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Functional groups of entomofauna associated to aquatic macrophytes in Correntoso river, Rio Negro sub-region, Pantanal, Mato Grosso do Sul State, Brazil

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ABSTRACT. This work aimed to study the structure of functional groups of entomofauna associated to aquatic macrophytes in Correntoso river, Rio Negro sub-region, Pantanal, Mato Grosso do Sul State, Brazil. Six samples were taken in different seasonal periods; ebb, dry and wet. The organisms were collected using D net (300 µm mesh), sweeping five times through the roots of macrophyte banks at each sample session. Three environments were compared (open, intermediary, close) using data from six collection sites, through which were analyzed absolute abundance, observed richness of families and the sampled specimens were also separated in functional groups. A total of 60 families from 12 orders of Insecta were registered, totaling 19,773 sampled insects. The largest number of families was categorized into predators functional group, with 34 families collected, followed by the collectors with 17, shredders-herbivores ten and scrapers eight.

Keywords: aquatic entomofauna, feeding groups, floodplain, Pantanal.

Grupos funcionais da entomofauna associada às macrofitas aquaticas no rio Correntoso, Pantanal do Negro, Estado do Mato Grosso do Sul, Brasil

RESUMO. Este trabalho teve como objetivo estudar a estrutura dos grupos funcionais da entomofauna associada às macrófitas aquáticas em um trecho do rio Correntoso, Pantanal do Negro, Estado do Mato Grosso do Sul, Brasil. Foram realizadas seis campanhas de coleta em diferentes períodos sazonais: vazante, seca e cheia. Os organismos foram coletados utilizando rede D com malha de 300 µm e esforço amostral de cinco lances de rede nas raízes dos bancos de macrófitas. Foram comparados três ambientes (aberto, intermediário e fechado), por junção dos dados obtidos de seis sítios de coleta. Foi analisada a abundância absoluta, a riqueza observada de famílias e realizada a separação dos insetos coletados por grupos funcionais. Foram registradas 60 famílias pertencentes a doze ordens da Classe Insecta (Hexapoda), totalizando 19.773 indivíduos coletados. O maior número de famílias foi categorizada ao grupo funcional dos predadores com 34 famílias coletadas, seguido dos coletores 17, fragmentadores-herbívoros dez e raspadores oito.

Palavras-chave: entomofauna aquática, grupo alimentar, planície de inundação, Pantanal.

Introduction

The Pantanal is located in the central portion of South America, in the Paraguai river Basin, comprising floodable areas of Brazil, Bolivia and Paraguay, and is considered one of the largest floodplains of Latin America. This region is a floodplain influenced by the rivers that drain the upper Paraguai river Basin, where there is great diversity of fauna and flora, determined by the contribution of four biomes: Amazon, "Cerrado", "Chaco" and Atlantic Forest (ALHO; GONÇALVES, 2005).

The floodplains are characterized by the presence of habitats ranging from aquatic to terrestrial, depending on their communication level with the main river (THOMAZ et al., 1997). These areas stand out by the complexity of their systems, as well as their functioning dynamism, clearly associated with the hydrological conditions that occur within these areas (ALHO, 2008; SILVA et al., 2009).

The aquatic entomofauna, mainly represented by specimens of the orders Ephemeroptera, Plecoptera, Trichoptera, Odonata, Coleoptera and Diptera, is one of the most important groups found in lotic aquatic ecosystems, associated with aquatic plants and sediment, actively participates in the nutrient cycling and energy flow and is widely used as indicator of environmental quality (MERRITT; CUMMINS, 1996).

The distribution of aquatic organisms, especially insects, is directly influenced by food availability and chemical and physical conditions of the water (BISPO; OLIVEIRA, 1998; SILVA et al., 2008). An important factor in the distribution and availability of food for aquatic insects is the association between lotic environment and marginal vegetation (VANNOTE et al., 1980).

According to Kikuchi and Uieda (1998), the riparian vegetation contributes significantly to the functioning of the river as a system, by showing high productivity, resources availability and being an essential source of nutrients and organic matter, which is the base of heterotrophic food chain in aquatic environments.

