

The Mangrove as a Temporary Habitat for Fish: the *Eucinostomus* Species at Guaratuba Bay, Brazil (25°52'S;48°39'W).

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ABSTRACT

Several coastal fish use the estuarine habitat during a part of their life cycle. These sites are considered good for the reproductive activity, as well as for the growth of larvae and juveniles. Concerning the Gerreidae, however, many studies reveal that most species leave the estuaries to reproduce at sea. At Guaratuba Bay, southern Brazil, this family is represented by three genera and five species, which make an important fraction of the local assemblage. The present study investigated the populational structure and breeding habits of three *Eucinostomus* species, in order to know what relationship exists between them and the mangrove. It was found that the Guaratuba mangrove represents a transitory habitat for the life cycle of the *Eucinostomus* species. The sub-adults grow in the mangrove throughout the year and leave this milieu in spring or summer, when they complete the gonadal maturation and presumably spawn. *E. argenteus* and *E. gula* do not return to the mangrove after spawning. The three species feed mainly on polychaetes, but differences occur with respect to the secondary components of the diet.

Key-words: Fish, Gerreidae, Estuaries, Mangrove.

INTRODUCTION

It is usually assumed that the estuarine habitats constitute a satisfactory site for the protection and growth of coastal fish species (Thayer *et al.*, 1987; Sasekumar *et al.*, 1992). Nevertheless, seasonal oscillations in the physicochemical parameters in this type of environment, that are a consequence of the strong, unstable continental influence, could be a selective factor for the permanency or not of the populations in an estuary throughout their life cycle. The inside/outside movements to/from the estuaries are a strategy adopted by many fish species, in order to utilize this milieu only when its conditions are satisfactory (Amanieu & Lasserre, 1982). These temporary, migratory species form an important part of the estuarine fish assemblages.

With respect to the mangrove at Guaratuba Bay, an estuarine ecosystem (*lato sensu*) in southern Brazil, biological data are available for some species. The Haemulidae *Pomadasys corvinaeformis* and the Sciaenidae *Bairdiella ronchus* and *Isopisthus parvipinnis* have been accepted to inhabit this region temporally (respectively Chaves, 1998, 1995; Chaves *et al.*, 1998), while *Stellifer rastrifer* (Sciaenidae), *Citharichthys arenaceus* and *C. spilopterus* (Bothidae) permanently (Chaves & Vendel, 1997a,b). The Gerreidae, one of the most abundant fish groups found in the region, have been represented by *Diapterus rhombeus* (Cuvier, 1829), *Eugerres brasiliensis* (Cuvier, 1830), *Eucinostomus argenteus* (Baird & Girard, 1854), *E. gula* (Cuvier, 1830) and *E. melanopterus* (Bleeker, 1863). The former could consist of a migratory population whose reproduction is not completed in the mangrove (Chaves & Otto, 1998). It however has been recorded that sympatric species of Gerreidae

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present different patterns in relation to the milieu. In eastern Atlantic, for example, *E. melanopterus* inhabits the estuaries of Ivory Coast only during the juvenile phase, while *Gerres nigris* inhabits it permanently (Albaret & Desfossez, 1988). The objective of the present study was to know the biological attributes of the *Eucinostomus* populations at the Guaratuba Bay, in order to evaluate if they utilize this milieu permanently or only during a certain period of their life cycle.

MATERIALS AND METHODS

Samples were taken monthly from September 1993 through February 1997 (except May 1995) in random points of the mangrove at Guaratuba Bay, southern Brazil (25°52'S;48°39'W). A map showing this area is available in Chaves (1995) and Chaves & Vendel (1997a,b). Fish were caught using an otter trawl with a 20mm mesh. The total number of specimens collected was 355 for *E. argenteus*, 191 for *E. gula* and 195 for *E. melanopterus*. The data of abundance are presented as number of individuals captured per unit of effort. Repeated Measures Analysis of Variance was used to examine the change in fish abundance over time.

