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The effect of the macroconsumer *Aegla longirostri* (Crustacea, Decapoda) on the invertebrate community in a subtropical stream

Efeito do macroconsumidor *Aegla longirostri* (Crustacea, Decapoda) sobre a comunidade de invertebrados em riacho subtropical

Gláucia Bolzan Cogo, Cristiane Biasi and Sandro Santos

Programa de Pós-graduação em Biodiversidade Animal, Departamento de Biologia, Centro de Ciências Naturais e Exatas, Universidade Federal de Santa Maria – UFSM, Avenida Roraima, 1000, prédio 17, sala 1140, Bairro Camobi, CEP 97105-900, Santa Maria, RS, Brazil
e-mail: glauciabcogo@gmail.com; cristiane.biasi@gmail.com; sandro.santos30@gmail.com

Abstract: Aim: This study tested whether the macroconsumer *Aegla longirostri* is able to modify the invertebrate community associated with decomposing leaves. **Methods:** The study was performed in a first-order stream located in central Rio Grande do Sul state. Two types of channels containing leaf litter of *Ficus luschnathiana* were placed in the stream; one type allowed aeglids to access the leaf litter (PA), and the other type did not (AA). Both types allowed aquatic insects to access the leaf litter. In addition, a control treatment (C) was established, in which no channel was used. After 3, 7, 11, 15 and 19 days, a litter bag was removed from each replicate of each treatment. **Results:** A total of 926 organisms belonging to 19 families were identified. The most common taxon in all treatments was Chironomidae, which comprised 71% of the total and was represented by 16 genera. The presence of aeglids decreased the total abundance of organisms by 89% and the taxonomic richness by 35%. The presence of *A. longirostri* altered the taxonomic composition of the invertebrates and the structure of the trophic groups, causing a decrease in the abundance of all groups, except for shredders and predators. The gathering-collectors trophic group was the most important (65%), in both the presence and absence of *A. longirostri*. **Conclusion:** Our study showed that *A. longirostri*, as well as other macroconsumers, was able to modify the structure of the invertebrate community associated with decomposing leaves in the stream.

Keywords: Chironomidae, shredder, trophic group, predator.

Resumo: Objetivo: O objetivo deste estudo foi testar se o macroconsumidor *Aegla longirostri* é capaz de modificar a comunidade de invertebrados associados ao folhiço em decomposição. **Métodos:** O estudo foi realizado em riacho de primeira ordem na região central do Rio Grande do Sul. Foram colocados no riacho dois tipos de canais com pacotes de folhas de *Ficus luschnathiana*, um canal permitia o acesso dos eglídeos (PA) às folhas e outro restringia o seu acesso (AA), mas ambos permitiam o acesso dos insetos aquáticos. Além disso, foi utilizado um controle (C) onde não havia a presença dos canais. Após 3, 7, 11, 15 e 19 dias foi retirado um pacote de folhas de cada réplica de cada tratamento. **Resultados:** Foram identificados 926 organismos pertencentes a 19 famílias. O táxon mais comum em todos os tratamentos foi Chironomidae, compreendendo 71% do total e foi representado por 16 gêneros. A presença dos eglídeos diminuiu a abundância total dos organismos em 89% e a riqueza taxonômica em 35%. A presença de *A. longirostri* modificou a composição taxonômica dos invertebrados e também a estrutura dos grupos tróficos funcionais, promovendo um decréscimo na abundância de todos os grupos, com exceção dos fragmentadores e predadores. O grupo funcional coletor-galhador foi o mais representativo (65%) tanto na presença quanto na ausência de *A. longirostri*. **Conclusão:** Nosso estudo demonstrou que *A. longirostri*, assim como outros macroconsumidores, é capaz de modificar a estrutura da comunidade de invertebrados que fica aderida às folhas no riacho, corroborando nossa hipótese inicial.

Palavras-chave: Chironomidae, fragmentador, grupo trófico funcional, predador.

1. Introduction

Manifold interactions between species occur in freshwater streams. Basal resources (e.g., algae and detritus) and microorganisms sustain the consumers of higher trophic levels (e.g., herbivores, predators and parasites) (Allan and Castillo, 2007). In these systems, the aquatic invertebrate community occupies a key position in the interactions of the trophic chain, since its members have different functions (Covich et al., 1999). Some invertebrates accelerate leaf decomposition, thus participating in nutrient cycling (Wallace and Webster, 1996); some are predators controlling the population density of other organisms (Crowl and Covic, 1990, 1994); and others are prey to fish, turtles and birds.

