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A NURSERY GROUND FOR TWO TROPICAL PINK-SHRIMP *Farfantepenaeus* SPECIES: UBATUBA BAY, NORTHERN COAST OF SÃO PAULO, BRAZIL

R. C. COSTA & A. FRANSOZO

Departamento de Zoologia - IB – UNESP - 18618-000 - Botucatu, SP, Brasil- NEBECC (Group of Studies on Crustacean Biology, Ecology and Culture) - e-mail: fransozo@ibb.unesp.br

ABSTRACT

The objective of this study is to investigate the population structure of two shrimp species, *Farfantepenaeus brasiliensis* (Latreille, 1817) and *Farfantepenaeus paulensis* (Pérez Farfante, 1967), with emphasis on the recruitment of young in Ubatuba Bay, SP, Brazil. Monthly samplings were carried out from September 1995 to August 1996, using a commercial fishery boat supplied with two double rig nets. The obtained material was sorted, identified and the cephalothoracic length (CL) of each shrimp was measured. Specimens measuring less than 25 mm CL were considered young. Young shrimps comprised the vast majority of the total collected: 77,43% (199 shrimps from a total of 257) of all *F. brasiliensis* obtained, and 84.4% (160 individuals out of 189) in the case of *F. paulensis*. In both species recruitment of young shrimps begins in summer, when approximately 18% of the incoming recruits incorporate into the adult population. However, recruitment was more intense during autumn when 50% of all young individuals were obtained. In *Penaeus* species, post-larval stages settle in estuarine areas, where they remain until the juvenile phase. Adults will then migrate to the open sea to breed. Based on the results presented herein, the management of these shrimp species' fishery could be re-evaluated in the study area. Shrimp fishery activities should be reduced and selective nets should be used for trawling, especially during summer and autumn.

Keywords: pink-shrimp, *Farfantepenaeus*, nursery, Ubatuba Bay, Brazil.

INTRODUCTION

Pérez Farfante & Kensley (1997) proposed recent classification in the suborder Dendrobranchiata with keys and diagnoses for two superfamilies, seven families and 56 genera. The species and subspecies list of almost 500 names includes the authors and date, and geographical records. In this study, *Penaeus brasiliensis* and *Penaeus paulensis*, will be considered as *Farfantepenaeus*.

According to Dall *et al.* (1990), adults of most *Penaeus* species usually inhabit offshore areas where reproduction takes place. After that, larvae migrate into estuaries where they grow and develop to juvenile shrimps. Once attaining the juvenile phase, they initiate a migration to the open sea, thus completing their life cycle.

Studies concerning the population structure of decapod crustaceans often rely on size frequency analyses (Díaz & Conde, 1989 and Negreiros-Fransozo *et al.*, 1994). In the case of penaeid shrimps, Rodrígues (1986); Freitas (1987); Gab-Alla *et al.* (1990); Palacios *et al.* (1993) and Bauer & Lin (1994) have condutes studies on the population biology of these organisms.

In the northern coast of São Paulo State, Brazil, *Farfantepenaeus brasiliensis* (Latreille, 1817) and *Farfantepenaeus paulensis* (Pérez Farfante, 1967), although not very abundant, are heavily exploited because of their high commercial value. Besides,

there is no efficient control of this activity, which results in a particularly damaging fishery since young shrimps are constantly being eliminated from these populations. The characterization of these populations' structure and the determination of their recruitment periods may provide basic information for a more rational exploitation of this fishery resource, as already mentioned by Neiva (1966), Zenger & Agnes (1977); Staples & Vance (1986 e 1987); Stoner (1988); D'Incao (1991); Chagas-Soares *et al.* (1995) and Branco & Verani (1998a,b).

The purpose of this study is to investigate the population structure of *F. brasiliensis* and *F. paulensis*, with emphasis on the recruitment of young individuals in Ubatuba Bay, SP, Brazil.

