

# SIZE STRUCTURE IN *MICROPOGONIAS FURNIERI* (DESMAREST, 1823) (TELEOSTEI, SCIAENIDAE) IN THE SEPETIBA BAY, RJ, BRAZIL

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Recrutamento, estrutura de tamanho, peixes costeiros, Sciaenidae.

## Abstract

The white croaker, *Micropogonias furnieri*, is one of the most abundant species in commercial fisheries in the Sepetiba bay (22°54'- 23°04'S; 43°34'- 44°10'W), Rio de Janeiro State, Brazil. Two fishing sampling programmes were carried out, from July 1993 to December 1997, with objective to analyze the size structure of white croaker population that uses the bay as rearing grounds. In the shallow waters (beaches), a beach seine was used to catch young-of-year, and in the deeper waters inside the bay an otter trawl was employed to catch yearling and adults. Length-frequency distributions on CPUE-LC ( $\Sigma$  captures /  $\Sigma$  effort) were performed, with individuals being measured to total length (TL). Size structure varied from 15 mm to 250 mm TL, with modes distributed mainly in

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three size groups: recruits, juveniles and subadults. The first group is constituted by fish averaging 60 mm TL, comprising recruits up to eight months old, that use the beaches; the second group is composed by juveniles TL=80-110 mm, comprised by individuals at the end of the first year and ready to move away from the beach to deeper zones inside the bay; and the third group, constituted by subadults more than one year old (TL 130-200 mm) distributed inside the bay, with smaller size groups concentrated in the inner bay, and the larger size group in the outer bay. A long period of recruitment occurs from March to October, when most young-of-the-year use the beaches in the inner bay. Yearling and subadults use deeper areas in the bay in the first year of life, and when they reach TL > 200 mm, they probably moving away from the bay, joining the adults at the continental shelf. The Sepetiba bay, therefore, plays an important role as rearing grounds for *M. furnieri*, which developed along their evolutionary history, the capacity to recruit in most internal areas of bays, which are most prone to suffer human disturbances.

## Resumo

ESTRUTURA DE TAMANHO DE *MICROPOGONIAS FURNIERI* (DESMAREST, 1823) (TELEOSTEI, SCIAENIDAE) NA BAÍA DE SEPETIBA, RJ, BRASIL A corvina, *Micropogonias furnieri* é uma das espécies mais abundantes nas capturas comerciais, na baía de Sepetiba (22°54' - 23°04'S; 43°34' - 44°10'W), RJ. Dois programas amostrais foram executados de julho de 1993 a dezembro de 1997 visando analisar a estrutura de tamanho da população de corvina que utiliza a baía como área de criação. Ao longo das praias foram realizados arrastos de praia, com uma rede do tipo picaré, para capturar jovens-do-ano, e no interior da baía foram realizados arrastos de fundo, para capturar jovens e adultos. As distribuições de frequência de comprimento, com base no comprimento total (CT) foram analisadas através do cálculo de CPUE-CC ( $\Sigma$  capturas/ $\Sigma$  esforço). A estrutura de tamanho compreendeu indivíduos variando de 15 mm a 250 mm de CT, distribuídos basicamente em três grupos de tamanhos: recrutas, jovens e subadultos. O primeiro grupo, formado por peixes com CT < 60 mm, é compreendido de recrutas nos primeiros oito meses de vida que usam as zonas rasas das praias da baía; o segundo, compreende peixes jovens de CT=80-110 mm, corresponde a indivíduos que se deslocam das zonas rasas (praias) para zonas mais profundas no interior da baía, ao final do primeiro ano; e o terceiro grupo, formado por jovens e subadultos com mais de um ano de idade com CT de 130-200 mm. Como padrão geral de recrutamento, observou-se um amplo período de captura de recrutas de março a outubro; no verão não ocorre registro deste grupo de peixes na baía de Sepetiba. Os jovens e subadultos usam o interior da baía nos primeiros anos de vida, e a partir de CT > 200 mm, não são mais registrados nas amostragens, quando os mesmo juntam-se aos adultos na plataforma continental. A baía de Sepetiba, portanto, desempenha um papel importante como área de criação de *M. furnieri*, que desenvolveu ao longo de sua história evolutiva, a capacidade de recrutar na parte mais interna desta baía, onde independente de sua maior probabilidade de alterações por atividades humanas.

## Introduction

The white croaker *Micropogonias furnieri* is a very abundant fishery resource in Southeast Brazil with wide distribution over the Western Atlantic coast, from the Caribbean (20°N) to Argentina (41°S) (VAZZOLER, 1991). Its life cycle has been described for some coastal zones, which included the adults distribution in coastal shelf at depth up to 100 m, spawning next to semi-closed protected coastal zones, recruiting and spending early lifestage years in semi-closed areas such as bays and estuaries. In Sepetiba bay (22°54'-23°04'S; 43°34'-44°10'W) this species figures as the 5<sup>th</sup> most numerical abundant fish contributing to 5.8 % of all fish and occurring in 68 % of all samples (ARAÚJO et al. 1997; 1998).