Aquatic invertebrates in small streams can be classified according to their feeding habit into functional feeding groups (FFG), which are designated according to morphological characteristics (Merritt et al., 2008). These groups include: shredders that feed on coarse particulate organic matter; predators that attack and eat other animals; scrapers, scraping rocks and feeding on the adhered periphyton; gathering-collectors, which consume fine particulate organic matter; and filtering-collectors, which filter organic matter dissolved in water (Cummins et al., 2005). In addition to this classification, the larger organisms in a food chain can be defined as macroconsumers. Among aquatic invertebrates, decapod crustaceans (crabs, crayfishes and shrimps) are considered macroconsumers and can influence, among other processes, leaf decomposition (Yule et al., 2009; Crowl et al., 2001; March et al., 2001; Cogo and Santos, 2013) and the structure of the aquatic insect community (Usio, 2000; Schofield et al., 2001; Landeiro et al., 2008). Thus, macroconsumers can act as key species in the aquatic ecosystem functioning.

In low-order streams of southern Brazil, the presence of a macroconsumer, *Aegla longirostri* Bond-Buckup and Buckup, 1994 is common. Aeglids are opportunistic, generalist omnivores. They can occur in stream sections that accumulate leaves, where they cause significant fragmentation of leaf litter. Thus, aeglids participate in the decomposition of allochthonous material, and consequently in the nutrient cycling of these systems (Cogo and Santos, 2013). In addition to plant material, the stomach contents of aeglids includes periphyton, body parts of aquatic insects, fishes, other aeglids, and sand (Bueno and Bond-Buckup, 2004; Castro-Souza and Bond-Buckup, 2004; Santos et al., 2008). In low-order streams the entry of allochthonous material provides energy for the ecosystem, and the accumulated leaf litter is used by benthic invertebrates as refuge and shelter. The decomposition of plant material provides a favorable environment for the colonization of microorganisms, such as bacteria and fungi, making the detritus attractive to aquatic invertebrates (Gessner, 2005). The leaf litter accumulation increases the substrate heterogeneity, favoring the benthic community and usually increasing the diversity of invertebrates in plant substrates (Silveira, 2004). Thus, in these habitats, the aquatic invertebrate community contains, among others, groups of insects as well as macroconsumers that interact in this ecosystem.

The wide distribution of aeglids in streams of southern South America probably alters the ecological processes of these environments, and the aquatic invertebrate community. This study tested whether the aeglid macroconsumer *A. longirostri* is able to alter the taxonomic composition, abundance of invertebrates, abundance of functional groups, and richness of the community of aquatic invertebrates associated with leaf litter decomposition. We presumed that the abundance and richness of aquatic invertebrates would decrease in the presence of aeglid due to predation and bioturbation promoted by them. We also presumed that the abundance of the functional groups would decrease due to the top-down control by the macroconsumer.

2. Material and Methods

2.1. Study area

The study was performed in Crab Creek (29°38'21"S; 53°32'02"W), a first-order stream, tributary of the Arroio da Divisa (Baixo Jacuí subbasin), São João do Polêsine municipality in the central region of Rio Grande do Sul state, Brazil. The study area is composed by a semideciduous seasonal forest with native riparian vegetation composed of several tree species. The stream substrate is composed mainly of boulders, bedrock and gravel. Leaf litter and sediment patches occur, especially in the pools. According to the Köppen classification, the climate is Cfa, humid subtropical with hot summers and no defined dry season.

The riparian vegetation is composed of several native species. The most common are *Cabralea canjerana* (Vell.) Mart., *Campomanesia xanthocarpa* O. Berg., *Casearia sylvestris* Sw., *Cupania vernalis* Cambess., *Enterolobium contortisiliquum* (Vell.) Morong, *Erythrina falcata* Benth., *Ficus luschnathiana*

(Miq.) Miq., *Inga alata* Benoist, *Ocotea puberula* (Rich.) Nees, *Parapiptadenia rigida* (Benth.) Brenan, *Phytolacca dioica* L., *Rollinia emarginata* Schltdl., and *Trema micrantha* (L.) Blume.

