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FEEDING HABITS OF THE GIANT GOBY, *GOBIOIDES BROUSSONNETTI* L., IN THE AMAZON ESTUARY

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ABSTRACT – Gobioides *species are abundant large fishes in the Amazon River estuary, with total length greater than 50 cm. Many predatory fish species of fresh, brackish and salt water eat at least two large species of this genus in the estuary. Qualitative and quantitative analyses of the gut contents of the Gobioides broussonnetti were undertaken in order to investigate the species' diet, and results indicate a strong relationship between primary productivity and the diet of the giant goby. Four genera of diatoms (Actinocyclus, 49%; Coscinodiscus, 37%; Polymyxes, 7%; Triceratium, 5%) represent about 98% of the stomach contents of* Gobioides broussonnetti *during the entire year. Qualitative and quantitative changes in phytoplankton abundance of the stomach contents are related to seasonal changes of the salinity in the estuary, ranging from freshwater in the rainy season to brackish in the dry season.*

KEY WORDS: *Gobioides broussonnetti*, Gobiidae, Feeding habits, Estuary, Amazon.

RESUMO – As espécies de Gobioides *no estuário do Rio Amazonas são abundantes e de grande porte, com comprimento total maior que 50 cm. Muitas espécies piscívoras de água doce, estuarina e marinha comem*

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pelo menos duas espécies deste gênero no estuário. Análises qualitativas e quantitativas dos conteúdos estomacais de Gobioides broussonnetti *foram realizados. Os resultados indicam haver uma relação forte entre a produtividade primária do estuário e a dieta deste Gobiidae de grande porte. Quatro gêneros de Diatomáceas representaram 98% (Actinocyclus, 49%; Coscinodiscus, 37%; Polymyxes, 7%; Triceratium, 5%) do conteúdo estomacal de* Gobioides broussonnetti *ao longo do ano. As mudanças qualitativas e quantitativas da abundância de fitoplâncton nos conteúdos estomacais foram relacionadas à mudanças sazonais da salinidade no estuário, que variaram de água doce na estação chuvosa para salobra na estação seca.*

PALAVRAS CHAVES: *Gobioides broussonnetti*, Gobiidae, Hábitos Alimentares, Estuário, Amazonas.

INTRODUCTION

Gobies are common and widely distributed fishes in coastal and estuarine waters of subtropical and tropical regions (Fitzhugh & Fleeger 1985). Considering that the Amazon estuary is a large mixing place of fresh and salt waters in the tropics, where the equivalent of one-fifth of the annual discharge of all the rivers in the world meets the ocean (Milliman & Meade 1983), we expected to find gobies in that saline gradient.

The Amazon estuary is formed by the interface of the Amazon River discharge with the Atlantic Ocean, in northeastern South America. It is divided in two by Marajó Island, forming the "true" Amazon River mouth to the north, and Marajó Bay to the south (Barthem & Schwassmann 1994). Few studies have been done to identify the Amazon estuary goby species and only four species are known: *Gobioides broussonnetti* and *G. grahamae*, in the open waters of the estuary; and *Bathygobius soporator* and *Awaous flavus*, in the shallow waters adjacent to mangrove dominated areas (Barthem 1985).

Gobioides comprises the largest goby along the entire Brazilian coast, exceeding 50 cm in total length. A third species of this genus (probably *G. guichenoti*) is also believed to occur in the salt waters of the coast of Amapá and French Guyana.

Gobioides is abundant in the mouth of the Amazon and constitutes an important dietary item for predatory fish, both of the estuary (*Arius phrygiatus, A. quadriscutis, A. rugispinis, A. couma, Batrachoides surinamensis* and *Plagioscion* spp.) and freshwater (*Brachyplatystoma vaillantii* and *B. flavicans*) (Barthem 1985). These gobies are exploited commercially by local fishermen as bait for long-line fishing. Goby fishermen dive at low tide in shallow waters near mangroves and catch these fish with their hands on the soft mud bottom (Barthem 1990). This paper analyses the diet of the giant goby, *Gobioides broussonnetti,* and relates the observed qualitative and quantitative changes of the stomach contents with seasonal variations in the salinity in the Amazon River estuary.

