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Feeding of six fish species in Jiqui Lagoon, eastern coast of Rio Grande do Norte, Brazil

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ABSTRACT. This paper presents the study of the stomach content of six fish species of Jiqui lagoon (5°55'00"S and 35°11'28"W), located in the municipality of Parnamirim, Rio Grande do Norte, Brasil. A total of 261 specimens, collected monthly between March 1994 and February 1995 were examined. The relative importance of the diet components was measured through the frequency of occurrence, method of the dots and the use of the feeding index proposed by Kawakami and Vazzoler (1980). The specimens were found to feed mainly on fish, insects, crustaceans, mollusks, and organic matter. This suggests that the trophic habit of those specimens takes place in the pelagic area of the lagoon.

Key words: trophic habits, fish species, Jiqui lagoon, pelagic area.

RESUMO. **Alimentação de seis espécies de peixes da Lagoa do Jiqui, costa leste do Rio Grande do Norte, Brasil.** Foi examinado o conteúdo estomacal de seis espécies de peixes da lagoa do Jiqui (5°55'00"S e 35°11'28"W), Parnamirim, Rio Grande do Norte, coletados mensalmente durante o período de março de 1994 a fevereiro de 1995. A importância relativa dos componentes da dieta foi medida pela freqüência de ocorrência, método dos pontos e pelo uso do índice alimentar proposto por Kawakami e Vazzoler (1980). Verificou-se que as espécies se alimentam principalmente de peixes, insetos, crustáceos, moluscos e matéria orgânica, apresentando um hábito alimentar pelágico.

Palavras-chave: hábitos alimentares, espécies de peixe, Lagoa do Jiqui, área pelágica.

According to Esteves *et al*. (1983), there are lakes on practically all the coast and, considering their total area, they make up the main limnological system in Brazil. Oliveira (1948) comments on their great importance for the production of fish and crustaceans of high economic value and concludes that, due to their high fishing productivity, they are a significant factor in the economic life of many Brazilians. Despite their importance, ecologically speaking they are known little, still according to Esteves *et al.* (1983).

Lowe-McConnell (1975) points out that the fact that tropical ecosystems have been quickly altered by human action shows how essential it is to study the complex structure of these ecosystems' interrelations, so as to prevent irreparable damage to the environment and its fauna.

In Rio Grande do Norte, few are the coastal ecosystems that still do not show significant alterations due to human utilization. Jiqui Lagoon, on the eastern coast, is one of them.

Fish are an important component of aquatic ecosystems both ecologically and economically. In the last decade, fish commnities have come to be considered excellent indicators of environmental quality in fresh water systems (Fausch *et al*., 1990; Jordan *et al*., 1990) *in* Hartz (1997).

Pianka (1982) states that the studies concerning community structure aim to establish the different ways of interaction among the species present, as well as any resulting properties. Lagler *et al.* (1977) describe the complexity of the food chain in the aquatic environment as they consider all the organism life cycle - from the larval to the adult stage and pose that most fish species, with few exceptions, adapt to the feeding variations derived from availability of food.

The number of studies of the constitution of the diet of fish has increased a lot in the past years. However, the literature concerning studies of the

feeding diet of ichthyological species in waters in the interior of the Northeast is scarce. From Rio Grande do Norte, specifically, we cite the work of Magalhães *et al.* (1990) about the diet of *Serrasalmus brandtii*, of Piranhas-Açu River; *Metynnis* cf. *roosevelti,* of Redonda Lagoon, Nísia Floresta Gurgel (1994); feeding habits of the fish community of Pium River (1994), as well as ongoing studies related to the diet of fish species in waters in the semi-arid region of Rio Grande do Norte (1995).

Based on the information above, the present study was carried out to establish the eating habits of fish in the Jiqui Lagoon ecosystem.

Material and methods

Sampling took place between March 1994 and February 1995, at Jiqui Lagoon (5°55'00"S and 35°11'28"W) located in the municipality of Parnamirim, Rio Grande do Norte, in monthly collections at five collecting points. Nylon nets of 5, 10, 20 and 50m length with meshes of 2.0, 2.5 and 3.0cm were used and exposed for 24 hours, with checks every six hours.

Samples of *Psectrogaster sagüiru* (Fowler, 1941), *Leporinus piau* (Fowler, 1941), *Hoplias malabaricus* (Bloch, 1794), *Cichlasoma bimaculatum* (Linnaeus, 1754), *Crenicichla lepidota* (Heckel, 1840), and *Parauchenipterus galeatus* (Linnaeus, 1766) were analyzed regardless of sex. Stomachs were removed by sectioning at the cardia and the pylorus, and stored in alcohol at 70%.

The analysis of the stomach content was established through the frequency of occurrence and the method of the dots of food items (Hynes, 1950), together with a few alterations and combinations of these modified methods through the Feeding Index (IAi) of each item ingested as proposed by Kawakami and Vazzoler (1980), according to the formula:

$$IA_i = \frac{F_i * V_i}{\sum_{n=1}^{n} (F_i * V_i)}$$

where: i = 1,2,... n = a given food item
F_i = frequency of occurrence (%) of the given item
V_i = volume (%) of the given item

The total number of points was then defined as 100%, being distributed among the various feeding items according to the proportion with which each item was represented in relation to the total content. The method of frequency of occurrence showed the number of occurrences of a given feeding item in each stomach.

