Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1679-9283
ISSN on-line: 1807-863X
Doi: 10.4025/actascibiolsci.v35i2.13408

Population parameters of the shrimp *Xiphopenaeus kroyeri* (Heller, 1862) (Crustacea, Penaeidae), caught by artisanal fisheries in Anchieta, Espírito Santo State

Frederico Jacob Eutrópio[1*], Fátima Lieberenz Falleiros Mariante[2], Paulo Dias Ferreira Junior[2] and Werther Krohling[2]

*[1]Universidade Vila Velha, Laboratório de Microbiologia Ambiental e Biotecnologia, Rua Comissário José Dantas de Melo, 21, 29102-770, Boa Vista, Vila Velha, Espírito Santo, Brazil. [2]Universidade Vila Velha, Laboratório de Ecologia Terrestre e Aquática, Boa Vista, Vila Velha, Espírito Santo, Brazil. *Author for correspondence. E-mail: eutropiofj@gmail.com*

ABSTRACT. The fishery on Penaeidae shrimp is done all over the Brazilian coast, especially the seabob shrimp (*Xiphopenaeus kroyeri*). It is captured in large quantities in the Southeast and Southern Brazil. In order to study the population structure of *X. kroyeri* from Anchieta Municipality, Espírito Santo State, during the period from January to December 2008, monthly samplings with one-hour-long were conducted to verify the number of individuals, biomass, sex, total length and gonad maturity stage. The specimens had total length ranging from 2.96 to 9.96 cm, and females were larger than males. It is suggested that the population of *X. kroyeri* presents patterns of recruitment and reproduction similar to those of the Northeast region. The estimated size of first gonadal maturation was 4.5 and 6.9 cm for males and females, respectively. The fishing operates on a stock composed of predominantly adult males and juveniles and adult females. The mesh size of the nets and the high plant biomass in the fishing areas may be contributing to the increased catch of juveniles, undermining the recruitment of *X. kroyeri*.

Keywords: seabob shrimp, estuary, gonadal maturation, Penaeidae, trawling fishery, brazilian Southeast.

Parâmetros populacionais do camarão *Xiphopenaeus kroyeri* (Heller, 1862) (Crustacea, Penaeidae) capturados na pesca artesanal em Anchieta, Estado do Espírito Santo

RESUMO. A pesca de camarões Penaeidae é realizada em todo o litoral brasileiro, com destaque para o sete-barbas (*Xiphopenaeus kroyeri*) capturado em grande quantidade nas regiões Sudeste e Sul do Brasil. Com o objetivo de estudar a estrutura populacional de *X. kroyeri* de Anchieta, Estado do Espírito Santo, durante o período de janeiro a dezembro de 2008 foram realizadas coletas mensais com 1h de duração. Foram registrados o número de indivíduos, a biomassa, o sexo, o comprimento total e o estádio de maturação gonadal. Os exemplares amostrados apresentaram comprimento total que varia entre 2,96 a 9,96 cm sendo as fêmeas maiores que os machos. Sugere-se que a população de *X. kroyeri* estudada apresente reprodução e recrutamento semelhantes ao da região Nordeste. O tamanho estimado de primeira maturação gonadal foi de 4,5 cm para machos e 6,9 cm para fêmeas, sendo que a pesca atua sobre um estoque composto por machos predominantemente adultos e por fêmeas juvenis e adultas. O tamanho de malha das redes e a elevada biomassa vegetal presente nas áreas de pesca podem estar contribuindo para o aumento da captura de juvenis, comprometendo o recrutamento de *X. kroyeri*.

Palavras-chave: camarão sete-barbas, estuário, maturação gonadal, Penaeidae, pesca de arrasto, Sudeste brasileiro.

Introduction

Shrimps of the suborder Dendrobranchiata are among the most important marine fishery resource worldwide (COSTA et al., 2007). In this suborder, the family Penaeidae contributes with some of the most commercially important crustacean caught in the Southeastern and Southern coast of Brazil, which have significant historical, social and commercial relevance (BRANCO, 2005; D'INCAO et al., 2002).

Among these crustaceans, *X. kroyeri* is one of the most important species for the fishing economy of the Southern Brazilian coast (GRAÇA-LOPES et al., 2002). The higher concentrations of its biomass are found in shallow waters (between 5 and 27 m) on sandy and muddy substrate (COSTA et al., 2003). Along the Brazilian coast, numerous informations are presented relative to fishery, morphological parameters, reproductive period and recruitment of *X. kroyeri*, with regional divergences in relation to these attributes (GRAÇA-LOPES et al., 2007). This study aimed to provide information about population parameters of *X. kroyeri* captured in the municipality of Anchieta.