Callisto and Esteves (1998) point out that the study of a natural biological community can be accomplished at different levels: density species^{-1}, species diversity, food webs and energy flow. In this context, Odum (1988) states that the guild concept becomes useful, since it is considered a functional unit in the community analysis, dismissing the necessity of study each species as a separate entity. Accordingly, this approach allows for comparisons of functional organization of different communities, especially when they are not constituted by common species.

According to Simberloff and Dayan (1991), the functional groups of Cummins (1973, 1974) are trophic guilds that classify river macroinvertebrates, from where these groups use common resources in a similar morpho-behavioral manner. Therefore, their recognition may be based mainly on the diet type presented by the taxa and the feeding behavior associated to the substrate on which food is available.

According to Silva et al. (2009), the approach to the trophic guilds concept in ecological studies enables the understanding of the energy distribution within a community, in terms of complexity and diversity. Consequently, the biomass assessment in each trophic guild and the diversity of feeding items used by each taxon, provide information for the study of energy distribution within communities (AGUIARO; CARAMASCHI, 1998).

Regarding the importance of the entomofauna structure in aquatic ecosystems and the lack of available information about their feeding habits, especially in the Pantanal region, the present work aims to study the structure of the functional groups of aquatic entomofauna in a stretch of Correntoso river, Rio Negro sub-region, Pantanal, State of Mato Grosso do Sul, Brazil.

Material and methods

The study was conducted in a stretch of about 3,600 meters of the Correntoso river (located in the Negro river floodplain), which cross the Santa Emilia Farm (19º 30' 18" S and 55º 36' 45" W), and where is situated the Instituto de Pesquisa do Pantanal (IPPAN/ UNIDERP), Aquidauana municipality, Mato Grosso do Sul, Brazil (Figure 1). Six sites with three distinct phytophysiognomies of riparian formation were chosen for the insect sampling: (a) open riparian physiognomy (ORP), (b) intermediary riparian physiognomy (IRP) and (c) closed riparian physiognomy (CRP) (Appendix 1).

Six sampling sessions were performed in different seasonal periods: ebb, dry and wet, between March 2006 and February 2007, at six collection sites of the river.

The specimens were collected using a D net (300 μm mesh), and sampling effort consisted of five sweeps in the roots of the macrophyte banks, composed of several species of aquatic plants.

The collected material was transferred to plastic bags, labeled and transported to the laboratory. The material was washed using a sieve with the same mesh and then the specimens were separated from the organic material on plastic trays under transilluminated light.

The found specimens were fixed in ethylic ethanol (70%), conditioned in glass jars and then identified using specific literature (BOUCHARD JR., 2004; COSTA et al., 2006; MERRITT; CUMMINS, 1996; PEREZ, 1988).

The absolute abundance and family richness were determined. Furthermore, the collected insects were separated by functional groups: predators, scrapers, filterers, collectors, collectors-filterers, piercers-herbivores, shredders-herbivores, shredders-detritivores, as proposed by Merritt and Cummins (1996).

Results and discussion

In the present study, were registered 60 families belonging to 12 orders of the class Insecta, totaling 19,773 specimens (Appendix 2). These values can be considered relatively high when compared to the work of Oliveira et al. (2006) in the same region of Pantanal.