Results

A total of 261 stomachs of six fish species in Jiqui Lagoon were analyzed (Table 1). Of those, 79 (30.27%) were *Parauchenipterus galeatus*, 63 (24.14%) *Psectrogaster sagüiru*, 39 (14.94%) *Cichlasoma bimaculatum*, 38 (14.56%) *Crenicichla lepidota*, 35 (13.40%) *Hoplias malabaricus*, and 7 (2.68%) *Leporinus piau*. The following results were found for each species:

Table 1. Feeding index (IAi) of the diet components of fish of Jiqui Lagoon (1=Crustaceans; 2=Insects; 3=Fish; 4= Others)

Species	Stomachs	Items			
	Analyzed	1	2	3	4
Hoplias malabaricus	35	-	0,72	0,68	-
Leporinus piau	7	-	0,49	-	0,49
Psectrogaster saguiru	63	0,18	-	-	0,81
Parauchenipterus galeatus	79	-	0,72	-	-
Cichlasoma bimaculatum	39	-	0,64	0,25	-
Crenicichla lepidota	38	-	0,84	-	-

Discussion

Knowing the feeding habits of fish is of great importance for understanding the trophic system of an aquatic ecosystem (Hartz, 1997). According to Sabino and Correa e Castro (1990), cited by Hartz (1997), the diet and food collection are determining factors in the distribution of organisms in the habitat.

The comparison of the IAi values obtained for the feeding habits of the species studied reveals similarity in their diets with predominance of insects, represented by Odonata (Libellulidae and Agrionidae), Hemiptera (Naucoridae), Diptera (Chironomidae), Hymenoptera (Vespidae and Formicidae), and Orthoptera (Gryllidae), followed by crustaceans, Decapoda (Caridae) and mollusks, Gastropoda (Pomacea). Others appearing in the digestive tract could not be identified in taxonomic levels because of their advanced level of digestion.

These results allow the inference that these species are generalist carnivorous and predators in their eating habits. According to Lowe-McConnell (1987), in tropical regions, regardless of the existence of fish that present specialization as to certain types of food, most species present a great plasticity in their diets, which makes the establishment of trophic patterns difficult.

The results obtained in this study were similar to those obtained by several authors with the same species in different places. Studying aspects of the diet of *Hoplias* cf. *malabaricus*, Hartz (1997) found that fish were the main feeding component, despite the presence of some insects. Hahn *et al.* (1997), studying the same species, reported a diet composed

almost exclusively of fish. For those authors, the prevalence of this item in the diet allows to characterize it as essentially piscivorous. Similar results were obtained by Caramaschi (1979), Faccio and Torres (1988) and Canan *et al.* (1997). Welcomme (1979) also points out that piscivorous predators are very frequently found in systems of tropical and subtropical waters.

The analysis of the stomach content of *Leporinus piau* carried out by Silva and Torres (1988) showed insects to be the most frequent item, followed by gramineus plants and planktonic algae, while microcrustaceans and arachnids exhibited the lowest frequency.

Honda (1979), analyzing the results concerning the feeding habits of *Pseudocurimata gilberti*, which belongs to the same family as *Psectrogaster sagiiiru*, noticed the prevalence of organic wastes and sediments, followed by algae. This authoress states that, according to Angelescu and Gneri (1949), such types of food are characteristic of ilio-feeding fish. Azevedo *et al.* (1938) observed that *Curimatus elegans* feeds "exclusively on organic matter present in mud, of which microscopic algae predominate over insect remains". Castro and Torres (1988) reported to have found this species to have ilio and phytoplankton-feeding habits, eating mainly vegetable matter contained in sediments (sedimentary phytoplankton and epibenthic algae).

As shown in the studies carried out by Hahn *et al.* (1997), insects are the item with the highest participation in the diet of *Parauchenipterus galeatus*, which also includes a wide feeding spectrum, possibly heavily determined by availability, pinpointing the species' opportunism. For the same species, Andrian and Barbieri (1996) observed omnivorous habits with strong tendency to insectivory. Boneto *et al* (1963) argue that the diet of species from limnological environments is more frequently and abundantly composed of insect larvae, diatomaceae, mollusks, and oligochaeta associated to debris.

Canan (1997), analyzing the stomach content of *Cichlasoma bimaculatum*, reports to have observed fish, insects, and mollusks, besides digested material, as components of this species' diet. Hartz (1987), studying *Cichlasoma facetum* and *Cichlasoma portalegrenses*, found the prevalence of, respectively, aquatic insects and fish, defining both species as benthic-feeding omnivorous.

As for *Crenicichla lepidota*, Gurgel *et al.* (a) (on press) observed insects as being the main item in the species' diet, followed by crustaceans, fish, and mollusks. Gurgel *et al.* (b) (on press) reported this species' diet to be made up of insects, crustaceans, and fish, which suggests carnivorous eating patterns. Hartz (1997) classifies this species as typically carnivorous, as it was observed throughout the study to have eaten fish, shrimp, and insects. Canan *et al.* (1997) found crustaceans as the most frequent item for this species. Hahn (1997) classifies *Crenicichla sp*. as piscivorous, whereas Teixeira (1989) and Lóbon-Cerviá *et al.* (1993), in Hartz (1997), reported mainly insectivorous diet for this species, which secondarily also eats shrimp and fish.

It has been established that those species feed mainly on fish, insects, shrimp, mollusks, and organic wastes, presenting carnivorous eating habits. Considering the results obtained it is possible to infer that the trophic habit of the six species analyzed takes place in the body of water.

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