MATERIAL AND METHODS

We obtained seven samples of giant gobies on the coast of Marajó Bay near of the city of Vigia , located about 50 km inland from the open sea, from November 1994 to December 1995 (Figure 1). We contracted local fishermen to collect about 30 giant gobies in each sample. They dived at low tide in shallow waters near mangroves during the day and caught these fishes with their hands on the soft mud bottom. Standard length and weight of each specimen were taken prior to stomach and gut dissection. The stomach of each specimen was removed, and its contents were centrifuged before being analyzed. The total solid volume of the centrifuged contents was recorded, and one random sample of 1 ml of this material was taken for further qualitative and quantitative analysis under the microscope. After the identification of

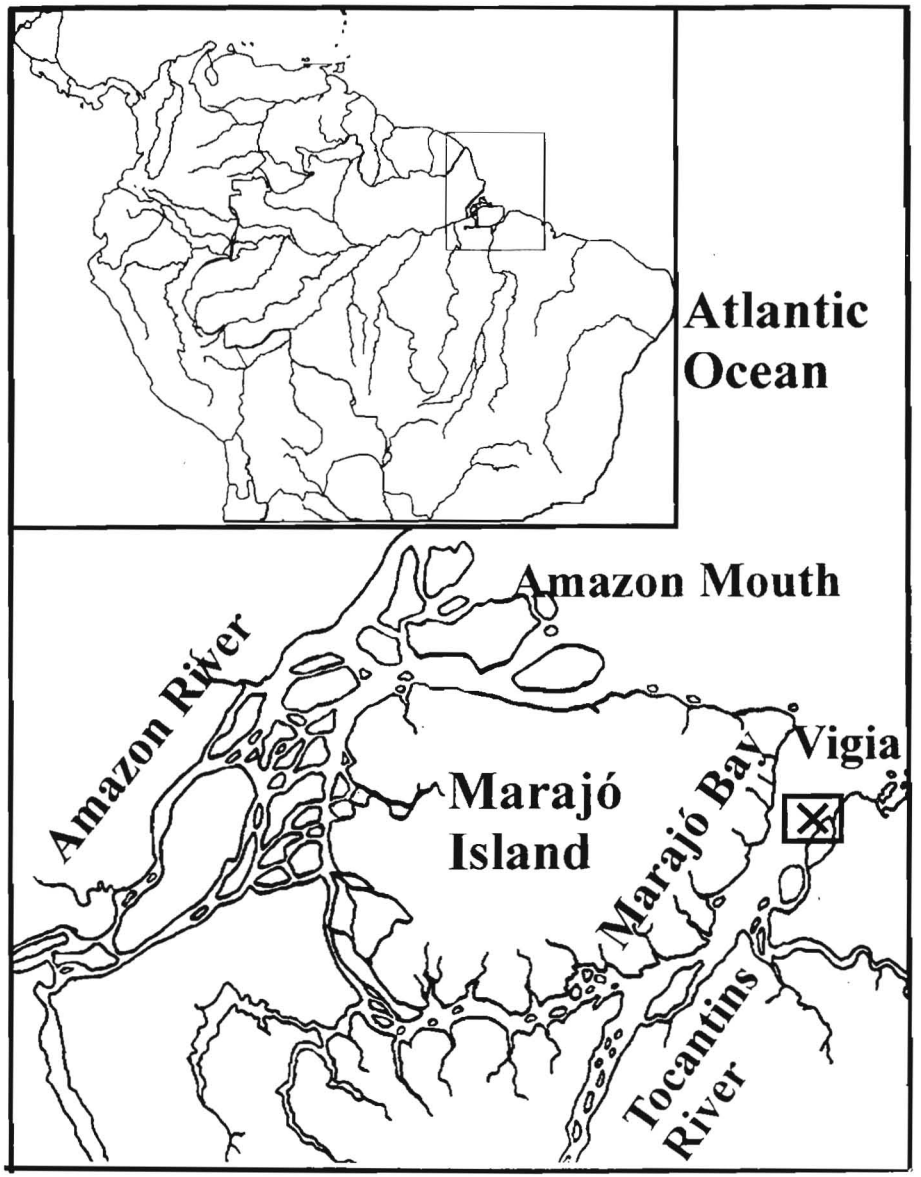

Figure 1 - The Amazon estuary and detail of Marajó Bay where the gobies were collected.

the main food items, we estimated the relative proportions and the volume of each. We observed gonadal maturation in order to identify the spawning season.

