

# Population structure of *Cyrtograpsus angulatus* Dana, 1851 (Brachyura, Grapsidae) in the Lagoa do Peixe, Rio Grande do Sul, Brazil

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## Abstract

The aim of this work was to study the population biology of *Cyrtograpsus angulatus*, by the analysis of the following aspects: distribution frequency, sex-ratio and recruitment. Crabs were obtained from August 1994 to July 1995 at seven different areas from Lagoa do Peixe, RS, Brazil (31°13'S/ 50°55'W - 31°26'S/51°09'W). A total of 2646 animals was collected, with 1681 females (1367 ovigerous and 27 juveniles), 962 males (27 juveniles) and 3 specimens unsexed. The size (carapace width) of the population was 2.7 to 51.1 mm (average  $\pm$  S.d. = 26.8  $\pm$  5.1 mm). The relationship between size and sex-ratio fits to a pattern at which the ratio differed at intermediary classes, favoring females and at the largest size classes, favoring the males. *Cyrtograpsus angulatus* was collected in all studied months, with greater frequency in August, September, October, and November 1994. The average sex-ratio was 1.74 in favor of females. Juvenile individuals were sampled in all months, except in September 1994 and January 1995, and the highest frequencies were obtained in May and June/95, when the lagoon's mouth was closed. The water flow through the lagoon mouth probably has a powerful influence in the population dynamic.

**Key words:** *Cyrtograpsus angulatus*, Grapsidae, distribution, recruitment, sex-ratio.

## Introduction

The family Grapsidae is constituted by a diversified group of crabs living at marine, freshwater, saltwater and semiterrestrial environments. *Cyrtograpsus angulatus* Dana, 1851 is commonly captured in tide zones, at depths of 10 cm, where they form high concentrations of crabs (Buckup and Bond-Buckup, 1998). This species is distributed from west Atlantic - Brazil (from Rio de Janeiro to Rio Grande do Sul), Uruguay and Argentina (including Patagonia) to east Pacific - Peru and Chile (Melo, 1996).

The population structure of crustaceans has been analyzed mainly by the distribution of individuals in size classes, population density, recruitment, sex-ratio, growth and birth and mortality rates (Alves and Pezzuto, 1998; Diaz and Conde, 1989; Santos *et al.*, 1995; Fransozo and Mantelatto, 1998; Negreiros-Fransozo *et al.*, 1999). Based on those informations, the biology of a certain species can be understood, beyond to provide subsidies for the knowledge of the ecological stability of the species in a determined habitat.

The population biology has been well studied among the crabs of the family Grapsidae (Brachyura), pointing out the works of McDermott (1998) about *Hemigrapsus sanguineus*; Flores and Negreiros-Fransozo (1999), on *Pachygrapsus transversus*; Kowalczyk and Masunari (2000), on *Armases angustipes*.

Despite of the grapsid crab *C. angulatus* being one of the most abundant in estuary ecosystems in southern Brazil (Santos *et al.*, 2000), little is known about the biology of these populations, except a study on its larval development (Rieger and Vieira, 1997). The present study aims to provide information on some aspects of the population structure of *C. angulatus* at Lagoa do Peixe, Rio Grande do Sul State (RS), such: seasonal occurrence, size of the animals, frequency distribution, recruitment and sex-ratio.

## Material and Methods

Lagoa do Peixe (31°13'S / 50°55'W - 31°26'S / 51°09'W) is located 120 Km north from Rio Grande County, southern Brazil and presents approximately 30 km of extension, 500m of width and an average depth of 40 cm. Crabs were sampled monthly from August 1994 to July 1995. Sampling was carried out from seven distinct areas in the lagoon, which were defined in a previous study (July 1994), mainly in function of the salinity gradient established between the mouth and the extremity of the lagoon (Santos *et al.*, 2000) (Fig. 1). In each station sampling were done with a "coca net" (mouth = 3m, length = 8m, and side mesh = 15mm), which was dragged by 100m (about 300 m<sup>2</sup> of sampled area).