During the study, the stream had well-oxygenated water (9.6 ± 1.0 mg L^{-1}) and mild temperatures (13.5 ± 4.5 °C). The mean current speed was 0.16 ± 0.05 m s^{-1} and the water electrical conductivity was 22.08 ± 0.69 µS m^{-1}. The mean pH was 5.9 ± 1.0. The mean depth of the stream is 40 cm and the mean width is 66 cm.

2.2. Experimental design

Channels made of PVC pipes cut in half horizontally (20 cm diameter and 1 m long) were placed in the stream, with litter bags attached inside. Three treatments were used: (1) channel closed at both ends and on top by a 5 mm mesh, which prevented aeglids from accessing the litter bags (AA); (2) channel open, allowing *A. longirostri* to enter the interior (PA); and (3) control, with no PVC channel (C), and the litter bags attached directly on the streambed (Figure 1). All treatments allowed aquatic invertebrates to access the litter bags. Each treatment consisted of 3 replicates, and all were placed in stream pools.

A group of five litter bags (10 cm x 15 cm) was placed inside each channel. Each bag was made with 10 mm mesh containing 2 g ± 0.01 of leaves (dry mass after oven-drying at 45 °C for 96 h). The species *Ficus luschnathiana* (Moraceae) was chosen since it is one of the most abundant species, and its leaves are retained in the leaf-litter patches in the streams of this region. Furthermore, fig trees are key elements of many tropical and subtropical forests, since many animals feed on their fruits and leaves (Carauta, 1989). The litter bags were placed separately in the channels, with plastic clamps.

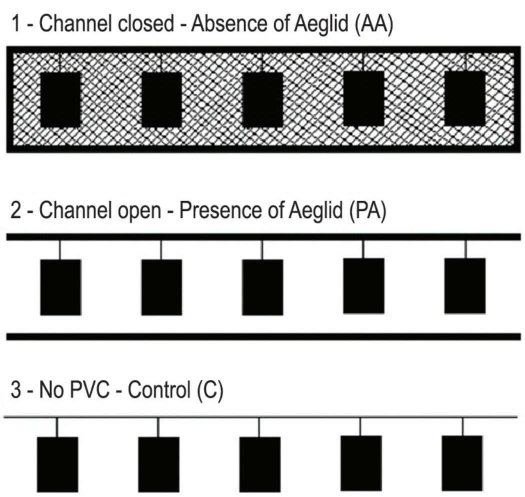

Figure 1. Experimental design, indicating the different types of treatment used in the study. The solid rectangles indicate the litter bags, the thick bars indicate the channel PVC.

After 3, 7, 11, 15 and 19 days of exposure, one litter bag was collected from each replicate of each treatment. These days were chosen following previous studies of leaf decomposition in southern Brazil (Biasi et al., 2013; König et al., 2014). The leaves were gently washed in the laboratory to remove the invertebrates, which were fixed in 70% ethanol. The organisms were identified to the lowest possible taxonomic level, using the identification keys of Trivinho-Strixino and Strixino (1995), Costa and Simonka (2006), Mugnai et al. (2010) and Trivinho-Strixino (2011). The taxa were classified in trophic groups according to Cummins et al. (2005), Wantzen and Wagner (2006) and Merritt et al. (2008).

2.3. Data analysis

An analysis of variance (bifactorial ANOVA) with a post-hoc Tukey test was used to test if the aquatic invertebrate community structure changed in the presence/absence of *A. longirostri*. The presence or absence of aeglids was used as the independent variable. The abundances of organisms and trophic groups were used as response variables. A paired t-test was performed to test whether the rarefied richness was different in the presence/absence of aeglids. For the rarefied richness analysis, the control treatment was excluded, so that the number of samples was smaller than the number of species, a premise of the analysis. A Cluster analysis with the UPGMA method and a Bray-Curtis similarity index were used to analyze the composition of the invertebrate community in the different treatments (presence/absence of the aeglid). A Multivariate analysis of variance (MANOVA) was used to test the difference in the composition of the community (Scheiner, 2001), in which only taxa with an abundance greater than five were used. The ANOVA and paired t-test were performed in the software R (R Development Core Team, 2010) using the "vegan" package (Oksanen et al., 2010). The cluster analysis and the MANOVA were performed in the softwares Primer and PAST, respectively.