RESULTS

A total of 236 giant goby specimens was captured in seven collecting trips, with a range of 26 to 36 specimens per trip. Four phytoplankton genera were identified as comprising 98% of the volume of food items in the stomachs, namely: *Actinocyclus*, *Coscinodiscus*, *Triceratium*, and *Polymyxes* (Table 1). Other items were sporadically found, including polychaete setae, sponge spicules, and small crustaceans.

Table 1 - The monthly mean stomach contents volume (ml) and the relative proportions (%) of each food item for *Gobioides broussonetti* (N= size sample).

Year	**1994**	**1995**						**Total**
Month	*Nov.*	*Feb.*	*Mar.*	*Jun.*	*Aug.*	*Oct.*	*Dec.*	
N	26	30	36	36	36	36	36	236
Volume (ml)	3.03	0.29	0.25	0.14	3.06	3.19	1.81	
Actinociclus	46	41	34	56	55	52	46	49
Coscinodiscus	50	58	15	36	34	28	37	37
Polymyxes	1	0	0	0	7	15	10	7
Triceratium	3	0	26	2	4	6	8	5
Others	0	1	24	6	0	0	0	1

Weight (W) and standard length (L) relationship is described by the equation $W=0.066*L^{2.195}$; minimum and maximum values recorded were 28 and 576 g and 16 and 57 cm, respectively. Year-long variation of the mean value of the condition factor (K= W/L3) is shown in Figure 2. The spawning season observed for the giant goby was

