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Population biology of two sympatric crabs: *Pachygrapsus transversus* (Gibbes, 1850) (Brachyura, Grapsidae) and *Eriphia gonagra* (Fabricius, 1781) (Brachyura, Eriphidae) in reefs of Boa Viagem beach, Recife, Brazil

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Abstract. This study characterizes the population biology of two crabs: *Pachygrapsus transversus* and *Eriphia gonagra* from reefs at Boa Viagem Beach, Pernambuco. Carapace width (CW) was measured and all animals were sexed. A total of 1.174 specimens of *P. transversus* and 558 specimens of *E. gonagra* were sampled. Carapace width for *P. transversus* males ranged from 3.46 to 18.37 mm and from 2.96 to 18.1 mm for females. As for the species *E. gonagra,* the CW ranged from 4.75 to 35.06 mm for males and from 2.8 to 35.85 mm for females. Males of *P. transversus* reached sexual maturity ($CW_{50\%}$) at 10.10 mm, and females at 9.50 mm. Males of *E. gonagra* reached $CW_{50\%}$ at 14.50 mm, and females at 15.70 mm. Males and females attained sexual maturity at comparable sizes, fact that may favor the formation of couples. The reproductive period of *P. transversus* occurred in the fall, while the reproduction of *E. gonagra* was only in the warmer months of the year. The results of this study are important for an understanding of the life cycle and the population dynamics of both species in Boa Viagem Beach, as well as the simpatry between the species.

Keywords: body size, sex ratio, breeding period, fecundity, crabs

Resumo. Biologia populacional de dois caranguejos simpátricos : *Pachygrapsus transversus* (Gibbes, 1850) (Brachyura, Grapsidae) e *Eriphia gonagra* (Fabricius, 1781) nos recifes da praia de Boa Viahem, Recife, Brasil. Este trabalho caracteriza a biologia populacional dos caranguejos *Pachygrapsus transversus* e *Eriphia gonagra* dos recifes da Praia de Boa Viagem, Pernambuco. Os animais foram mensurados quanto à largura de carapaça e sexados. Um total de 1.174 exemplares de *P. transversus* e 558 exemplares de *E. gonagra* foram amostrados. A largura da carapaça (LC) dos machos de *P. transversus* variou de 3,46 a 18,37

mm e a das fêmeas variou de 2,96 a 18,1 mm. Já para a espécie *E. gonagra*, a amplitude na LC foi de 4,75 a 35,06 mm para os machos e de 2,8 a 35,85 mm para fêmeas. Os machos de *P. transversus* atingiram a maturidade sexual ($LC_{50\%}$) aos 10,10 mm e as fêmeas aos 9,50 mm. Já os machos de *E. gonagra* atingem o $LC_{50\%}$ aos 14,50 mm e as fêmeas aos 15,70 mm. Machos e fêmeas atingiram a maturidade sexual com tamanhos comparáveis, fato que pode favorecer a formação de casais. O período reprodutivo de *P. transversus* ocorreu no outono, enquanto a reprodução de *E. gonagra* foi nos meses mais quentes do ano. Os resultados deste trabalho possibilitaram a constatação do equilíbrio populacional das referidas espécies na Praia de Boa Viagem, bem como a simpatria entre as espécies.

Palavras-chave: tamanho corpóreo, proporção sexual, período reprodutivo, fecundidade, caranguejos

Introduction

The reef ecosystems are areas of great biological interactions and productivity, serving as breeding area, shelter and food for many species of animals (Correia & Sovierzoski 2005). Among the species that use the reefs as shelter, feeding and reproduction are the decapod crustaceans, especially the crabs (Infraorder Brachyura). In the sandstone reefs from Boa Viagem Beach in Recife, state of Pernambuco, 24 species of brachyurans were registered (Coelho *et al.* 2002; Nascimento & Torres 2007). Among them, stand out *Pachygrapsus transversus* (Gibbes, 1850) and *Eriphia gonagra* (Fabricius, 1781), abundant species at the reef coast of Brazil (Melo 1996).

The reef environments are highly diverse in natural resources and of great biological, economic and social importance (Sale 1991; Ferreira *et al.* 1998). As open, fragile and complex ecosystems, their structure, function and biodiversity are dependent on the dynamic interactions between various species.

