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Morphometrics relationship of the Mangrove crab from the Mangrove Swamp of Panganiban, Catanduanes Philippines

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Abstract

Mangrove crab is a commercially important commodity in Catanduanes. But little is known in the study of morphometrics and its relationship. This study investigates some aspects of biology, particularly on sex ratio, morphometrics (Carapace Length, Carapace Width, and Body), and its relationships. Samples were gathered during the full moon last January 16 to 26, 2019, during both low and high tide using lift-net at the estuary part of Panganiban, Catanduanes. A total of 53 crabs were collected, of which 48.83% were male and 52.17% were females. The sex ratio of females to males was 1:1.12 and not significantly different from the hypothetical distribution of 1:1. Results revealed that a female crab seems to have a smaller carapace width compared to males. Bodyweight favored the male mangrove crabs with a mean bodyweight of 132.89g compared to females (113.23 g). A positive correlation was observed between carapace length- carapace width and carapace width - body weight in both sexes (R^2= 0.8). Both sexes showed negative allometric growth on CL-CW and CW – BW with b<3. It showed that carapace length grows faster than carapace width and body weight increases faster than carapace width. Hence, harvesting of this resource should be minimized to the sizes of >8cm to allow continuous breeding and recruitment thus ensuring the sustainability of this resource. A follow-up study is needed in some areas to determine the status of mangrove crab covering a different period that will serve as a continuation of the study for the whole year-round.

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Introduction

Mangrove crab (MC) locally known as *"alimango"* or "*kinis*" is an important fishing commodity in the Philippines and Indo-Pacific Region. Mangrove crab belongs to the family Portunidae of the class Crustacea plays a vital role in the ecological balance and income generation (Keenan, 1999). Mangrove crab includes four different species; *S. serrata*, *S. tranquebarica, S. olivacea, and S. paramamosain* (Keenan *et al.,* 1998). The mangrove crab is a relatively large crab with a smooth carapace that can grow more than 3kg (Kaliola *et al.*, 1993). The color varies from dark brown to mottled green, depending on the dominating habitat. Located on each side of the carapace are nine similar-sized spines and the hind legs are flattened to aid the animal in swimming (Kaliola *et al.,* 1993). In nature, male mangrove crabs are normally larger than female mangrove crabs (Keenan, 1999).

They are crabs that live among mangroves and may belong to many different species and even families. They are ecologically significant in many ways. They keep much of the energy within the forest by burying and consuming leaf litter. Along with burrowing in the ground, at high tide, and in the face of predators these crustaceans can climb trees to protect themselves (Makowski and Finkl, 2012). Mangrove crabs are euryhaline animals and can tolerate a wide range of salinities, ranging between 1 and 42 ppt (Davenport & Wong, 1987).

In the Philippines, the farming of mangrove crab has been progressing rapidly due to a promising market and profitability. With the availability of mud crab juveniles from the wild throughout the year and the recent development in hatchery technology, there is a strong indication that the production of mud crabs on a commercial scale could be a lucrative industry.

Their size, high meat yield, delicate flavor, and ease of capture mean that almost everywhere they occur mangrove crabs are highly sought-after as a quality food item. Their sedentary habits, accessible habitat, and relative ease of capture also, however, make them susceptible to overexploitation (Brown, 2013). The current price of mangrove crabs in the local market is relatively higher than fish and mollusks and is projected to increase in the world market. This increasing trend in the domestic and export market is expected to step up the demand for crab seeds. In the Philippines, the technology of mangrove crab grow-out culture is already being transferred to resource-poor fisher folks for adoption as an alternative livelihood. However, buying competition among big and small crab farmers is foreseen to be disadvantageous to small farmers. There is a need to hasten the development and transfer of technology on mangrove crab breeding and hatchery to stabilize the supply and price of crab seeds. Mangrove crabs are known for their major importance in the Philippines, particularly in Catanduanes Island. But little is known on the study of morphometrics and its relationship with mangrove crabs on Catanduanes. According to Bagenal (1978), a study of the length-weight relationship in aquatic animals has a wide application in delineating the growth patterns during their developmental pathways. In population studies, the morphometric analysis provides a powerful complement to genetic and environmental stock identification approaches (Cadrin, 2000) and length-weight relationships allow the conversion of growth-in-length equations to growth-in-weight for use in a stock assessment model (Moutopolos & Stergiou, 2002). Information about individual body weight-length/width relationships in populations is important for estimating the population size of stock, specifically for its exploitation. The length-width/weight relationships are regarded as more suitable for evaluating crustacean populations (Atar & Sector, 2003; Gorce *et al.*, 2006; Sangun *et al.*, 2009). Thus, this study input some essential information on the sex ratio, morphometrics, and its relationships particularly in carapace width, carapace length, and body weight.