Knowledge about the habitat and distribution of fishes, specially the juvenile stage, is essential to assess and interpret the early life stages, such as growth, survival, and subsequent recruitment to adult stock. Size structure and length frequency distributions of *M. furnieri* adult populations were performed on continental shelf by VAZZOLER et al. (1973), COTRINA (1990), REIS & CASTELLO (1996), GONZALEZ-SANSÓN et al. (1996), HAIMOVICI & UMPIERRE (1996) e CAROZZA et al. (1997). All these studies were carried out in latitudes below the tropic of Capricorn, therefore in subtropical and temperate regions, from 23°30' -33°00'S. Studies based on length-frequency distributions are useful to follow growth and estimate age when recruits and early juveniles are caught; in this first life stage the large abundance of length frequency data enable it to follow modal sizes which are conspicuous. Early studies on fish growth dated from the early last century with PETERSEN (1895 in BARBIERI & BARBIERI, 1984), which developed a method based on length frequency distribution. Several workers (BARBIERI & BARBIERI, 1984, GONZALEZ-SANSÓN et al., 1996; HAIMOVICI & UMPIERRE, 1996; REIS & CASTELLO, 1996; CAROZZA et al., 1997) have used the length frequency distribution as a tool for assessing growth, distribution pattern, and as a support to evaluate age class in fishes (VON BERTALANFFY, 1938).

The present work aims to analyze size structure in *M. furnieri* populations which use the Sepetiba bay, aiming to contribute to knowledge of ecology, focusing on recruitment period and growth during the early life stage.

## Material and Methods

Two fish sampling programmes were carried out in the Sepetiba bay: one using bi-monthly beach seine over three years at five sites, from de July 1993 to December 1997; and the other using monthly otter trawls, between July 1993 and June 1994, and bi-monthly, between August 1994 and June 1996.

Beach seines were performed parallel to the coast line at depth about 1.5 m, covering an extent of approximately 30 m, with nets measuring 10 m long, 2.5 m height e 7 mm size mesh between consecutive knots. Trawls were performed by a 12 m long boat, provide by a net with 12 mm mesh size at the cod end, 8 m long wings; and the tows last for 30 min, covering approximately 1.5 km extension. Capture per sampling unit effort (CPUE) was standardized as total number of fish caught per haul in each sampling programme. Three replicates samples were performed at each site. All fish were fixed in 10 % formalin, measured to total length at nearest mm. Preserved fishes usually show a decreasing in size between 2 % and 10 % total length, mainly for larval stages (HAY, 1982; HJÖRLEIFSSON, 1992; THEILACKER, 1980). As most fishes used in size studies are based on preserved fishes, comparisons with other studies could be performed with the same accuracy. Length frequency distribution was organized at 5 mm size classes.

For spatial comparisons, the study area was divided in shallows (five sites sampled by beach seine) and deeper area in the inner Bay (seven sites sampled by otter trawl): Inner: 5-10 m depth; Outer = 10-20 m depth (FIGURE