The population structure of marine and estuarine crabs has been analyzed mainly by the distribution of individuals in size classes, through comparison of males and females body size, sex ratio, recruitment and reproductive period (Araújo & Calado 2008; Costa & Soares-Gomes 2009; Castiglioni *et al.* 2010; Castiglioni *et al.* 2011; Araújo *et al.* 2012; Menezes *et al.* 2012; Hirose *et al.* 2013; Lira *et al.* 2013; Ribeiro *et al.* 2013). These population data provide information about the knowledge of the ecological stability of different species in a given habitat. In addition, many studies have estimated the fecundity of Crustacea Brachyura (Mantelatto & Fransozo 1997; Graham *et al.* 2012; González-Pisani & López Greco 2014).

The crabs of the genus *Pachygrapsus* Randall, 1840 are the most common inhabitants of the intertidal zone of rocky coastline in warm, tropical and subtropical temperate regions (Capparelli 2010). In Brazil, there are the species *P. gracilis* (Saussure, 1858) and *P. transversus*. The species *P. transversus* occurs along the tropical-subtropical band of the Brazilian coast (from state of Ceará to state of Rio Grande do Sul), inhabiting rigid substrates typical of coastal regions (Melo 1996; Flores & Negreiros-Fransozo 1999a, b). Besides its abundance, it is a key species in the intertidal zone because of its generalist eating habits (Furtado-Ogawa 1977) and its role in energy transfer to adjacent marine and terrestrial habitats (Abele *et al.* 1986). The crabs of the genus *Eriphia* Latreille, 1817 are commonly found in rocky beaches and reefs in tropical and subtropical regions (Koh & Ng 2008). As *P. transversus*, *E. gonagra* is a species commonly found in the intertidal regions of rocky coastline, whose distribution in Brazil extends from state of Pará to state of Santa Catarina (Melo 1996; Góes *et al.* 2005), being the only species of the genus occurring in the Brazilian coast.

Despite the abundance and importance of these species to maintain the trophic balance in the intertidal zone, there are few studies related to their population dynamics. Among the studies related to the grapsid *P. transversus*, we highlight Abele *et al.* (1986), Brossi-Garcia & Rodrigues (1997) and Flores & Negreiros-Fransozo (1998, 1999 a, b), all addressing issues such as larval morphology, reproductive cycle, larval development and population biology. Regarding the studies related to *E. gonagra*, we highlight Fransozo (1986), Fransozo & Negreiros-Fransozo (1986, 1987), Góes & Fransozo (1997, 1998, 2000) and Góes *et al.* (2005), where all analyzed morphological aspects, larval development, relative growth and sex ratio of the species. However, there are few published articles on these species for the North/Northeast region of Brazil (for *P. transversus*, Ogawa & Rocha 1976 on fertility and Furtado-Ogawa 1977 on biology population at state of Ceará). Thus, this study plans to characterize the population biology of crabs *P. transversus* and *E. gonagra* in a reef area of Boa Viagem Beach, state of Pernambuco, northeast of Brazil.

Material and Methods

The Boa Viagem Beach, in the city of Recife, state of Pernambuco (8º07'59,31" S and 34°53'59,25" W) is about 8 km long, with a landscape set consisting of sandy beach, sea and sandstone reefs parallel to the coastline (Costa & Souza 2002; Costa & Kahn 2003). The littoral of Boa Viagem Beach is urbanized (Project Orla 2001) and highly developed (Morgan 1999). During low tide, pools are formed between the beach and the sandstone reefs and are used for recreation.

The crabs were manually collected monthly from March/08 to February/09 in an area of about 30 m² in sandstone reefs from Boa Viagem Beach during 60 minutes, for each species, by the same person during low tide. Individuals of all sizes were sampled. After collection, the crabs were placed in plastic bags with ice and transported to the laboratory. Furthermore, the ovigerous females were individualized in the field, in pots containing 70% alcohol, to avoid errors during egg counts.

In the laboratory, each individual was identified according to Melo (1996), sexed and measured: carapace width (CW) for both sexes, chelipod length (CL) and abdomen width (AW) for males and females, respectively, with a digital caliper (accuracy 0.01 mm). The minimum, mean (± standard deviation) and maximum values of CW, CL and AW were estimated. The CW of males and females of *P. transversus* and *E. gonagra* were compared by a Student's *t* test ($\alpha = 0.05$) (Zar 1996), a parametric test after checked the normality of the data.