MATERIALS AND METHODS

F. brasiliensis is distributed from North Carolina (USA) to Lagoa dos Patos, RS (Brazil); while *F. paulensis* is found from Ilhéus, BA (Brazil) to Mar del Plata (Argentina) (D'incao, 1995).

Monthly samplings, were conducted from September 1995 to August 1996. Three replicates from different 1-km transects were carried out during three consecutive days in Ubatuba Bay (23° 25' 00" to 23° 27' 34"S and 45° 00' 30" to 45° 03' 30" W) (Fig. 1). These trawlings were conducted using a fishing boat equipped with two double rig nets, with a 3.5 m opening and a mesh size of 12 mm, reduced to 10 mm in the cod end. Each transect covered an area of approximately 7,000 m^2. Temperature, salinity and dissolved oxygen were measured on water samples obtained with a Van Dorn bottle to which a ruled rope was attached for depth determination. In order to quantify the organic matter contents in the substratum, sediment samples were taken with a Van Veen grabber enclosing a 0.025 m^2 area. The details of the methodological procedure in the analysis of each abiotic factor can be verified in Mantelatto & Fransozo (1999).

The morphology of the thelycum in females and petasma in males was used for identification of adult individuals. For juveniles, the opening shape of the dorsal groove in the 6^{th} abdominal segment was used for species identification, according to Pérez Farfante (1969) and D'Incao (personal communication).

Collected specimens were counted and their sex determined. The cephalothoracic length (CL), measured from the orbital angle to the posterior margin of carapace, was measured. Shrimps smaller than 25 mm CL were considered young (Pérez-Farfante, 1969 and Zenger & Agnes, 1977).

Monthly mean size of individuals was calculated and pooled over the seasons, spring, summer, autumn and winter. 95% confidence intervals were constructed to compare these means. Average values of abiotic factors in each month were compared in an ANOVA. A Tukey test was used to test for differences at a 5% statistical significance level.

RESULTS

Mean values of salinity, dissolved oxygen contents and temperature during the sampled period are listed in Table I. Depth in Ubatuba Bay varies from 3.1 to 16.6 m, and organic contents in the sediment ranges from 5.3 to 20.3%. However, the occurrence of *F. brasiliensis* and *F. paulensis* is restricted to areas between 9.5 and

