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Variação geográfica dos padrões reprodutivos de caranguejos grapsóideos do Brasil (Decapoda: Brachyura) MacLeay, 1838: Uma revisão

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RESUMO

O presente artigo reuniu as principais tendências reprodutivas e suas variações geográficas para grapsóideos ao longo da costa brasileira. Por se tratar de uma revisão bibliográfica, foram feitas pesquisas em sites de busca a partir das palavras-chave: crab reproduction, crab breeding period, crab reproductive output e grapsoid reproduction, juntamente com a consulta em bibliotecas públicas. Foram encontrados 33 artigos que abordam a biologia reprodutiva de 10 espécies de grapsóideos ao longo da costa brasileira, dos quais 55% pertencem à região Sudeste, o que indica maior esforço de captura ou maior atividade de pesquisa na região. Com relação à maturidade sexual, a mesma espécie comparada em diferentes regiões evidenciou uma tendência inversamente proporcional do tamanho da maturidade sexual à latitude, o que vai contra ao que é explicado pelo paradigma latitudinal. O padrão de período reprodutivo contínuo com picos foi o mais visto, sendo que os picos ocorreram nos meses de média de temperatura mais elevada. Mudanças ambientais, como nos padrões de salinidade e temperatura, podem explicar a ausência de fêmeas ovígeras em determinados meses, uma vez que têm influência direta nos padrões reprodutivos de tais animais. Variações encontradas nos artigos de fecundidade utilizados podem ser explicadas por fatores ambientais e condições biológicas de cada região, que podem impactar no desenvolvimento fisiológico das gônadas e, em consequência, na produção de ovos. Nesse sentido, é possível concluir que características ambientais locais influenciam as tendências reprodutivas dos grapsóideos.

Palavras-chave: Biologia reprodutiva; Grapsoidea; Paradigma Latitudinal.

ABSTRACT

The present study summarized the main reproductive trends and its geographical variation for grapsoids along the Brazilian coast. As a review, website searches were carried out from these keywords: crab reproduction, crab breeding period, crab reproductive output and grapsoid reproduction, together with a consult in public libraries. Thirty-three studies were found which approached the reproductive biology of 10 grapsoid species along the Brazilian coast, of which 55% belonged to Southeastern region. To the onset of sexual maturity, the same species compared in different regions indicated an inversely proportional tendency of the onset of sexual maturity size to latitude, in opposite of which is proposed by the latitudinal paradigm effect. The continuous breeding period with peaks pattern was the most viewed, being that the peaks were found in months with more elevated average temperature. Environmental changes, as salinity and temperature patterns, could explain the ovigerous female absence in specific months. Fecundity variations were found and could be explained by environmental factors and biological conditions of each region, which could affect in the gonads physiological development and, in consequence, in the eggs production. Thus, it is possible to conclude that local environmental features influence the grapsoid reproductive trends.
Keywords: Reproductive biology; Grapsoidea; Latitudinal Paradigm.

INTRODUCTION

The remarkable success of the crustaceans in different environments, in different regions of the world, is reflected in the diversity of its life history and reproductive strategies (SASTRY, 1983).

The superfamily Grapsoidea MacLeay, 1838 gathers some crustacean species of remarkable ecologic and economic importance (MARTIN, DAVIS, 2001) that are distributed, mostly, in supralittoral and intertidal zones, besides some terrestrial and freshwater species (SCHUBART et al., 2000). According to Guinot (2018), this superfamily is taxonomically organized in nine families that can be recognized by the quadrilateral shape of their carapace.

About the biology of these animals, the reproduction is certainly one of the most important strategies to species maintenance; therefore, researches about reproductive biology as size at onset of sexual maturity, breeding period, fecundity and reproductive output, can subsidize conservation policies for the species stocks maintenance (SASTRY, 1983; COBO, FRANSOZO, 2000). Differences in reproductive features may be the results of local genetic variation, due to natural selection, or may reflect the phenotypic plasticity that is largely restricted in the environment (VIA, LANDE, 1985; ENDLER, 1986).

Latitudinal variation is commonly associated to reproductive traits of crab maternal investment, such as egg size, brood weight, larval size, among others, which has been documented for a many crustacean species (THORSON, 1950; MARSHALL, KEOUGH, 2007).