Material and methods

Study area

The area studied consists of the Central beach (20°49'10"S and 40°39'00"W) (Figure 1) characterized by being a relatively exposed region, with prevailing wind from the Southeast quadrant (NALESSO et al., 2008), tide with an amplitude of 1.9 m, with a minimum of -0.2 m and a maximum of 1.7 m (DHN, 2008), with influence of Benevente river, an important carrier of nutrients to the beach. The rainfall is around 1,200 mm year^{-1} (FERREIRA JUNIOR et al., 2008) with rainy summer. The annual water temperature ranges from 23.7 to 27.5°C (SÁ et al., 2007).

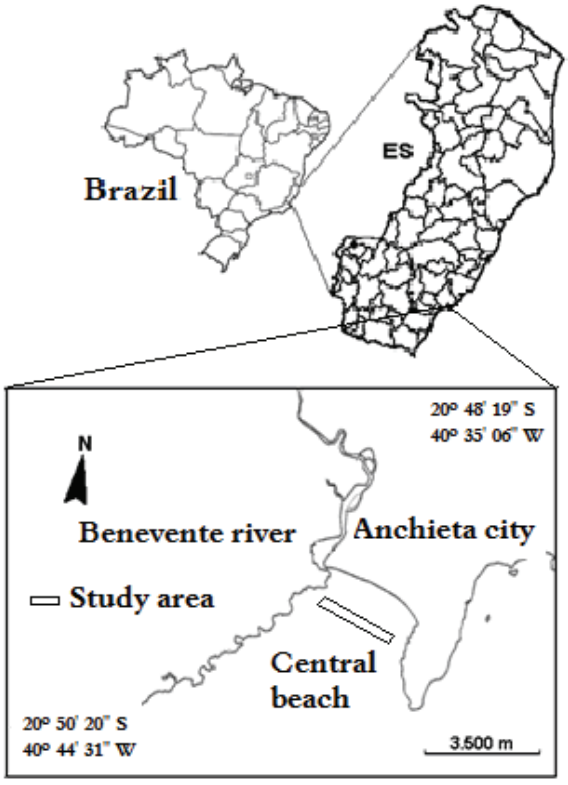

Figure 1. Area of sample collection (highlighted), in front of Central beach, Anchieta municipality (Espírito Santo State).The fishing fleet of the Central beach is compounded by 40 wooden boats, measuring 8 to 9 meters length, which use simple trawl instead of double trawl, common in other Brazilian regions.

Data collection

Monthly samplings were undertaken between January and December 2008, along the fishing area of shrimp boats of Anchieta, which operates between 6 and 8 meters deep. During the closed season, the samplings were performed with authorization of the Brazilian Institute of Environment and Natural and Renewable Natural Resources - Ibama (license number 13489-1) based on the Ibama Normative Instruction number 154/2007.

Each sampling consisted of one-hour-long trawl. Samples were obtained by a boat from the local fleet, using bottom trawl nets, with approximate dimensions of 5 length and 5 m width. The opening of the bagger has about 3 length and 3 m width. The sleeve mesh had 30 mm diameter and at the end portion (bagger) presented 25 mm diameter between opposite nodes. The average speed of the boat was 2 knots.

All the material collected was placed in Styrofoam box with ice and taken to the Laboratory of Aquatic and Terrestrial Ecology of the University Centre of Vila Velha for sorting and identification. The total biomass of the shrimp *X. kroyeri* was weighed every month, using a precision scale (0.01 g), separating 400 g of the shrimp to measure the following variables: weight (g), total body length (cm), shell length (cm), sex, sex ratio, and gonad maturity stage of males and females.

The total length was taken in rectilinear projection, from the anterior tip of the rostrum to the posterior tip of the telson (SANTOS et al., 2008). The identification of sex was made according to Mota-Alves and Rodrigues (1977), based on the characterization of external organs, telic (female) and petasma (male). Gonad maturity followed the classification of Dumont and D'incao (2004), based on the structure of petasma for males and macroscopic observation of the gonad color for the females.

The chi-square test (χ^2), at 5% significance level and n-1 degrees of freedom (n = 2), was employed to test possible differences between sex ratio over the months (ZAR, 1999).

The body size at the first gonadal maturation, which corresponds to the estimated length at which 50% of the individuals have already started the reproductive process, was estimated graphically for males and females according (VAZZOLER, 1981). To the suggestion of the closed season, it was considered the presence of 50% or more females at stages 2; 3 and 4 (VAZZOLER, 1996).