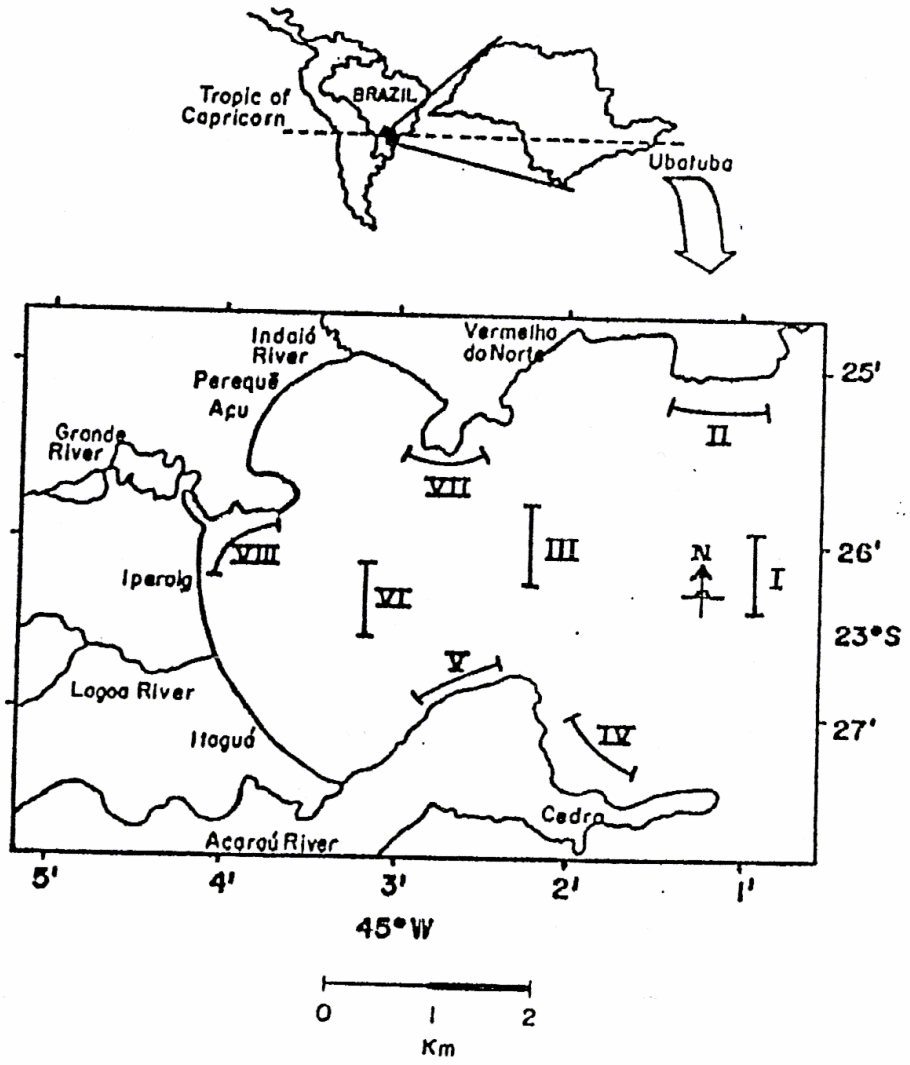


Figure 1. The Ubatuba bay map with the indication of the transects.

7.8m deep (transects IV and V respectively), where organic contents in the sediment range from 14.5 to 20.3%.

During the studied period, a total of 257 individuals of *F. brasiliensis* and 189 shrimps of *F. paulensis* were collected. Average size and respective range are shown in Table II. In both species, size range in females is highest.

For the analysis of size frequency distributions, 10 size classes were standardized with the first one enclosing individuals measuring from 7 to 10 mm CL (Table III and Fig. 2). Most sampled individuals were young shrimps. Their percentage from the total catch was 77% and 84% for *F. brasiliensis* and *F. paulensis*, respectively. Figure 3 represents the size frequency distributions for major seasonal groupings in both species. The beginning of the recruitment period occurs during the summer in these species, when 18% of all recruits incorporate into the adult population. The rate of incoming recruitment peaks in autumn, when 50% of all sampled recruits was obtained. During winter and spring, adult shrimps dominates in monthly samples.

In figure 4, it can be noticed that average size of individuals sampled in summer and autumn is significantly lower than that obtained for shrimps trawled during winter and spring.

Table I. Monthly mean values of abiotic factors quantified in Ubatuba Bay from September 1995 to August 1996. Lettering corresponds to statistical differences after an ANOVA analysis and a Tukey test at 5% significance level.

Abiotic factors	**Salinity**	**Dissolved oxygen**	**Temperature**
Month	**‰**	**(g/ml)**	**°C**
September	31.63 ± 0.61 c	5.44 ± 0.76 ab	22.40 ± 0.50 c
October	32.65 ± 0.37 c	5.08 + 0.58 abc	22.40 ± 0.40 c
November	29.63 ± 0.86 c	5.12 + 0.86 abc	23.50 ± 0.80 c
December	31.53 ± 0.48 c	5.54 ± 0.53 ab	22.20 ± 2.80 c
January	35.30 ± 0.37 a	4.73 ± 0.66 c	26.60 ± 0.50 ab
February	31.80 ± 0.86 c	4.71 ± 0.60 c	27.90 ± 0.90 a
March	34.50 ± 0.41 ab	5.90 ± 0.72 a	27.40 ± 1.10 ab
April	35.22 ± 0.26 ab	4.70 ± 0.47 c	26.00 ± 0.30 b
May	32.70 ± 1.02 c	5.28 ± 0.53 ab	23.50 ± 0.90 c
June	34.36 ± 0.16 ab	4.28 ± 0.50 c	23.10 ± 0.20 c
July	34.59 ± 0.62 ab	5.09 ± 0.42 abc	20.20 ± 0.30 d
August	34.24 ± 0.48 bc	5.46 ± 0.21 ab	19.60 ± 0.30 d