In this sense, investigations about the size at onset of sexual maturity include macroscopic and microscopic criteria, and the gonadal volume and size are a valuable reference as well (SOUZA, 2008). The presence of the spermatophores in the deferent duct, associated with the puberty moult morphological changes, pointing out the maturation of the male reproductive trait (HARTNOLL, 1969). For females, the puberty moult also represents an inflexion point in its reproductive development, which brings some morphological changes, as in males, followed by the egg extrusion, larvae or juvenile release (ITUARTE et al., 2004) that indicates the females sexual maturity. According to Hines (1982), size and age are critical determinants of crab reproductive output, hence it is important to consider patterns of geographical variations in size at maturity in these animals.

The proportion of ovigerous females regarding the total frequency of adult female in a population, over the time, can be defined as the breeding period and can vary in three temporal patterns of frequency: continuous; continuous with peaks, and discontinuous (see LIMA et al., 2006; PINHEIRO, FRANSOZO, 2002; NÓBREGA et al., 2021).

For crabs, the fecundity is measured as the number of eggs produced per female in each clutch, and it is described as a function of body size (COREY, REID, 1991). However, according to Steachey, Somers (1995) and Luppi et al. (1997), it is convenient to distinguish fecundity estimates according to the stage of egg production, i.e., 1) potential fecundity, as the number of oocytes stored in the ovaries; 2) realized fecundity, as the number of extruded eggs attached to the pleopod setae; and 3) actual fecundity, represented by the number of released larvae.

In this sense, crab fecundity investigation is an important tool to access the reproductive output, which is defined as the egg production energy budget that represents about 10% of the female body weight (HINES, 1982, 1992; MANTELATTO, FRANSOZO, 1997).

The present study aimed to summarize available information in the literature about the most relevant reproductive trends, and its geographical variation, as size at onset of sexual maturity, breeding period and reproductive output for grapsoid crabs over the Brazilian coast.

DEVELOPMENT

Bibliographic research was carried out from research websites such as Google Scholar, using the selected key-words: crab reproduction; crab breeding period; crab reproductive output and grapsoid reproduction. Public libraries such as University of São Paulo and University of Taubaté libraries were also consulted during the construction of the bibliographic collection.

A total of 33 articles was obtained and evaluated in this study, comprising 10 grapsoid species distributed over the Brazilian coast (figure 1).

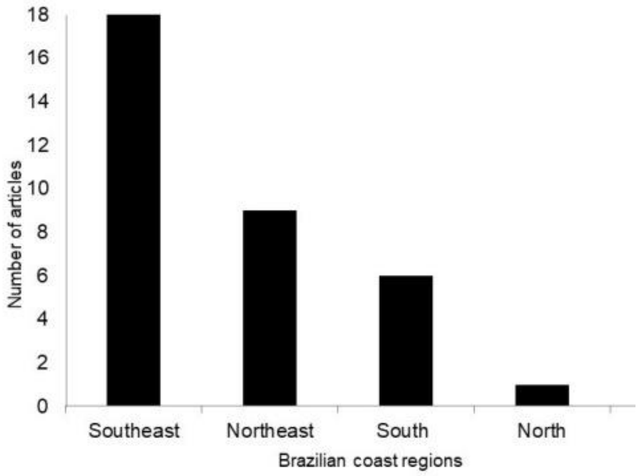

Figure 1: Researches of the reproductive patterns of the grapsoid in Brazilian coast regions.

Figura 1: Pesquisas dos padrões reprodutivos dos grapsóideos por regiões da costa brasileira.

Grapsoid crabs from the Brazilian southeastern region gathers 55% of the scientific production about this subject, suggesting a larger research effort and/or a larger number of researchers acting in this region. Otherwise, from the North region only one publication was recorded reporting some crab's reproductive aspect that did not allow any comparative analysis among grapsoid crab from this region.

Regarded the size at onset of sexual maturity was verified that the same species show an interesting tendency to an inversely proportional relationship between size and latitude, i.e., larger specimens in minors' latitudes, as can be viewed in the table 1.

Information summarized in table 1 suggest that some grapsoid species also tend to be smaller in relation to the latitude, in opposition to the classical paradigm of latitude, in which is proposed that individuals tend to reach the onset of sexual maturity with larger body size at higher latitudes (THORSON, 1950; SASTRY, 1983; BAUER, 1992; CASTILHO et al., 2007).