Results

In the total, 1,266 exemplars of *X. kroyeri* from 12 samplings have been analyzed. The frequency of males (45.97%; n = 582) and females (54.03%; n = 684), resulted in a male:female ratio of 1:0.85 that is not statistically different (χ^2 = 1.144; df = 1; p = 0.285) from the expected (1:1). This ratio was analyzed over the months through the χ^2, and indicated significant difference, favoring the females in February (ratio 1:0.31; χ^2 = 24.045; df = 1; p = 0.0001) and October (1:0.53; χ^2 = 10.178; df = 1; p = 0.001); and favoring the males in May (1:2.28; χ^2 = 14.411; df = 1; p = 0.0001).

In the other months, we observed a balance in the sex ratio in the samples ($p > 0.05$) (Figure 2).

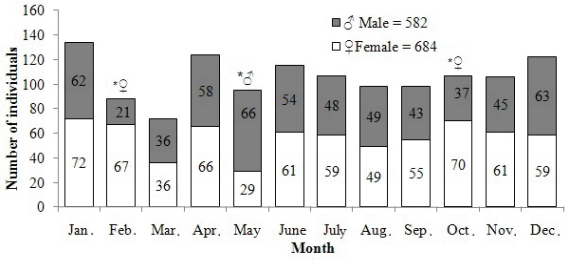

Figure 2. Monthly distribution of males and females of *X. kroyeri*, in 2008. *= significant difference; χ^2 ($p < 0.05$).

The distribution of total length classes present in the samples ranged from 2 to 9 cm; the class 6.0-6.9 cm was the most abundant (Figure 3). The mean (± standard error) of the total length was significantly different ($t = 2.72$; $p = 0.006$) between males (6.36 ± 0.96 cm) and females (6.54 ± 1.29 cm). This same pattern was registered for the shell length ($t = 4.13$; $p = 0.001$), with males (1.69 ± 0.28 cm) smaller than females (1.77 ± 0.39 cm). Regarding the body weight ($t = 2.98$; $p = 0.002$), males (3.57 ± 1.63 g) were lighter than females (4.11 ± 2.30 g). For both sexes, the class 6.0-6.9 cm had the greatest frequency. However, it was observed for the females (2.96-9.96 cm) larger length amplitude than for males (3.66-9.26 cm) (Figure 3).

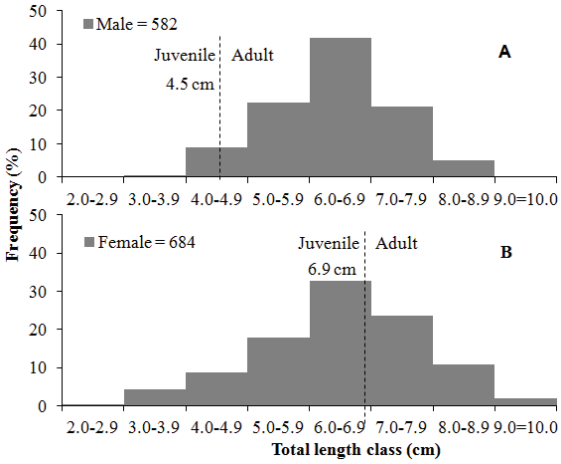

Figure 3. Distribution by total length class (cm) of males (A) and females (B) of *X. kroyeri* captured in Anchieta (Espírito Santo State), in 2008. The vertical line indicates the length of the first gonadal maturation.

Over the months, the modal length classes were between 5 and 7 cm for males and females, with a high incidence of captures of juvenile females (Figure 4).