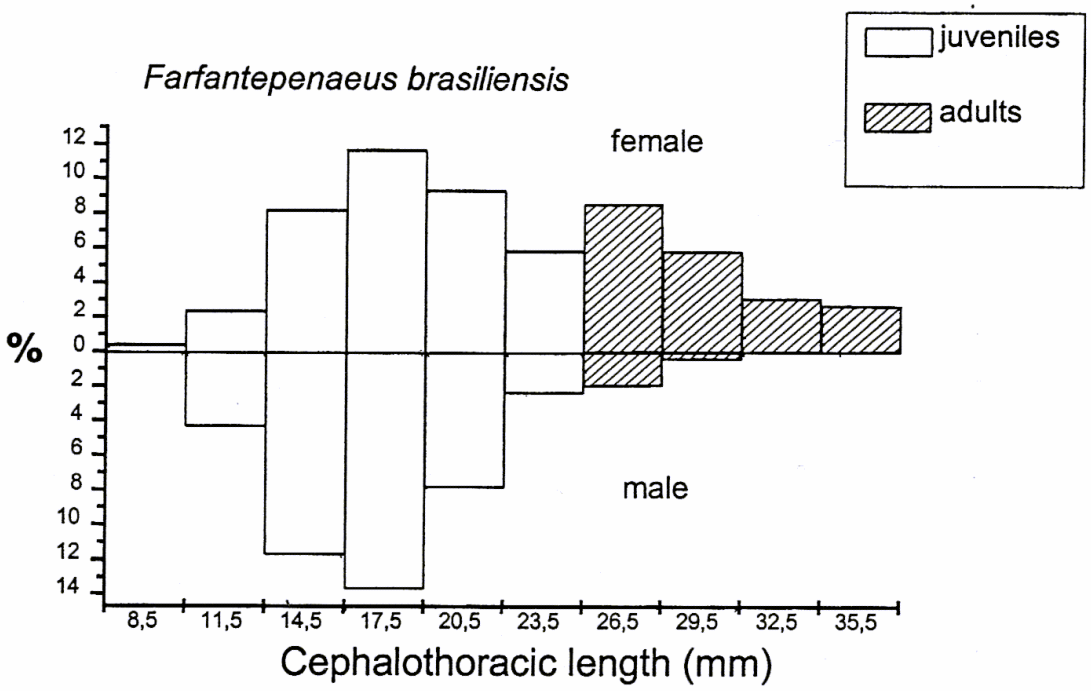
Mean values in months sharing at least a single letter do not significantly differ.

Table II. *F. brasiliensis* and *F. paulensis*. Mean standard deviation and size range (mm) for males and females during the study period.

Species	**Sex**	**Mean**	**Minimum**	**Maximum**
F. brasiliensis	Male	17.31 ± 3.65	10.3	30.4
	Female	22.23 ± 6.38	9.3	36.5
F. paulensis	Male	18.56 ± 4.47	9.1	28.8
	Female	20.34 ± 6.80	8.1	34.7

Table III. Size frequency distributions for studied species.