The obtained studies about breeding period pointed out a larger frequency of ovigerous females associated to higher temperature months for grapsoid species at southeastern and northeastern Brazilian coasts (figure 2).

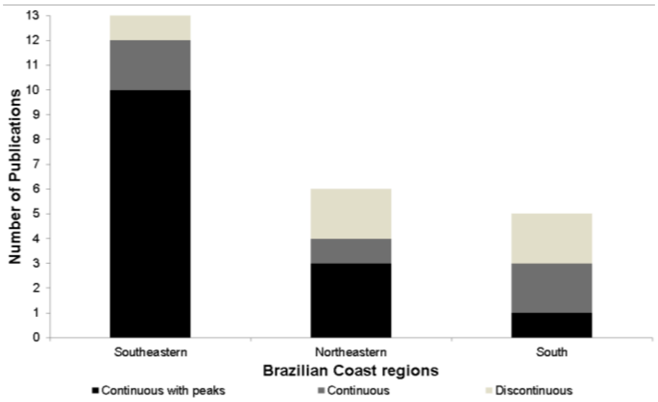

Figure 2. Distribution of breeding period patterns over the regions of the Brazilian coast.

Figura 2: Distribuição dos padrões de período reprodutivo por regiões da costa brasileira.

Accounts about fecundity of these crabs over the Brazilian coast evidenced a large range of maximum, minimum and mean number of eggs produced over the Brazilian coast as can be viewed in table 2. This can be result of the regional environmental and biological conditions, such as photoperiod, predation pressure, food availability, diseases and parasites that impact on the physiologic gonad development and the following egg production (CASTIGLIONI, SANTOS, 2001; ARAÚJO et al., 2016).

Table 1: Intraspecific geographic variation of size at the onset of sexual maturity for the species of the Grapsoidea superfamily over the Brazilian coast

Tabela 1: Variações geográficas intraespecíficas do tamanho da maturidade sexual de espécies da superfamília Grapsoidea na costa brasileira.

Location and Brazilian region	Latitude	Site at the onset sexual maturity (Carapace width - mm)	Author(s)
Aratus pisonii (H. Milne Edwards, 1837)			
Bertioga Canal - Southeastern	23°50´S	females: 10.97mm	Conde et al. (2000)
Mundaú and Manguaba estuarine complex – Northeastern	9°38'28" and 9°38'35"S	males: 20.08mm; females: 17.62mm	Santana et al. (2018)
Cardisoma guanhumi Latreille in Latreille, Le Peletier, Serville, Guérin, 1828			
Guaratiba mangrove, Sepetiba bay - Southeastern	22° 59'S	males: 51.0 mm; females: 53.0 mm	Silva, Oshiro (2002)
Jaguaripe estuary – Northeastern	04°26'S- 04°32'S	males: 60.91mm; females: 60.12mm	Shinozaki-Mendes et al. (2008)
Goniopsis cruentata (Latreille, 1803)			
Rio Escuro mangrove, Ubatuba - Southeastern	23°29'S	males:20-24mm; females: 18-29mm	Cobo, Fransozo (1998)
Sepetiba bay - Southeastern	22°56'S	females: 26-29mm	Silva, Oshiro (2002)
Paribe estuary – Northeastern	7°41'39", 7°48'54" S	from 32.0mm	Moura, Coelho (2004)
Sergipe river mangrove and Vaza-Barris river mangrove- Northeastern	10°48'52"S and 11°06'26.6"S	males: 31.49mm; females: 27.23mm	Hirose et al. (2015)
Sesarma rectum Randall, 1840			
Rio Escuro mangrove, Ubatuba - Southeastern	23°29'S	females: 15-18mm	Leme (2005)
Paraty, RJ - Southeastern	23°13'S	males: 14.7mm; females:13.2-18.5mm	Silva et al. (2007)
Cocó river State Park, Fortaleza - Northeastern	3°45'07"S	males: 27.14mm; females: 22.97mm	Ribeiro et al. (2012)

Table 2: Intraspecific geographic variation fecundity for the species of Grapsoidea superfamily over the Brazilian coast.