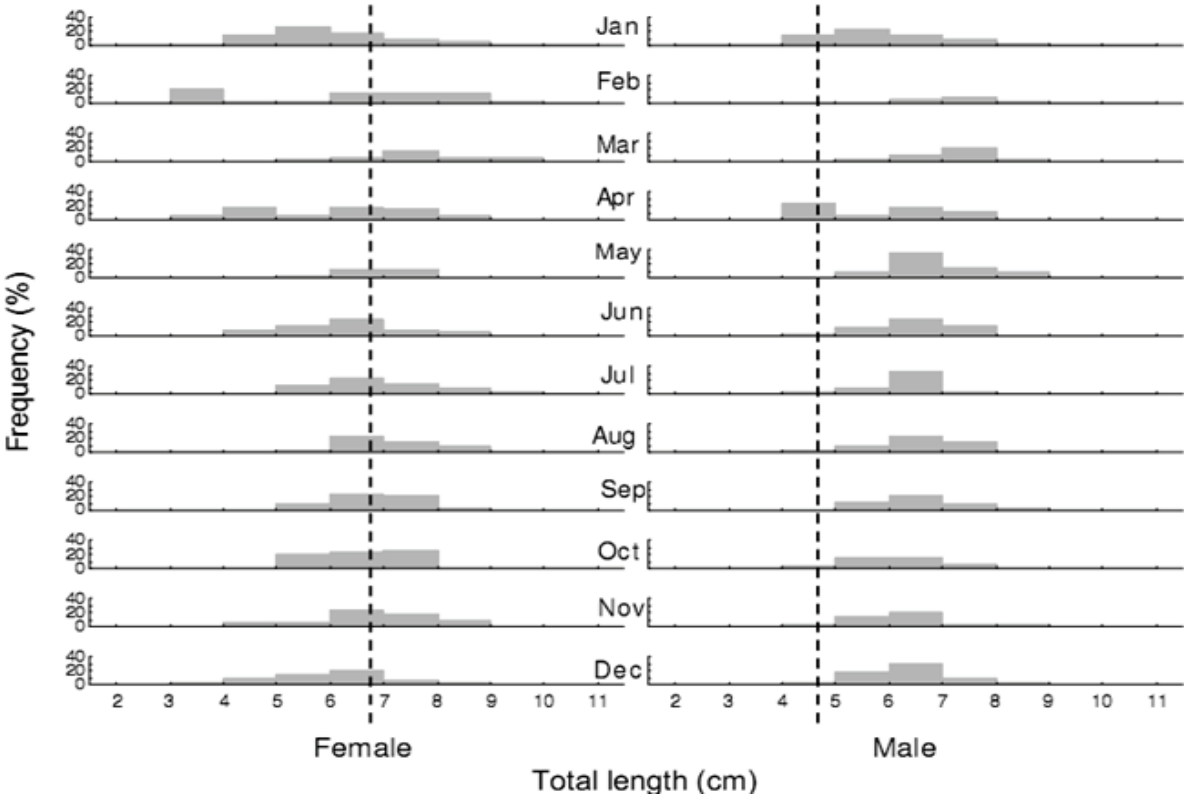

Figure 4. Temporal distribution by total length classes (cm) of males and females of *X. kroyeri* captured in Anchieta (Espírito Santo State), in 2008. The vertical line indicates the estimated length of the first gonadal maturation.

The immature males of *X. kroyeri* presented mean total length of 5.07 ± 0.08 cm, ranging from 3.68 and 7.35 cm over the year. In February, no immature male was observed. The mean total length of mature males was 6.58 ± 0.03 cm, ranging from 4.16 and 8.85 cm. The higher abundance of immature males occurred in April, and of mature males, in January, May and December (Figure 5).

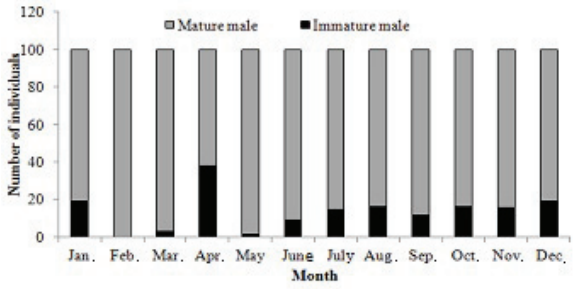

Figure 5. Monthly distribution of gonad maturity stages of *X. kroyeri* males captured in Anchieta (Espírito Santo State), in 2008.

The mean total length of immature females was 5.81 ± 0.05 cm, varying between 2.97 and 7.38 cm. Maturing females had mean total length of 7.27 ± 0.06 cm, ranging from 4.99 to 9.31 cm. Mature females presented mean of 7.84 ± 0.09 cm in total length, ranging from 6.15 to 9.79 cm. Spawned females presented mean total length of 8.06 ± 0.07 cm, ranging from 7.30 and 9.68 cm.

Immature females were more abundant in October and December, and at maturation in January, July and August. In January and February, there were more mature females, and the spawned females were more abundant in January and March (Figure 6).