After being removed to the laboratory under freezing conditions, the specimens were measured (total length, **TL**) and frequently weighted (**W**). Gonads from 213 individuals of *E. argenteus*, 121 of *E. gula* and 122 of *E. melanopterus* were examined in order to know the sex and to evaluate a possible spawning activity. For this, we adopted the visual attributes presented by Vazzoler (1996), that included the differentiation between the immature, developing, ripe and post-spawning stages. In the presentation of the results, however, considering the objective of the study, the data were assembled in only two groups: the "immature" and the "non-immature", the latter consisting of the last three stages mentioned above and functioning as a signal of near spawning activity.

Individual values of the Condition Factor (**K**) (Vazzoler, 1996) were given by $K=W/TL^b$, where **b** is the coefficient angular from weight/length relationship adjusted to each

species (300 specimens of *E. argenteus*, 160 of *E. gula* and 193 of *E. melanopterus*).

The stomach content of 32 individuals of *E. argenteus* (86mm CT 135mm), 26 of *E. gula* (100mm CT 136mm) and 25 of *E. melanopterus* (110mm CT 218mm), proceeding from all season of the year, was fixed in a 10% formaldehyde solution for a microscopical analyses. The data obtained were processed by the Frequency of Occurrence method, which is defined as a proportion of individuals that present a certain item with respect to the total number of individuals whose stomach content was examined (Zavala-Camin, 1996).

RESULTS

Monthly distribution of catch of the three *Eucinostomus* species along the period of study is showed in Fig. 1. ANOVA demonstrated that the three species had similar changes in abundance over time. That is, there were no significant differences in abundance among species over years or months of the year (repeated measures ANOVA, all month and year contrasts by species $p>0.05$). Because years and months were not different among species, species were grouped to examine monthly changes in abundance. Significant change in fish catch occurred over months (Wilk's lambda = 0.575, $p<0.05$). Catches were highest during the months of June and September, and these months were not significantly different only from May, August and October (Table 1).

The length of sampled specimens varied between 80 and 182mm for *E. argenteus*, 73 and 150mm for *E. gula* and 80 and 227mm for *E. melanopterus* (Fig. 2). In *E. argenteus* and *E. melanopterus*, the modal length classes increased from summer to spring, but in *E. gula* they increased from autumn to summer (Fig. 2).

The weight/length (gram and millimetre) relationship is expressed by the following equations:

$$W = 3.76 \times 10^{-8} TL^{3.2448} \quad (r=0.9708)$$

in *E. argenteus*;