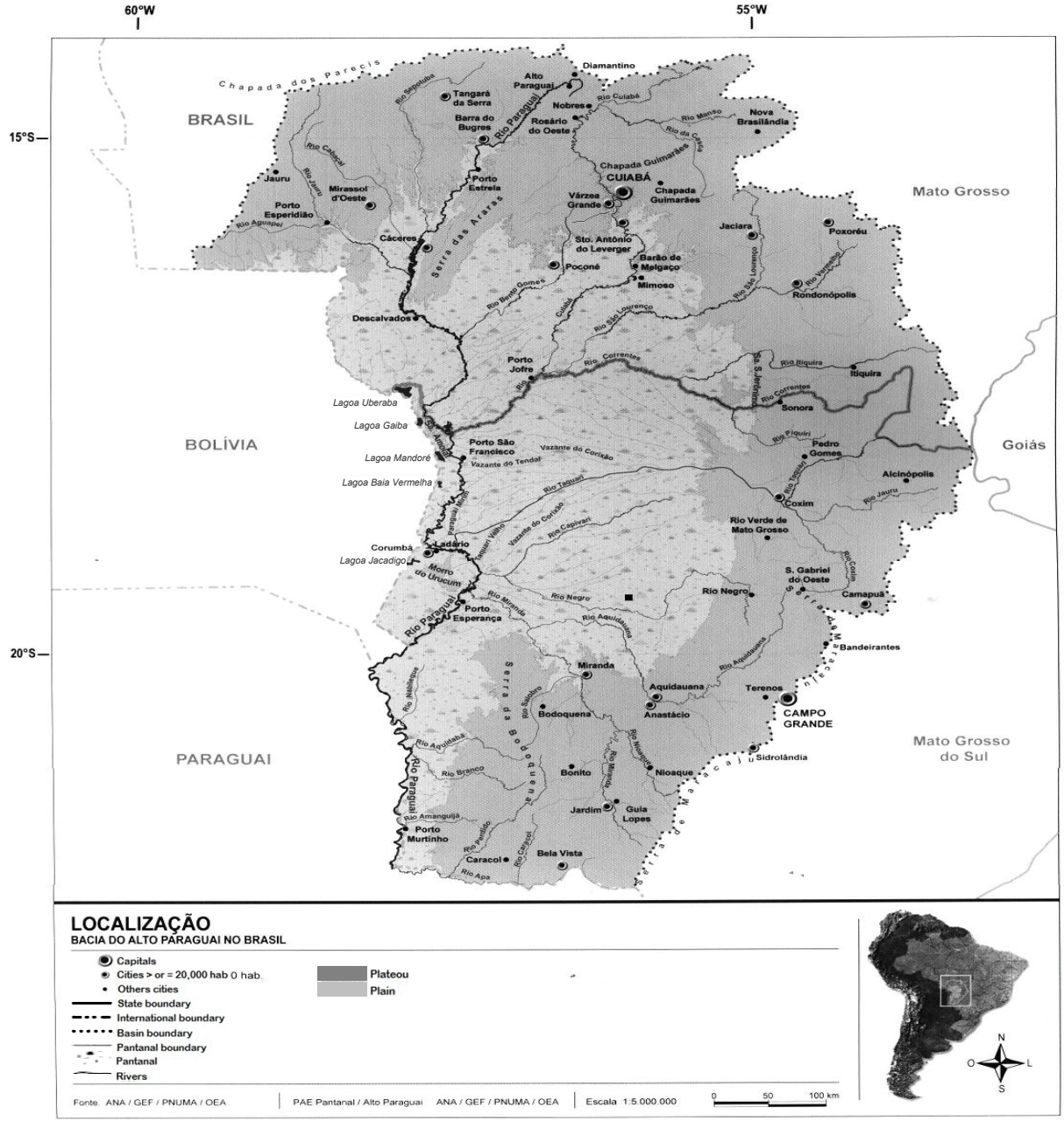

Figure 1. Upper Paraguai river Basin and approximate location of IPPAN/Uniderp (■), (adapted from ANA/GEF/PNUMA/OEA, 2004).

For better understanding of the structure, organization and energy distribution within the aquatic insect community, the captured specimens were separated into categories of functional groups, as proposed by Merritt and Cummins (1996).

Accordingly, families and specimens were categorized into eight distinct groups for each studied environment: predators grouped 34 families, collectors 17, shredders-herbivores ten, scrapers eight, collectors-filterers three, piercers-herbivores three, filterers two and shredders-detritivores two (Appendix 3). Although all categories were represented in the studied environment, the proportion between them and the families represented in each category has changed according to the marginal vegetation structure and the study period.

During ebb season, were recorded 1,858 individuals from 43 families, corresponding to 9.4% of the sampled insects, the lowest abundance found during the study. Predators group showed the highest number of families in this period, 18 families were sampled in ORP, 20 in IRP and 23 in CRP. Followed by collectors group with eight families collected in ORP, seven in IRP and 13 in CRP, shredders-herbivores with six families in

ORP, five in IRP and seven in CRP and scrapers with three families in ORP, four in IRP and six in CRP (Figure 2).

