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SIZE AT SEXUAL MATURITY IN *Callinectes ornatus* (BRACHYURA, PORTUNIDAE) FROM THE UBATUBA REGION (SP), BRAZIL.

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ABSTRACT

Size at sexual maturity is reported for 3,256 specimens of *Callinectes ornatus* from the Ubatuba region (SP), Brazil. Samples were obtained at 2-month intervals from January/1991 to November/1992 with an otter-trawl net. Males reached larger sizes than females. The sex-ratio did not differ from 1 : 1 in the smaller sizes; medium sizes were dominated by females, whereas males were more abundant in the larger sizes. The mean size of Carapace Width (CW), excluding lateral spines, at sexual maturity was estimated at 43.0 mm for females and 50.0 mm CW for males.

Keywords: Brachyura, Portunidae, Sexual maturity, Reproduction.

INTRODUCTION

The reproductive biology of brachyuran crabs has been well documented, particularly for portunids (Van Engel, 1958; Tagats, 1968; Hill, 1975; Paul, 1982; Jones & Simons, 1983; DeVries *et al.*, 1983; Haefner, 1976; Campbell & Fielder, 1986; Prasad & Neelakantan, 1990).

Despite the abundance of literature, however, very little is known about the reproductive biology of Portunidae, including the swimming crabs of the genus *Callinectes* Stimpson, 1860, from the Brazilian coast.

Callinectes ornatus Ordway, 1863 is a relatively large portunid crab closely related to the commercial blue crab, *Callinectes sapidus* Rathbun, 1896, of the Atlantic and Gulf coasts of North America (Williams, 1974). *C. ornatus* may be of potential commercial value in Bermuda (Haefner, 1990), as well as along the northern coast of São Paulo state, Brazil, where it is informally commercialized in the Ubatuba region (Negreiros-Fransozo *et al.*, in press). Although it is the most abundant species in the region (Fransozo *et al.*, 1992), its significance is mainly related to its ecological role as a scavenger, predator, and food resource for aquatic organisms.

According to Melo (1985), *C. ornatus*, is distributed in the western Atlantic from North Carolina through Florida, Bermuda, Gulf of Mexico, Central

America, Antilles, Guyanas and Brazil (from Amapá to Rio Grande do Sul). It can be found near river mouths and in bays but is most common in moderate salinity waters, inhabiting sand, mud or shell bottoms. The species occurs from the intertidal zone to a depth of 75 m.

Sexual maturity is understood as the set of morphologic and physiologic transformations whereby young or immature individuals reach the ability to produce gametes that may fecundate or be fecundated. Sexual maturity permits these animals to start acting directly on the mechanisms of population fluctuation.

For crustaceans there are not always outer characteristics such as color and size that will inform in a rapid, direct and inequivocal manner about the exact moment when an individual reaches sexual maturity. More precise estimates in the determination of the size at which males and females reach sexual maturity are currently based on comparative studies using a physiological (macroscopic and/or microscopic (histological) gonad size) and morphological approach (analysis of the changes in shapes and size of body structures).

Morphological maturity may often be out of synchrony with gonadal maturity, characterizing morphologically mature but functionally immature individuals, or vice versa (Hartnoll, 1982; Sastry, 1983). Reproductive potential is intimately related to the size at which an individual presents the first maturation. Thus, these two features require the search for parameters that will help us to understand the functioning of Brachyura populations.

Several methods may be used to detect externally the morphological sexual maturity of brachyurans. Most studies have used relative growth, taking into consideration changes in body structures. This biometric approach (weight, shape, size) as an indicator of maturity in Brachyura was studied in the pioneering investigations of Cott (1929), Huxley & Richards (1931), Weymouth & Mackay (1936), which were extremely important for the development of this line of research.

In some Brachyura species, modifications may be detected in the sex appendages during the pubertal period, usually at the level of the pleopod setae. The size and shape of the abdomen and chelipods also vary between males and females starting at sexual maturity (puberty molt), which can be detected by the changes in allometry levels. Alterations in body weight may also indicate sexual maturity. Particularly outstanding within this context are the studies of Watson (1970) for *Chionoectes opilio* (O. Fabricius, 1788); Brown & Powell (1972) for *Chionoecetes bairdi* Rathbun, 1924; Haefner (1977) for *Geryon quinquedens* Smith, 1879 females; Perez & Bellwood (1989) for *Matuta lunaris* (Forskal) and Mantelatto & Fransozo (1992, 1994) for *Hepatus pudibundus* (Herbst, 1785).