3. Results

A total of 926 organisms belonging to 19 families were identified (Table 1). In the litter bags with *A. longirostri* excluded (AA), 787 individuals were

Table 1. Mean abundance (± standard deviation) of the aquatic invertebrate community in the presence and absence of *A. longirostri* in leaves exposed 3, 7, 11, 15 and 19 days to the stream.

	Absence of *A. longirostri*					**Presence of *A. longirostri***					**Control**				
	3	**7**	**11**	**15**	**19**	**3**	**7**	**11**	**15**	**19**	**3**	**7**	**11**	**15**	**19**
Insecta															
Trichoptera															
Leptoceridae	-	0.3±0.5	0.3±0.5	-	-	-	-	-	-	-	-	-	-	0.3±0.5	-
Polycentropodidae	-	-	-	1±0	-	-	-	-	-	-	-	-	-	-	-
Sericostomatidae	-	-	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-	-
Ephemeroptera															
Baetidae	2.3±3.2	3.3±1.5	5.6±6.4	5.6±2.3	4±6.1	1.3±1.5	1±1	3±4.3	0.3±0.5	-	0.6±1.1	0.3±0.2	-	0.3±0.5	-
Caenidae	0.6±1.5	2±2.6	2.3±2.3	7±4	3.3±2.5	-	0.6±0.5	1.6±2.1	1.3±1.1	-	-	0.6±1.1	0.6±1.1	0.3±0.5	-
Leptoplhebiidae	0.3±0.5	0.6±1.1	2.3±0.5	2±1	0.6±0.5	-	-	0.3±0.5	-	-	0.3±0,5	-	-	-	0.3±0.5
Plecoptera															
Gripopterygidae	-	0.3±0.5	-	1.3±1.1	2±2	-	0.3±0.5	0.3±0.5	2.3±2.1	0.3±0.5	-	2.3±1.2	0.6±1.1	3.6±2.5	-
Perlidae	-	-	-	-	-	-	0.3±0.5	-	-	-	-	-	-	-	-
Coleoptera															
Elmidae	-	-	0.6±0.5	0.3±0.5	-	-	0.3±0.5	-	-	-	-	-	-	-	-
Hydrophilidae	0.3±0.5	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemiptera															
Mesoveliidae	-	-	-	-	-	0.3±0.5	-	-	-	-	-	-	-	-	-
Diptera															
Empididae	-	0.3±0.5	-	2.6±3.7	1.6±2.1	-	-	-	-	-	-	-	-	-	-
Ceratopogonidae	-	-	-	0.6±0.5	-	-	-	-	-	-	-	-	-	-	-
Chironomidae															
Beardius Reiss and Sublette, 1985	-	-	-	-	-	-	-	-	0.3±0.5	-	-	-	-	-	-
Corynoneura Winnertz, 1846	1±0	5.6±5.5	18.3±29.1	44.1±64.9	9.3±7.1	1.6±2.8	3.6±4.1	2±2	0.6±1.1	0.6±1.1	-	1.3±0.8	0.3±0.5	2.3±1.5	0.3±0.5
Chironomus Meigen, 1803	-	-	0.3±0.5	1.3±2.3	0.6±0.5	-	-	0.3±0.5	-	-	-	-	-	-	-
Cricotopus van der Wulp, 1874	-	-	-	-	1.6±2.8	-	0.3±0.5	0.3±0.5	-	-	-	-	-	-	-
Dicrotendipes Kieffer, 1913	-	-	-	1.3±2.3	-	-	-	-	-	-	-	-	-	-	-
Endotribelos Grodhaus, 1987	-	-	-	1±1.7	-	-	-	-	-	-	-	0.3±0.4	-	-	-
Lopescladius Oliveira, 1967	0.3±0.5	-	-	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-
Nanocladius Kieffer, 1912	-	-	-	-	-	-	-	-	0.6±0.5	-	-	-	-	-	-
Parachironomus Lenz, 1921	-	-	-	2±3.4	-	0.3±0.5	-	-	-	-	-	-	-	-	-
Parametriocnemus Goetghebuer, 1932	-	0.3±0.5	3.3±4.9	5.3±5.7	0.6±1.1	-	-	-	-	-	-	-	-	-	-

Table 1. Continued...