Materials and methods

Description of the Study Site

Mangrove Areas in Sitio Tarahid, San Pedro, Panganiban, Catanduanes was selected for this study. (Fig. 1) The reason for selecting this area was that crab fattening has been well established in San Pedro,

Panganiban. The area had extensive mangrove forests that were suitable for mud crab aquaculture and the area also consist of poorer fishing villages involved in the crab farming activities.

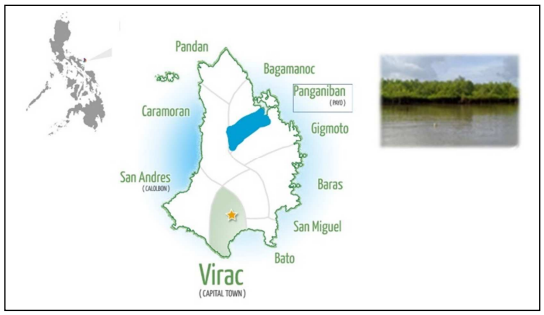

Fig. 1. Map of the Study Area in Barangay San Pedro, Panganiban, Catanduanes. Photo credit: Word Press. com

Data Collection

A total of 54 mangrove crabs were collected from January 16 to January 26, 2019, during low tides and high tides around 7:30 to 10:30 am. Samples were collected inside the study area using a lift net or locally known as bintol" (Fig. 2). Samples were brought to the landing site for sexing and measurement of Carapace Width (CW), Carapace Length (CL), and Body Weight (BW) (Fig..3) Carapace Widths (CW) and Carapace Length (CL) were measured using a ruler to obtain measurements to 1cm. Body Weight (BW) measurements were made using an ordinary weighing scale to 0.01g.

Fig 2. Lift net used in catching MC.

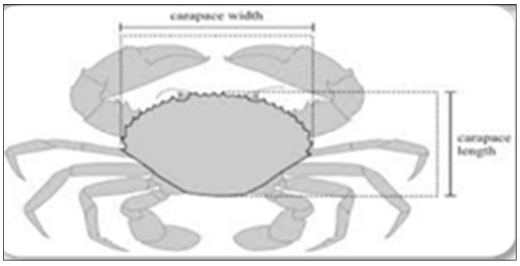

Fig 3. Measurement of CW and CL of MC.

Data Analysis

The sex ratio of mangrove crab given as males/ females (M/F) was calculated using the formula: total number of males/total number of females. Descriptive statistics were used to describe the no. of males and females and morphometrics of mangrove crabs. The CW-CL relationship was determined separately for males and females of mud crab by using linear regressions. The CW-BW relationships were determined separately for males and females of *S. serrata* by using the exponential regression. The square of the coefficient (R^2) was determined to identify the degree of association between the two variables. The growth pattern related to the value of coefficient (b) was defined; the isometric growth (b=3), negative allometric (b3) following Araujo and Lira (2012).

Results and discussion

Sex Ratio and Morphometrics of Mangrove Crabs Collected

The sex ratio for males/females (M/F) was calculated using the formula: total number of males/total number of females. The sex of the mud crabs captured was identified following Keenan *et al.* (1998). Fig. 4. A total of 53 mangrove crabs were collected of which 25 were female and 28 males. The number of mangrove crabs captured for both sexes was equivalent however, males were more numerous (52.83%) compared to females (48.17%).

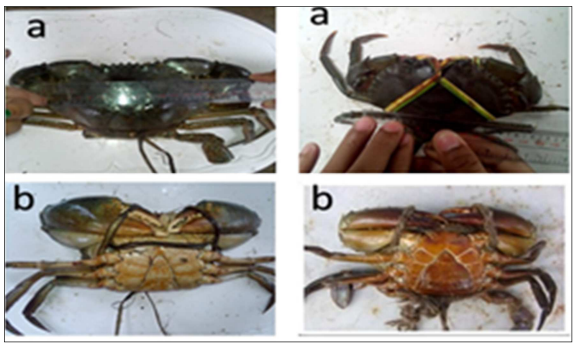

Fig. 4. Dorsal view (a) and Ventral view (b) of male, MC (left) and Female, MC (right).

