-	53	3	101	1	10	-	34	1
Hirudinea	-	-	43	**15***	-	-	125	8	263	3	-	-	62	1
Veneroida	-	-	10	3	29	9	-	-	-	-	479	**15***	5	-
Sphaeridae	-	-	-	-	-	--	43	3	43	1	29	1	5	-
Corbiculidae	101	8	19	6	10	3	86	5	330	4	29	1	383	7
Hidrobiidae	498	**40***	-	-	-	-	101	6	369	5	5	-	2,548	**48***
Corophiidae	67	5	-	-	5	2	287	**18***	3,822	**51***	5	-	24	-
Tanidae	14	1	-	-	10	3	359	**22***	1,609	**21***	24	1	38	1
Sphaeromatidae	-	-	-	-	38	**12***	29	2	96	1	455	**15***	1,523	**29***
Cumacea	-	-	5	2	-	-	53	3	-	-	1,346	**43***	-	-
Chironomidae	273	**22***	96	**32***	29	9	115	7	805	**11***	19	1	326	6
Polymitarcidae	77	6	38	**13***	129	**41***	268	**16***	**5**	-	-	-	-	-
Total	1.255	100	297	100	316	100	1.633	100	7.547	100	3122	100	5.297	100

FL= Flores Lake, NI= Nicola Lake, JA= Jacaré Lake, TB= Mangueira Lake - Taim Wetland, TN= north Mangueira Lake , TC=central Mangueira Lake, TS= south Mangueira Lake.

Table V: ANOVA test results considering mean density of taxonomic groups, family richness, equitability and diversity index, among sample points and seasons and interaction among them. (QM = mean square; F = distribution of the variance; NS = non significant difference and ND = non detected difference).

Biologic Descriptors	Among environment		Among season		Interaction	
	F	Scheffé Results	F	Scheffé Results	F	Scheffé Results
Mean Density	7.46	TN, TS› FL (p=0.0001)	1.54	NS (p=0.225)	5.61	p=0.0001
S	11.20	TN, TS› NI, JA FL›NI, JA (p=0.0001)	0.81	NS (p=0.450)	1.16	NS (p=0.338)
J'	1.46	NS (p=0.216)	1.16	NS (p=0.323)	0.47	NS (p=0.923)
H'	2.67	ND (p=0.027)	3.10	NS (p=0.055)	0.69	NS (p=0.753)

FL= Flores Lake, NI= Nicola Lake, JA= Jacaré Lake, TB= Mangueira Lake - Taim Wetland, TN= north Mangueira Lake , TC=central Mangueira Lake, TS= south Mangueira Lake.



FL= Flores Lake, NI= Nicola Lake, JA= Jacaré Lake, TB= Mangueira Lake - Taim Wetland, TN= north Mangueira Lake , TC=central Mangueira Lake, TS= south Mangueira Lake.

Figure 2: Cluster analysis considering the average total densities (ind/m²) and macroinvertebrate composition at the THS sampling stations – southern coast of Rio Grande do Sul.

Tanidae (22 and 21%, respectively) families. Group 4 was formed by Flores Lake (FL) and South Mangueira Lake (TS) sampling stations, which were characterized by a greater abundance of Hidrobiidae (40 and 48%, respectively).

From the results obtained in the Cluster analysis were calculated the percentual of functional feeding groups of the Taim benthic macroinvertebrates community, that was characterized by a predominance of gathering collectors following in order of abundance by scrapers and filterers (Fig.3).

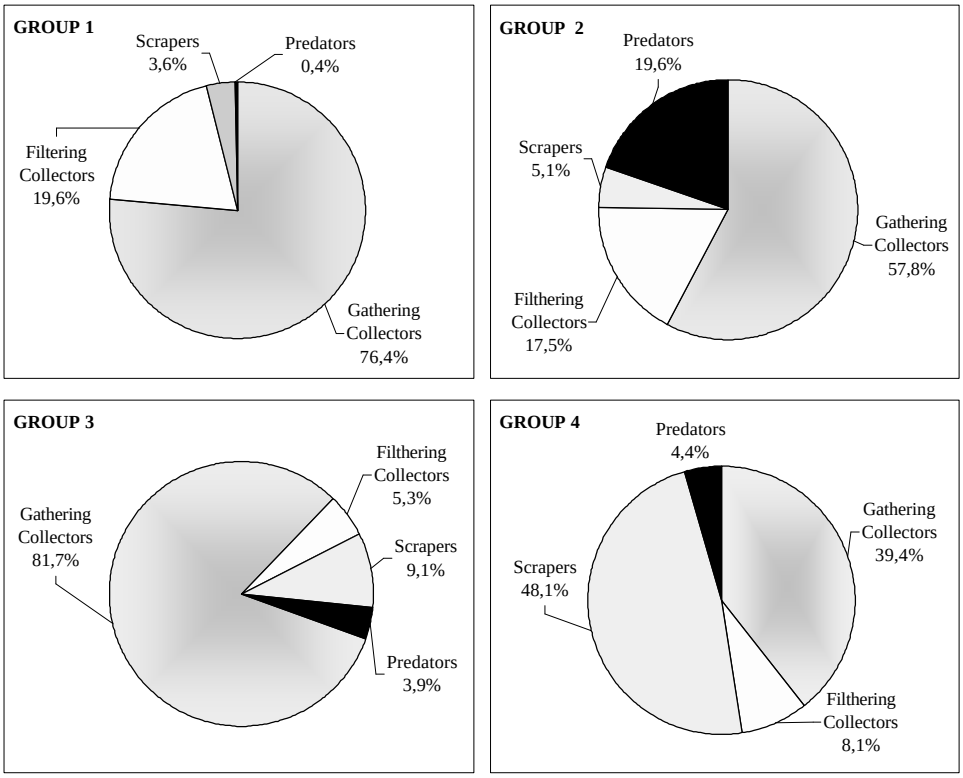


Figure 3: Percentage composition of invertebrates functional feeding groups according distribution in cluster analysis.