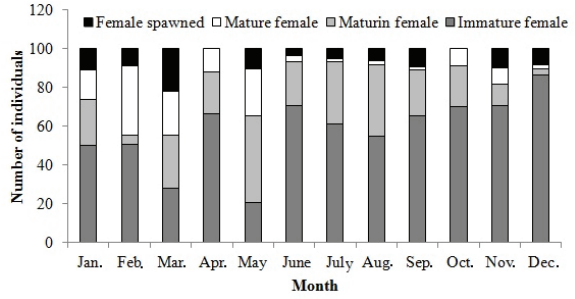

Figure 6. Monthly distribution of gonad maturity stages of *X. kroyeri* females captured in Anchieta (Espírito Santo State), in 2008.

The size at first maturity was estimated in 4.5 cm for males, and 6.9 cm for females (Figure 7). From the total length of 8.0 cm, all the collected shrimps, males and females, were adults.

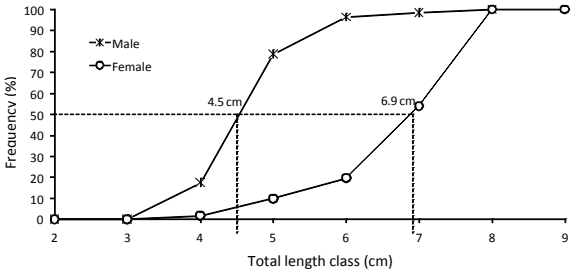

Figure 7. Cumulative frequency (%) of males and females of *X. kroyeri,* per total length class, captured in Anchieta (Espírito Santo State), in 2008.

Through the distribution of total length frequency and considering the estimated lengths at first maturity, we observed that the artisanal fishing effort in Anchieta is focusing on the stock of males already considered adults (90.4% of the total) and females still juvenile (63.6% of the total) (Figure 3).

Discussion

Sex ratio is important information to characterize the population structure, to assist the calculation of reproductive potential and the estimate of the stock size of a given species (VAZZOLER, 1996). In this study it was verified a sex ratio of 1:1 when considering the set of samples, although there was variation over the sampling months, with significant differences in some of them. In the class of total length 6.0-9.0 cm, there was a predominance of both males and females, but females have achieved larger sizes. The sex ratio 1:1 was also registered for *X. kroyeri* in the region of Tamandaré (Pernambuco State) (COELHO; SANTOS, 1993), Armação do Itapocoroy (Santa Catarina State) (BRANCO, 2005). In Santa Catarina State, Branco (2005) indicated the predominance of males in the classes of 7.0 and 9.0 cm, and of females in the classes 5.0-7.0 and 12.0-13.0 cm. Severino-Rodrigues et al. (1993), Nakagaki and Negreiros-Fransozo (1998) and Castilho et al. (2008) have quoted as possible reasons for the variation in male:female ratio, the distinct responses from each sex to natural mortality, migrations, use of habitats, etc. For Costa et al. (2005), heterogeneity in environmental conditions, temperature, salinity, available nutrients, etc, can result in differences in the predominant classes of total length.

In Anchieta, males and females of *X. kroyeri* have presented length ranges with different amplitudes; and females had the largest sizes. Branco et al. (1999), Castro et al. (2005) and Yamada et al. (2007) have suggested that the larger body length of the females is probably due to their exponential increase in fecundity with the increase in body size. Thus, females with larger size can be an adaptation of *X. kroyeri* to add to egg production.

In the samples from Anchieta, the juvenile males, despite occurring in all seasons, were more abundant in the summer and autumn, the mature males, in the autumn and winter, although these always had been predominant in relation to the juvenile males. On the other hand, juvenile females predominated in all year seasons. Adult females were more frequent in summer and autumn, despite not exceeding numerically the juveniles. Branco (2005) verified higher frequency of juveniles in the summer and winter; despite observing their occurrence throughout all seasons, except spring. This same author indicates the lack of recruitment migration in the adult stock, allowing the simultaneous occurrence of juvenile and adult in the same collection area, which is in accordance to our data. Nevertheless, for Severino-Rodrigues et al. (1993) and Graça-Lopes et al. (2002), the males are morphologically mature, but not physiologically, and under this conditions, these individuals stay in shallower area; hence the predominance of mature males in Anchieta. The females mature morphologically larger, then they are closer to physiological maturity, and migrate from the shallower area, hence the predominance of immature females in the sampled area.

By assessing the gonad maturity stage of the specimens of *X. kroyeri*, it can be supposed that the reproductive period in Anchieta is similar to the Northeast region, but it can not be asserted, since the occurrence of few mature females in the trawling areas suggests a migration to a spawning area. While the existing information about the reproduction of *X. kroyeri* is contradictory, the authors agree with the occurrence of individuals with mature gonads throughout the year, suggesting a long spawning period (BRANCO, 2005). In the Southeast and South regions, Neiva and Wise (1967) and Tremel (1968) list the months between September and March as the period of intense reproduction, Branco (2005), in Santa Catarina State, cites two spawning peaks, one in December and another between April and July.