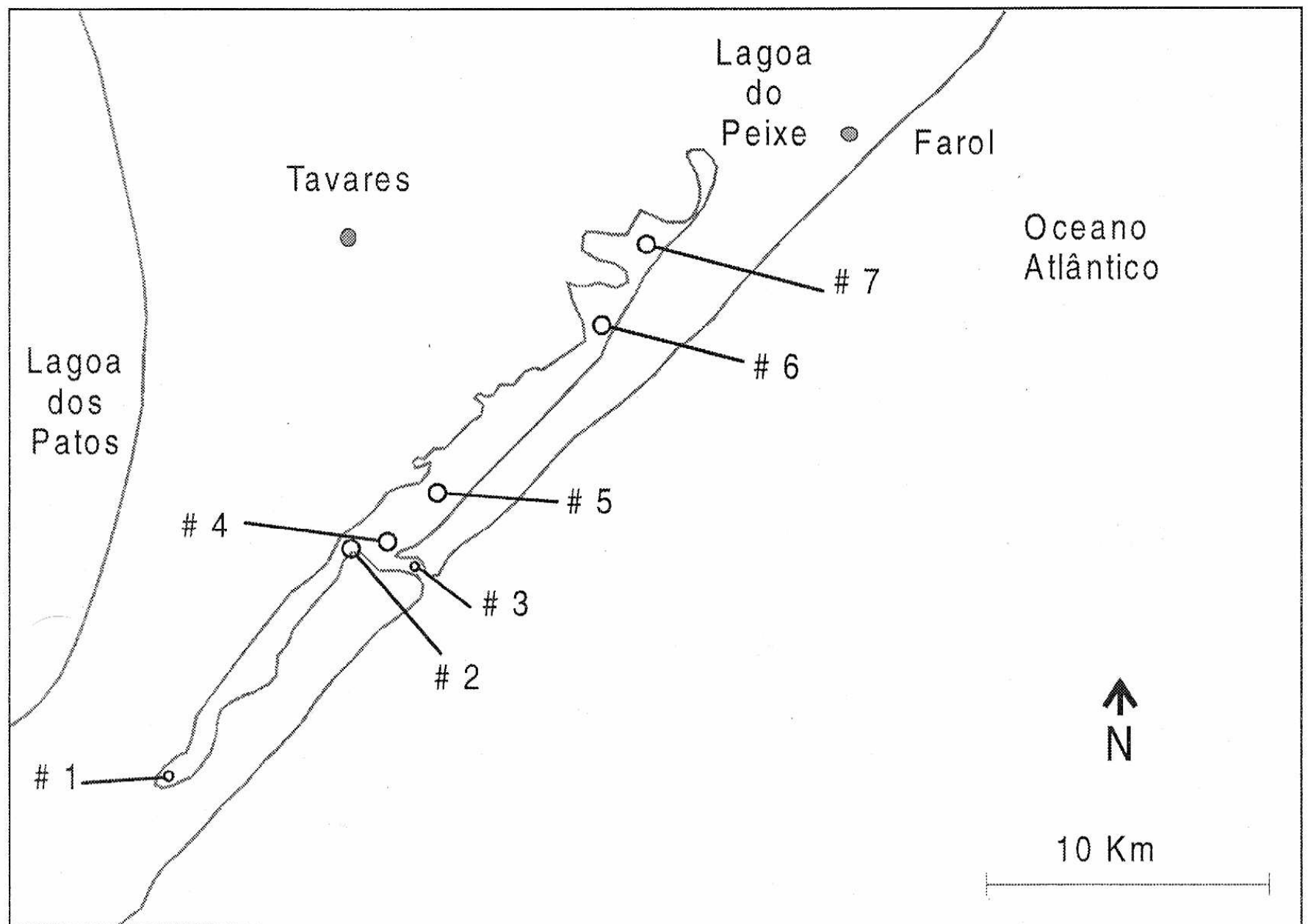


Figure 1: *C. angulatus*, Lagoa do Peixe, RS: Localization of the seven sampling areas.

In the laboratory the animals was analyzed, as follows:

1) Sex and maturity: immature males - few filamentous setae in the first thoracic sternites, unclear segmentation of the abdomen, first and second pleopods are translucent; adult males - many filamentous setae in the first thoracic sternites, segmentation of the abdomen is very clear, the first pleopod is white and the second is translucent; immature females- triangular abdomen; adult females: semicircular abdomen; ovigerous female.

2) Carapace width (CW): the greatest distance between the lateral margins of the carapace. The measures were taken with a caliper (0.01 mm).

For the analysis of population structure, the animals were sexed and grouped into size classes (carapace width - mm). Sex-ratio during the study were determined for each size class and a Chi-square ( $\chi^2$ ) Test was used to compare if the proportion of females and males differs of 1:1.

The period of recruitment was determined based on the proportion of juveniles sampled in relation to total of crabs collected in each month.