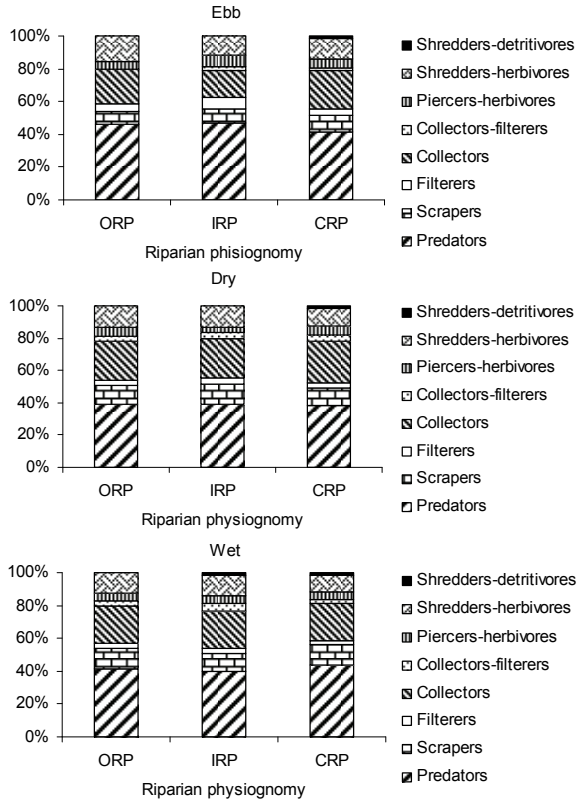

Figure 2. Functional groups of insect families captured in different sampled environments, between March 2006 and February 2007, Correntoso river, Rio Negro sub-region, Mato Grosso do Sul, Brazil. ORP = Open riparian physiognomy; IRP = Intermediary riparian physiognomy; CRP = Closed riparian physiognomy.

Considering the specimen participation in each functional group, the predators were predominant with 368 collected individuals in ORP, 422 in IRP and 793 in CRP. Followed by the collectors (294 individuals captured in ORP, 258 in IRP and 695 in CRP) and the filterers (156 individuals in ORP, 118 in IRP and 442 in CRP). In this period, the collectors-filterers group had low participation in IRP and CRP with only two collected specimens in each site and the shredders-detritivores in CRP with only one individual (Figure 3).

According to Callisto and Esteves (1998), the highest or lowest guild number in a given ecosystem may be related to the variety of available and occupied microhabitats in the littoral and limnetic region, in different periods of the regional hydrological cycle.

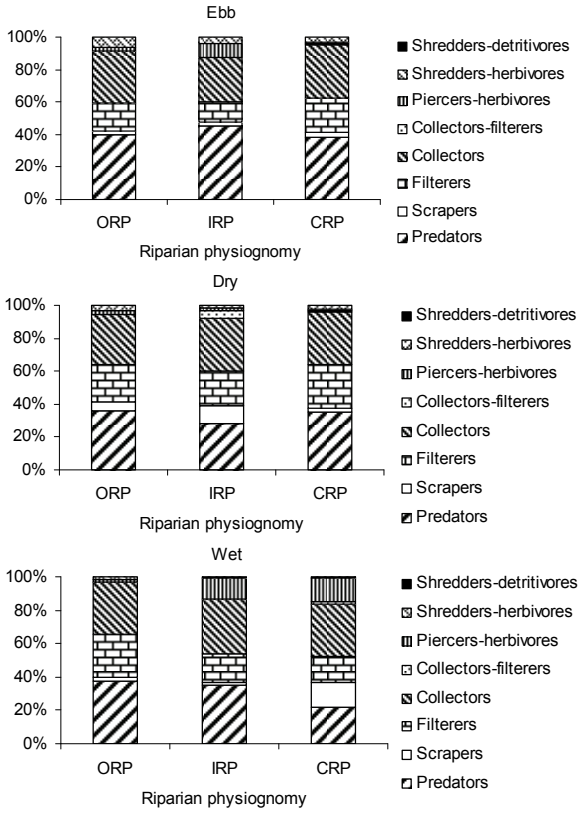

Figure 3. Functional groups of captured specimens in different sampled environments, between March 2006 and February 2007, Correntoso river, Rio Negro sub-region, Mato Grosso do Sul, ORP = Open riparian physiognomy; IRP = Intermediary riparian physiognomy; CRP = Closed riparian physiognomy.

