DIET OF *HYPHESSOBRYCON AUCA* (PISCES, CHARACIDAE) IN IBERA WETLAND (NORTHEASTERN, ARGENTINA)

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ABSTRACT: *Hyphessobrycon auca* Almirón, Casciotta, Bechara & Ruiz Díaz, 2004, inhabit small lakes located at the northwest of Iberá wetland in Argentina. This research describes some aspects of its feeding. Samples were collected from its type locality from 2007 to 2009. Analysis of 70 digestive tracts of individuals ranging from 24 to 56 mm standard length (SL) showed that higher plants, algae, and quironomids larvae dominated the diet in terms of relative volume and occurrence frequency. Therefore, this species was characterized as omnivorous, but there was a growing trend towards herbivory when size class increased. Smaller size class (< 35 mm SL) fed on higher proportion of animal preys such as quironomids larvae and protozoans, in contrast to larger ones who consumed almost exclusively plants and algae.

RESUMEN: *Hyphessobrycon auca* Almirón, Casciotta, Bechara & Ruiz Díaz, 2004, habita en pequeñas lagunas localizadas al noroeste de Los Esteros del Iberá en Argentina. Este trabajo describe algunos aspectos de la alimentación de la especie. Los ejemplares fueron colectados de su localidad tipo durante muestreos realizados entre 2.007 y 2.009. El análisis de 70 tractos digestivos de ejemplares que variaron de 24 a 56 mm de longitud estándar (LE) mostró que las plantas superiores, algas y larvas de quironómidos dominaron la dieta en términos de abundancia y frecuencia de ocurrencia. Por lo tanto, esta especie fue caracterizada como omnívora, aunque hubo una tendencia creciente hacia la herviboría al incrementarse la talla. Los especimenes más pequeños (< 35 mm LE) consumieron una elevada proporción de presas de origen animal, tales como larvas de quironómidos y protozoos, a diferencia de los ejemplares de mayor tamaño que se alimentaron casi exclusivamente de plantas y algas.

Key words: diet, omnivory, herbivory.
Palabras claves: dieta, omnivoría, herviboría.

INTRODUCTION

The genus *Hyphessobrycon* has high species richness and a wide distribution in Neotropical region (Reis *et al.*, 2003). In the Esteros del Iberá, one of the largest wetland in South America, *H. anisitsi*, *H. auca*, *H. elachys*, *H. eques*, *H. igneus*, *H. luetkenii*, *H. meridionalis*, and *H. wajat* have been registered (Casciotta *et al.*, 2005). Most of them have a widespread distribution across the wetland, but *Hyphessobrycon auca* (Fig. 1), recently discovered species, is restricted to small lakes located at the northwestern (Almirón *et al.*, 2004).

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The knowledge about the biology, distribution, and abundance of species is an essential tool for their conservation. Particularly, studies about trophic ecology allowing a better understanding about their ecological role in communities.

Hyphessobrycon auca is a poorly known species. Besides, its apparently endemic distribution in fast-growing human activities areas requires more investigations. The aim of the present paper was to describe some aspects of the feeding of *H. auca* from the type locality. In this sense, this study represents the first contribution to biological knowledge of this species.

Fig. 1: *Hyphessobrycon auca*

MATERIALS AND METHODS

Hyphessobrycon auca occurs in small lakes (area: < 0.5 km^2), very shallow, with low levels of conductivity and nutrients, and high transparency and dissolved oxygen (Casciotta *et al.*, 2005). Littoral areas have patches of *Eichhornia azurea, Nymphaea* sp., and *Schoenoplectus californicus* and sandy bottom are completely covered by dense mats of *Egeria* spp.

Fishes were collected by electro-fishing and seine nets from two lakes (Lake 1: 27° 41′ 40.6″ S; 57° 12′ 54.3″ W; Lake 2: 27° 41′ 29.1″ S, 57° 12′ 51.7″ W). Sampling was performed in 2007, 2008 and 2009 summer. All specimens were fixed in 10 % formalin and the standard length (SL; mm) measured.

The diet from 70 specimens was analyzed and the feeding items were identified up to the lowest possible taxonomic levels using stereoscopic microscopy. A semi-quantitative scale of abundance was used as equivalent measurement to volume, based on a combination of abundance and size of each feeding items through a visual valuation on scaled plate. Besides, occurrence frequency was calculated (Hyslop, 1980). In order to ponder both relative volume and occurrence frequency was used the Feeding Index (IA_i, Kawakami & Vazzoler, 1980), described by the equation:

$$IA_i = \frac{F_i * V_i}{\sum_{i=1}^{L} F_i * V_i}$$

where: IA_i= Feeding index; i= 1,2,3....feeding item; F_i= occurrence frequency percentage and V_i= volumetric percentage.

To explore diet variations according to size, the specimens were classified in size class: 1(24-34 mm SL, n= 23), 2 (35-44 mm SL, n= 36), and 3 (45-56 mm SL, n=11). The examined material was deposited in the Instituto de Ictiología de Nordeste belonging to Universidad Nacional del Nordeste.