	F. brasiliensis		*F. paulensis*	
Classes (mm)	**n**	**%**	**n**	**%**
7.0 -----| 10.0	1	0.39	4	2.12
10.0-----| 13.0	17	6.61	16	8.47
13.0-----| 16.0	51	19.84	45	23.81
16.0-----| 19.0	65	25.29	38	20.11
19.0-----| 22.0	44	17.12	32	16.93
22.0-----| 25.0	21	8.17	25	13.23
25.0-----| 28.0	27	10.51	9	4.76
28.0-----| 31.0	16	6.23	12	6.35
31.0-----| 34.0	8	3.11	6	3.18
34.0-----| 37.0	7	2.72	2	1.06



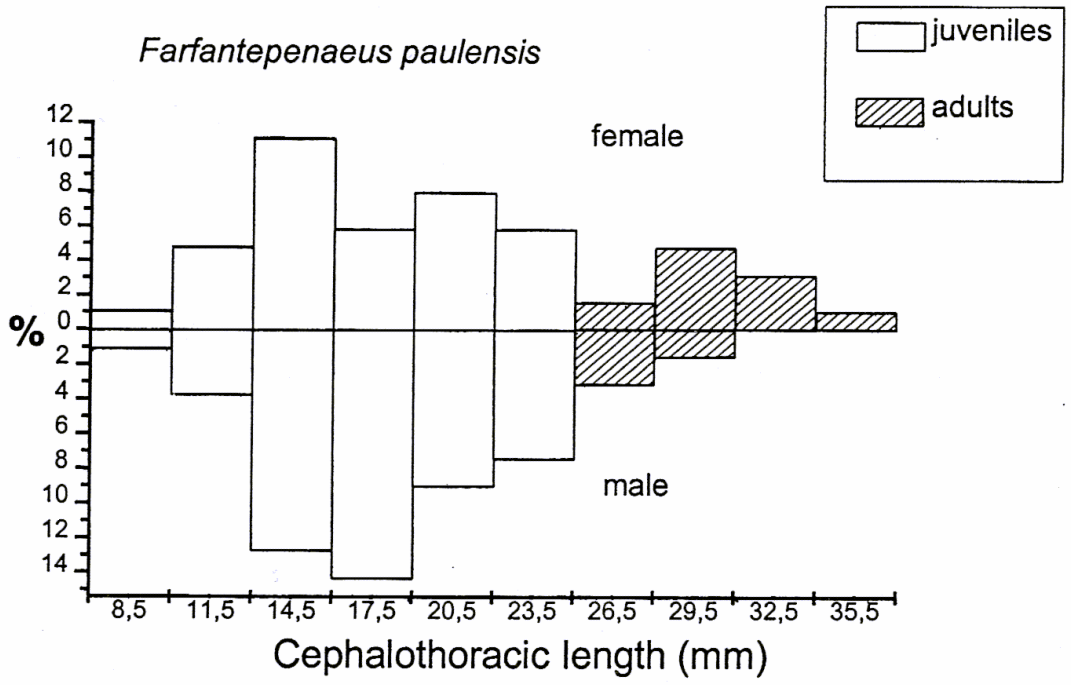


Figure 2. Size frequency distributions for *F. brasiliensis* and *F. paulensis* from September 1995 to August 1996.