$$W = 1.29 \times 10^{-5} TL^{3.0014} \quad (r=0.9462)$$

in *E. gula* and

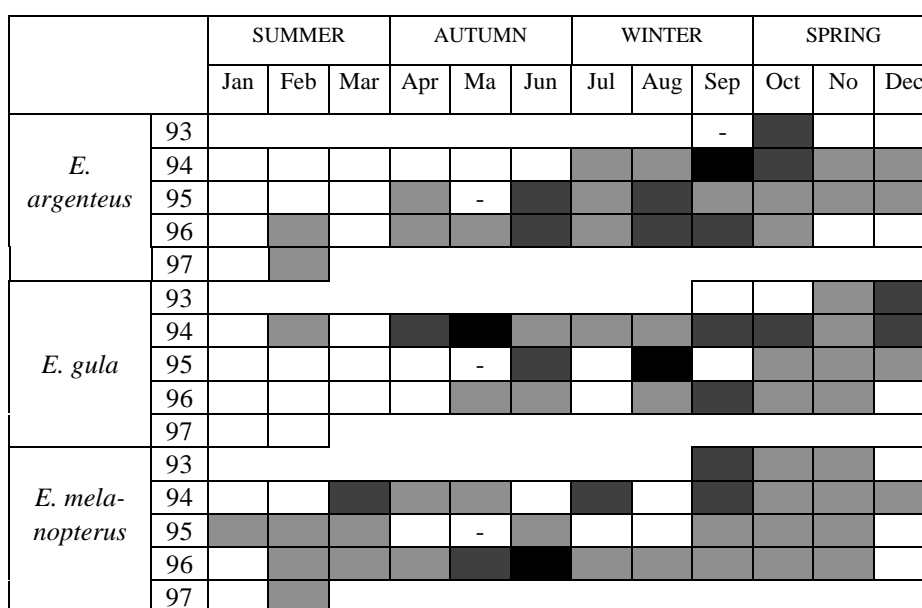


Fig. 1 - Relative numerical abundance of the *Eucinostomus spp* specimens caught at Guaratuba mangrove between September 1993 and February 1997, according to the species. Code:

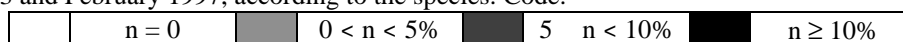


TABLE 1 - Results of the least significant difference test to ANOVA Repeated Measures applied to compare the numerical abundance in pairs of months. 1 to 12: January to December. +: with difference; -: no difference (p<0.05).

	1	2	3	4	5	6	7	8	9	10	11	12
1	-	-	-	-	+	+	-	+	+	-	-	-
2	-	-	-	-	-	+	-	-	+	-	-	-
3	-	-	-	-	-	+	-	-	+	-	-	-
4	-	-	-	-	-	+	-	-	+	-	-	-
5	+	-	-	-	-	-	-	-	-	-	-	-
6	+	+	+	+	-	-	+	-	-	-	+	+
7	-	-	-	-	-	+	-	-	+	-	-	-
8	+	-	-	-	-	-	-	-	-	-	-	-
9	+	+	+	+	-	-	+	-	-	-	+	+
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	+	-	-	+	-	-	-
12	-	-	-	-	-	+	-	-	+	-	-	-

$$W = 7.72 \times 10^{-6} TL^{3.0723} \quad (r=0.9823)$$

in *E. melanopterus*.

The monthly average values of the Condition Factor showed an irregular variation along the time in all species (Fig. 3). The minimum mean values were registered in autumn (*E. argenteus* and *E. gula*) or summer (*E. melanopterus*); the

maximum being in spring or in the middle of winter, in the same order.

Analysis of the gonads showed that the percentage of the non-immature individuals increased for all species from winter through spring, reaching the most important value in November for *E. argenteus* and *E. melanopterus* and in October for *E. gula* (Fig. 3). No post-spawning individuals were registered in the material examined.

Polychaetes (approximately 70% of the non-empty stomachs) were the most frequent items registered in all species (Table 2). The secondary items (frequency of occurrence superior to 10%), however, reveal that in addition to polychaetes, the diet of *E. argenteus* is based on Gammaridae, Bivalvia, plants and algae; that of *E. gula*, on algae, Gammaridae, Copepoda and plants; and that of *E. melanopterus* on algae, Gammaridae, Copepoda, Gastropoda, plants and Decapoda. Nematoda and sand were found in all species, but they were not considered food items (Table 2).