Tabela 2: Variação geográfica intraespecífica da fecundidade para espécies da superfamília Grapsóidea na costa brasileira.

Location and Brazilian region	Latitude	Female average size (Carapace Width - mm)	Fecundity (minimum, maximum and average number of eggs)	Author(s)
Goniopsis cruentata (Latreille, 1803)				
Rio Escuro Mangrove - Southeastern	23°29'24"S	-	12,240 and 95,440; 49,126 ± 22,128	Cobo, Fransozo, (1997)
Rio Sergipe Mangrove and Vaza-Barris river mangrove - Northeastern	10°48'52" S - 11°06'26.6"S	25.71-42.04; 35.23 ± 4.46 and 25.62-42.08; 34.51	50,460±19,828; 40,005±18,508	Hirose et al. (2015)
Neohelice granulata (Dana, 1851)				
Patos Lagoon - South	31°58'99"S - 32°09' 011"S	12.8-28.7; 22.9±0.2 and 12.6-25.5; 17.9±0.2	29,019±1,014 and 19,968±1,159	Barutot et al. (2009)
Jabaquara beach - Southeastern	23°12'09.75"S	-	7,328 and 53,248; 30,028.33 ± 10,861.19	Gregati, Negreiros-Fransozo (2009)
Pachygrapsus transversus (Gibbes, 1850)				
Prainha beach, Torres - South	29°20'40.1"S	6.42-16.88 11.47 ± 2.34	693 and 10,487 2,395 ± 1,876	Torramilans (2019)
Ibicuí beach - Southeastern	22° 57' 45"S	8.5 - 20	540and 5,273; 1,770	Campos, Oshiro (2001)
Boa Viagem beach - Northeastern	08°07'59.31"S	-	350 and 14,700; 3,818 ± 3,349	Araújo et al. (2016)

The geographic variation of the size at onset of sexual maturity verified to the grapsoid species in the Brazilian coast may be drive by local pressures, as climate, oceanic and coastal parameters, such as temperature and salinity, besides food availability (LEME et al., 2014; HERRERA, 2017).

In most of the breeding period research selected, the species studied showed the continuous pattern for hatching over the year. Moreover, the absence of ovigerous females during some seasons may be an answer to local environmental changes and/or the geographical variation, once the reproductive traits vary as a temperature and salinity function, especially for those species that presents large geographic distributions (COBO, FRANSOZO, 2003; DALABONA, SILVA, 2005).

According to Hines (1982, 1992), even small variations of the fecundity and reproductive output are significative for the comprehension of the evolutive patterns of the grapsoid families, despite the, so common, positively proportional relationship among female size and number and weight of the eggs.

In general, environmental parameters, such as temperature, pH, dissolved oxygen, salinity, sediment texture, and nutrient contents are being most important abiotic factors in ecological investigation, particularly to the grapsid ecology

(CHATTERJEE, CHAKRABORTY, 2015), and seems to be key features that drives the reproduction in this group of Decapods.

The pool of information assembled in this paper is robust to indicate that the size at onset of sexual maturity for grapsoid species studied not respond to the paradigm of latitudinal trends in life-history traits (THORSON, 1950; SASTRY, 1983). Especially most of the grapsoid species explore intertidal habitats, such mangrove and/or estuarine regions, which likely constrained by local environmental and climate conditions and are transitional environments that are characterized by large varying and often unpredictable hydrological and chemical parameters (DAY et al., 1989; MCLUSKY, 1989, 1993; COSTANZA et al., 1993). In this sense, any change in environmental features, as tidal cycle, sea level, or river discharge, may cause perturbations of the dynamic balance, followed by a new balance state (PETHICK, 1994) that may be strong enough to impose significant differences in the biological responses, for instance, the latitudinal trends in life-history traits.

FINAL CONSIDERATIONS

In an overview, the reproductive trends recorded for grapsoid species indicate that the onset of sexual maturity opposes the paradigm of latitudinal effects and could be explained by local pressures. Continuous breeding with peaks was most frequently observed in the analyzed studies, and the absence of ovigerous females in specific months could be a response to climate and environmental conditions. Furthermore, regional environmental and biological conditions can explain the obtained results in fecundity studies, reinforcing the major impact of local environmental features on reproductive trends

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