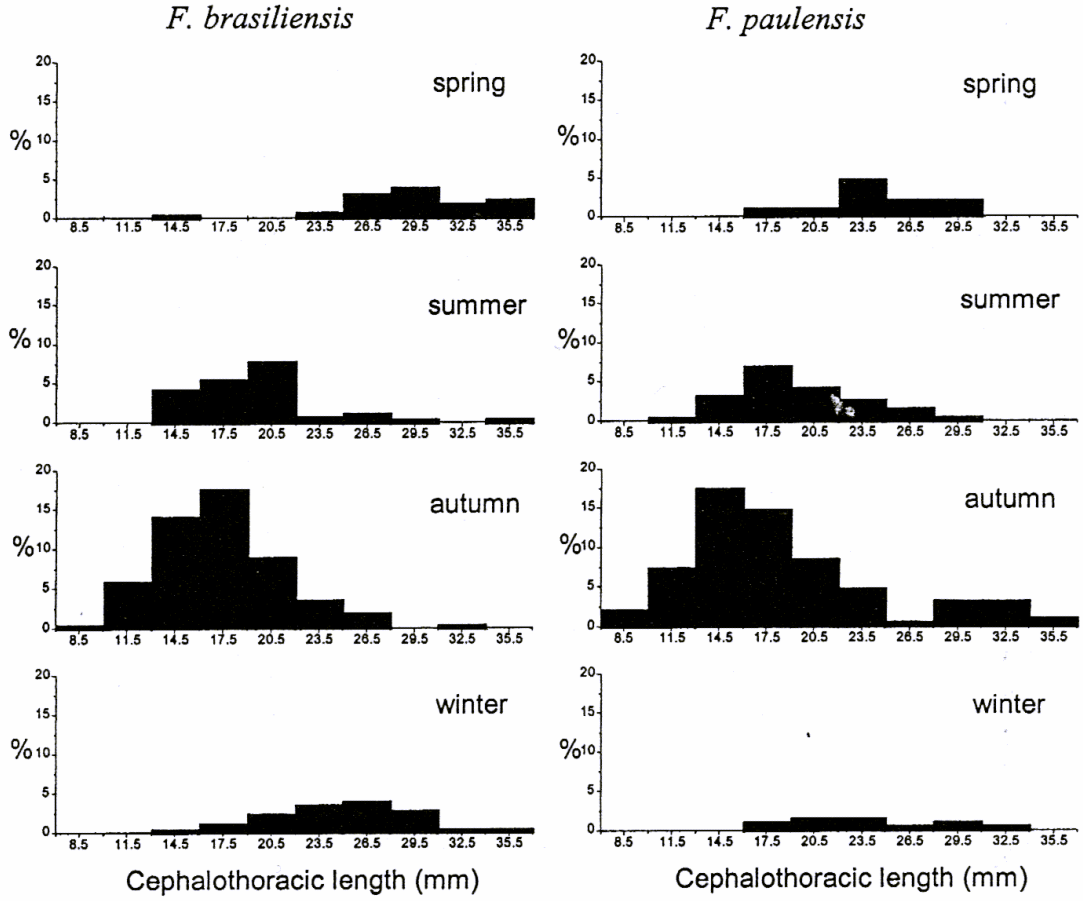


Figure 3. Size frequency distributions for *F. brasiliensis* and *F. paulensis* during the study period.