For the analyzes of population structure, the animals were grouped by sex and distributed in 12 size classes based on the CW, with an amplitude of 1.5 mm for *P. transversus* and 15 size classes of CW with an amplitude of 2.5 mm for *E. gonagra*. The normality of the total frequency distribution of males and females crabs sampled during the period of one year was checked using the Shapiro-Wilk test ($\alpha = 0.05$) (Zar 1996).

The sex ratio of *P. transversus* and *E. gonagra* during the study was determined for the total sampled crabs and for each month. The chi-square goodness of fit test (χ^2) was applied in order to verify if the sex ratio for each species follows the expected 1: 1 ratio ($\alpha = 0.05$) (Zar 1996).

The growth of *P. transversus* and *E. gonagra* was described through the allometric equation $y=ax^b$ (Huxley 1950). The CW was used as the independent variable (x), and the dependent variables (y) were CL for males and AW for females. The "b" of the equation is the allometric constant that expresses the relationship between the two variables. It is used to determine the growth pattern: $b > 1$, positive allometric growth, $b = 1$ isometric growth and $b <1$, negative allometric growth. The value of "b" was tested through the Student t test ($\alpha = 0.05$).

The determination of the size at morphological maturity for both species was based on the relationship between CL *vs*. CW in males and AW *vs.* CW in females, based on Sampedro *et al.* (1999) and Araújo *et al.* (2012). Besides, the interval in which males and females of both species reached sexual maturity was estimated using the size of the largest immature individual and the size of the smallest mature individual.

To determine the reproductive period of *P. transversus* and *E. gonagra*, the frequency of ovigerous females were calculated in relation to adult females in each month. For the analysis of *P. transversus* and *E. gonagra* recruitment, juveniles were considered both the males and females smaller than the estimated values in the analysis of morphological sexual maturity for each species of crab. The proportion of juveniles on the total crabs sampled by month determined the recruitment period, tested by the chi-square goodness of fit test (χ^2) ($\alpha = 0.05$).

The female fecundity was obtained by counting the eggs. Thus, the egg mass was removed from each female pleopods and placed into a 5% sodium hypochlorite (NaClO) in 100 ml of water and the eggs were stirred for 5 minutes to permit their separation. The eggs were separated after homogenization in 50 ml of deionized water and then three random samples of 1.0 ml were removed and counted under a stereomicroscope. The number of eggs in the sample was multiplied by the total volume of 100 ml. The eggs of the females were classified in three embryonic stages according to their development: 1. Initial: eggs with orange color and the egg yolk occupying the entire embryo, without clear cell differentiation; 2. Intermediate: eggs with dark orange color up to brown color; 3. Final: eggs with dark gray color, reduced egg yolk, embryo showing well-developed eyes (adapted from Boolootian *et al*. 1959; Cobo & Okamori 2008). For the fecundity analysis, we considered only females bearing eggs at an early stage. Fecundity was correlated graphically to the size of each female (CL), and obtaining the coefficient of determination (r^2).

Results

During the period of one year, 1.174 specimens of *P. transversus* were sampled, of which 662 were males and 504 were females (of these, 145 were ovigerous females). Total sex ration differed significantly to the whole period (1♀: 1.31♂; χ^2 = 21.41), with males being more abundant than females, especially in March, May and November (Fig. 1). In relation to *E. gonagra*, 558 specimens were sampled, of which 252 were males and 306 were females (of these, 11 were ovigerous females). Total sex ratio differed significantly to the whole period (1♀: 0.82♂; χ^2 = 5.23), with females being more abundant than males, especially in April and December (Fig. 2).

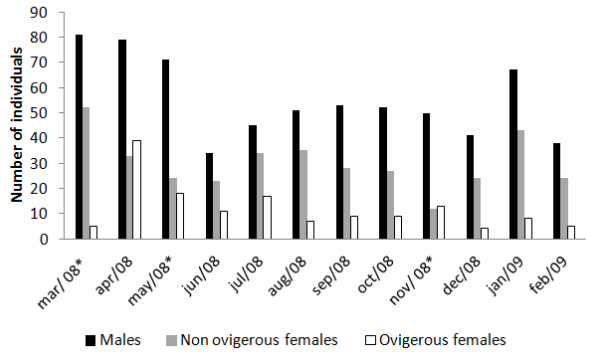

Figure 1. Monthly number of males, non ovigerous females and ovigerous females for *Pachygrapsus transversus* Gibbes, 1850 on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. * = significant differences in the sex ratio.