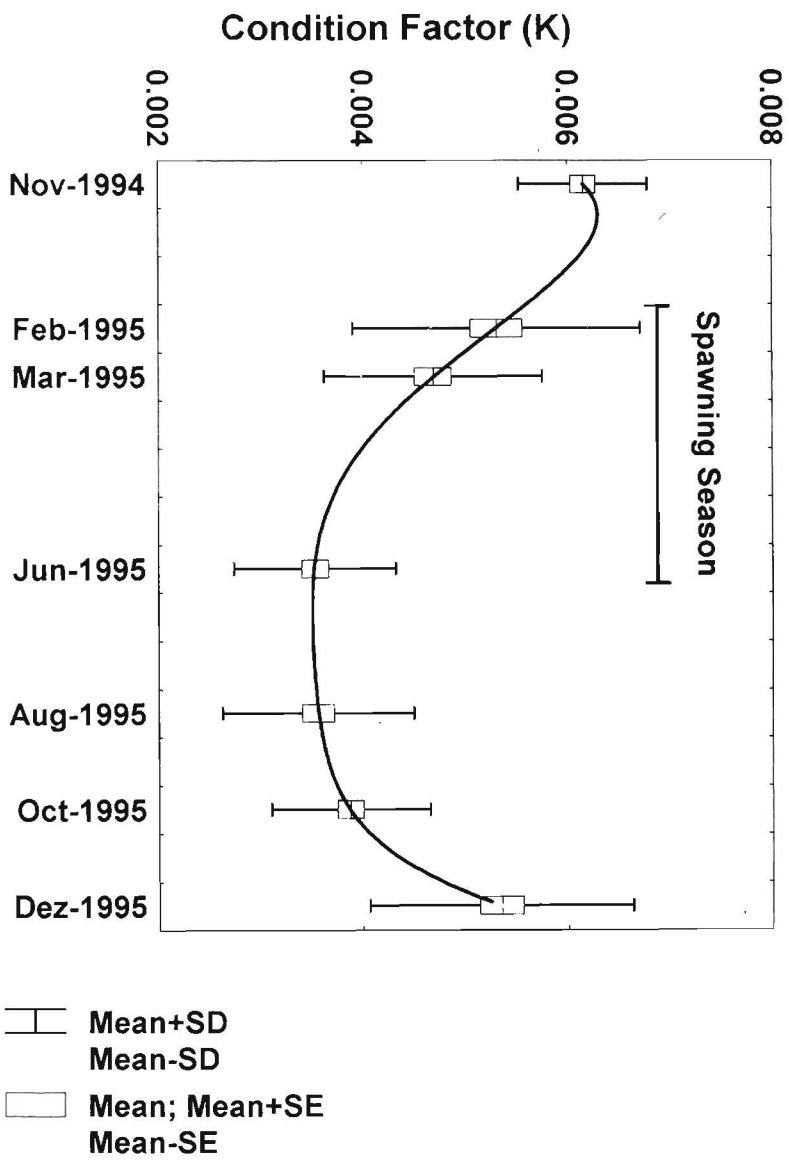

Figure 2 - Year-long variation of the mean value of the condition factor (K=W/L3).

between February and June, a time when K also decreased, indicating a period of starvation. On the other hand, K increased from August to December, a fattening period for the giant goby.

The giant goby, *Gobioides broussonnetti,* feeds principally on phytoplankton the year round, despite the fact that its gill-arches bear a small number of short and stubby gill-rakers more suited to a predator, than the numerous, long and slender ones typical of filter-feeders. The phytoplankton genera were present during the study period in the following percentages: *Actinocyclus*, 49%; *Coscinodiscus*, 37%; *Polymyxes,* 7%; *Triceratium,* 5%. Mean volume and food item composition of stomach contents also changed during the year (Figure 3). Total stomach contents volume was very low (0.3 ml) during the rainy season, between February and June, when the water of estuary is completely fresh. In March, middle of the rainy season, the proportions of *Actinocyclus* and *Coscinodiscus* were reduced, and the contribution of *Triceratium* in the giant goby diet reached its highest proportion when compared to the values obtained for rest of the year. The estuary's salinity increases in the months of the dry season. The highest salinity measured was 8 psu in November. In this period, the mean volume of stomach contents in giant gobies was ten times that of the rainy season (>3 ml). The absolute values of *Actinocyclus*, *Coscinodiscus* and *Polymyxes* genus are higher in the salty waters, and the last mentioned genus was found only in these months.

DISCUSSION

The feeding biology of *Gobioides broussonnetti* can be understood through the relationships among the condition factor (K), mean volume contents, the spawning period, and salinity changes in the estuary. The dry season (August to November) is the period when the salinity increases and phytoplankton productivity is very high