The determination of the monthly and average sex-ratio was based on the proportion of females for each male. A Chi-square ( $\chi^2$ ) Test was utilized to verify if the number of females and males differs of the proportion 1:1.



## Results

Among the 2,646 crabs sampled throughout the studied period, 935 were adult males, 27 were young males, 1,654 adult females (including 1,367 ovigerous females), 27 young females and 3 young animals were of undefined sex (juveniles).

*Cyrtograpsus angulatus* was present in all months of sampling, with higher frequency in August, September, October and November 1994 (Table I). The total number of sampled males varied from nil (June 1995) to 228 individuals (November 1994) and from 2 (April 1995) to 596 (November 1994) for females.

Males were more abundant in August, September, October and November 1994. Females were sampled at all studied months, and they were more abundant at the same months as males (Table I). The period of lower abundance of *C. angulatus* in the lagoon coincides with the closing of the mouth that connects the Lagoa do Peixe to Atlantic Ocean. In July the mouth was opened and the abundance of individuals increased again. Frequently, after a drought period, with tides of lower range associated to the wind's action that dislocate the sand dunes, the lagoon mouth becomes closed, mainly between the months of March and June. Sometimes is necessary that IBAMA provide the opening of the mouth with the help of digging machines.

Concerning on the size of the collected individuals, it was registered an average ( $\pm$  S.d.) size of  $26.8 \pm 5.1$  CW with lower and greater limits of 3.0 and 46.0 mm, respectively. Carapace width ranged from the 14.4 to 51.1mm for adult males ( $27.7 \pm 6.4$ ) and 2.7 to 18.8 mm for young males ( $10.4 \pm 4.9$ ). For adult females, the carapace width varied from 6.6 to 45.6 mm ( $26.8 \pm 4.2$ ), for young females, from 3.3 to 9.7 mm ( $13.8 \pm 5.9$ ), and for ovigerous females from 15.0 to 43.9 mm ( $27.4 \pm 3.4$ ).

Table I. *C. angulatus*, Lagoa do Peixe, RS: Sex-ratio in each month, of sampling.

Classes	Number of males	Number of females	Sex-ratio	$\chi^2$
August 1994	129	253	1:1.96	*
September 1994	163	223	1:1.37	*
October 1994	165	387	1:2.35	*
November 1994	228	596	1:2.61	*
December 1994	32	20	1:0.63	
January 1995	18	9	1:0.50	
February 1995	147	31	1:0.21	*
March 1995	3	4	1:1.33	
April 1995	1	2	1:2.00	
May 1995	6	5	1:0.83	
June 1995	0	5	0:5.00	*
July 1995	70	146	1:2.09	*

significant difference p . . .

Figure 2 shows the size frequency distribution of males and females. Males were registered at all size classes and females were not registered only in the largest size class. For all classes, except between 24.0 and 36.0 mm CW, males occur in higher number than females.

Juveniles crabs, although at low frequency, were registered at almost all studied months, except in September 1994 and January 1995 (Figure 3): highest frequencies were obtained in May (83.3%) and June 1995 (60.0%).

