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NATURAL HISTORY NOTE

Dining out: *Bryconops caudomaculatus* jumps out of water to catch flies

Cenar afuera: *Bryconops caudomaculatus* salta del agua para atrapar moscas

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The input of organic matter from riparian vegetation connects aquatic and terrestrial ecosystems (Lorion & Kennedy 2009). Allochthonous organic matter, mainly terrestrial insects and fruits, are often the main food source for fishes (Vannote et al. 1980). The capture of these resources usually depends on the rate they fall into the water. Some biotic and abiotic agents, as wind and rain, can increase the allochthonous input into the water and then contribute to their consumption for fish (Sabino & Sazima 1999, Rezende & Mazzoni 2005). However, the capture of these items available out of the water can be more active.

The "fish jumpers" are popularly well known, especially among riverside communities (Costa-Neto & Marques 2000). Indeed, studies have reported fishes jumping out of the water by several factors, such as migration (Godinho et al. 2010), predator avoidance (Major 1978, Davenport 1994, Tsikliras et al. 2004), unfavorable physicochemical water conditions (Mast 1915), diseases (Li et al. 2002), and the capture of resources, mainly insects and fruits (Seghers 1978, Lowry et al. 2005, Wassenberg et al. 2006, Reys et al. 2008). Here, we report and describe the behavior of the fish *Bryconops caudomaculatus* jumping out of the water to capture food items, and analyze the diet of this species.

We collected data on a lentic backwater on the Cravari river (12º31'49" S / 57º52'51" W), Mato Grosso, Brazil, during November 2009. The site was about 1.7 m deep, with sandy substrate and preserved marginal vegetation. We observed the foraging *Bryconops caudomaculatus* with snorkel and diving mask in the pre-twilight (14:00-16:00) and twilight (17:30-18:30) periods, totaling 16 hours of sampling effort. We captured 34 individuals of *B. caudomaculatus* with a seine during the twilight period. These individuals were killed with benzocaine (40 ppm), fixed in formaline (10 %) and then preserved in alcohol (70 %). The fish specimens were identified with specific literature (Chernoff & Machado-Alisson 2005) and are deposited in the Zoological Collection of Universidade Federal de Mato Grosso do Sul (ZUFMS nº 2102).

We removed the stomach content and identified the food items with the aid of specialized literature (Triplehorn & Johnson 2004). We calculated the index of alimentary importance (IAi) for each food item using volumetric proportions (Vi) and the frequency of occurrence (Fo) according to the following formula: Fo % x Pi % / ∑ Fo % x Pi % (Kawakami & Vazzoler 1980).

During the pre-twilight, individuals of *B. caudomaculatus* assumed benthic foraging strategies by collecting food items carried by the flow and substrate grubbers. We observed these fishes swimming in the water column, revolving sandy bottom and looking for food items in the algae clusters.

During the twilight, we observed hundreds of *B. caudomaculatus* jumping out of water. Our subaquatic observations showed that before jumping out, the individuals searched for food items drifting in the water surface or even those above the water surface, like small flying insects. The fishes remained in constant movement near water surface with the body slightly tilt (Fig. 1A). When the individual selected a particular food item, it would stop swimming and take a more acute angle (Fig. 1B). Then, the individual would move quickly to capture the food item, jumping out of the water surface (about 15 cm).