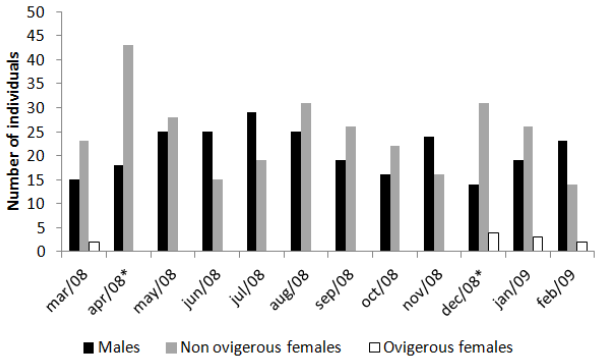

Figure 2. Monthly number of males, non ovigerous females and ovigerous females for *Eriphia gonagra* (Fabricius, 1781) on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. * = significant differences in the sex ratio.

Carapace Width (CW), Chelipod Length (CL) and Abdominal Width (AW) mean (± standard deviation), plus minimum and maximum values for both species are listed in Table I. For both *P. transversus* and *E. gonagra*, males were significantly higher than females in terms of CW (t = 3.96 and t = 2.04, respectively; p <0.05).

The distribution frequency of size classes (CW) for males and females of *P. transversus* did not show a normal distribution ($W_♂$ = 0.97; $W_♀$ = 0.97; p < 0.05) and was unimodal for both male and females (Figure 3a). For *E. gonagra*, the frequency distribution into size classes was also not a normal distribution ($W_♂$ = 0.90; $W_♀$ = 0.93; p < 0.05), being, however, bimodal for both sexes (Figure 3b).

The ovigerous females of *P. transversus* were sampled in every month of the year (Figure 1), featuring a continuous reproductive period. On the other hand, all *E. gonagra* ovigerous females were sampled in the months of December to March (Figure 2), being the reproduction characterized as seasonal. The juveniles of both crab species were sampled throughout the year. For *P. transversus*, juveniles were more abundant than adults in the whole sampling period (χ^2 = 50.40, p < 0.05), especially in March, May, from August to October, and from December to February (Figure 4). For *E. gonagra*. juveniles were more abundant than adults in the whole sampling period (χ^2 = 27.56, p < 0.05), especially in June, September, January and February. However, in July adults were more abundant (Figure 5).

In females of *P. transversus*, abdominal growth was allometric positive in both phases, but this structure grows more in juvenile females (juveniles - b = 1.56, p <0.05; adult - b = 1.08, p <0.05) (Figure 6a). In males of *P. transversus*, chelipod growth was allometric positive in both phases, but this structure grows more in young males (juveniles - b = 1.10, p <0.05; adults - b = 1.07, p <0.05) (Figure 6b).

In females of *E. gonagra*, abdominal growth was allometric positive in both phases, but this structure grows more in juvenile females (juveniles - b = 1.28, p <0.05; adults - b = 1.16, p <0.05) (Figure 7a). In males of *E. gonagra*, chelipod growth was allometric positive in both phases, but this structure grows more in adult males (juveniles - b = 0.88, p <0.05; adults - b = 1.03, p <0.05) (Figure 7b).

To males of *P. transversus*, the estimated carapace width ($CW_{50\%}$) was 10.10 mm, varying from 10.02 (smallest adult male) to 10.40 mm CW (largest juvenile male). Regarding females of *P. transversus*, the estimated $CW_{50\%}$ at morphological maturity was estimated at 9.50 mm, however this size may vary from 9.42 (smallest adult female) to

Table I. Minimum, mean and maximum values for the biometric variables of *Pachygrapsus transversus* Gibbes, 1850 and *Eriphia gonagra* (Fabricius, 1781) on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. Note: CW = Carapace Width, CL = Chelipod Length, AW = Abdominal Width, Min. = minimum; Max. = maximum; ± = standard deviation.