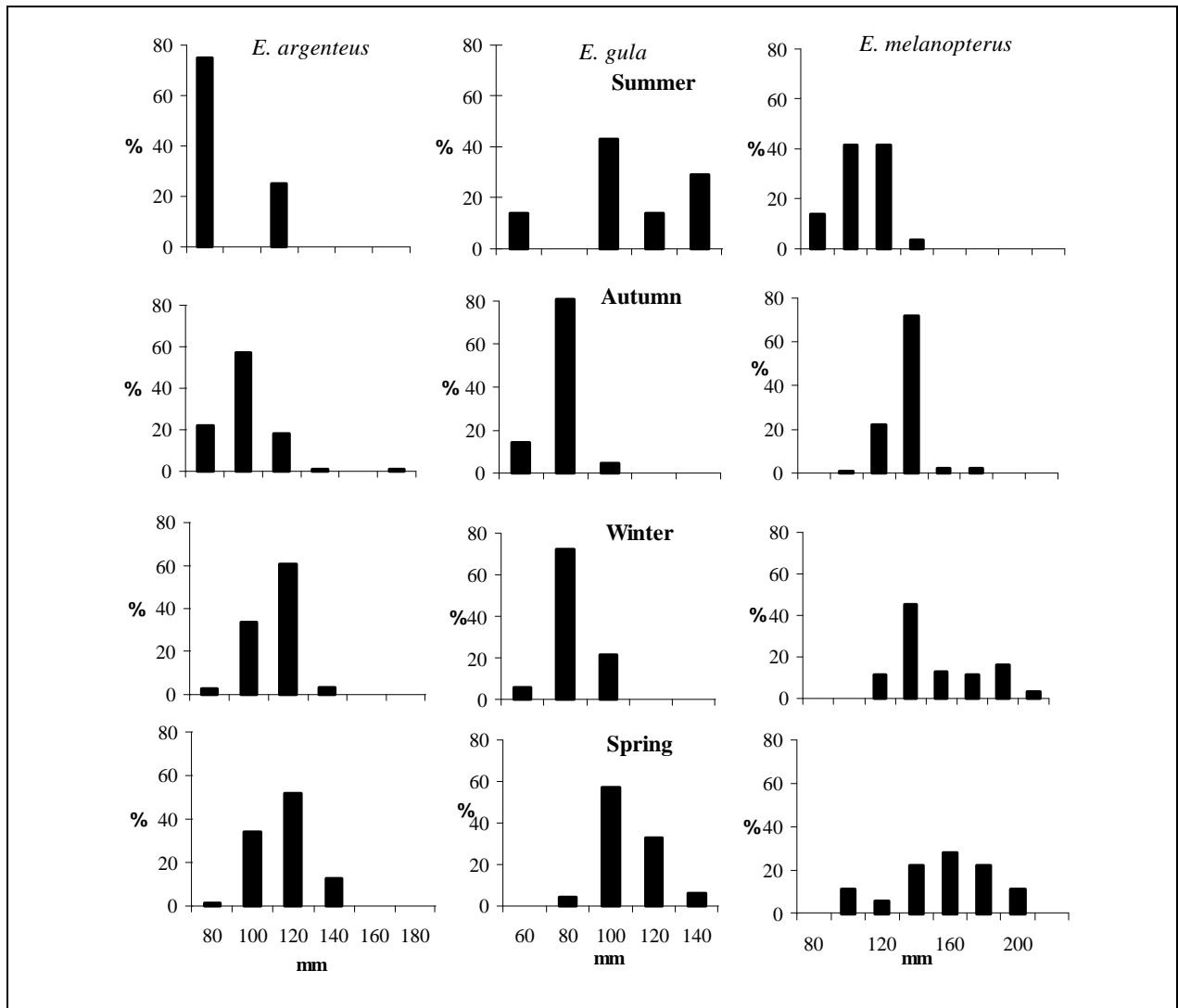


Fig. 2 - Relative size class frequency of the *Eucinostomus spp* specimens, with respect to the total number of individuals per species caught each season.

DISCUSSION

Considering the abiotic data obtained by Chaves & Vendel (1997b) for the same period, the three *Eucinostomus* species are more abundant at Guaratuba mangrove when the salinity reaches the most important level (more than 15‰ from May to October, eventually 35‰). In summer, when the input of fluvial waters is most expressive (the salinity level decreases to less than 5‰), the populational density reaches its minimum value. In fact, the sensibility of Gerreidae species to salinity levels in a milieu has been mentioned in many studies. Cyrus & Blaber (1982) associated this

parameter to the distribution pattern of *Gerres spp* in estuaries of Natal, South Africa, and a similar pattern to that observed in Guaratuba is cited by Albaret & Desfossez (1988) for *E. melanopterus* at Ivory Coast: this species presents a maximal abundance when the salinity level is higher, and migrate to sea when the lagoon is under freshwater inputs.