The gonad maturity stage of the exemplars of *X. kroyeri* allow inferring that the recruitment occurred all over the year, disagreeing Santos and Coelho (1996, 1998) and Santos and Ivo (2000) that point out two recruitment peaks, but the authors affirm that there are divergences regarding the recruitment period for *X. kroyeri*.

The estimated size at first gonadal maturation is essential for the rational management of shrimp stocks, since it determines the minimum size (ideal) for the capture and the dimension of the mesh size of the nets (BRANCO, 2005). In Anchieta, despite the diameter of the net mesh is smaller to the estimated total length for the first maturation for males and females, the preponderant factor for the great capture of juveniles was the amount of vegetal organic matter captured (leaves, branches, and mangrove propagules), representing 34.25% of the landed mass, once it contributes to clog the net mesh and decrease the selectivity. This situation can influence the reproductive success of the species, since immature individuals are being caught in large numbers. The estimated total length for the first gonadal maturation found to Anchieta (males = 4.5 cm and females = 6.9 cm) was smaller than that found by Branco (2005) in Santa Catarina State (males = 7.3 cm and females = 7.9 cm).

The overlap of the size at first gonadal maturation with the frequency distribution curves of length allows determining the stratum of the population in which the fishing has operated with higher intensity (juvenile or adult) (BRANCO, 2005). In Anchieta, the fishing is more effective on the population of adult males and immature females, which can cause an imbalance in the reproduction peak, decreasing the chances of mating and recruitment of females. The fishing on *X. kroyeri* in the region of Caravelas (Bahia State) exploits the juvenile stock (SANTOS; IVO, 2000) corroborating our data; however Branco et al. (1999) pointed out a more intense exploitation on adults in the Armação do Itapocoroy (Santa Catarina State).

The closed season imposed by the legislation (IBAMA Normative Instruction number 189/200) takes place between November 15 and January 15th, and from April 1 to May 31st, partially covering the reproductive period of and recruitment of *X. kroyeri*, for the Anchieta region. The closed season also encompasses the species of pink shrimp (*F. paulensis*, *F. brasiliensis* and *F. subtilis*), white shrimp (*L. schmitti*), red shrimp (*Pleoticus muelleri*) and camarão-barba-ruça (*A. longinairs*); being a way to cover at maximum the periods of reproduction and recruitment of these species. Long-term monitoring to verify the annual and seasonal variations could determine with greater accuracy the closed season of each species in the region, generating more reliable data for the correct management of this resource.

Conclusion

The greater incidence of fishing for seabob shrimp in the region of Anchieta (Espírito Santo State) on exemplars of the classes of 5; 6 and 7 cm, the great occurrence of immature animals and the small amount of mature and spawned females, have indicated that the fishing area serves for the species growth. Despite the

great number of males morphologically mature in the fisheries products, their small size and massive presence in area with predominance of immature females, suggest that they also had no opportunities to contribute to reproduction.

The estimated lengths for the first maturation had been smaller than estimated by other authors, especially for males. This implies a strategy used by overexploited species for population recovery. In this group of *X. kroyeri* captured in Anchieta over the months, mature individuals were always present as well as great number of juveniles, probably indicating long period of reproduction and recruitment, but the data are not conclusive in support to the periods established by the Ibama Normative Instruction number 189/2008.

The mesh size of the nets used in the present study is small, which hampers the selectivity of the equipments, in order to respect the length at first maturation of the individuals, meanwhile, it is the large amount of vegetal organic matter collected (34.25% of the landed biomass) that contributes significantly to the increase of the capture of small-sized individuals.

Acknowledgements

The authors thank to FIBRIA for the scholarship to the first author. To the post-graduate course in Ecosystems Ecology of the University Centre of Vila Velha (UVV). To the fisher Jaldemar Silva Frontino for his help in field work.

References

BRANCO, J. O. Biologia e pesca do camarão sete-barbas *Xiphopenaeus kroyeri* (Heller) (Crustacea, Penaeidae), na Armação do Itapocoroy, Penha, Santa Catarina, Brasil. **Revista Brasileira de Zoologia**, v. 22, n. 4, p. 1050-1062, 2005.