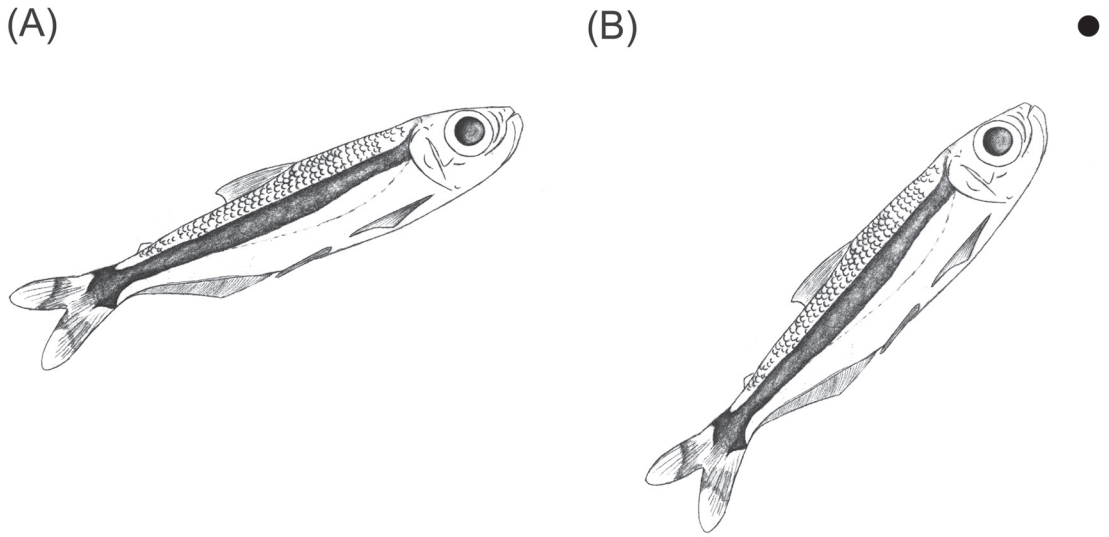

Fig. 1: (A) Individual of *Bryconops caudomaculatus* searching for food items drifting in the water surface or even those above the water surface with the body slightly tilt; (B) Individual of *Bryconops caudomaculatus* with a more acute body angle after selected a particular food item.

(A) Individual de *Bryconops caudomaculatus* en busca de alimentos a la deriva en la superficie del agua o por encima de la superficie del agua con el cuerpo ligeramente inclinado; (B) Individual de *Bryconops caudomaculatu*s con un ángulo más agudo del cuerpo después de seleccionar un alimento.

All 34 stomachs were full and we found 23 food items in the diet of *B. caudomaculatus.* Allochthonous food items (IAi = 0.98) had an alimentary importance far greater than autochthonous (IAi = 0.02), and were present in 97 % of stomachs. Flying adults of Phoridae flies were the most frequent and important food items (Table 1). Furthermore, one of the individuals of *B. caudomaculatus* had 42 Phoridae flies in its stomach content. Other groups of Diptera, mainly Chironomidae adults, were also found in stomach contents. Non-flying terrestrial insects (Coleoptera, Homoptera-Cercopidae and Hymenoptera-Formicidae) and aquatic larvae (Odonata, Ephemeroptera and Diptera) showed low alimentary index (Table 1).

The high frequency of occurrence and alimentary importance of allochthonus food items, specially the Phoridae flies, suggests that the strategy of jumping out of the water to catch food items may be important in the diet of *B. caudomaculatus*. Other food items with relative alimentary importance, like fruits and terrestrial insects, were probably available drifting on the water, and were captured during the search on the water surface during the twilight period. Moreover, the fact that all stomachs were full indicates that the twilight is an important period for *B. caudomaculatus* foraging. On the other hand, the autochthonous food items that had low alimentary importance, as aquatic insect larvae and sand, must have been captured before twilight, when *B. caudomaculatus* assumes benthic foraging strategies.

The variation in the foraging strategy of *Bryconops* before and during the twilight may explain the disparity in the results of dietary studies of the genus. Sazima (1986) and Sánchez et al. (2003) found a greater importance of allochthonous food items in diet of *B. melanurus*. Whereas Silva (1993) described *B. melanurus* as benthic/nektonic, with autochthonous food items predominating in the diet, a similar result to that found by Silva et al. (2008) to *B. caudomaculatus*. We believe that the time of the day that sampling is carried out may affect the food items found in stomach contents.

TABLE 1
Frequency of occurrence (FO%) and alimentary index (IAi) of food resources consumed by *Bryconops caudomaculatus* in Cravari River, Mato Grosso, Brazil.

Frecuencia de ocurrencia (FO%) y índice alimentar (IAi) de los recursos alimenticios consumidos por *Bryconops caudomaculatus* en río Cravari, Mato Grosso, Brasil.

Food item	FO%	IAi
Phoridae adult	88	0.811
Terrestrial insects	35	0.152
Diptera	21	0.008
Allochthonous plant fragments and fruits	18	0.006
Allochthonous items	97	0.977
Aquatic insects	21	0.006
Filamentous algae and aquatic plants	18	0.010
Sand and scales	12	0.003
Free-living helminths	9	0.003
Cladocera	3	< 0.001
Autochthonous items	38	0.022

Besides the daily temporal variation in resource availability, we believe that the ability of seeing food items out of the water can vary according to the sun's position. When the incidence of light in the water is higher, the sight of benthic food items is easier, because the strong sunlight allows an increase in the search range (Guthrie & Muntz 1993). On the other hand, looking up for items out of the water is complicated by the reflected sunlight on the water slide. During twilight, the situation is reversed; thus the search for food items at or above the water surface may be easier without the reflected sunlight.

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