During the dry season, 3,573 individuals belonging to 50 families were collected, corresponding to 18.07% of the sampled organisms. The highest number of families were categorized into predators group, 23 captured families in ORP, 21 in IRP and CRP. Followed by collectors with 13 families captured in IRP, 14 in ORP and CRP, shredders-herbivores with eight families sampled in ORP, seven in IRP and six in CRP, scrapers with seven families in ORP and IRP, and six in CRP. Regarding the specimen participation in each functional group, predators were the most representative with 971 individuals captured in ORP, 810 in IRP and 1,090 in CRP, follow by the collectors group with 819 specimens sampled in ORP, 956 in IRP and 993 in CRP and the filterers with 617 individuals captured in ORP, 602 in IRP and 804 in CRP. During this period, only one specimen was categorized into shredders-detritivores group, collected in IRP.

According to Fidelis et al. (2008), in areas where the marginal vegetation has better environmental conditions, plant cover contributes large amount of organic material of allochthonous origin and shading

reduces autotrophic production of the aquatic environment. In these areas there is a significant involvement of collectors and shredders group duo to the high availability of organic material deriving from the marginal vegetation. Alternatively, open areas and with higher light intensity favor the establishment of macrophytes and associated periphyton, providing major resources for the scrapers, piercers-herbivores and shredders-herbivores.

During wet season was registered the greatest insect abundance, 14,342 specimens of 54 families were captured, representing 72.53% of collected organisms. The largest family number was categorized into predators functional group, with 26 families sampled in ORP and IRP, 30 in CRP, followed by the collectors group with 14 families collected in ORP, 15 in IRP and CRP, scrapers with eight families captured in ORP and CRP, seven in IRP and shredders-herbivores with eight families in ORP and IRP, seven in CRP. The specimen participation in each functional group also showed the highest values, 4,077 specimens categorized into predators group were sampled in ORP and 3,408 in IRP, followed by the collectors with 3,422 individuals in ORP and 3,200 in IRP, filterers with 2,797 individuals ORP and 1,615 in IRP. Otherwise, in CRP the greatest specimen number was categorized into collectors group, 5,257 individuals sampled, followed by predators (3,571) and filterers (2,514). During this period was observed low participation of the collectors-filterers group, with six captured individuals in ORP, 50 in IRP and 196 in CRP, and shredders-detritivores group with only one individual collected in IRP and CRP.

Cummins and Klug (1979) state that seasonal and local differences, associated to entry, production and stocks of food resources available to the aquatic entomofauna, assign dynamics to the system, which varies in space and time. Therefore, the greatest abundance and richness of insect families in all study sites were recorded during the wet season, which can be attributed to the greater availability of resources found in this period.

Regarding the number of families, predators group was the most representative throughout the study period, confirming the results obtained by Oliveira et al. (2006) in the same region of the Pantanal. According to Nessimian (1997), the predator category demonstrates weak relationship with the marginal vegetation and strong with the existing macroinvertebrate community in the environment, that is, with the available feeding resources.

The predators group demonstrates relatively constant abundances, since they depend directly on the presence of other groups of organisms and not on the availability of particulate matter and environmental gradients (VANNOTE et al., 1980). Conversely, the group of collectors and scrapers is favored by the decaying organic matter availability, brought by the flood pulse during wet period (OLIVEIRA et al., 2006).

The collectors group was the second most representative. According to Callisto and Esteves (1998), this group feeds on small particles of organic matter (usually less than 1 mm in size), either by water filtering, or direct collection in sediment deposits at the rivers bottom.

Cheshire et al. (2005) emphasize that the participation of different categories of functional groups, in terms of individual and species numbers, varies between different habitat types.

According to Cummins et al. (1989), the shredders are more abundant in areas with high availability of plant resources, and their participation in the fragmentation of plant remains into smaller particles is greater after these resources suffer some kind of structural and/or biochemistry change.