Pachygrapsus transversus									
Sex	CW			CL			AW		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
♂	3,46	9,20± 3,11	18,37	2.12	6.50 ± 2.78	13.67	-	-	-
♀	2,96	8,53± 3,30	18,10	-	-	-	0.87	4.72 ± 2.29	10.56
Eriphia gonagra									
Sex	CW			CL			AW		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
♂	4,75	16,00± 7,73	35,06	3,52	11,28 ± 6,18	26,82	-	-	-
♀	2,80	14,60± 7,71	35,85	-	-	-	0,50	4,11 ± 2,77	11,70

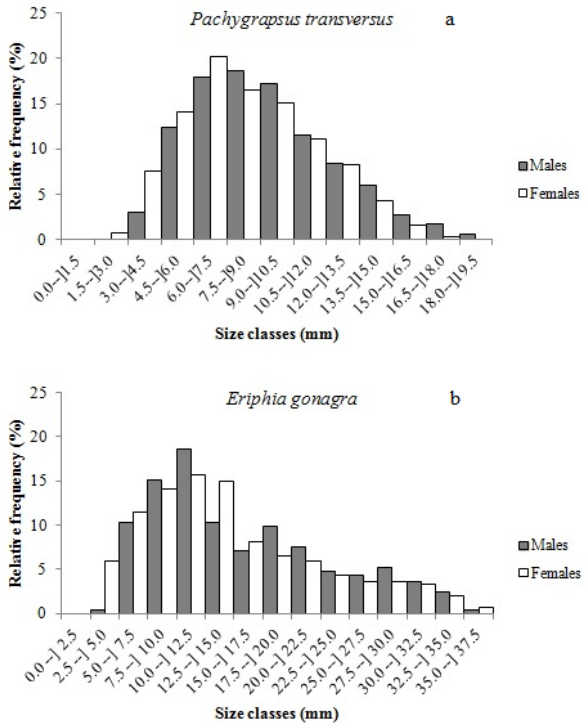

Figure 3. Distribution of frequency by size classes (mm) of males and females of *Pachygrapsus transversus* Gibbes, 1850 (a) and *Eriphia gonagra* (Fabricius, 1781) (b) on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil.

9.58 mm CW (largest juvenile female). To males of *E. gonagra*, the estimated size of the $CW_{50\%}$ was 14.50 mm, varying from 14.47 (smallest adult male) to 15.35 mm CW (largest juvenile male). Regarding females of *E. gonagra*, the $CW_{50\%}$ at morphological maturity was estimated at 15.70 mm, however this size may vary from 14.70 (smallest adult female) to 16.82 mm CW (largest juvenile female).

The mean number of eggs produced by *P. transversus* in the initial stage of development was 3,818 ± 3,349 eggs, ranging from 350 to 14,700 eggs, showing large amplitude (14,350). In addition, there was a positive correlation between the size of females (CW) and the number of eggs produced (r^2 = 0.84), as shown in Figure 8. It was not possible to determine the fecundity of *E. gonagra* because a small number of ovigerous females of this species were sampled during a one year period.

Discussion

The two species analyzed in this work, *P. transversus* and *E. gonagra*, were present in every month of sampling events in the reef area of Boa Viagem Beach. Corroborating the observations that both species are common in rocky areas along the Brazilian coast (Furtado-Ogawa 1977; Melo 1996; Flores & Negreiros-Fransozo 1999a; Capparelli 2010). Both species showed sexual dimorphism in mean sizes, with males being larger than females. However, species differed regarding modality of distribution, sex ratio, seasonality of reproduction and size at sexual maturity.

At the reefs of Boa Viagem Beach, the

populations of *P. transversus* and *E. gonagra* exhibited males attaining larger sizes than females. This pattern is very common in crustaceans of Infraorder Brachyura, especially estuarine species (Castiglioni *et al.* 2006; Costa & Soares-Gomes 2009; Castiglioni *et al.* 2010). Nalesso (1993) confirms this, founding that *E. gonagra* males reach larger maximum size compared to females. However, there are exceptions; for *P. transversus*, Flores & Negreiros-Fransozo (1999a) observed that females have larger carapace width, probably because dominant males select larger females for mating, a social behavior already described for this species by Capparelli (2010).

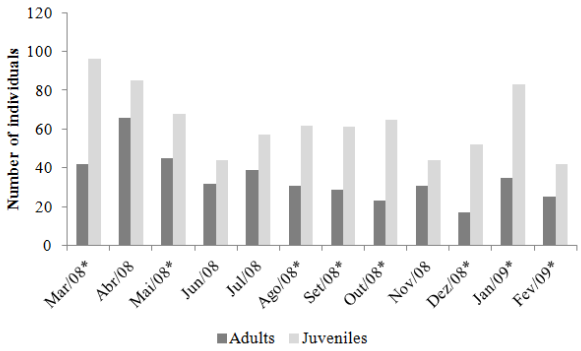

Figure 4. Monthly number of adults and juveniles for *Pachygrapsus transversus* Gibbes, 1850 on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. * = juveniles significantly more abundant than adults.