Many studies have demonstrated that the Gerreidae species usually spawn in marine waters (Cyrus & Blaber, 1984; Thayer *et al.*, 1987; Albaret & Desfossez, 1988). The individuals of *E. gula* from Florida

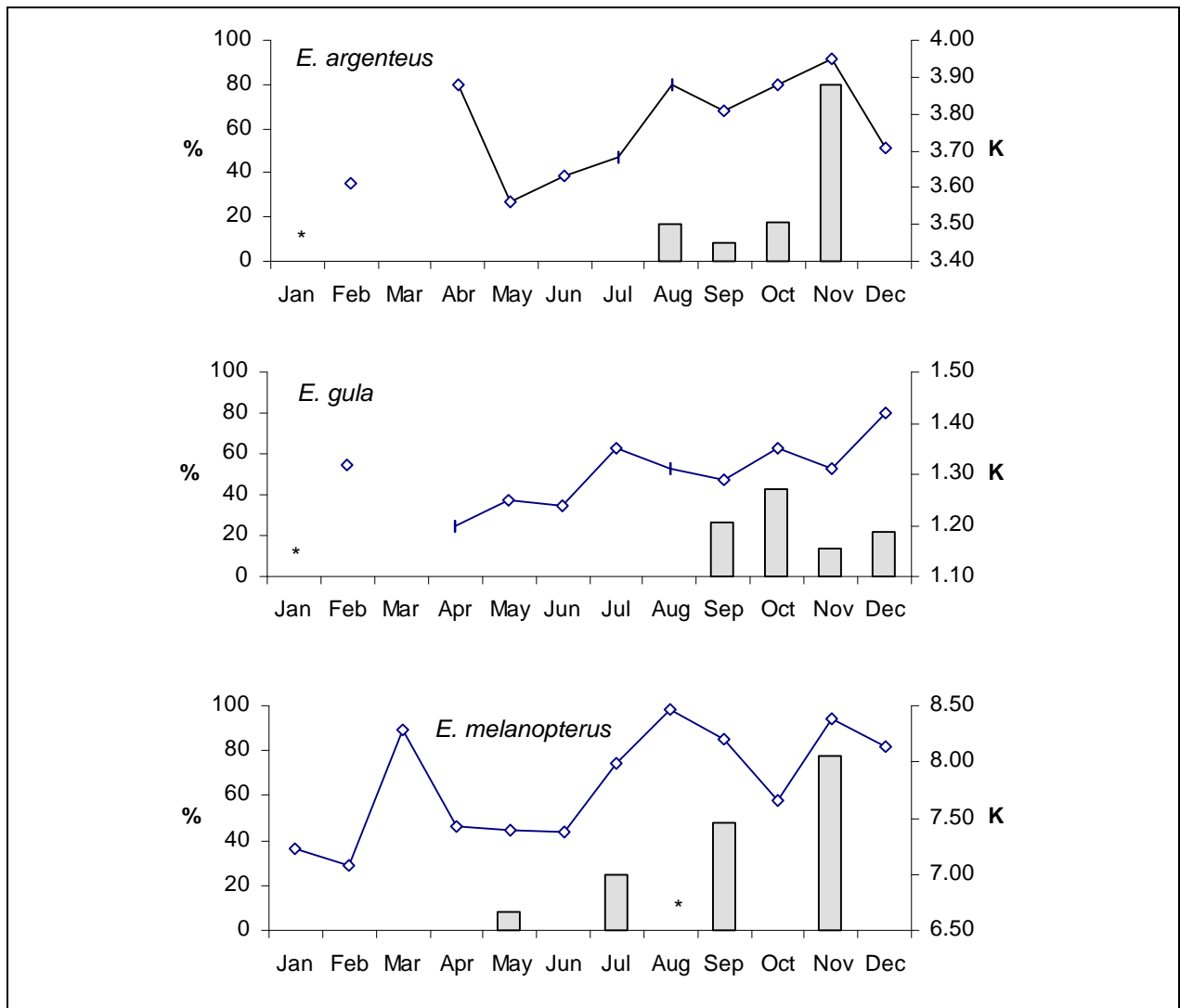


Fig. 3 - Relative frequency variation of the Non-immature individuals (% , bars) and mean values of the Condition Factor (**K**, polygon) according to the species. Values of **K** are multiplied per 10^6 in *E. argenteus* and *E. melanopterus* and per 10^5 in *E. gula*. (*) no individuals were analysed with respect to the stage of maturation.

coast, for example, move to mangroves only at the juvenile phase, an event considered by Thayer *et al.* (*op. cit.*) as an indicator of the protection role presented by this ecosystem. In the *Eucinostomus* species of Guaratuba mangrove, the increase in percentage of non-immature individuals (spring) precedes the minimum abundance of stocks (summer). Hence, it is supposed that the spawning activity occurs during summer and in the adjacent marine zone or, if internally to Guaratuba Bay, out of mangrove. Additionally, the increase in the Condition Factor values, verified from autumn to spring, can be associated to the usual

increase in both the gonadal volume and the somatic reserves at the final period of maturation (Vazzoler, 1996).

At Ivory Coast, only the juveniles of *E. melanopterus* enter the estuaries; the adults larger than 140mm do not return after spawn (Albaret & Desfossez, 1988), a pattern similar to that found by Cyrus & Blaber (1984) in three *Gerres* populations from a southern African estuary. At Guaratuba mangrove, this pattern is observed only in *E. argenteus* and *E. gula*. In these species, the largest individuals have a length that corresponds to 60% of the maximal