	Absence of *A. longirostri*					Presence of *A. longirostri*					Control				
	3	**7**	**11**	**15**	**19**	**3**	**7**	**11**	**15**	**19**	**3**	**7**	**11**	**15**	**19**
Paratendipes Kieffer, 1912	-	-	-	0.3±0.57	-	-	-	-	-	-	-	-	-	-	-
Pentaneura Philippi, 1865	1±1	1.3±1.1	-	1.6±1.5	1.3±1.1	0.3±0.5	0.6±1.1	-	-	-	0.3±0.5	-	0.3±0.5	-	-
Phaenopsectra Meigen, 1818	-	2.6±2.8	1±1	23.3±39.5	9.6±1.5	-	-	-	-	-	-	-	-	-	-
Polypedilum Kieffer, 1912	-	1±1.7	3.3±5.7	14±13.7	5.3±3.7	-	0.3±0.5	-	-	-	-	-	-	-	-
Rheotanytarsus Thienemann and Bause in Bause, 1913	-	-	-	0.3±0.5	-	-	-	-	0.3±0.5	-	-	-	-	-	-
Tanytarsus van der Wulp, 1874	-	-	0.3±0.5	14±21.7	24.3±22.1	0.3±0.5	-	-	-	-	-	-	-	-	-
Psychodidae	-	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-
Stratiomydae	-	-	-	0.3±0.5	-	-	-	-	-	-	-	-	-	-	-
Mollusca															
Gastropoda	0.6±1.1	-	1.3±1.5	1±1	1.6±1.5	0.3±0.5	0.3±0.5	-	-	0.6±1.1	0.3±0.5	-	2.3±4.0	-	-
Colembolla															
Isotomidae	-	-	-	-	-	-	0.3±0.5	-	-	-	-	-	-	-	-

sampled (85% of the total). The treatment that allowed access by aeglids (PA) yielded 86 individuals (9%), and in the control treatment 53 individuals were found (6%) (Figure 1a). The number of aeglids in the samples was not counted, because these animals were not present in the litter bags, and the aeglids were recorded only visually. The most common taxon in all treatments was Chironomidae, which comprised 71% of the total and was represented by 16 genera. Within Chironomidae, members of the genera *Corynoneura* and *Tanytarsus* were the most abundant in all treatments, with 45.1% and 17.7%, respectively. The taxonomic richness was 30 taxa when aeglids were excluded from the litter bags, and 19 taxa when they had access to the litter bags (Figure 2b).

The presence of *A. longirostri* altered the composition and structure of the invertebrate community (Table 2). The presence of aeglids decreased the total abundance of organisms by 89% and the taxonomic richness by 35% (Figure 2a, 2b and 2c). The presence of *A. longirostri* also altered the structure of the functional groups, decreasing the abundance of all categories except for shredders and predators (Figure 3a and 3b). However, the exposure time did not alter the functional structure of the invertebrates (Table 2).

The gathering-collectors functional group was the most important (65%) in both the presence and absence of *A. longirostri* (Figure 3a and 3b), mainly due to the dominance of *Corynoneura* and Baetidae. Filtering-collectors comprised 14% of the total; the chironomid *Tanytarsus* was the most numerous taxon in this group. Shredders were represented mainly by Grypopterigidae (7% of the total), scrapers by Gastropoda (10%), and predators by *Pentaneura* (4%).

All groups showed a similarity of approximately 30%, forming three distinct groups (Figure 4). One group was formed by samples PA + 3AA (presence of aeglids and day 3 in the absence of aeglids, respectively). A second group was composed of samples where the aeglids were absent (AA). The third group contained only the sample from day 19, in the presence of aeglids (19PA). The taxonomic composition of invertebrates showed a significant difference in the presence and absence of *A. longirostri* (MANOVA; Table 2).

4. Discussion

Our study demonstrated that *A. longirostri* was able to alter the structure of the invertebrate community associated with leaf litter in the

