ABUNDANCE AND DISTRIBUTION OF FISH

IN LITTER BANKS OF THE AMAZON

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Introduction

The black water rivers from Amazonia originate from the lower and plain zones of the Guiana and Central Brazil shields, where erosion processes are not very intense and also reduced by the dense gallery forests. These rivers carry large amounts of humic and fulvic acids and are extremely poor in nutrients, due to water infiltration in the soil, which prevents a complete litter decomposition. There is almost no primary production in these environments and adjacent forests are the main source of nutrients. In small streams these resources concentrate in meanders, originating large litter banks to which several organisms associate. The trophic chain in this habitat starts with decomposing fungi, ending with small fishes and shrimps. Besides being a source of nutrients, litter banks also provide shelter against predators. These habitats are in a continuous process of decomposition and respiration.

Material and Methods

Data was collected in a small tributary (Tarumã-Mirim) of Negro River, 25 km from Manaus, during September, October and December 1999, which represent the dry season in the region. Three kilometers of the stream were mapped and

divided in 30 plots of 100 m. Ten plots were randomly selected to be sampled each month. Fishes were captured using a hand net in 10 throws per bank. Oxygen concentration was measured in a depth of 15 cm with an YSI MODEL 58 oxymeter. Total bank depth was measured with a graduated stack to the contact with the ground substrate. Bank volume was calculated by the product of length, width and depth. Flow speed in each bank was determined by the time necessary for a semi-floating body to cover 1m of distance.

Results

We captured 3943 individuals, representing 6 orders, 17 families and 33 species during the period of study (Table 1). Oxygen concentration was highly correlated to bank volume and depth (statistics), but flow speed was not correlated to any of these variables. The abundance of each of the commonest species was not related to oxygen concentration and flow speed. Total number of species was negatively related to oxygen concentration (r^2=0.232, p=0.000) and flow speed (r^2=0.038, p=0.000), Figure 1.

Table 1. Number of animals captured, in brackets, with indication of Species, Families and Orders.

Characiformes		
	Crenuchidae	
		Characidiinae

			Klausewitzia sp. (66) *Elachocharax pulcher* (2340) *Microcharacidium eleotrioides* (30) *Ammocryptocharax minutus* (2) *Characidium sp.* (1) *Microcharacidium weitzmani* (481)
	Curimatidae		
			Curimatopsis evelynae (34)
	Lebiasinidae		
			Pyrrulina latae (1) *Nanostomus eques* (6) *Copella sp.* (27)
	Erytrinidae		
			Hoplias malabaricus (4)
	Characidae		
			Gnatocharax steindachneri (1) *Hemigrammus stictus* (3) *Hemigrammus belloti* (31) *Hemigrammus worderwinkler* (5)
Perciformes			
	Ciclidae		
			Apistogramma sp. (139) *Aequides pallidus* (13) *Crenicichla notophtalmus* (30)
	Eleotridae		
			Microphilipnus sp1 (102) *Microphilipnus sp2* (41)
Gymnotiformes			
	Hypopomidae		
			Microsternarchus billineatus (74) *Hipopygus sp.* (147)
	Gymnotidae		
			Gymnotus anguilaris (82)
Siluriformes			
	Pimelodidae		
			Nemuroglanis sp1 (117) *Nemuroglanis sp2.* (147)
	Scoloplacidae		
			Scoloplax dolicholophia (76)

	Trichomycteridae		
			Trichomycterus sp1 (1)
			Trichomycterus sp2. (1)
			Phreathobius sp. (1)
			Phisopixis aff. lira (1)
	Loricariidae		
			Acestridium discus (3)
Cyprinodontiformes			
	Rivulidae		
			Rivulus aff. ornarus (1)
Synbranchiformes			
	Synbranchidae		
			Synbranchus sp. (7)

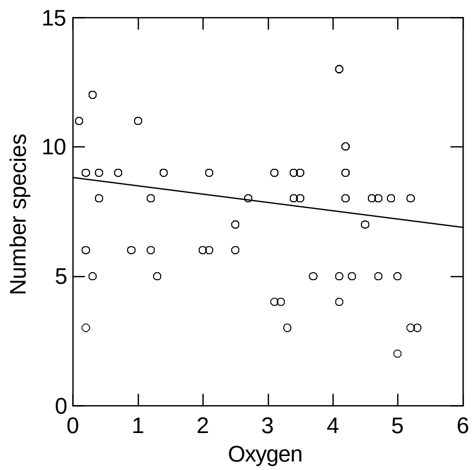

Figure 1. Relationship between number of fish species and dissolved oxygen in litter banks of Tarumã-Mirim. r^2=232, p= 0.000.

Discussion

In small black water streams, the organic matter accumulated in marginal meanders is the main nutrient source. A diversity of organisms, around 122 species, including insects, larvae, crustaceans and fishes, can be found associated to these habitats (Walker, 1994). The environmental factors we analyzed (oxygen concentration, bank depth, bank volume, and flow speed) did not explain much the pattern of species distribution and abundance in the litter banks. Several studies have shown a relationship between the distribution of aquatic organisms and physical and chemical parameters like temperature, oxygen concentration, depth, flow speed, water chemistry and light. When anoxic conditions are created in *várzea* lakes, several fish species move to more favorable environments, and only resistant species stay in these conditions (Junk *et al*., 1983). In macrophytes banks there is a high diurnal oxygen production and a high nocturnal consumption. Species associated to these banks move to open areas at night and use superficial aerial respiration (Saint-Paul & Soares, 1987).

Decomposition processes in litter banks are accelerated by the action of microorganisms and fungi, which together with crustaceans, fishes, insects and larvae reduce the amount of available oxygen. Its known that adaptive responses (morphological, physiological and genetic) are common in fish living in extreme conditions were environmental factors are much variable (Val, 1993). Laboratory experiments of oxygen consumption by the most abundant species revealed that they are very resistant to hypoxic conditions, what suggests that oxygen is not a limiting factor for the distribution of fishes in litter banks. The greatest number of species was found in places with the lowest oxygen concentration. Low oxygen conditions were found in the larger banks, which have a greater availability of resources, what might explain the use of the banks by so many species.

Another hypothesis is that these species stay in litter banks during the day and reduce their metabolism to avoid predators that not exploit this habitat. This pattern was observed in aquariums mounted to simulate natural conditions. During the night several species were seen leaving the bank to explore neighbors habitats such as sand substrate.

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