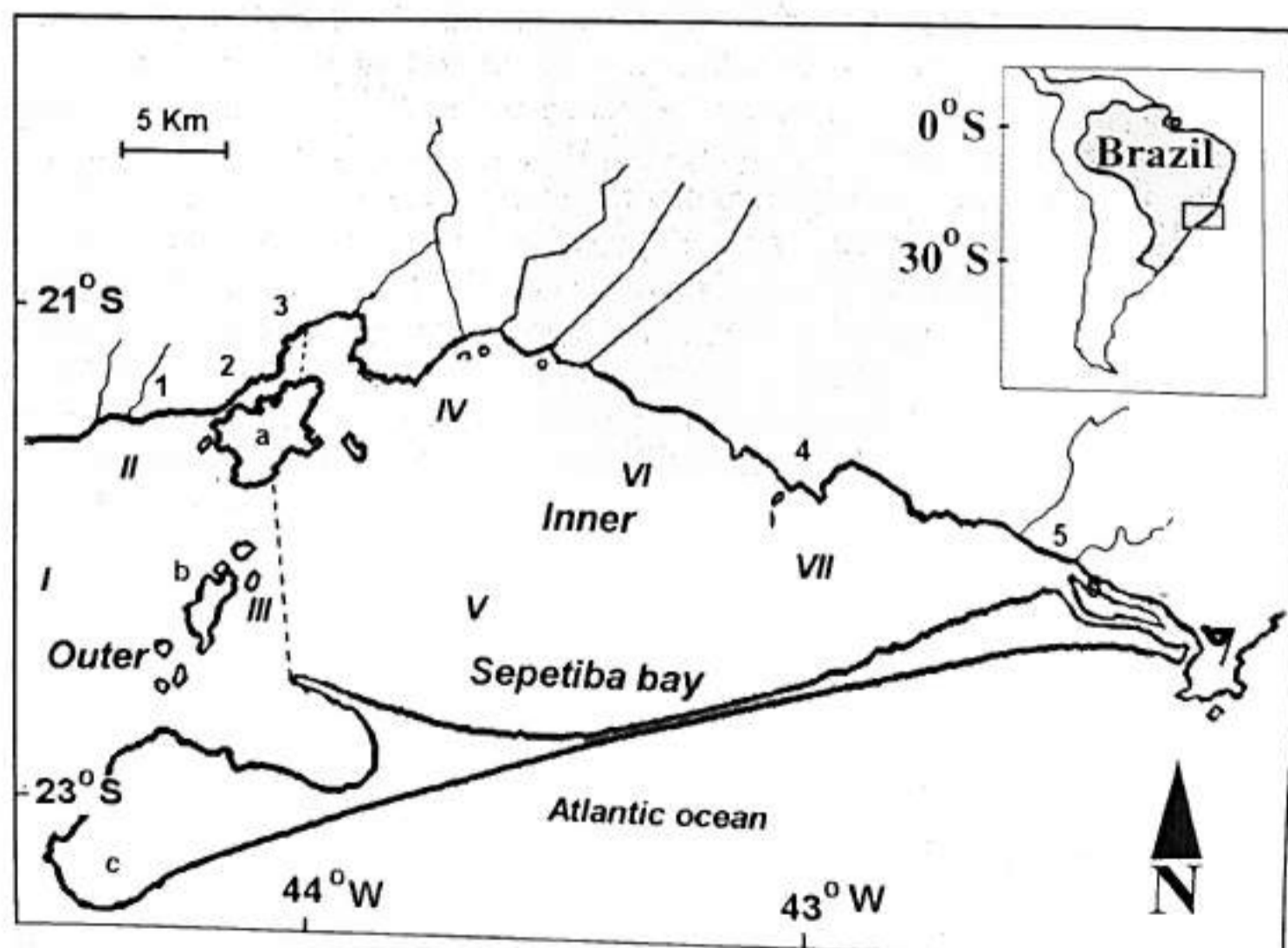


FIGURE 1 – Area of study, Sepetiba bay, with indication of the beaches seine sites (outer beaches: 1, 2 and 3; inner beaches: 4 and 5) and otter trawl sites (outer bay: I, II and III; and inner bay: IV, V, VI and VII).

1). Seasonality was assessed considering the following group of months: Winter (July, August and September), Spring (October, November and December), Summer (January, February and March) and Autumn (April, May and June).

CPUE-LC (capture per unit effort by length class) is the sum of all catches divided by the sum of all effort, as proposed by VIEIRA (1991) shows the advantage of summarizing the species abundance and size. When all caught individuals are measured, the CPUE-LC is calculated by dividing the total catches in each size class by the unit effort, but when it would not be possible to measure all individual, a correction factor (CF) is used to multiply each number of individuals in each class.  $CF = TN / MN \times 100$  where, TN = total number of individuals caught; MN = total number of measured individuals. The CF enables keep abundance proportional to the total fish number in each length group.

## Results

Fish size ranged from 15 and 250 mm TL. In the beaches, individuals captured ranged from 15 to 100 mm TL, while in the bay, from 45 to 250 mm TL. Three size groups were observed and can be followed by accompanying modal class: recruits showing <60 mm TL; young-of-the-year, showing 80 to 110 mm TL; and juveniles older than one year and sub-adults with size >130 mm TL.

Recruits appear in the beaches in a wide period all over the year, but some shifts in occurrence were shown among the three-year studied period. They were rare between January and April 1994, January and June 1996 and May and August 1997.

Two recruitment periods were shown in 1993/94 (R1, in early Winter, and R2, in Autumn) with smaller individuals showing 15 and 10 mm TL in both periods, then reaching 35 - 40 mm TL approximately six months later. (R1) (FIGURE 2). In 1996, only one size group was recorded with 15 - 20 mm TL in March/April, then reaching 35 - 40 mm TL in September/October (FIGURE 3). In 1997, recruits averaging 15 - 30 mm TL were recorded from January to June; in September/October they reach 20-35 mm TL, then in November/December, 45-55mm TL (FIGURE 4).

Two peaks of abundance in 1993/94 occurred in September/October and May/June, in 1996 one peak in September/October, and in 1997 again two peaks in March/April and September/October (FIGURES 2 - 4).

In the inner bay, young-of-the-year were abundant at 80-110 mm TL in August/October 1993 (J1), and juvenile at 130-160 mm TL in November/February 1994 (J2); in May/June they reached 140-200 mm TL being considered subadults (SA) (FIGURE 5). Young-of-the-year with 80-110 mm TL (J1) were re-

corded from August to June in 1994/95, and from October to June in 1995/96, with highest abundance in October 1995/96, and lowest in October 1994/95 and August 1995/96 (FIGURE 6). Largest individuals showing  $> 110$  mm TL (J2), were recorded all year in 1994/95, with exception of October, when the lowest abundance were recorded. In 1995/96, this size group also occurred all over the year, but showing lowest abundance in August and December 1995 and June 1996. Individuals larger than 200 mm TL or subadults (SA) were not very common in the bay all over the studied period.

In spite of not very clear modes in size groups, it can be observed that the pattern of fish occurrence was enough to suggest that of the recruitment and growth of *M. furnieri* in the Sepetiba bay can be identified through the distribution of size classes. This approach could be summarized as follows (FIGURE 7): recruits from Winter/Summer spawning recruit (10-45 mm TL) from March to October in the inner beaches of Sepetiba bay, and at the end of the first year (80-110 mm TL) move away from the beaches to deeper areas inside the bay. After spending the first two years in the bay, they move away from the bay to continental shelf, joining to adults stocks ( $>200$  mm TL).