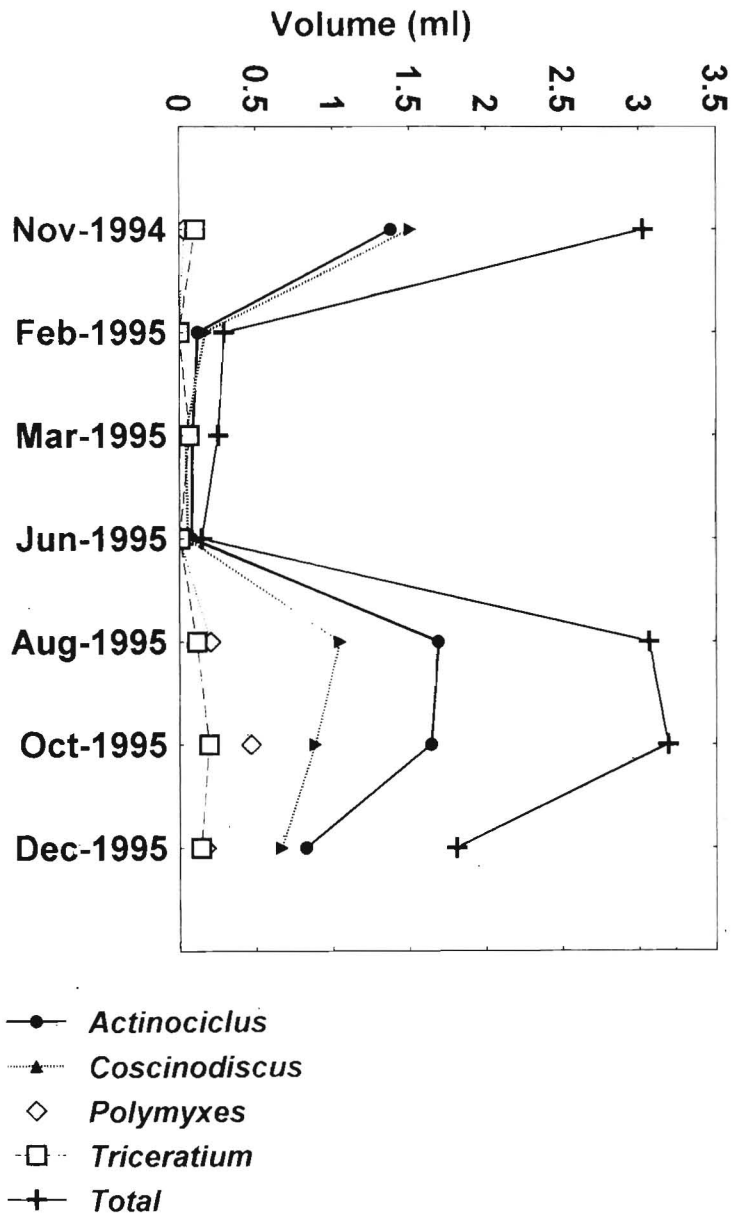

Figure 3 - Mean volume and food item composition of stomach contents of *Gobioides broussonetti*.

(Schwassmann *et al.* 1989, Barthem & Schwassmann 1994). At this time, the gobies feed intensely on the phytoplankton and gradually become fatter (high K values). The rainy season is characterized as a freshwater period, when the Amazon and Tocantins Rivers expel the salty wedge to places beyond Marajó Bay (Barthem & Schwassmann 1994). In this period, the gobies feed less and spent their stored energy to spawn and survive. *Actinocyclus* and *Coscinodiscus* are the most common algae all year round, with the exception of the freshwater period, when *Triceratium* becomes one of the dominant items. Productivity in the Amazon estuary is still poorly known; the data available are mostly from the outer portion, closer to more saline water (Curtin & Legeckis 1986), with little qualitative data available from the estuarine part that is closer to the river (Egler & Schwassmann 1966; Schwassmann *et al.* 1989).

Considering that gobies are generally known to prey on small invertebrates and algae (Carle & Hastings 1982; Bennett *et al.* 1983; Fitzhugh & Fleeger 1985) and also that *Gobioides* bear conical teeth typical of a predator, it is expected that these fish species would feed on shrimp or other small crustaceans and polychaete worms that abound in the estuary. The predominance of phytoplankton in the stomachs of the *Gobioides broussonnetti* leads us to ask about the feeding habits of the giant goby: "How does it consume so much phytoplankton, and phytoplankton alone, if it lacks a filtering apparatus?" At present we can not answer this question, though we might advance a hypothesis on the relationship between predation of polychaetes and ingestion of phytoplankton. Polychaete worms are abundant filter feeders that inhabit the soft muddy bottom of the Amazon River estuary. Since the giant gobies burrow in that substrate, it is conceivable that they prey on polychaetes found there, an idea supported by the presence of setae in their stomachs. If phytoplankton-filtering polychaetes are eaten by

gobies and are digested faster than the plankton is, then what was found in the fish stomachs could well be phytoplankton previously filtered and ingested by polychaetes. In this case, gobies would be feeding on phytoplankton in an intermediate way, by preying on polychaetes. An alternative hypothesis is that gobies could be eating dead clumps of phytoplankton precipitated on the soft muddy bottom, clumps of a kind very common in the transitional zone between salt and freshwater (Morris *et al.* 1978). One problem in accepting this latter hypothesis is the fact that gobies would presumably find it difficult to collect and sort bottom material with a mouth shaped quite differently from a sucking apparatus such as that found in *Prochilodus, Semaprochilodus,* and other known mud-feeders. In any case, the components of the stomach contents of the giant goby are basically the most common or accessible forms of phytoplankton found in the estuary, and these are directly or indirectly ingested.

This work shows the qualitative change in phytoplankton communities in the estuary and also indicates a strong relationship between primary productivity and the diet of the giant goby. The relationship between the feeding habits of *Gobioides broussonnetti* and the first level in the trophic web may be the reason for the abundance of this species in the Amazon estuary.

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