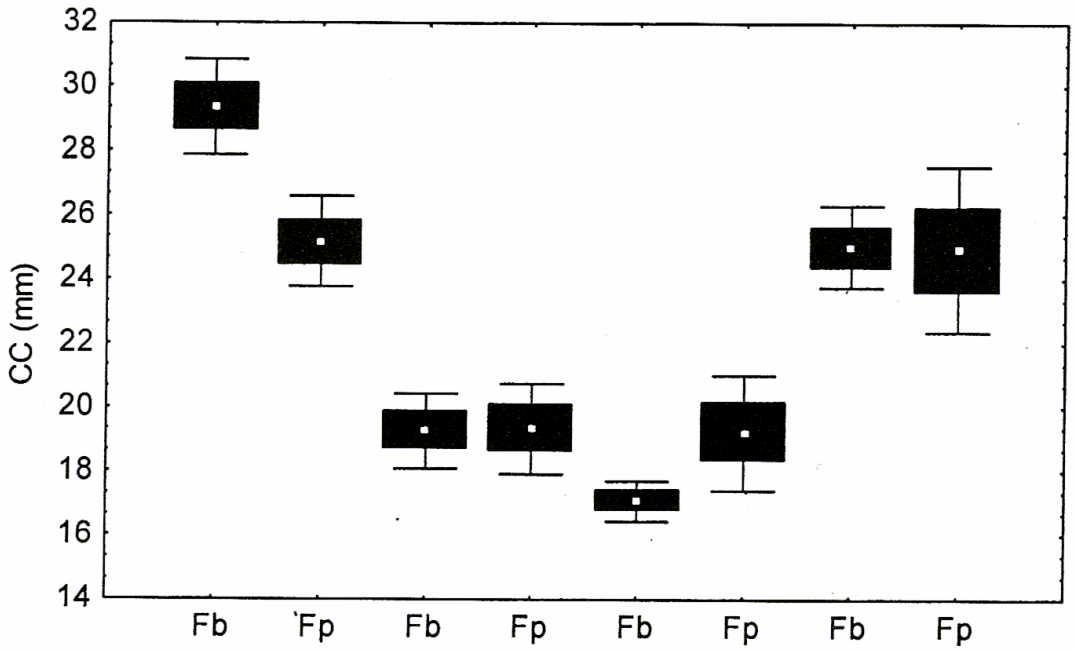


Figure 4. *F. brasiliensis* (Fb) and *F. paulensis* (Fp). Box and whisker plots representing the mean, standard error and 95% confidence intervals of cephalothoracic length (CL) of sampled individuals pooled in each season.

DISCUSSION

Along the southern and southeastern coast of Brazil, size ranges of these shrimp species attain 40 and 60 mm CL for males and females, respectively (Zenger & Agnes, 1977). In Ubatuba Bay, larger individuals of both *F. brasiliensis* and *F. paulensis* are still consideratly smaller than those collected in deeper regions.

Size is a sexual dimorphic characteristic in all penaeid species, with females larger than males (Boschi, 1969). In this study, only females were distributed in the larger size classes in both species, what might be attributed to a differential growth between sexes or to a delayed offshore migration in the case of females. According to Rodríguez (1987), an increased cephalothoracic size in females may enhance the reproductive output of the species by means of maximizing the space available for the development of gonads.

In the study region, *F. brasiliensis* and *F. paulensis* are less abundant than the penaeid *Xiphopenaeus kroyeri* (Heller, 1862). Stoner (1988) had mentioned that *Penaeus* species occurring in large estuarine areas do often constitute large populations. The author also states that penaeids may be less dependent upon coastal estuarine areas when large adequate extensions of such grounds are not available.

Because of the characteristic geography of the northern coast of São Paulo State, which encloses several small scale embayments, it is possible that young *Farfantepenaeus* spp. are retained within small coves only for a brief period, migrating shortly after to larger shallow bays where food is particularly abundant.

Otherwise, in Lagoa dos Patos, a larger estuarine area in southern Brazil, the postlarvae of *P. paulensis* settle in this estuary in early spring, remain during their

juvenile development and only after 4 to 5 months they begin their offshore migration. By that time, these shrimps have already grown to a size of about 14 - 17 mm CL (D'Incao, 1991).

For *F. brasiliensis* and *F. paulensis* in Ubatuba Bay, recruitment of young begins in summer and peaks in autumn. D'Incao (1991) and Branco & Verani (1998a,b), who have carried out their field work in Lagoa dos Patos and Lagoa da Conceição, respectively, report that young shrimps are found in those locations year-round but their abundance is highest in autumn, as observed in this study. Despite this agreement, these estuaries are quite different, which prevent further comparisons. Lagoa dos Patos and Lagoa da Conceição are typical estuarine areas subjected to great environmental instability, mainly regarding salinity.

In the case of *F. brasiliensis* and *F. paulensis*, the highest recruitment rates observed during summer and autumn are probably results of breeding activity in spring and, mainly, in summer. Reproduction occurring in these seasons may optimize larval development since environmental conditions are better in this period and adequate food supply is available for early life stages. These conditions are probably main factors causing the autumn recruitment peak in Ubatuba Bay. The reduced abundance of young individuals during spring may be due to an extensive offshore winter migration.

Based on the results obtained in this study, it is suggested a better control of shrimp fisheries in the study region, particularly during summer and autumn. The perpetuation of uncontrolled fishery may endanger the adult catch in deeper areas and the survivorship of these species in the region, since estuarine bays are of most importance during a critical development phase of these organisms.

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