size registered for the southern Brazilian coast (Menezes & Figueiredo, 1980).

TABLE 2 - Frequency of Occurrence values (%) for the stomach contents of 32 specimens of *E. argenteus* (**E.a.**), 26 of *E. gula* (**E.g.**) and 25 of *E. melanopterus* (**E.m.**) from Guaratuba mangrove, during the study period. (1) to (5) indicate the ranking of the main alimentary items.

ITEM	E.a.	E.g.	E.m.
Polychaetes	68.8 (1)	73.1 (1)	76.0 (1)
Gammaridae	34.4 (2)	42.3 (3)	16.0 (3)
Copepoda	3.1	15.4 (4)	16.0 (3)
Decapoda	3.1	3.8	12.0
Caridea	3.1	-	8.0
Caprellidae	3.1	-	-
Bivalvia	21.9 (3)	7.7	4.0
Gastropoda	-	3.8	16.0 (3)
Sipunculida	6.2	3.8	4.0
Turbelaria	3.1	-	-
Eggs	-	3.8	-
Larvae	-	3.8	-
Scales	6.2	7.7	8.0
Algae	15.6 (5)	50.0 (2)	24.0 (2)
Plants	21.9 (3)	11.5 (5)	16.0 (3)
Nematoda	25.0	38.5	28.0
Sand	31.2	50.0	56.0

Thus, after spawning, the largest individuals presumably remain at open sea or at another place in the Bay. However, for *E. melanopterus*, the individuals are usually found in the mangrove at a length similar to the maximum known for this species, indicating that after spawning some adults enter this area. This conclusion is also supported by the presence of *E. melanopterus* in the mangrove during summer, suggesting that the return movement may start immediately after the breeding activity. The absence of small individuals in samples of all species can be explained by the selectivity of the sampler instrument (mesh size and depth), as well as by the use of the marginal areas protected by roots, where the otter trawl is not operable.