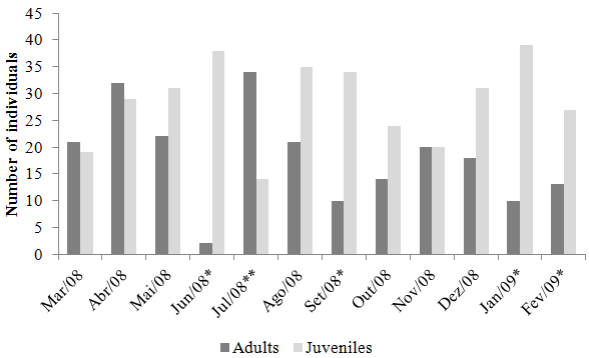

Figure 5. Monthly number of males, non ovigerous females and ovigerous females for *Eriphia gonagra* (Fabricius, 1781) on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. * = juveniles significantly more abundant than adults; ** = adults significantly more abundant than juveniles.

There are several reasons for sexual dimorphism in crustaceans of Infraorder Brachyura: males can reach larger size, investing more in growth than in reproduction (Adiyodi & Adiyodi 1970; Wenner 1972; Hartnoll 2006), ensuring copulation and intraspecific competition (Abrams 1988). Further, different rates of mortality and migration can influence the growth rate between males and females of brachyurans (Warner 1967; Giesel 1972; Crane 1975; Montague 1980; Diaz & Conde 1989; Hartnoll 2006), favoring the size advantage of one of the sexes.

Results indicated that *P. transversus* has a higher numbers of males compared to females, unimodal size class distribution, and continuous reproduction. The unimodal frequency distribution by size classes (CW) observed in males and females of *P. transversus* demonstrates the balance of this population in the reef area of the Boa Viagem Beach, probably due to an almost continuous recruitment. Authors such as Thurman II (1985), Díaz & Conde (1989), Hartnoll & Bryant (1990), Colpo & Negreiros-Fransozo (2004) and Castiglioni & Negreiros-Fransozo (2006) also reported the unimodal distribution in other populations of crabs, confirming the balance of this species in the study area. Moreover, the sex ratio was shifted in favor of males for *P. transversus*. Deviations in sex ratio may be related to different behavioral patterns between the sexes and temporal or spatial differentiation in the use of resources from the habitat (Genoni 1985; Montague 1980; Christy & Salmon 1984).

The ovigerous females of *P. transversus* were sampled in every month of the year, characterizing the reproduction of the species as continuous, according to the classification proposed by Sastry (1983) and Pinheiro & Fransozo (2002), a fact also observed by Furtado-Ogawa (1977) for a population of this species in the State of Ceará coast. Probably this continuous reproduction ensures continuous recruitment of the species, as observed before. Flores & Negreiros-Fransozo (1998) also observed a continuous reproduction in a population of *P. transversus* in the northern coast of São Paulo.

In this study, the results indicated that *E. gonagra* has more abundant females, bimodal distribution in the classes and seasonal reproduction. The population of *E. gonagra* showed bimodal distribution for both males and females. The bimodality in frequency distribution of size classes, among other factors, is probably the result of a slower growth rate of crabs during certain phases of their life cycle when compared to other phases, migration pulses and mortality, processes of recruitment, or behavioral differences between various stages of the life cycle (Diaz & Conde 1989).

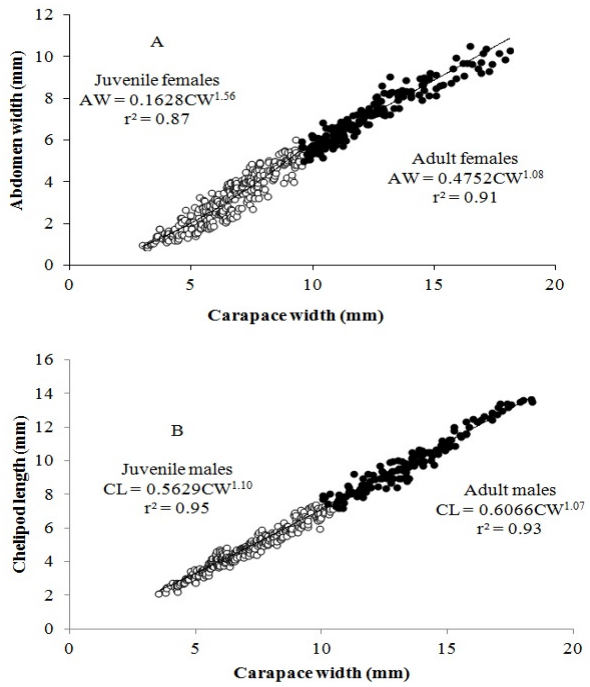

Figure 6. Relative growth of the abdomen in females (a) and chelipod in males (b) of *Pachygrapsus transversus* Gibbes, 1850 on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. CW = carapace width; AW = abdomen width; CL = chelipod length