In this study, male crabs were dominant compared to female crabs. Male crabs in Panganiban, Catanduanes preponderated over females (1.12: 1) however, the Chi-square test revealed no significant difference

from the hypothetical distribution of 1:1. It increases the success of mating and repro since crab repro between male and female is a 1:1 ratio. The dominance of males over females occurs frequently in the crab population (Warburg *et al.*, 2012.) Hence, the conditions of mangrove crab stocks of the said swamps are in good condition based on the result of the sex ratio of females and males.

Similarly, the present results were consistent with the report of Ikhwanuddin *et al. (*2010) who reported that male mangrove crabs are more abundant compared to female mangrove crabs sampled from Setiu Wetlands. Sex ratios of females to males were 1:1.12 and not significantly different from the hypothetical distribution of 1:1. Jirapunpipat (2008) also reported that a higher proportion of *S. olivacea* males were collected from Ranong Province, Thailand with a sex ratio of 1.3:1 with the number of males mangrove crabs.

Table 1. Morphometrics of Mangrove Crabs (n=54) caught in Mangrove Swamps of Panganiban, Catanduanes, Philippines.

Sex	N	%	Carapace Width (cm)		Carapace Length (cm)		Body Weight (g)	
			Size Range	Mean	Size Range	Mean	Size Range	Mean
F	25	47.17	3-13	8	2-11	5.82	20-345	101.65
M	28	52.83	3-17.5	8.33	1.5-14.8	7.39	20-620	120.43

In population studies, the morphometric analysis provides a powerful complement to genetic and environmental stock identification approaches (Cadrin, 2000) and length-weight relationships allow the conversion of growth-in-length equations to growth-in-weight for use in a stock assessment model (Moutopolos & Stergiou, 2002).

Carapace Width (CW) of both male and female crab specimens caught in the study area ranged from 3 to 17.5cm with a mean CW of 8cm (Female) and 8.33cm (Male). (Table 1). Carapace Length of both male and female crab specimens caught in the study area ranged from 1.5cm to 14.8cm with a mean CL of 5.82 (Female) and 7.39 (Male).

Body Weight of both male and female crab specimens caught in the study area ranged from 20g to 620g with a mean BW of 113.28 (Female) and 132.89 (Male) (Table 1).

In this study, the male crab was bigger and heavier compared to female crabs. According to Pinheiro & Fiscarelli, (2009) the tendency of males being larger and heavier than females is a common pattern across many portunids. Furthermore, the larger and stronger carapace of males can be attributed to the necessity for insertion of strong muscles of pereiopods and chelae to guard females during mating and subsequently ensure successful reproduction (Pinheiro & Fiscarelli, 2009 and Alencar *et al.*, 2014). Researchers assumed that a higher weight implies a better condition. This condition factor is influenced by both exogenous and endogenous factors which may vary among seasons and also populations (Froese, 2006; Pinheiro & Fiscarelli, 2009).

Carapace Width and Body Weight Relationship

Information about individual body weight-length/width relationships in populations is important for estimating the population size of stock, specifically for its exploitation. The length-width/weight relationships are regarded as more suitable for evaluating crustacean populations (Atar & Sector, 2003; Gorce *et al.,* 2006; Sangun *et al.,* 2009). Females are smaller in terms of CW and BW compared to males. A scatter diagram for males and females of *S. serrata* was obtained by plotting the CL against CW and CW against BW of individual crabs.

The square of correlation coefficient (r^2) obtained for the CW and CL of males and females was nearly equal to 1 indicating a high degree of positive correlation. (r^2=0.89 and r^2=0.84). It was revealed in the study that the CW of female and male mangrove crabs had the highest correlations. Almost the same r2 value was obtained from the correlation of CW and BW between male and female mangrove crabs with r2=0.83 and r= 0.85 respectively. The exponential value (b) of the relationship of female carapace length and body weight of female and male were 0.31 and 0.30, indicating that females are slightly heavier than males at a given width.

Hence, female and male mangrove crabs showed negative allometric growth both on CL-CW and CW – BW (b<3) showing that carapace length grows faster than carapace width and body weight increases faster than carapace width.