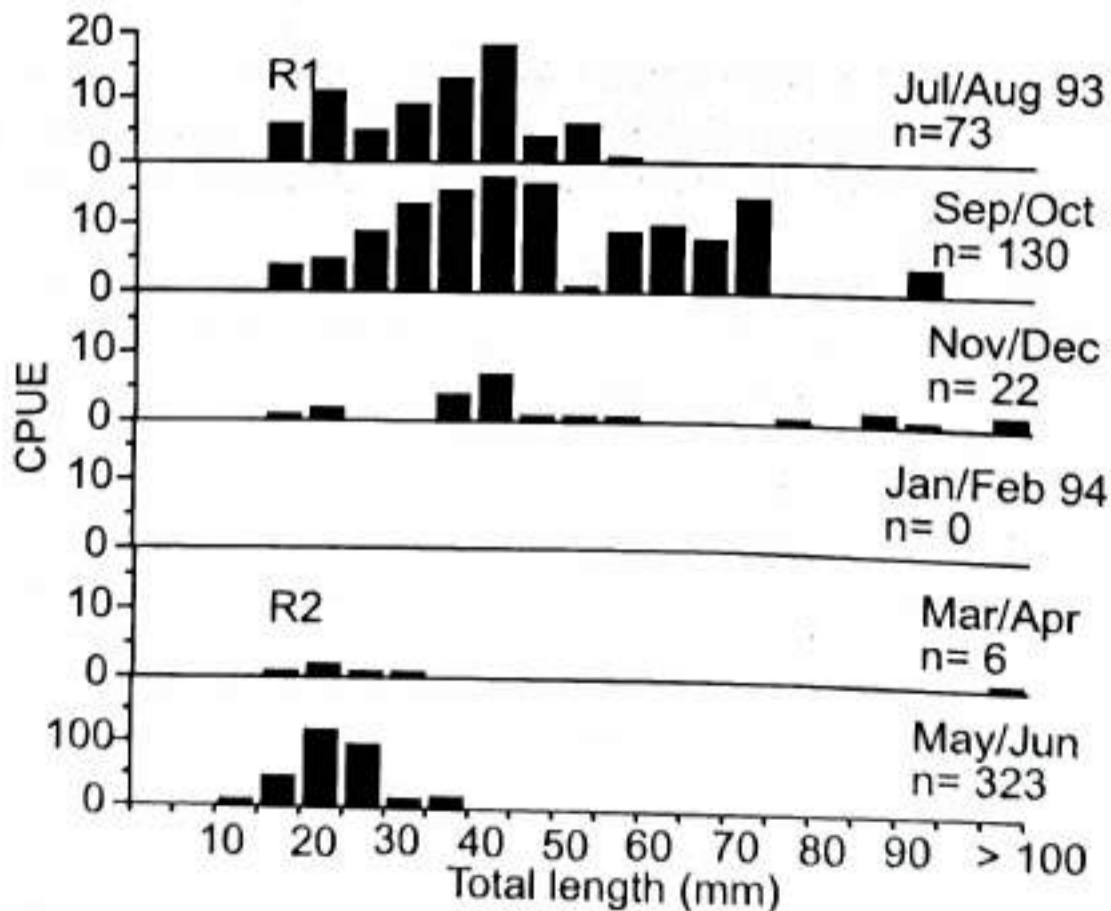


FIGURE 2 – Bi-monthly length-frequency distribution (CPUE-LC) of *Micropogonias furnieri* individuals, at beaches in the Sepetiba bay, in the 1993/94. n = number of individuals.