Groups 1, 2 and 3 are very similar, the second differing something by the abundance of predators. Group 4 differed of the others by the abundance of scrapers.

Discussion

The Taim Hydrological System is compound by small lakes such as Flores Lake, interior lakes of the Taim Wetland, like Nicola and Jacaré and the large Mangueira Lake. We can expected that the macrofauna community differed according the environmental changes observed in these ecosystems. Communities are structured by both abiotic and biotic factors nested along spatial and temporal scales and that knowledge of relationships and ecological linkages is important for understanding large- and small- scale variability (Johnson & Goedkoop, 2004). Stoffels et al. (2005) comments that at finer scales, the composition of substrates, particularly macrophytes and inorganic sediments, may be drivers of community spacial structure. The results of ANOVA test indicated that mean densities of invertebrate community and family richness differed significantly along the Taim Hydrological System. Local characteristics like differences in substratum and the proximity of the wetland vegetation probably can explain the changes in the composition, density and richness of the macrobenthos.

Physical and chemical data measured in the studied lakes are relatively similar, but sediment grain size and the organic matter presented variations (Tab.II). Jacaré and Nicola lakes, have registered 40.95% and 27.7% of organic matter and sedimentar substratum of mud and sandy mud, respectively. The benthic community structure is formed by Tubificidae, Chironomidae and Polymitarcyidae groups, suggesting a food chain predominantly based on detritus. Lakes Jacaré and Nicola naturally receive a high detritic load from the Taim Wetland's macrophytic banks, which may corroborate with over 70% of the deposit feeders. According Spieles & Mitsch (2000), the distribution and abundance regarding the invertebrate functional groups in wetlands and other aquatic systems are influenced by organic material availability as a food source.

In Flores Lake, the sediment is sand with mud, and scrappers represented by the Hidrobiidae showed good representativity, with 40% of abundance. According to Szalay & Resh (1996), the perception that algal herbivores are relatively unimportant in wetland macroinvertebrate communities may be based on a lack of knowledge on the taxa feeding ecology. Many studies do not distinguish between those taxa feeding on detritus or algae. Ephiphytic habitats and benthic algal biomass available in Flores Lake probably support Hidrobiidae and explain its high abundance.

The substratum of Mangueira Lake / Taim Wetland and the North Mangueira sampling stations differs something from Jacaré and Nicola lakes registering 22.70% and 12.70% of organic matter and substratum of mudy sand and sand, respectively. In the first one the macrofauna are characterized by the presence of Tanaidae, Corophiidae, and Polymitarcyidae. North Mangueira exhibited these same families, and Chironomidae additionally. These two points differed from the others by a greater abundance of Corophiidae and Tanaidae families. Thus, the sampling stations also exhibited a food chain made up of detritus. According Merritt & Cummins (1996) depending on the food source, some taxa can change their feeding habits. Amphipoda and Tanaidacea could feed on coarse organic matter and behave as shredders, changing the trophic structure at these points in Mangueira Lake. This area is prone to receive coarse organic matter from the Taim Wetlands under special hydrodynamic conditions which draw water from the wetlands toward Mangeira Lake (Fragoso Jr., 2005).

At central and south Lake Mangueira the sediment is sandy and the organic matter was not detected.

In central Mangueira station the crustaceans, Cumacea and Sphaeromatidae corresponded to 58% of the community, and together with Oligochaeta, form a trophic structure of deposit feeders. This point of Mangueira Lake is farther from the macrophytic banks and, therefore, must receive organic material from other areas of the lake. Due to the strong presence of Hidrobiidae, South Mangueira Lake alone had a community structure where the dominant trophic group was scrapers, followed by gathering collectors.

In the Taim Hydrological System, considering the system as a whole, a

predominantly detritic food chain was observed. The predominance of a detritivore food chain was also observed in most of the lakes in the northern coastal region of Rio Grande do Sul (Würdig et al., 1998). The fauna composition is quite similar, with the exception of the presence of Corophiidae and the great density of Cumacea, present in both the wetland zones and principally in the free waters of Mangueira Lake.

Corophiidae and Cumacea are characteristics in environments with a saline influence, such as lagoons and estuarine regions, conditions that were not observed on present-day in the Taim Wetlands. The presence of these species might be explained by the marine origin of this coastal system (Vilwock, 1984) and by the considerable tolerance of these groups to salinity gradients. Historical processes support the presence of these taxa, considering an ecological and large temporal scale. Johnson et al. (2004) in their comparative studies about spatial scales and ecological relationships between macroinvertebrates find that species distribution is determined fundamentally by conditions prevailing at the local scale and important regional factors such as land use and the role of history which act as strong determinants of large-scale patterns in biodiversity.

The macroinvertebrate community structure in the wetlands and associated lakes of Taim Hidrological System differ in local scale due to many components, like macrophytes presence, detritus abundance, sediment granulometry, and water hydrodynamics, which contributed to the high variability along the system. However more and objective studies dealing with different spatial and temporal scales that influence the distribution and structure of the macrofauna communities are necessary, in order to explain the importance of ecological characteristics and processes at different levels in this System, permiting to interpret changes in the fauna and in ecosystem responses to natural and human-induced perturbation.

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