BRANCO, J. O.; LUNARDON-BRANCO, M. J.; SOUTO, F. X.; GUERRA, C. R. Estrutura populacional do camarão sete-barbas *Xiphopenaeus kroyeri* (Heller, 1862), na foz do rio Itajaí-Açú, Itajaí, SC, Brasil. **Brazilian Archives of Biology and Technology**, v. 42, n. 1, p. 115-126, 1999.

CASTILHO, A. L.; FURLAN, M.; COSTA, R. C.; FRANSOZO, V. Reproductive biology of the rock shrimp *Sicyonia dorsalis* (Decapoda: Penaeoidea) from the southeastern coast of Brazil. **Invertebrate Reproduction and Development**, v. 52, n. 1-2, p. 59-68, 2008.

CASTRO, R. H.; COSTA, R. C.; FRANSOZO, A.; MANTELATTO, F. L. M. Population structure of the sea-bob shrimp *Xiphopenaeus kroyeri* (Heller, 1862) (Crustacea, Penaeoidea) in the littoral of São Paulo, Brazil. **Scientia Marina**, v. 69, n. 1, p. 105-112, 2005.

COELHO, P. A.; SANTOS, M. C. F. Época da reprodução do camarão sete-barbas, *Xiphopenaeus kroyeri* (Heller, 1862) (Crustácea, Decapoda, Penaeidae) na região de Tamandaré, PE. **Boletim Técnico Científico do Cepene**, v. 1, n. 1, p. 171-186, 1993.

COSTA, R. C.; FRANSOZO, A.; MELO, G. A. S.; FREIRE, F. A. M. Chave ilustrada para a identificação dos camarões dendrobranchiata do litoral norte de São Paulo, Brasil. **Biota Neotropica**, v. 3, n. 1, p. 1-12, 2003.

COSTA, R. C.; FRANSOZO, A.; CASTILHO, A. L.; FREIRE, F. A. M. Annual, seasonal and spatial variation of abundance of the shrimp *Artemesia longinaris* (Decapoda: Penaeoidea) in south-eastern Brazil. **Journal of the Marine Biological Association of the United Kingdom**, v. 85, n. 1, p. 107-112, 2005.

COSTA, R. C.; FRANSOZO, A.; FREIRE, F. A. M.; CASTILHO, A. L. Abundance and ecological distribution of the 'sete-barbas' shrimp *Xiphopenaeus kroyer*i (Heller, 1862) (Decapoda, Penaeoidea) in three bays of the Ubatuba region, southeastern Brazil. **Gulf and Caribbean Research**, v. 19, n. 1, p. 33-41, 2007.

DHN-Diretoria de Hidrografia e Navegação. **Tábuas das marés**: Terminal da Ponta do Ubu (Estado do Espírito Santo). 2008. Available from: <http://www.mar.mil.br/dhn/chm/tabuas>. Access on: Oct. 10, 2008.

D'INCAO, F.; VALENTINI, H.; RODRIGUES, L. F. Avaliação da pesca de camarões nas regiões Sudeste e Sul do Brasil. 1965-1999. **Atlântica**, v. 24, n. 2, p. 49-62, 2002.

DUMONT, L. F. C.; D'INCÃO, F. Estágios de desenvolvimento gonadal de fêmeas do camarão-barbaruça (*Artemesia longinaris* - Decapoda: Penaeidae). **Iheringia, Série Zoologia**, v. 94, n. 4, p. 389-393, 2004.

FERREIRA JÚNIOR, P. D.; ROSA, M. F.; LORENZO, M.; MONTEIRO, M. F.; JÚNIOR, R. A. Influência das características geológicas do local de desova na duração da incubação e no sucesso da eclosão dos ovos de *Caretta caretta* na praia da Guanabara, Anchieta, Espírito Santo. **Iheringia, Série Zoologia**, v. 98, n. 4, p. 447-453, 2008.

GRAÇA-LOPES, R.; TOMÁS, A. R. G.; TUTUI, S. L.; SEVERINO-RODRIGUES, E.; PUZZI, A. Comparação da dinâmica de desembarques de frotas camaroeiras do Estado de São Paulo, Brasil. **Boletim do Instituto de Pesca**, v. 28, n. 2, p. 163-171, 2002.

GRAÇA-LOPES, R.; SANTOS, E. P.; SEVERINO-RODRIGUES, E.; BRAGA, F. M. S.; PUZZI, A. Aportes ao conhecimento da biologia e da pesca do camarão-sete-barbas (*Xiphopenaeus kroyeri* Heller, 1862) no litoral do Estado de São Paulo, Brasil. **Boletim do Instituto de Pesca**, v. 33, n .1, p. 63-84, 2007.