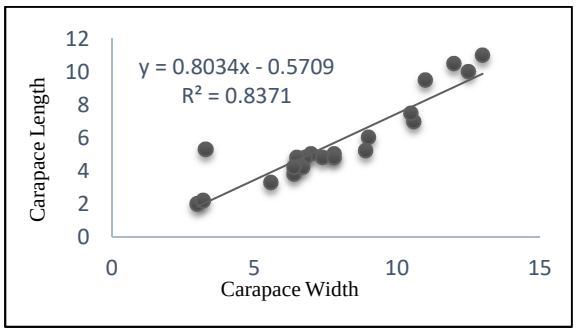

Fig. 5. A linear relationship between CW and CL of female Mangrove Crabs.

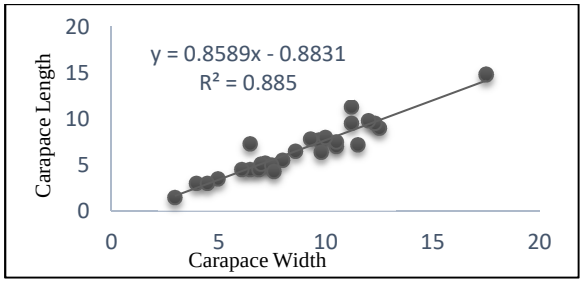

Fig. 6. A linear relationship between CW and CL of male Mangrove Crabs.

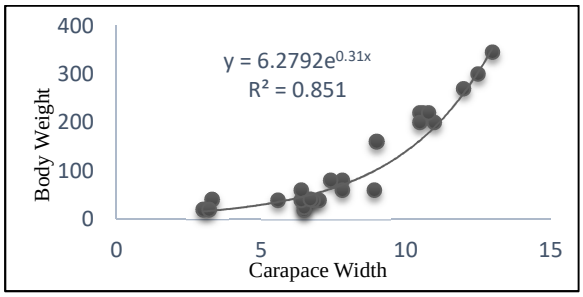

Fig. 7. The exponential relationship between CW, BW of female Mangrove Crabs.

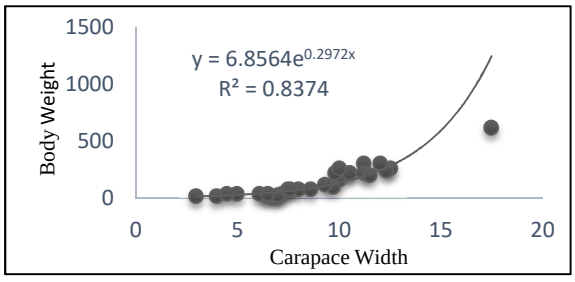

Fig. 8. The exponential relationship between CW, BW of male Mangrove Crabs.

According to Shingleton, (2010) allometric growth is a natural phenomenon occurred during the ontogeny of organisms and it describes the disproportional growth of different body parts. It can be influenced by molting or environmental effects and physical condition (Thompson & Bonner, 1917). Allometric growth includes three main types: (a) ontogenetic, shape changes resulting from different size and age in population; (b) static, shape variation among individuals of the same developmental stage or age within one population; and (c) evolutionary, different species evolving diverse size and/ or shape ratios in individuals of the same age or stage (Shingleton *et al.*, 2007).

This negative allometric trend was also reported in females of *Rhithropanopeus harrisii* (Hegele-Drywa *et al.,* 2014), *Ocypode macrorera* (Dubey *et al.,* 2014), and S. *tranquebarica (T*hirunavukkarasu & Shanmugam, 2011). In another study, the exponent 'b' was found to be 1.3, 2.9, and 3.2 (CW-BW relationship) in juvenile, adult male, and female *S. serrata* respectively (Prasad *et al.,* 1989). In *S. tranquebarica*, the 'b' values of width - weight relationships were found to be 3.2718 and 3.0202 for male and female crabs respectively (Thirunavukkarasu & Shanmugam, 2011). Thus, CW vs. BW relationship is significant for the sustainable exploitation of any species with socio-economic value (Froese, 2006).

Conclusion

Morphometrics of a species is essential as a practical index to determine the condition of the organism. It could also be used for comparison of the same species between regions. Individual body weight-length/width relationships in populations are important for estimating the population size of the stock, specifically for its exploitation. Harvesting of this resource should be minimized to the sizes of >8cm to allow continuous breeding and recruitment thus ensuring the sustainability of this resource. Expand the study to cover other mangrove areas with different mangrove architecture and geological history. More sample size and longer duration of the study should be done. Further studies on the population dynamics of the species considering

additional stations should be conducted to properly represent the total population of the species in a given fishing ground.

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