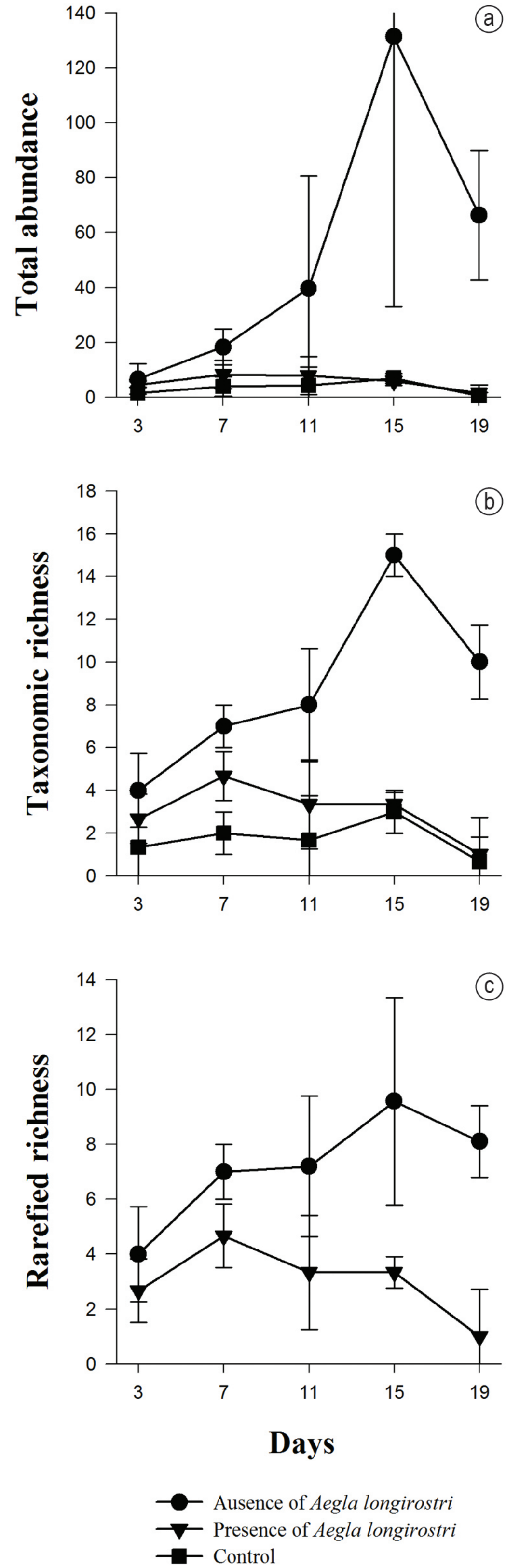

Figure 2. Total abundance (a), taxonomic richness (b) and rarefied richness (c) of aquatic invertebrates in the presence and absence of *A. longirostri* in leaves exposed 3, 7, 11, 15 and 19 to the stream. The bars indicate the standard deviation.

Table 2. Statistical values of the analyses (bifactorial ANOVA, paired t-test and MANOVA) testing the effect of *A. longirostri* and time exposed in the stream on general abundance, abundance of trophic groups and rarefied richness of aquatic invertebrates. The contrasts were evaluated with a Tukey test by comparing the treatments. Significance results in bold. Different letters denote significant differences (confidence interval of 95%). DF = degrees of freedom; SS = sum of squares; AA = absence of *A. longirostri*; PA = presence of *A. longirostri*; C = control.

	DF	SS	F	P	Tukey		
					AA	PA	C
Total abundance							
Treament	2	23.044	14.217	**<0.001**			
Time	4	10.265	3.166	**0.027**	b	a	a
Treatment X Time	8	19.279	2.974	**0.014**			
Functional groups							
Gathering-collectors							
Treatment	2	9.610	7.955	**0.001**			
Time	4	4.305	1.782	0.158	b	a	a
Treatment X Time	8	8.413	1.741	0.129			
Filtering-collectors							
Treatment	2	650.8	5.258	**0.011**			
Time	4	517.4	2.090	0.106	b	a	a
Treatment X Time	8	1.037	2.091	0.068			
Shredder							
Treament	2	177.4	1.985	0.155			
Time	4	179.1	1.002	0.422	a	a	a
Treament X Time	8	278.2	0.788	0.625			
Scrapers							
Treatment	2	419.6	4.452	**0.020**			
Time	4	79.5	0.422	0.791	b	a	a
Treatment X Time	8	217.6	0.577	0.788			
Predator							
Treatment	2	23.318	2.947	0.067			
Time	4	18.039	1.140	0.356	a	a	a
Treatment X Time	8	37.211	1.176	0.345			
Rarefied richness							
Treatment	1	130.52	28.435	**<0.001**			
Time	4	34.83	1.897	0.144			
						Contrast between pairs	
MANOVA - composition	30	4.207	3.035	**<0.001**	b	a	a

stream. Similar results were found for the crayfish *Paranephrops zealandicus* White, 1847 (Usio, 2000), and for other decapods as well as fish (Rosemond et al., 1998), in which the presence of macroconsumers decreases the density of aquatic invertebrates. Studying the effect of macroconsumers, such as fish and shrimp, on the density of Chironomidae and other shredders, Landeiro et al. (2008) demonstrated that macroconsumers negatively affected only Chironomidae. Their results were attributed to larvae predation or substrate bioturbation, which can dislocate the Chironomidae between the leaves.