MOTA-ALVES, M. I.; RODRIGUES, M. M. Aspectos da reprodução do camarão sete-barbas *Xiphopenaeus kroyeri* (Heller) (Dacapoda, macrura), na costa do Estado do Ceará. **Arquivos de Ciência do Mar**, v. 17, n. 1, p. 29-35, 1977.

NALESSO, R. C.; PARESQUE, K.; PIUMBINI, P. P.; TONINI, J. F. R.; ALMEIDA, L. G.; NÍCKEL, V. M. Oyster spat recruitment in Espírito Santo State, Brazil, using recycled materials. **Brazilian Journal of Oceanography**, v. 56, n. 4, p. 281-288, 2008.

NAKAGAKI, J. M.; NEGREIROS-FRANSOZO, M. L. Population biology of *Xiphopenaeus kroyeri* (Heller, 1862) (Decapoda: Penaeidae) from Ubatuba bay, São Paulo, Brazil. **Journal of Shellfish Research**, v. 17, n. 4, p. 931-935, 1998.

NEIVA, G. S.; WISE, J. P. A biologia e pesca do "camarão sete-barbas" da Baía de Santos, Brasil. **Revista Nacional de Pesca**, v. 1, n. 1, p. 12-19, 1967.

SÁ, F. S.; NALESSO, R. C.; PARESQUE, K. Fouling organisms on *Perna perna* mussels: Is it worth removing them? **Brazilian Journal of Oceanography**, v. 55, n. 2, p. 155-161, 2007.

SANTOS, M. C. F.; COELHO, P. A. Estudo sobre *Xiphopenaeus kroyeri* (Heller, 1862) (Crustacea, Decapoda, Penaeidae) em Luís Correia, PI. **Trabalhos Oceanográficos da Universidade Federal de Pernambuco**, v. 24, n. 1, p. 241-248, 1996.

SANTOS, M. C. F.; COELHO, P. A. Recrutamento pesqueiro de *Xiphopenaeus kroyeri* (Heller, 1862) (Crustacea: Decapoda: Penaeidae) na plataforma continental dos estados de Pernambuco, Alagoas e Sergipe. Brasil. **Boletim Técnico Científico do Cepene**, v. 6, n. 1, p. 35-45, 1998.

SANTOS, M. C. F.; IVO, C. T. C. Pesca, biologia e dinâmica populacional do camarão sete-barbas, *Xiphopenaeus kroyeri* (Heller, 1862) (Crustácea: Decapoda: Penaeidae), capturado em frente ao município de Caravelas (Bahia-Brasil). **Boletim Técnico Científico do CEPENE**, v. 8, n. 1, p. 131-164, 2000.

SANTOS, J. L.; SEVERINO-RODRIGUES, E.; VAZ-DOS-SANTOS, A. M. Estrutura populacional do camarão-branco *Litopenaeus schmitti* nas regiões estuarina e marinha da Baixada Santista, São Paulo, Brasil. **Boletim do Instituto de Pesca**, v. 34, n. 3, p. 375-389, 2008.

SEVERINO-RODRIGUES, E.; PITA, J. B.; GRAÇA-LOPES, R.; COELHO, J. A. P.; PUZZI, A. Aspectos biológicos e pesqueiros do camarão-sete-barbas (*Xiphopenaeus kroyeri*) capturado pela pesca artesanal no litoral do Estado de São Paulo. **Boletim do Instituto de Pesca**, v. 19, n. único, p. 67-81, 1993.

TREMEL, E. Recursos camaroneiros da Costa de Santa Catarina, Brasil: resultados da pesquisa sobre o camarão sete-barbas. **Documentos Técnicos Carpas**, v. 21, p. 1-6, 1968

VAZZOLER, A. E. A. M. **Manual de métodos para estudos biológicos de populações de peixes**: reprodução e crescimento. Brasília: CNPq; Programa Nacional de Zoologia, 1981. p. 106.

VAZZOLER, A. E. A. M. **Biologia da reprodução de peixes Teleósteos**: teoria e prática. Brasília: CNPq; Nupélia, 1996.

YAMADA, R.; KODAMA, K.; YAMAKAWA, T.; HORIGUCHI, T.; AOKI, I. Growth and reproductive biology of the small penaeid shrimp *Trachysalambria curvirostris* in Tokyo Bay. **Marine Biology**, v. 151, n. 3, p. 961-971, 2007.

ZAR, J. H. **Biostatistical analysis**. 4th ed. New Jersey: Prentice Hall, 1999.

Received on May 13, 2011.
Accepted on August 31, 2011.