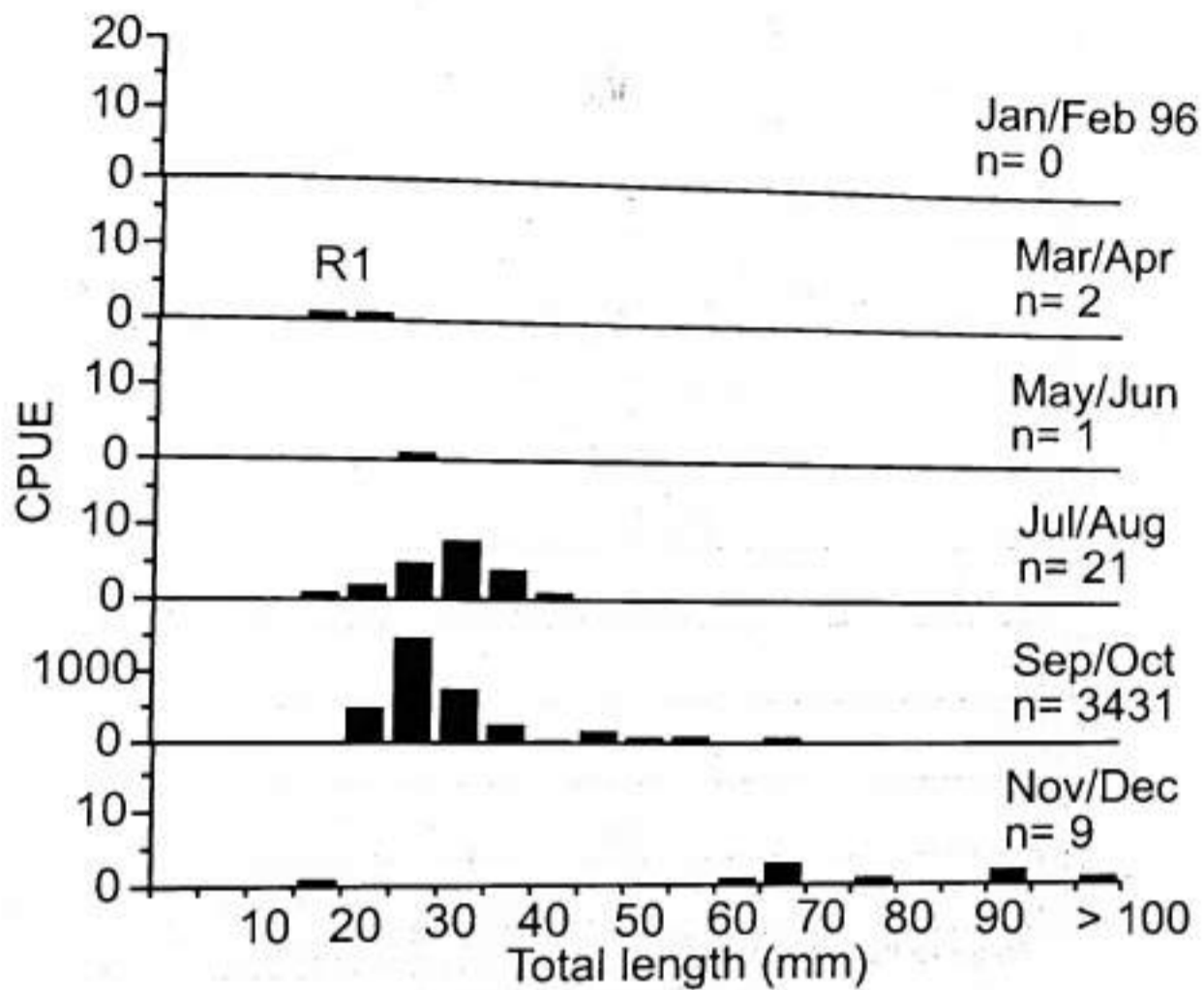


FIGURE 3 – Bi-monthly length-frequency distribution (CPUE-LC) of *Micropogonias furnieri* individuals, at beaches of Sepetiba bay, in 1996. n = number of individuals.