The scrapers functional group showed low abundance of families and individuals, being more representative in dry and wet seasons, which may be related to the greater water velocity during the runoff process in the ebb season, when occurs greater transport of plant resources and nutrients.

Callisto and Esteves (1998) highlight that because of the rapid decomposition of plant remains may not have time for the periphytic community establishment. Hence, leaves and branches that fall in the rivers beds are rapidly fragmented and decomposed in such a manner that does not support a constant periphyton biomass, necessary to sustain the scrapers group.

The filterers and shredders-detritivores groups were less representative, in relation to family richness, throughout the study period. Each group did not exceed 2.53% of the collected families and were represented by only two taxa: filterers of Chironomidae and Culicidae (Diptera) and shredders-herbivores of Tipulidae (Diptera) and Odontoceridae (Trichoptera).

Conclusion

The greatest abundance was recorded during the wet season, when resource availability is higher. The largest family number was categorized into predators functional group, followed by collectors, shredders-herbivores and scrapers. The functional trophic categorization of insects associated with aquatic macrophytes performed in this study, emphasizes the

importance of organic matter as food resource for aquatic entomofauna. In this context, the trophic guild concept enabled better understanding of the structure, organization and distribution of energy within the aquatic insect community, as well as the contribution of this community in nutrient cycling.

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Appendix 1

Description and location of the study areas, Correntoso river, Rio Negro sub-region, Mato Grosso do Sul, Brazil.

Site	Coordinates	Riparian physiognomy	General features
1	19º30'41''S 55º37'54''W	Open (ORP)	Riparian vegetation is scarce or absent. Connected to floodable fields during wet period. Emergent trees up to 6 meters. Arboreal species: "Cambará" (*Vochysia divergens*), "lixeira" (*Curatella americana*), "embaúba" (*Cecropia pachystachya*) and "acuri" (*Scheelea phalerata*). Aquatic species: "Erva-de-bicho" (*Poligonum acuminatum)*, "aguapé" (*Eichhornia azurea*)," alface d'água" (*Pistia stratiotes*) and "orelha de onça" (*Salvinia auriculata*).
2	19º30'19''S 55º37'41''W	Intermediary (IRP)	Riparian vegetation is present and/or in low density. No connection with floodable fields during wet period. Arboreal species: "Pimenteira" (*Licania parvifolia*), "lixeira" (*C. americana*), "acuri" (*S. phalerata*), "cambará" (*V. divergens*) and "lianas" (*Cissus erosa* and *Cissus spinosa*). Aquatic species: "Aguapé" (*E. azurea*), and "erva-de-bicho" (*P. acuminatum*).
3	19º30'10''S 55º37'40''W	Closed (CRP)	Riparian vegetation with high stature and density. No connection with floodable fields during wet period. Arboreal species: "Lixeira" (*C. americana*), "pimenteira" (*L. parvifolia*), "acuri" (*S. phalerata*), "tucum" (*Bactris glaucescens*) and "cambará" (*V. divergens*). Closed canopy, forming gallery forest. Aquatic species: "Erva capitão" (*Hydrocotyle leucocephala*), "erva-de-bicho" (*P. acuminatum*) and "aguapé" (*E. azurea*).
4	19º30'04''S 55º37'30''W	Open (ORP)	Riparian vegetation is scarce or absent. Connected to floodable fields during wet period. Emergent trees up to 6 meters. Arboreal species: "Cambará" (*V. divergens*), "pimenteira" (*L. parvifolia*), "lixeira" (*C. americana*), "acuri" (*S. phalerata*), "embaúba" (*Cecropia pachystachya*) and "lianas" (*C. erosa* and *C. spinosa*). Aquatic species: "Erva-de-bicho" (*P. acuminatum*), "aguapé" (*E. azurea*) and "orelha de onça" (*S. auriculata*).
5	19º29'48''S 55º37'23''W	Intermediary (IRP)	Riparian vegetation is present and/or in low density. No connection with floodable fields during wet period. Arboreal species: "Pimenteira" (*L. parvifolia*), "acuri" (*S. phalerata*) and "lianas" (*C. erosa* and *C. spinosa*). Aquatic species: "Dormideira" (*Neptunia plena*), "erva-de-bicho" (*P. acuminatum*) and "aguapé" (*E. azurea*).
6	19º29'21''S 55º37'13''W	Closed (CRP)	Riparian vegetation with high stature and density. No connection with floodable fields during wet period. Arboreal species: "Tucum" (*Bactris glaucescens*), "acuri" (*S. phalerata*), "lixeira" (*C. americana*), "pimenteira" (*L. parvifolia*), "ingá" (*Inga uruguensis*) and "cambará" (*V. divergens*). Closed canopy, forming gallery forest. Aquatic species: "Ninféa" (*Nymphaea jamesoniana*), "erva-de-bicho" (*P. acuminatum*), "orelha-de-onça" (*S. auriculata*), "dormideira" (*N. plena*) and "aguapé" (*E. azurea*).