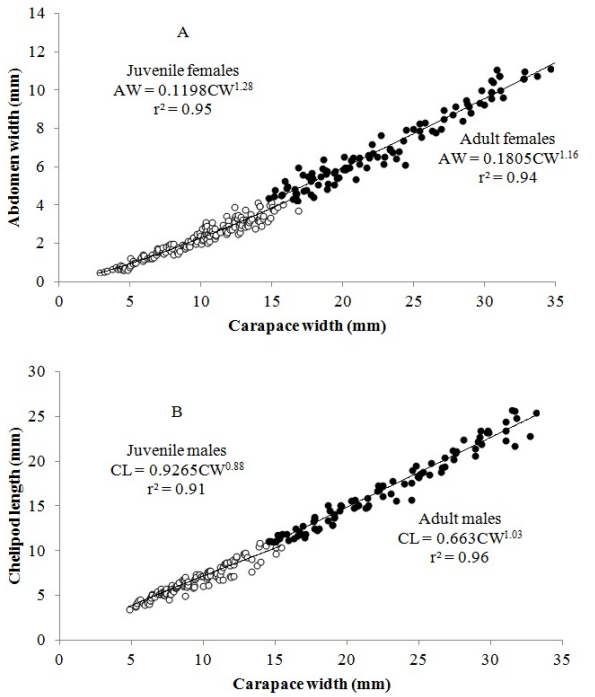

Figure 7. Relative growth of the abdomen in females (a) and chelipod in males (b) of *Eriphia gonagra* (Fabricius, 1781) on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil. CW = carapace width; AW = abdomen width; CL = chelipod length

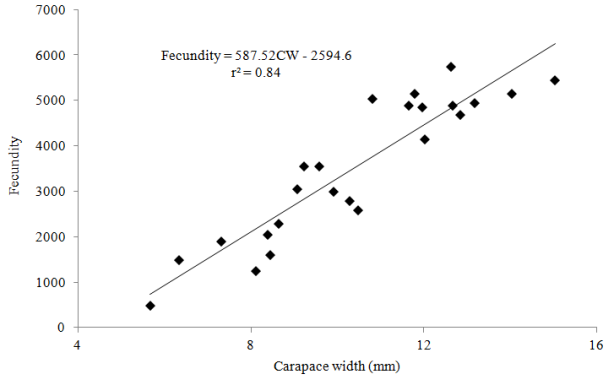

Figure 8. Relationship between fecundity and carapace width (CW) in females of *Pachygrapsus transversus* Gibbes, 1850 on the reefs of Boa Viagem, Recife, State of Pernambuco, Brazil.

A bimodal size distribution has been observed in other Brachyurans: *Leptuca subcylindrica* (Stimpson, 1859) (Thurman II 1985), *L. uruguayensis* Nobili, 1901 (Spivak *et al.* 1991), *Ocypode quadrata* (Fabricius, 1787) (Negreiros-Fransozo *et al.* 2002) and *U. rapax* (Smith, 1870) (Castiglioni & Negreiros-Fransozo 2005). Regarding the sex ratio, the greater number of females in the population of *E. gonagra* can reflect a higher mortality rate of males due to their greater exposition (Montague 1980; Emmerson 1994).

The reproductive period of *E. gonagra* was characterized as seasonal because females were sampled only from December to March. Seasonal breeding is usually related to larval release during the period of higher primary productivity (Boolootian *et al.* 1959; Sastry 1983; Emmerson 1994), since the microalgae are important dietary components for larval stages. Although this type of reproduction is more common for temperate species, studies suggest that the greater the size and the degree of terrestriality of a species, there is a higher probability that their reproductive period is set in a certain period of time (Emmerson 1994). This suggests that *E. gonagra* may be more terrestrial than *P. transversus*.