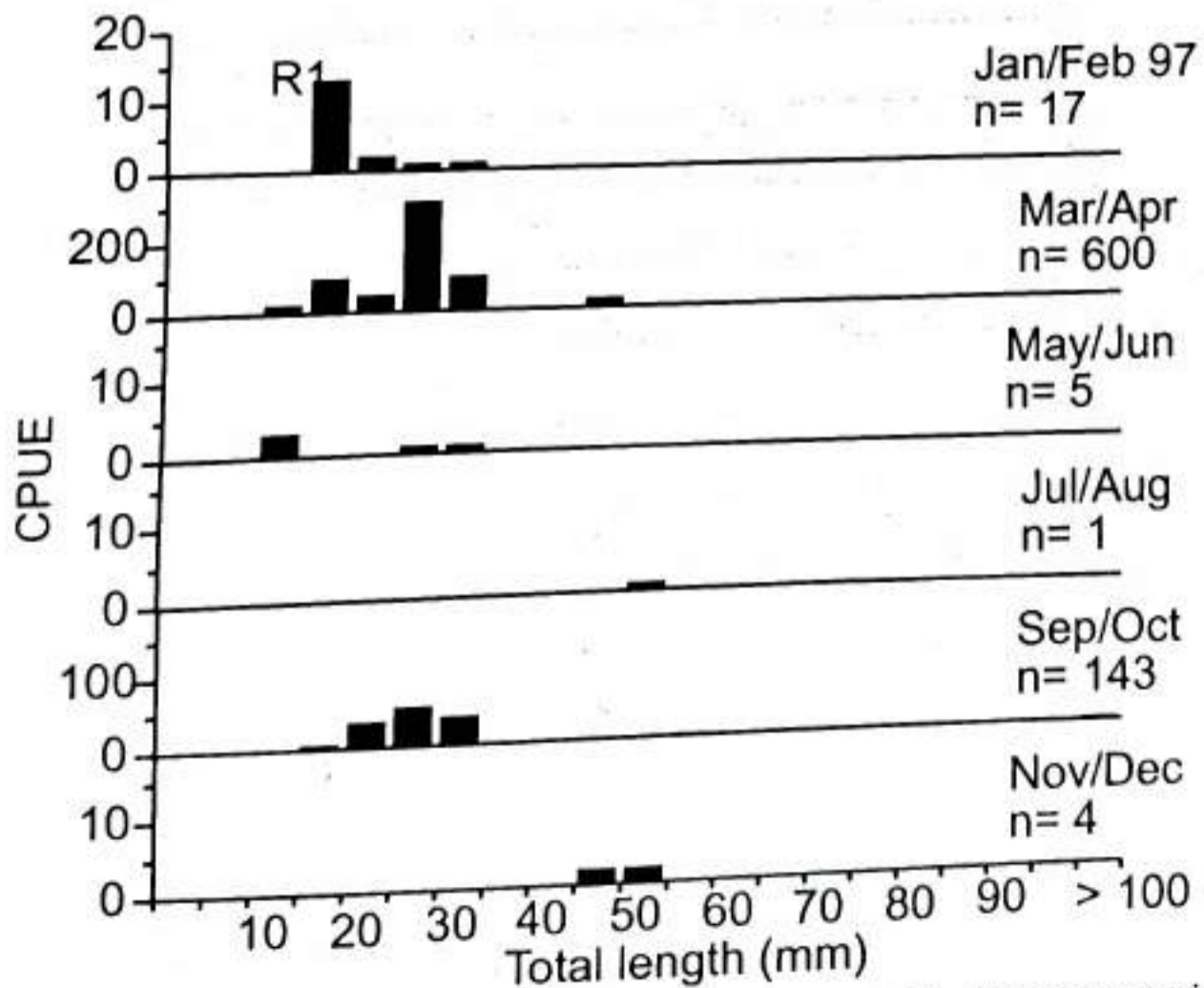


FIGURE 4 – Bi-monthly length-frequency distribution (CPUE-LC) of *Micropogonias furnieri* individuals, at beaches in Sepetiba bay, in 1997. n = number of individuals.

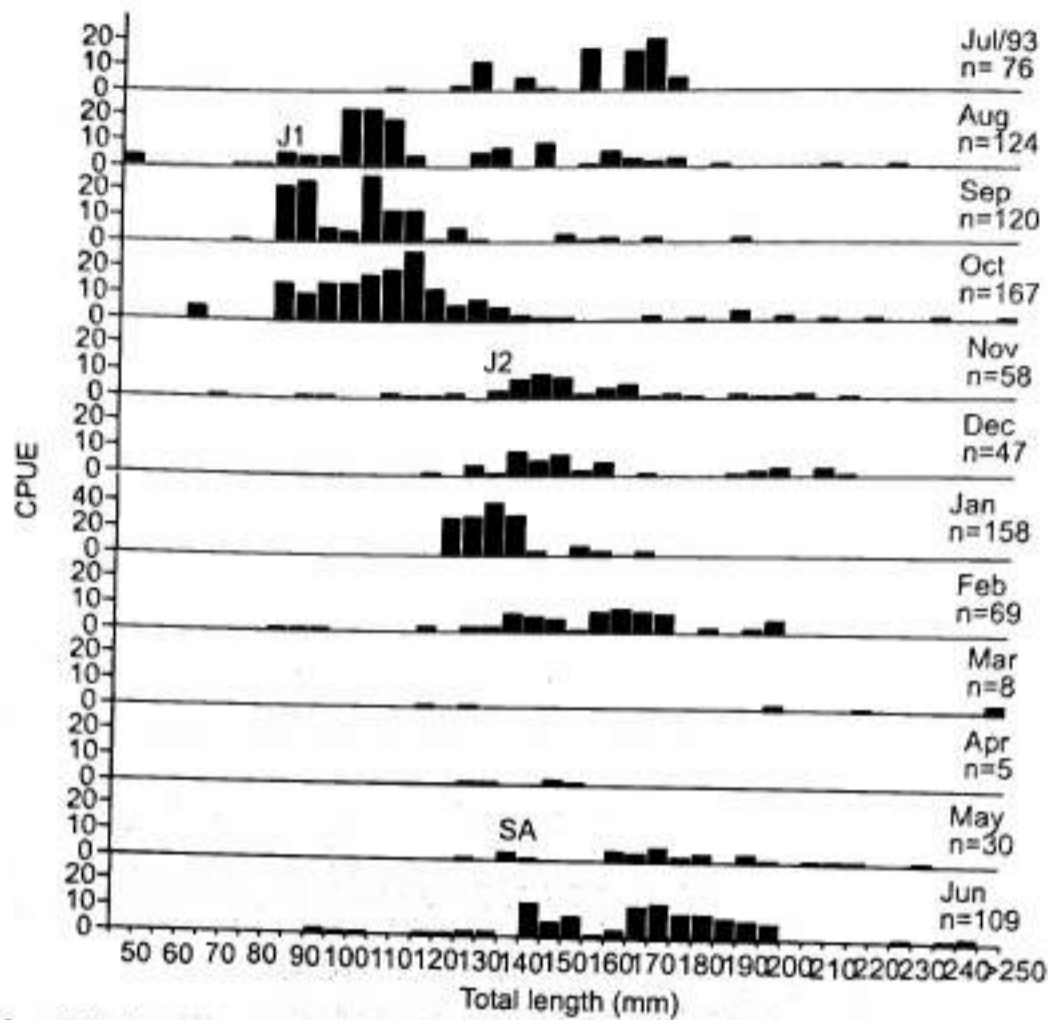


FIGURE 5 – Monthly length-frequency distribution (CPUE-LC) of *Micropogonias furnieri* individuals, from Sepetiba bay, in 1993/94. n = number of individuals.