Appendix 2

Found taxa in Correntoso river, Rio Negro sub-region, Mato Grosso do Sul State, Brazil.

		Ebb			Dry			Wet		
Taxa/sample	Functional group	ORP	IRP	CRP	ORP	IRP	CRP	ORP	IRP	CRP
Hexapoda										
Blattodea										
Blattellidae								2		1
Coleoptera										
Carabidae	Pred			1		1	1			1
Chrysomelidae	Shre-her			2		1				
Curculionidae	Shre-her	31	6	20	21	2	17	49	8	25
Dytiscidae	Pred	24	45	55	46	11	24	86	177	139
Elmidae	Scra; Coll	2	5	20	2	3	4	12	13	12
Gyrinidae	Pred		2	2	3			42		2
Hydrochidae	Shre-her							3		
Hydrophilidae	Pred; Coll	72	73	112	39	18	68	266	149	212
Noteridae	Pred; Coll	25	45	64	2	8	26	64	87	49
Psephenidae	Scra			1	4			4		2
Scarabeidae								1	1	
Scirtidae	Scra; Coll; Pier-her; Shre-her	13	5	12	47	34	35	60	32	40
Staphylinidae	Pred	2	5	1	29	1		24	2	1
Diptera										
Ceratopogonidae	Pred	24	4	41	142	12	28	469	47	82
Cecidomyiidae							1			
Chironomidae	Pred; Fil; Coll	155	108	438	595	600	783	2772	1609	2508
Culicidae	Fil; Coll	1	10	4	22	2	21	25	6	6
Dolichopodidae	Pred	1			1			1	1	2
Empididae	Pred; Coll					3	2			1
Muscidae	Pred			1						
Psychodidae	Coll	19		5	11		14	31	18	9
Sciomyzidae	Pred			1						
Stratiomyiidae	Coll			1						
Tabanidae	Pred	1	3	4	2	3	5	4	5	2
Tipulidae	Coll; Shre-her				1	3	1	3	1	
Ephemeroptera										
Baetidae	Scra; Coll			16	57	223	20	56	113	65
Caenidae	Scra; Coll	7	10	13	28	16	14	71	26	102
Leptophlebiidae	Scra; Coll				1	25	2	1	1	2
Hemiptera										
Belostomatidae	Pred	1	1	5	5	5	2	9	4	3
Corixidae	Pred; Pier-her	7	75	3	7		3	58	38	95
Gerridae	Pred			3		1	1	6	20	10
Hebridae	Pred				1				1	4
Hydrometridae	Pred							3		
Macroveliidae	Pred	1	1	1	2					2
Mesoveliidae	Pred		3		6		1	9	8	7
Naucoridae	Pred	12	13	18	3	8	12	15	14	11
Nepidae	Pred					1	1		3	
Notonectidae	Pred		1					4		1
Pleidae	Pred	1	6	1	2	3		83	51	109
Veliidae	Pred	8	4	3	13	4	3	2	17	5
Hymenoptera										
Trichogrammatidae					1			3		
Lepidoptera										
Coleophoridae	Shre-her	1								
Noctuidae	Shre-her	1	2	6	3		3	6	1	6
Pyralidae	Shre-her	1	1	17	2	4	3		3	7
Megaloptera										
Corydalidae	Pred					3	1		3	1
Odonata										
Coenagrionidae	Pred	13	5	16	15		28	31	28	24
Cordulegastridae	Pred	1	15	4	12	8	18	3	8	5
Libellulidae	Pred	18	9	12	31	1	69	108	44	90
Aeshnidae	Pred	2	2					6	2	1
Orthoptera										
Acrididae	Shre-her	10	20	6	5		4	16	7	3
Gryllidae	Pred; Coll; Shre-her			5	6	1		3	2	7
Thysanoptera										
Phloeothripidae							1	4	2	1
Trichoptera										
Glossosomatidae	Scra					12		1	1	21
Hydropsychidae	Pred; Coll-fil				7	112	10	2	1	2
Hydroptilidae	Scra; Coll; Pier-her		2	4	6	20	2	55	1132	2242
Leptoceridae	Pred; Coll; Shre-her				2			3	10	1
Odontoceridae	Coll; Shre-det			1			1		1	1
Philopotamidae	Coll-fil				3				44	
Polycentropodidae	Pred; Coll-fil		2	2		6	4	4	5	194
Total specimens		454	483	921	1185	1155	1233	4480	3746	6116
Total families		28	30	38	39	33	37	45	44	47