Among portunids, the following species were investigated: *Callinectes sapidus* by Gray & Newcombe (1938); *Portunus sanguinolentus* (Herbst, 1783) by Ryan (1967a,b); *Macropipus tuberculatus* (Roux, 1830) by Mori (1987) and Abelló (1989a); *Scylla serrata* (Forskal, 1775) by Prasad & Neelakantan (1990);

Arenaeus cribarius (Lamarck, 1818) by Pinheiro & Fransozo (1993a,b) and *Portunus spinimanus* Latreille, 1819 by Santos *et al.* (1995).

For the species reported here, the only references detected in the literature were the studies of Haefner (1990), Branco & Lunardon-Branco (1993a, 1993b), Negreiros-Fransozo & Fransozo (1995), Mantelatto & Fransozo (1996), Negreiros-Fransozo *et al.* (in press) and Mantelatto & Fransozo (in press).

This paper describes the size at sexual maturity of *C. ornatus* in the Ubatuba region which could provide information on the reproductive biology of the species.

MATERIAL AND METHODS

The specimens were collected by an otter-trawl (with 10 mm of cod end mesh size) at 2-month intervals for two consecutive years (January 1991 to November 1992) in Ubatuba Bay (23°26' S and 45°02' W).

After collection, the animals were screened, bagged, labeled, and stored frozen. In the laboratory the material was thawed at room temperature and the following features were determined: sex; carapace width (CW) measured between the bases of the last and penultimate lateral spines with a caliper (0.1 mm). Stage of gonadal development (two maturity stages: mature and immature) was defined according the size and color pattern of the gonads described by Mantelatto & Fransozo (in press).

Considering of the percentages of mature and immature specimens in each class size, the minimum size at first maturation was determined on the basis of the size at which 50% of the individuals in the population actively entered the gonadal maturation phase. The methodology used was based on the standards described by Watson (1970), Brown & Powell (1972), Hilsinger (1976), Somerton (1978), Somerton & McIntosh (1983) and Donaldson *et al.* (1981).

RESULTS

A total of 3,256 specimens of *C. ornatus* were obtained, of which 1,981 were males (60.84 %) and 1,275 were females (39.16 %).

Overall size frequency distributions showed that males reach larger sizes than females (Fig. 1).

Overall sex-ratio (proportion of males = 1.6 : 1.0) was significantly different from the expected 1:1 sex-ratio (^{2} test, p 0.01).

Size at Sexual Maturity

The percentage of mature individuals showed that sexual maturity occurs very early in the adult life of the species. Consequently, the estimated size at

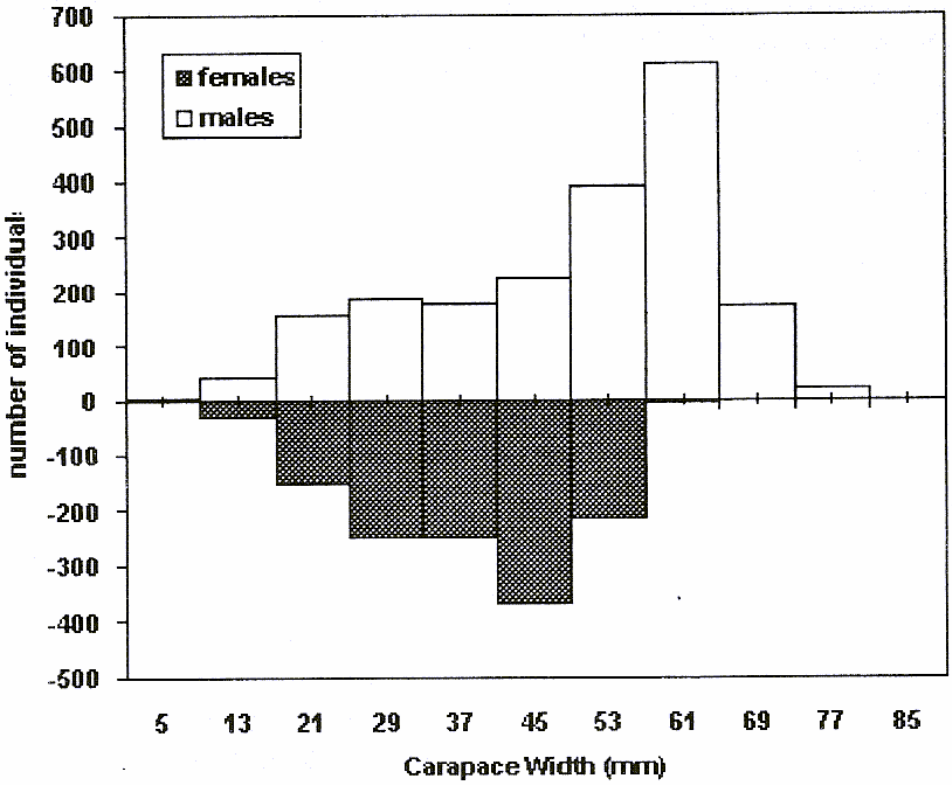

Figure 1. *Callinectes ornatus*. Overall size frequency distribution by sex.

which 50 % of the females reach sexual maturity was about 43.0 mm CW, with a range of maturity size between 42.0 and 48.0 mm CW (Fig. 2). For males the size was about 50.0 mm CW, with a range of maturity size between 48.0 and 54.0 mm CW (Fig. 3).