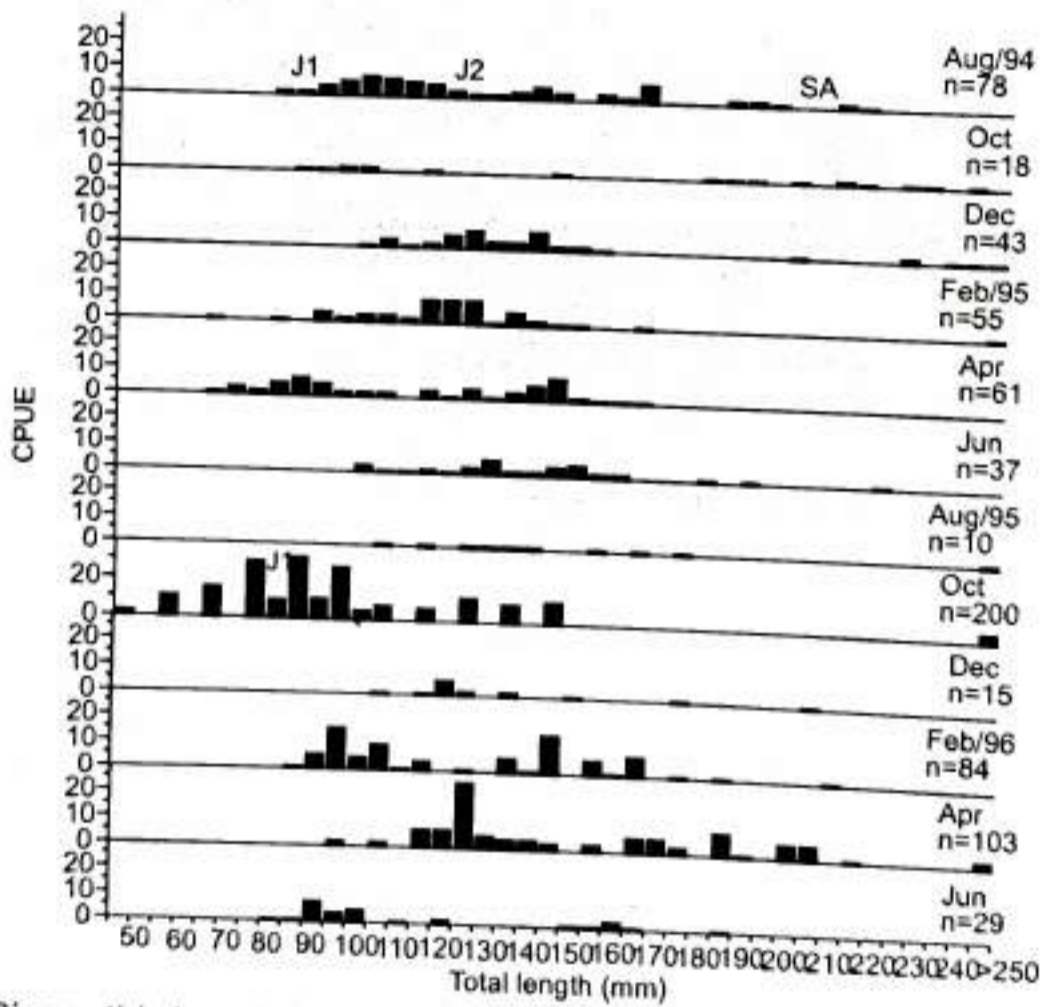


FIGURE 6 – Bi-monthly length-frequency distribution (CPUE-LC) of *Micropogonias furnieri* individuals, from Sepetiba bay, in 1994/96. n = number of individuals.