RESULTS AND DISCUSSION

All of examined specimens had contents in their digestive tracts and sixteen feeding items were registered in their diets. Vegetal foods, in which higher plants, algae and detritus are included, constituted almost the 50 % of total volume. In most of cases, higher plants remains, such as leaves and stems, and also seeds, mainly was belonging to *Egeria* spp. and secondarily to grass. Filamentous algae were consumed, but it represented less than 20 %. Animal items were highly diverse, but all together represented 47 % of volume. Among them quironomids larvae were the most important preys (17 %), while dipterans pupae, arachnids, beetles, and caddisflies represented less than 13 %. Different groups of microcrustaceans represented 6 % of total volume. In general, feeding items that showed highest volume coincidently were more frequently consumed, for example: plants (99%), algae (68%), quironomids larvae (55%), protozoans (32%), and detritus (24%) (Table 1).

Most species of the genus *Hyphessobrycon* show a great diversity of diets, including mostly invertebrates, such as microcrustaceans, larvae and adults of aquatic and terrestrial insects (Esteves & Galetti Jr., 1995; Merigoux & Ponton, 1998; Galacatos *et al.*, 2004; Pelicice & Agostinho, 2006). Particularly on this wetland, some species showed a wide interspecific variation, but are mainly characterized as invertebrate-feeders (Soneira *et al.*, 2006). Differently, *H. auca* could be characterized as omnivorous; in which higher plants have special relevance.

Dense mats of *Egeria* spp. as dominant vegetation are very common in lakes in the Neotropical region, and particularly abundant in Iberá wetland. Several studies have suggested that macrophytes play a key role on feeding fish, because they support other organisms such as microcrustaceans, aquatic insects and algae, which could represent preys for fishes (Casatti *et al.*, 2003; Pelicice & Agostinho, 2006). However, the importance of *Egeria* spp. as directly used resource by fishes has not been mentioned for other Neotropical fishes, even less in so abundant and frequent quantities that were registered on this paper.

Table 1: Relative Volume (RV, %) and Occurrence Frequency (OF, %) of feeding items in diet of *Hyphessobrycon auca*.

Feeding Items	Taxa	RV	OF
Protists	Rhyzopoda	11.2	32.4
Crustacean	Cladocera	2.6	7.0
	Copepoda	1.0	2.8
	Ostracoda	1.4	4.2
	Resistance eggs	1.0	2.8
Arthropods	Coleoptera	2.8	11.3
	Diptera Chironomidae larvae		
	Chironominae	10.4	33.3
	Orthocladiinae	0.6	2.4
	Tanypodinae	2.1	5.3
	Pupae	4.1	13.9
	Orthoptera	0.1	1.4
	Trichoptera	1.4	4.2
	Arachneae	1.3	4.2
	Acari	4.1	9.9
	Not identified	3.2	12.7
Higher plants		30.0	98.6
Filamentous algae		17.6	67.6
Detritus		5.7	23.9

When the items were separated in two wide categories according to their origins, i.e. vegetal or animal foods, the smaller specimens (< 35 mm SL) showed dominance of animal preys (IA_i= 0.43), reducing their importance with increasing in fish size, up to the lowest values (IA_i=0.05). In contrast, vegetal foods reached highest index values in larger specimens of *H. auca* (IA_i= 0.95) (Fig. 2). This pattern in trophic behavior has been mentioned in several fish species, even in the same genus (Kramer & Bryant, 1995). At least two possible explanations could be mentioned. Dietary changes could be associated to morphological constraint due to body size. Mouth opening and cavity are considered one of the most important factor determining preys types and size selected by fishes (Piet, 1998).

Second hypothesis is related to differential nutritional requirements during ontogeny of this species, involving protein-rich diet in immature earlier stages, and carbohydrates-rich diets in adults (Benavides *et al.*, 1994). Then, would expect that animal preys predominant in juveniles diets. Particularly, in *H. auca* has been observed mature specimens at 37 mm (pers. obs.), in coincidence with size at first maturity in other closer species (Fontoura *et al.*, 2010). Our results show an increase in plants consumption in individuals from this size on ahead.

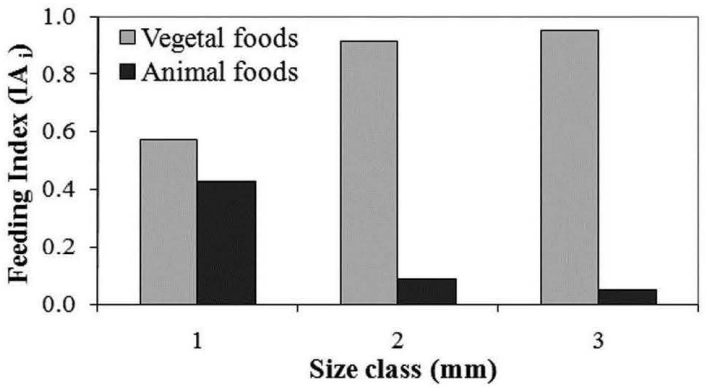

Fig. 2: Feeding Index (IA_i) of vegetal and animal foods in diet of different size class of *Hyphessobrycon auca*.

CONCLUSION

Our results show that *Hyphessobrycon auca* is an omnivore species with an apparent tendency towards herbivory with the increasing in fish size. This study contributes to knowledge of a recently discovered and endemic species, in spite of limited locations and seasons considered.

AKNOWLEDGMENTS

We thank financial support of Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT, PICT 01-13307/2003), and fellowships from Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET) for the first author.

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Recibido/Received/: 29-Jul-2011
Aceptado/Accepted/: 31-Nov-2011