DISCUSSION

A possible explanation for the decrease in percentage of males in the class (29 - 45 mm CW) is that the male and female growth rates differ, with different mortality rates and migration probably related to the different growth rates, because most of the energy is spent in reproductive mechanisms.

The maximum size of males is greater than that of females at points between 29 - 45 mm CW, probably resulting from the accumulation of adult females in that size class. The observation that male and female growth rates diverge at interval carapace width. This value is consistent with the 43.0 mm value for mean minimum size of reproductive maturity for females (Fig. 3). Presumably, mature females put more energy into reproductive growth than into somatic growth. If this reasoning is correct, males larger than 45.0 mm CW may invest more energy in growth, consequently growing faster than females of similar size. This hypothesis has been raised for other portunid crabs (Abelló, 1989a,b; Mori, 1987).

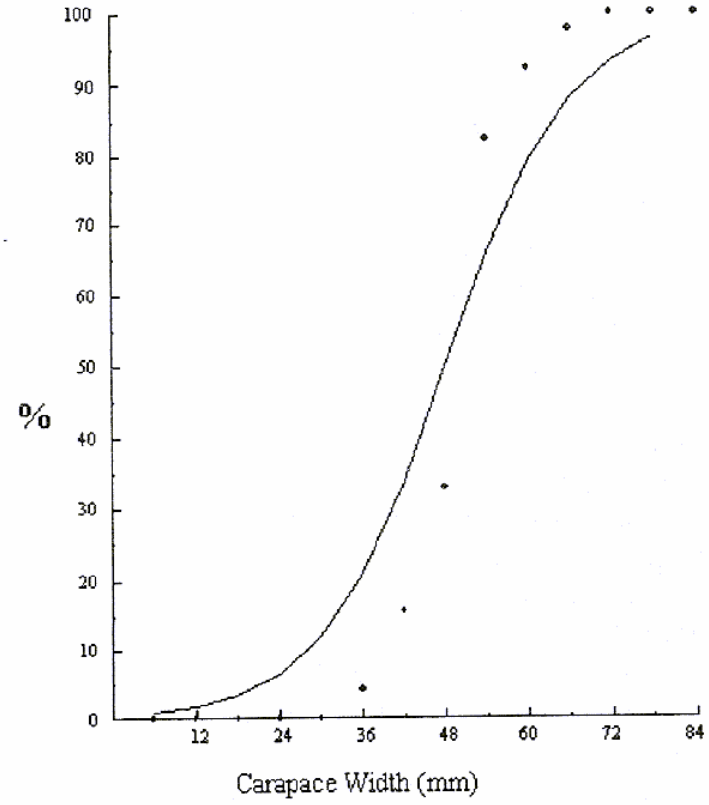

Figure 2. *Callinectes ornatus*. Relationship between proportion mature based on gonadal development and carapace width (CW) for males per six millimeter size class.