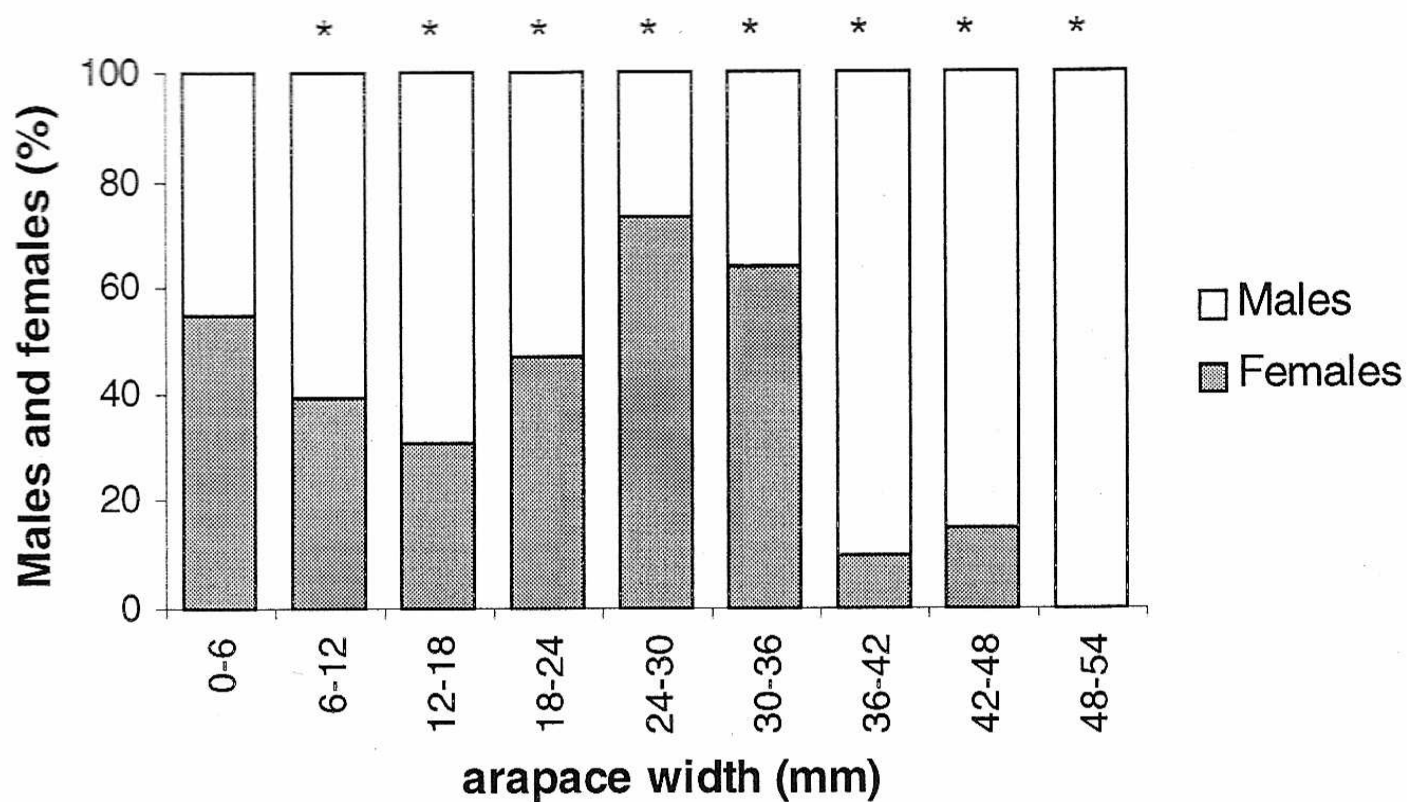


Figure 2: *C. angulatus*, Lagoa do Peixe, RS: Frequency histograms of size classes (CW) of males and females. \* = significant difference ( $\chi^2$ :  $p < 0.05$ ).