The invertebrate composition was also altered by the presence of the aeglid. The cluster analysis indicated differences in the invertebrate community caused by this macroconsumer. Only the 19th day, in the presence of the aeglid (19PA), showed differences due to a low abundance of organisms in the litter bags. The sample from the 3rd day, in the presence of the aeglid (3AA), also appears displaced because this period is the start of the decomposition process, in which colonization can be hampered by the leaching of water-soluble compounds, and the litter is not palatable to aquatic invertebrates. Our study was performed in pools with an accumulation of leaf litter. Pools are usually inhabited by a large number of predators, such as fish and decapods, which can reduce and alter the composition of aquatic organisms. Riffles can offer more protection to the invertebrates due to water turbidity, which does not favor visual predators (Ramírez and Hernández-Cruz, 2004). It can be difficult to distinguish the real effect of macroconsumers on the

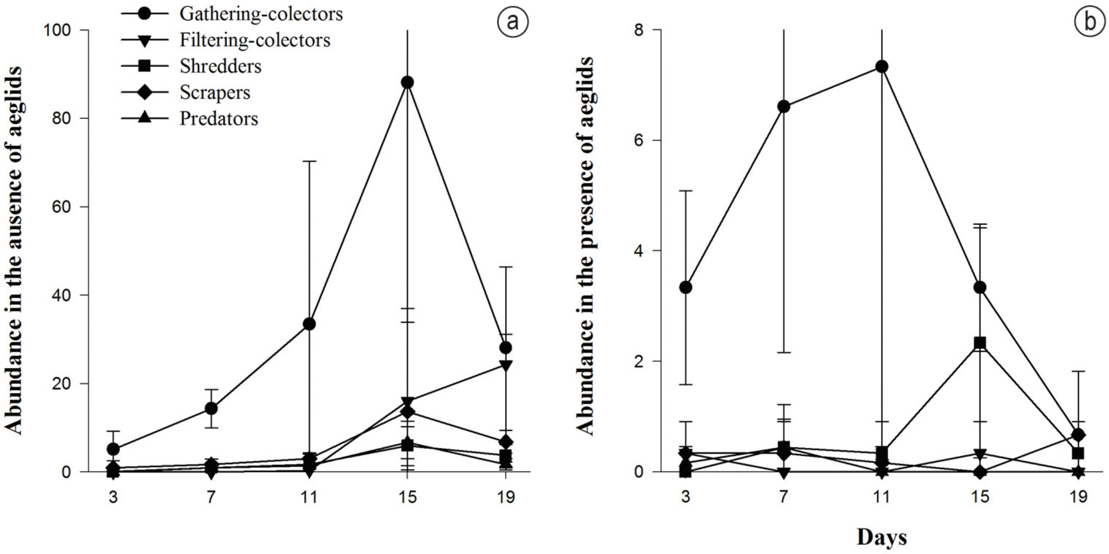

Figure 3. Abundance of the trophic groups on decomposing leaves after 3, 7, 11, 15 and 19 days of exposure to the stream in the absence (a) and presence (b) of *A. longirostri*. The bars indicate the standard deviation.