It was verified that the diet of the three *Eucinostomus* species has the same nature with respect to the chief items consumed. The higher percentage of sand and polychaetes, as well as the nature of other items in the stomach contents, indicate that at Guaratuba these species have a benthivorous habit. A similar pattern was known for *Diapterus rhombeus* (Chaves & Otto, 1998). In fact, the protrusible

mouth in this family helps the feeding activity on the substrate (Albaret & Desfossez, 1988). These authors found that an African population of *E. melanopterus* fed mainly on Decapoda crustaceans, fish eggs and small Gastropoda, items which were also found at Guaratuba, but at a less important percentage.

Between the three *Eucinostomus* species from Guaratuba mangrove, a relative uniformity was observed in some biological parameters: increase in abundance, coinciding with the period of higher salinity and smaller temperature values; increase of the Condition Factor values from autumn to spring; absence of spawning in the mangrove area; and a benthivorous diet primarily based on polychaetes. In other parameters, each species presents some particularities: the secondary items composing the alimentary regime; the migratory habit including or not a return to the mangrove. We conclude that *E. argenteus*, *E. gula* and *E. melanopterus* inhabit the Guaratuba mangrove temporarily, but utilize this milieu to grow during an extended period of the year (Fig. 4).

RESUMO

No manguezal da Baía de Guaratuba, litoral sul do Brasil, os Gerreidae são representados por 3 gêneros e 5 espécies, compondo uma parcela numericamente importante da ictiofauna local. Este trabalho descreve a estrutura populacional e os hábitos reprodutivos de *Eucinostomus argenteus*, *E. gula* e *E. melanopterus*, reconhecendo as relações que mantêm com o manguezal. Os resultados indicam que o manguezal representa para elas um habitat transitório. Os subadultos crescem na área ao longo do ano, deixando-na na primavera ou no verão, quando completam a maturação e desovam, no mar ou em outra região da Baía. *E. argenteus* e *E. gula* não retornam ao manguezal após a desova, mas *E. melanopterus* provavelmente sim. As três espécies alimentam-se sobretudo de poliquetos, apresentando diferenças nos itens secundários da dieta.

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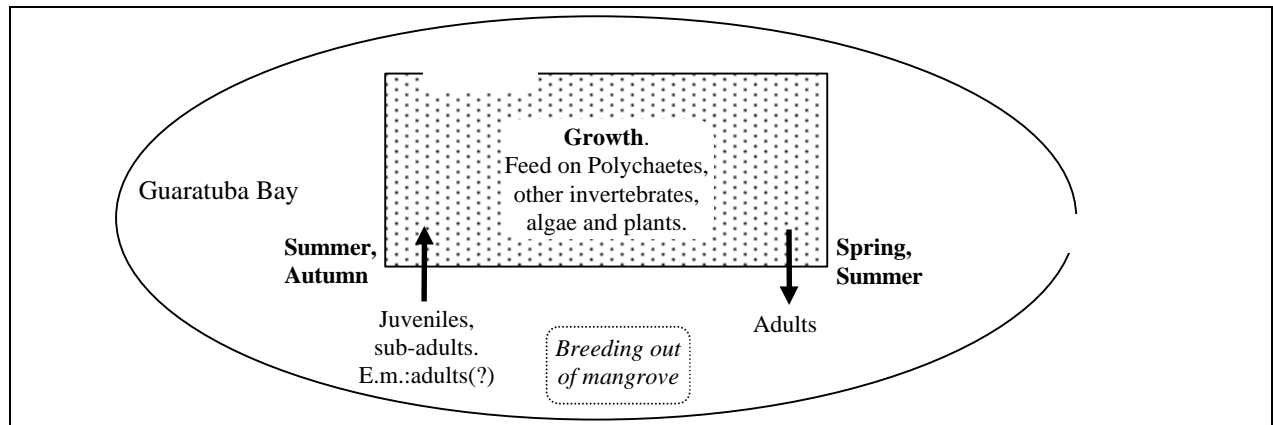


Fig. 4 - Diagram of movements and habits of the *Eucinostomus* species at the mangrove of the Guaratuba Bay. (E.m.= *E. melanopterus*.)

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