The growth of the abdomen of females *P. transversus* and *E. gonagra* was allometric positive in both phases of development (juvenile and adult), a pattern distinct from what is found in brachyuran crabs, but typically observed in the genus *Uca* Leach, 1814 (Araújo *et al.* 2012). This body dimension grows in higher rates in the juvenile females, indicating that they probably invest in the abdomen growth and, when they attain sexual maturity, they are ready to incubate the egg mass (Araújo *et al.* 2012). Since the abdomen is not an

independent appendage as the chelipods, and it works together with the sternum, any disproportionate growth after the puberty molt could impede the movement of the pereopods (Masunari & Dissenha 2005).

The growth of the chelipod of males *P. transversus* and *E. gonagra* was allometric positive, as observed for *P. marmoratus* by Protopapas *et al.* (2007), *P. transversus* by Flores & Negreiros-Fransozo (1999b). Góes & Frasozo (1997) observed that the growth of the chelipod in male *E. gonagra* is allometric, but this structure grows in higher rates than that of females. The growth pattern described by Hartnoll (1974) indicates a significant positive allometry in the growth of the cheliped in males, both in the juvenile and in the adult ontogenetic phases. However, in males of *P. transversus*, this structure grows more in juveniles ones, while in males of *E. gonagra*, this structure grows more in adult ones. Vannini & Gherardi (1988) observed that in males of *E. smithi* MacLeay, 1838, the major claw length exhibited positive allometry in relation to the carapace, more in the adults than in the juveniles, which corroborates our result for *E. gonagra.*

For both *P. transversus* and *E. gonagra*, males and females mature at very close size interval, i.e. the maturity is synchronous. This synchrony has also been reported for many species of Brachyura, for example: *P. transversus* (Abele *et al.* 1986), *Nanosesarma gordoni* De Man, 1887 (Fukui 1988), *E. gonagra* (Góes & Fransozo 1997) and *Goniopsis cruentata* (Latreille, 1803) (Cobo & Fransozo 1998, Cobo & Fransozo 2005 and Moura & Coelho 2004). Probably, this strategy favors the formation of couples to the copula.

Body size is the major determinant of fecundity for brachyuran crabs, because of allometric restriction for egg storage within the cephalothorax (Hines 1982). This condition corroborates the results observed for *P. transversus* in this study. The observed fecundity (3,818 ± 3,349 eggs) was lower than that reported for the same species by Ogawa & Rocha (1976) in Ceará (9,222 eggs) and Abele *et al.* (1986) in Panama (15,000 eggs), but higher than that observed by Campos and Oshiro (2001) in Ibicuí beach, Rio de Janeiro (1,700 eggs). This indicates that different environmental factors for each region due to variations of latitude can influence egg numbers.

According to Silva & Oshiro (2002), a low coefficient of determination was found for the ratio of carapace width against fertility for *G. cruentata*. According to Hines (1982) and Hartnoll (1969), the contrasting values for number of eggs for similar sized animals could be due to multiple clutches or because females lose eggs during incubation, due to parasitic attack or the mechanical activity of crabs rubbing against the substrate. In this study, the coefficient of determination was high, which may indicate that *P. transversus* does not perform multiple spawns, but further studies are still necessary. Additionally, it is important to note that few ovigerous females of *E. gonagra* were collected, which may that these females have cryptic habits.

In the studied area, the two species live in sympatry, but possibly do not compete for resources and space on the reefs of Boa Viagem Beach. The species have different eating habits: *P. transversus* is omnivorous, feeding on algae, porcellanids crabs, fish and conspecifics (Abele *et al.*, 1986). *E. gonagra*, on the other hand, is a well-known predator of mollusks, especially gastropods (Góes & Fransozo 1998). The following table (Table II) summarizes the similarities/differences between the two studied species:

Therefore, the results reported in this study are important tools for the study of population dynamics for the species reported here, enabling the understanding of their life cycle, the determination of their reproductive potential and the population balance, despite the intense anthropic interference observed in the study area.

Table II. A comparison of the similarities/differences between of *Pachygrapsus transversus* Gibbes, 1850 and *Eriphia gonagra* (Fabricius, 1781) on the reefs of Boa Viagem, Recife, state of Pernambuco, Brazil.

Characteristics	***P. transversus***	***E. gonagra***
Mean sizes	Males > females	Males > females
$CW_{50\%}$	Synchronous	Synchronous
Sex ratio	Abundant males	Abundant females
Distribution	Unimodal	Bimodal
Reproduction	Continuous	Seasonal
Feeding habits	Omnivorous	Carnivorous

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