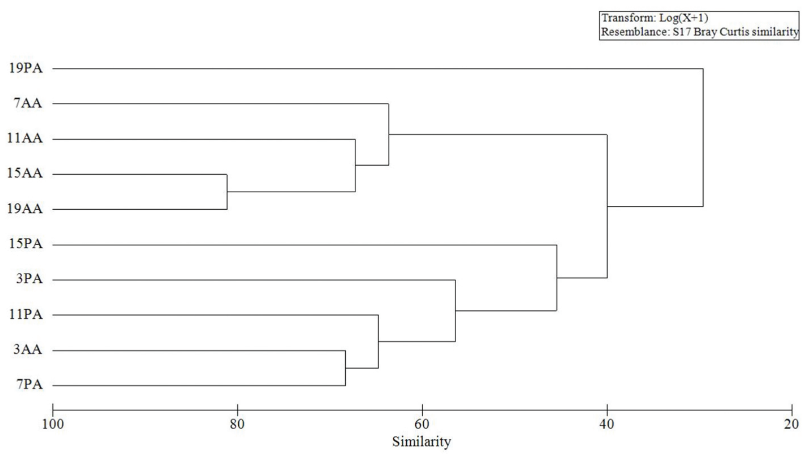

Figure 4. Dendrogram (UPGMA) based on the Bray-Curtis similarity index with the taxonomic composition of aquatic invertebrates in the presence (PA) and absence (AA) of *A. longirostri*, after 3, 7, 11, 15 and 19 days of leaf exposure to the stream.

benthic invertebrate community living in the plant substrate, since macroconsumers can indirectly affect the community by influencing the colonization and emigration of these organisms in leaf litter, or directly by consuming them (Zhang et al., 2004). Based on the results of this study, we cannot state that changes in the community were due to predation or to bioturbation, but we believe that these were the main causes.

Interactions between trophic guilds, such as between predators and detritivores, influence the community structure and ecosystem functioning. In our study, we did not observe a clear effect of top-down control on the aquatic invertebrate community, although it was possible to observe the decrease of collectors, filterers and scrapers caused by aeglids. In lotic systems that depend on allochthonous detritus, the detritivores process the organic matter, and their interaction with the macroconsumers can compromise the processing efficiency of the plant material entering these ecosystems (Zhang et al., 2004). However, in our study, the shredders were not influenced by the presence of *A. longirostri*. Considering that allochthonous material enters the stream year-round, and the large number of plant species in the region (Cogo and Santos, 2013), a significant abundance of shredders is expected, since this trophic group is important in processing this plant material. Nevertheless, in this area the fragmentation seems to be performed mainly by *A. longirostri* (Cogo and Santos, 2013). The gathering-collectors functional group was the most abundant in both the presence and absence of the aeglids. This functional group feeds on fine particulate organic matter that was previously processed by shredders, using the detritus as a substrate and the processed fragments of leaves as food (Mathuriau and Chauvet, 2002). Gathering-collectors comprise the most abundant functional group associated with leaf breakdown, in both tropical regions (Gonçalves et al., 2012; Biasi et al., 2013; Cogo and Santos, 2013) and temperate regions (Graça et al., 2001). Chironomidae are potential consumers of fine particulate matter due to their high density in low-order streams, including stream sections enriched with organic matter (Callisto and Graça, 2013).

The decrease in abundance of some groups, such as Trichoptera, Ephemeroptera and Diptera, especially Chironomidae, may have been caused by predation by *A. longirostri*, since this crustacean is omnivorous and preys on aquatic insects (Bueno and Bond-Buckup, 2004; Castro-Souza and Bond-Buckup, 2004; Santos et al., 2008); or by modification of the substrate from the bioturbation caused by foraging of macroconsumers (Landeiro et al., 2008). Similar negative effects of macroconsumers on Chironomidae were reported in other studies in tropical streams (Rosemond et al., 1998; Zhang et al., 2004). The family Chironomidae usually constitutes the most abundant benthic invertebrate group associated with detritus (chironomids comprised 71% of the total in this study), in both number of species and number of individuals. Furthermore, chironomids can tolerate environmental disturbances and colonize low-quality detritus, thus playing a community-structuring role. Chironomid larvae have important functions in the trophic chain of freshwater ecosystems, forming an important link between primary producers such as phytoplankton and benthic algae, and secondary consumers such as fish (Armitage et al., 1995). The larvae actively participate in recycling organic matter, since detritus and decomposing organic matter constitute a good part of their food (Pinder, 1986; Henriques-Oliveira et al., 2003).

The trophic processes in aquatic ecosystems can be closely associated with engineer species that can alter and create habitats within the system, modulating resources for other species (Jones et al., 1994). In this study, *A. longirostri* affected the community of invertebrates both directly (predation) and/or indirectly (bioturbation). Thus, *A. longirostri* can function as an ecosystem engineer, because when associated with the decomposing substrate it can cause significant fragmentation of the allochthonous material, influencing the sedimentation by bioturbation, energy cycling, and shaping benthic communities.

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