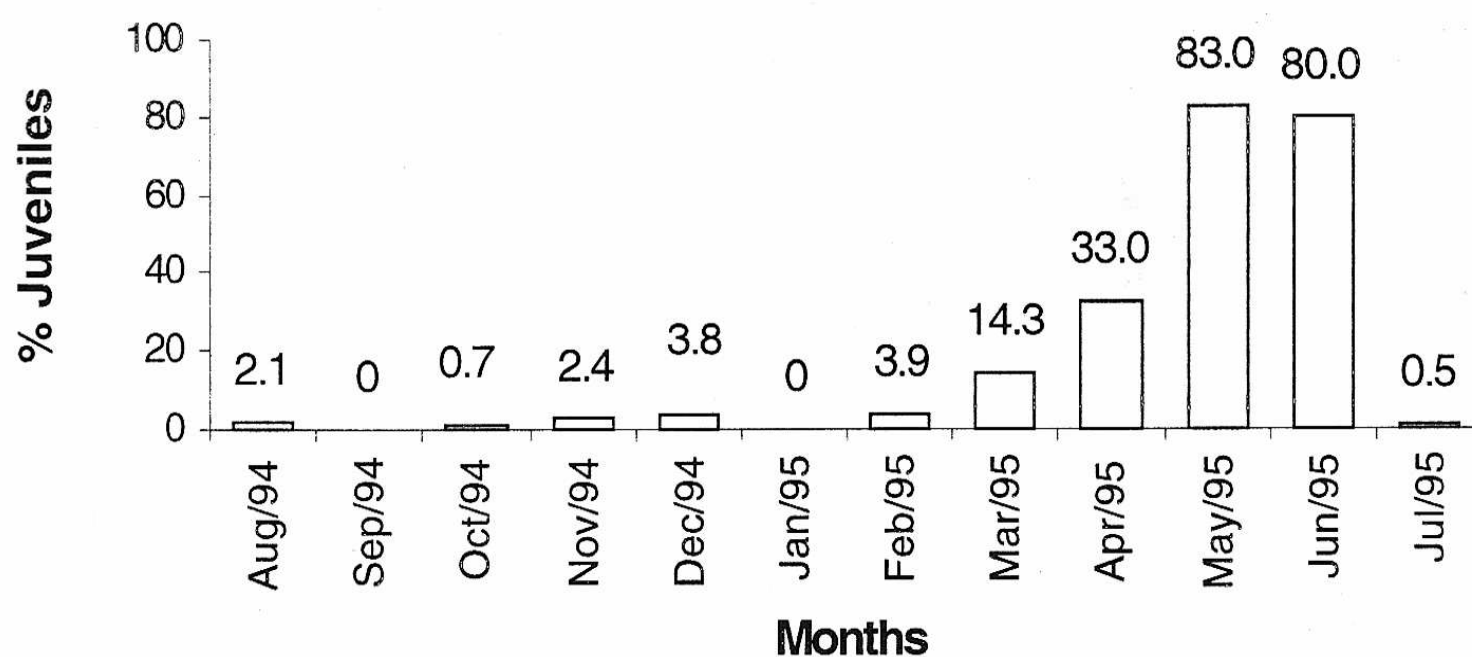


Figure 3: *C. angulatus*, Lagoa do Peixe, RS: Percentage of juveniles in population by each sampling months.

Overall sex-ratio obtained for the 12 studied months was 1.74 female/male, with females representing 63.50 % and males 36.35 % of the sampled individuals ( $\chi^2=195.6$ ;  $p < 0.05$ ). In February 1995, the proportion of males and females was significantly different, with predominance of males. However, in August, September, October and November 1994 and June and July 1995, females were predominant in population ( $p < 0.05$ ) (Table I).

## Discussion

*Cyrtograpsus angulatus* presents sexual dimorphism in relation to size with males reaching larger CW than females. From 36 mm of CW, males became more abundant, suggesting a higher growth rate or a longer growth period for males (Figure 1), while females spend an important amount of their energy for the reproductive propose, as described in brachyurans crabs (Warner, 1967; Diaz and Conde, 1989).

According to Wenner (1972), most mature marine crustaceans have a sex-ratio differing from 1:1. This was observed for *C. angulatus*, which presented significantly more females (1.74 female: 1 male). These variations on the proportions between males and females could be caused by differential mortality among sexes or by another factors like differential growth rates, longevity of each sex, differential migration and sexual reversion (Wenner, 1972). Food restriction, higher activity of one sex and utilization of different habitats by males and females can also be responsible for an apparent alteration of sex-ratio (Darnell, 1962).



The sex ratio in the size classes for *C. angulatus* presented an anomalous pattern as described by Wenner (1972), at which the sex-ratio differs at intermediary classes, favoring one of the sexes (females) and at greater classes, favoring the opposite sex (males). Fransozo and Mantelatto (1998) found similar results for the hermit crab *Calcinus tibicen* in the region of Ubatuba (SP-Brazil), showing higher number of females when compared with males at the smallest size classes and the number of males was higher at largest size classes. Diaz and Conde (1989) also observed similar results for the grapsid *Aratus pisonii*.

Kowalczyk and Masunari (2000) registered a pattern of the sex-ratio for *A. angustipes*, in which the size classes, in general, were equally represented by males and females. However the number of males was higher than that of females in the largest size classes. This does not fit the anomalous pattern or the sexual reversion proposed by Wenner (1972). The authors attributed this little difference among the number of males and females of *A. angustipes* to the low number of sampled animals, to a possibly delayed growth of females or also to migration of females that reached greater sizes.

*C. angulatus* presented a seasonal recruitment, with peak in winter (May and June 1995). Another grapsid, *P. transversus* studied by Flores and Negreiros-Fransozo (1999) in Ubatuba (SP-Brazil), presented recruitment throughout the year, but more intensively from April to June 99, suggesting that this species is stable and that young individuals reach the adult habitat gradually.

In the present study, the greater percentage of juvenile crabs was registered from March to June, when the lagoon's mouth was closed and the abundance of adults was lower. The closing of the lagoon's mouth probably has great influence on population dynamics and contributes for the pattern of g and adults occurrence be typically seasonal in Lagoa do Peixe.

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