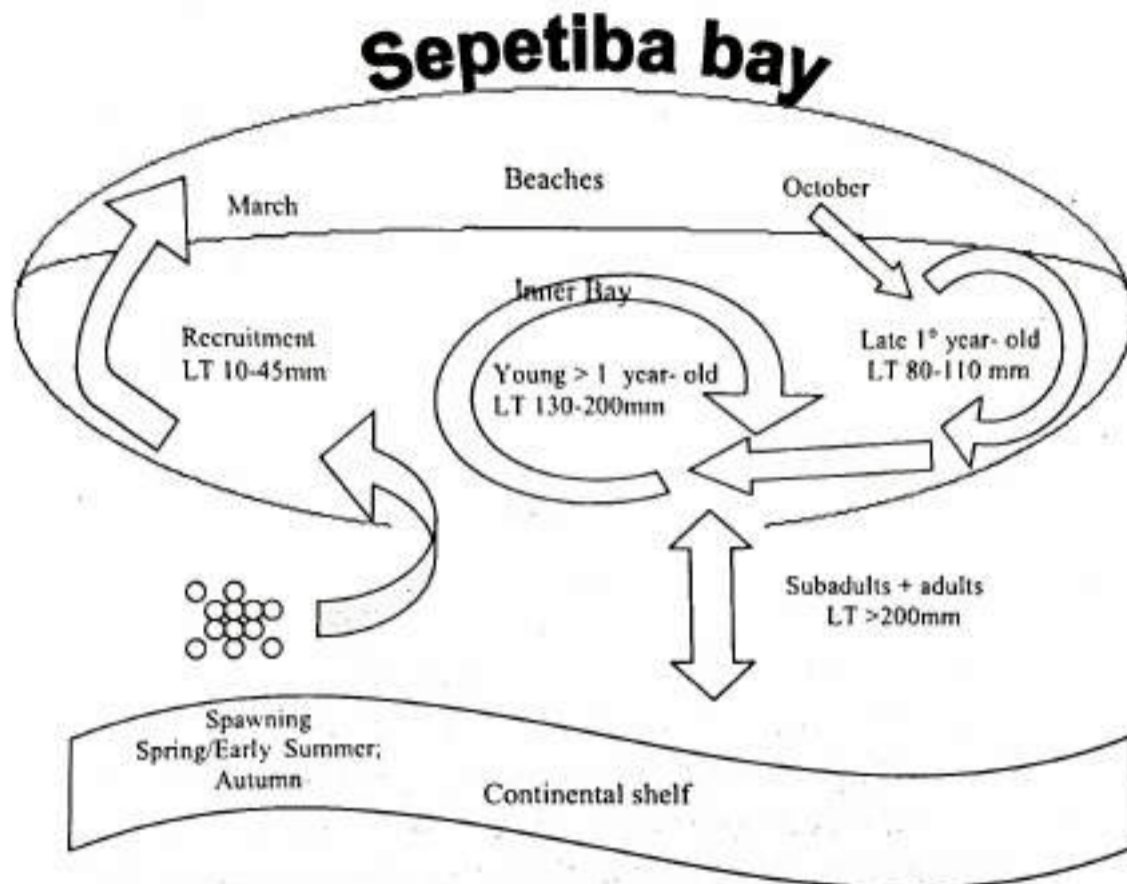


FIGURE 7 – The early life cycle of *Micropogonias furnieri* in Sepetiba bay.

## Discussion

A long and continuous recruitment period of *M. furnieri* in the inner beaches of Sepetiba bay occur from March to October, with recruits appearing with 10-15 mm TL and staying in the area until they reach approximately 60 mm TL. Movements of this fish from beaches to deeper areas in the inner bay occur in high abundance from August to October, when they present 80-110 mm TL, and are about to complete one year. From November to February, a second modal group was observed presenting 130-170 mm TL, that can be characterized as individuals in the second year. This can be indicated by following the length modal class in the three studied years, with recruits presenting higher abundance until they reach 60 mm TL, indicating a possible migration of larger size individuals (TL > 60 mm) from beaches to deeper areas in the bay, mainly in the summer, and a return to bays in early autumn when they reach 80 to 120 mm TL. In deeper areas in the bay this group of fish complete the first year life (J1) and mix to older juvenile of larger size from previous spawns (J2).

*Micropogonias furnieri* has been classified as a marine fish with high dependence of estuarine zones and bays. Individuals of this species inhabit these areas as recruits, juveniles and subadults, where they find protection from predator and abundant food, migrating to deeper areas in the continental shelf as they reach larger size (CASTELLO, 1985; VAZZOLER, 1991). GONZÁLEZ-

SANSÓN et al. (1996) studying size distribution of *M. furnieri* in Cienfuego bay, Cuba, reported that individuals presented size larger than those observed by CASTELLO (1985) in the Patos lagoon estuary and also found, similarly to CASTELLO (1985), that smaller individuals were present in the bay and largest individuals, in the continental shelf. It was observed in those populations that classes of sizes were homogeneous over the year, indicating a constant entrance of recruits all over the year, and a migration to outer bay as they reach approximately 220 mm TL.

Overall *M. furnieri* individuals of small sizes are associated to shallow, semi-closed coastal areas, with abundant food availability, as it matches the Sepetiba bay situation. Largest sizes, are in its majority, recorded along the continental shelf, as observed by CAROZZA et al. (1997) and REIS & CASTELLO (1996). CAROZZA et al. (1997) analyzing *M. furnieri* size structure in Mar del Plata, Argentina, reported that size ranged from 210-780 mm TL, with highest frequency from 300-500 mm TL, and modes at 360 and 400 mm TL; they also found seasonal variation in the population size structure with largest lengths being recorded in winter, and smallest ones in summer, an evidence that the caught fish in this area constitute subadults and adults part of the local population.

The population in the bay of Sepetiba, which was mainly constituted by fish measuring under 200 mm TL, is an indication that such individuals are in development phase, once adult individuals are common in the continental shelf; according to VAZZOLER (1991) size at first maturation is 250 mm TL for males and 275 mm TL for females. Another still unproved hypothesis is that a completely separated unit stock can be developed in bay and closed areas where they complete their life cycle; this later hypothesis have been support by local fisherman because they found some mature individuals measuring less than 200 mm in semi-closed areas.

Patterns of seasonal movement of *M. furnieri* in Sepetiba bay (FIGURE 7) is similar those described by GONZÁLEZ-SANSÓN et al. (1996) for the north limit of distribution of this species, and this also matches the patterns described by CASTELLO (1986) for the south limit, with both studies based mainly on adult populations. It can be concluded, therefore, that based on the length-frequency distribution, that recruits use the beaches and that young-of-the-year at the end of the first year of life move from the beach to deeper areas in bays, where they coexist with larger sized groups; after that they move away from closed areas and join to adult stock in the continental shelf.

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