*Categories of functional groups of aquatic insect (Pred = Predators, Scra = Scrapers; Fil = Filterers; Coll = Collectors; Coll-fil = Collectors-filterers; Pier-her = Piercers-herbivores; Shre-her = Shredders-herbivores; Shre-det = Shredders-detritivores).

Appendix 3

Functional group of found taxa in Correntoso river, Rio Negro sub-region, Mato Grosso do Sul State, Brazil.

Taxa	Pred	Scra	Fil	Coll	Coll-fil	Pier-her	Shre-her	Shre-det
Hexapoda								
Blattodea								
Blattellidae								
Coleoptera								
Carabidae	X							
Chrysomelidae							X	
Curculionidae							X	
Dytiscidae	X							
Elmidae		X		X				
Gyrinidae	X							
Hydrochidae							X	
Hydrophilidae	X			X				
Noteridae	X			X				
Psephenidae		X						
Scarabeidae								
Scirtidae		X		X		X	X	
Staphylinidae	X							
Diptera								
Ceratopogonidae	X							
Cecidomyiidae								
Chironomidae	X		X	X				
Culicidae			X	X				
Dolichopodidae	X							
Empididae	X			X				
Muscidae	X							
Psychodidae				X				
Sciomyzidae	X							
Stratiomyiidae				X				
Tabanidae	X							
Tipulidae				X				X
Ephemeroptera								
Baetidae		X		X				
Caenidae		X		X				
Leptophlebiidae		X		X				
Hemiptera								
Belostomatidae	X							
Corixidae	X					X		
Gerridae	X							
Hebridae	X							
Hydrometridae	X							
Macroveliidae	X							
Mesoveliidae	X							
Naucoridae	X							
Nepidae	X							
Notonectidae	X							
Pleidae	X							
Vellidae	X							
Hymenoptera								
Trichogrammatidae								
Lepidoptera								
Coleophoridae							X	
Noctuidae							X	
Pyralidae							X	
Megaloptera								
Corydalidae	X							
Odonata								
Coenagrionidae	X							
Cordulegastridae	X							
Libellulidae	X							
Aeshnidae	X							
Orthoptera								
Acrididae							X	
Gryllidae	X			X			X	
Thysanoptera								
Phloeothripidae								
Trichoptera								
Glossosomatidae	.	X						
Hydropsychidae	X				X			
Hydroptilidae		X		X		X		
Leptoceridae	X			X			X	
Odontoceridae				X				X
Philopotamidae					X			
Polycentropodidae	X				X			
Taxa number	34	8	2	17	3	3	10	2

*Categories of functional groups of aquatic insect (Pred = Predators, Scra = Scrapers; Fil = Filterers; Coll = Collectors; Coll-fil = Collectors-filterers; Pier-her = Piercers-herbivores; Shre-her = Shredders-herbivores; Shre-det = Shredders-detritivores).