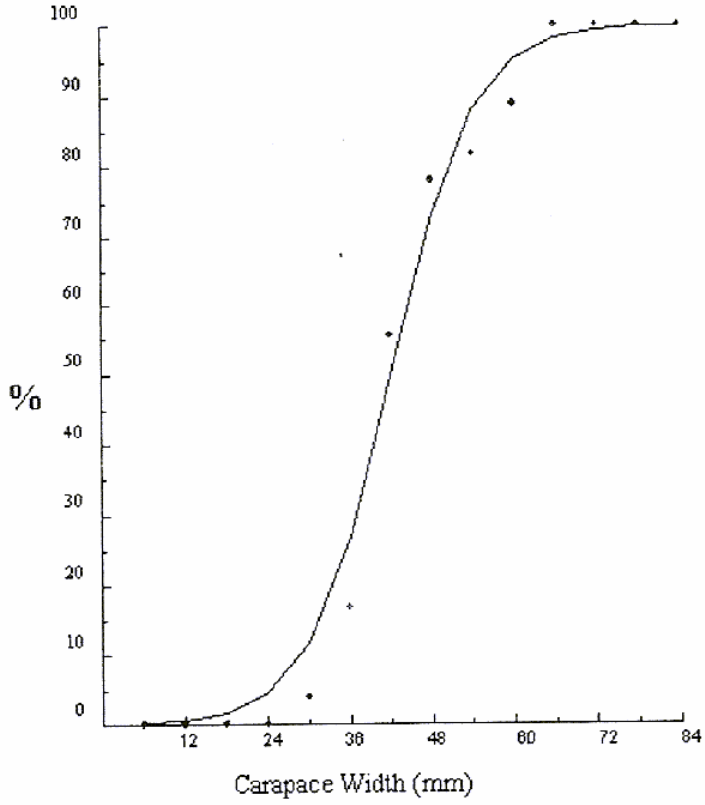

Figure 3. *Callinectes ornatus*. Relationship between proportion mature based on gonadal development and carapace width (CW) for females per six millimetre size class.

According to Emlen (1968), the discrepancy in age may be particularly pronounced in cases of delayed male maturity. Thus, maximization of the number of males by the number of females may require in general a longer life span for males compared to females. Furthermore, it may affect the evolution and maintenance of the sex ratio for all ages. This fact is supported by the observations of Negreiros-Fransozo & Fransozo (1995) who reported the presence of all age categories of *C. ornatus* in Fortaleza Bay, Ubatuba (SP), with a predominance of occupation of the bay only for spawning and incubation.

The results obtained by Negreiros-Fransozo *et al.* (in press) show that ovigerous females and juveniles of *C. ornatus* can be found almost the year around in Ubatuba Bay, although it is not possible to state with precision where and when these individuals occur.

According to Dillery & Knapp (1970), males at size "x" (a dip in the curve at points between 29.0 and 45.0 mm CW for the species of the present study) could have left the population at the time of sampling, or females of that size may have preferentially moved into the sampling. This behavior of habitat selection is common during the life of brachyurans of the genus *Callinectes*, and is observed in larvae and post-larvae (McConaugha, 1988), in the young (Hines *et al.*, 1987) and in adults (Pearson, 1948; Van Engel, 1958; Schaffner & Diaz, 1988; Lipcius & Van Engel, 1990).

We believe that differences in growth rate observed on the basis of the distribution of size frequency between males and females may cause the capture of specimens of one sex to a greater or lesser extent. Furthermore, there may be a space segregation by sex as the result of differential behavior according to season and location. For example, the hypothesis of greater male activity compared to females during the daytime (period when we collected our specimens) suggests that males are more likely to be captured. This aspect is the subject of a more detailed study currently underway in the region, which may help elucidate features related to *C. ornatus* distribution.

The estimate of size at sexual maturity was about 43.0 mm CW for females. According to Mantelatto & Fransozo (in press), the smallest female with developing gonads had 32.6 mm CW, and the smallest ovigerous female had 40.4 mm CW. For males, this size was about 50.0 mm CW, and the smallest male with developing gonads measured 38.5 mm in CW. This size, at which 50% of male and female individuals in the population are mature seems to be a good estimate for mean size (43.0 to 50.0 mm CW) at occurrence of the puberty molt. Although these data will be later analyzed with respect to morphologic maturation (Relative Growth), a comparison with a population from the northern hemisphere investigated by Haefner (1990) showed that the size of *C. ornatus* at morphological maturation is close to the size at gonadal maturation determined in the present study and the another study realized in Parana State by Branco & Lunardon-Branco (1993b). It should be remembered that small variations in morphology (size) and physiology (gonadal maturity) may occur as a function of population origin and of abiotic factors involved in the process; in addition, after the puberty molt the sexes usually present differences in growth rate (Hartnoll, 1982, 1985).

Some studies on marine crustaceans have demonstrated that body size and size at maturity increase with increasing latitude (Vernberg, 1962; Annala *et al.*, 1980; Hastings, 1981). These trends are a function of temperature and of the metabolic differences in the latitudinal range. Low temperatures lead to slow growth rates, with an increase in the time needed to reach sexual maturity, whereas high temperatures tend to stimulate growth, with an early beginning of ovarian development (Annala *et al.*, 1980; Armitage & Landau, 1982).

No estimates of juvenile growth are avaialable for the species, but as suggested by the size at sexual maturity (43.0 mm CW) and by the study of female size frequency distribution and ovigerous ratio by Negreiros-Fransozo *et al.* (in press) and by the study of growth by Branco & Lunardon-Branco (1993b), females may well reach fully maturity within their first year of life.

The conclusions about size at maturity seem to support and confirm evidence reported by Mantelatto & Fransozo (in press) about the complex reproductive cycle of *C. ornatus* in the region, further corroborating the idea of an intimate relationship between molting cycle and maturity for portunids from tropical regions. Although some points still need elucidation, the present data provide a better understanding of the reproductive strategy developed by *C. ornatus* in the Ubatuba region.

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