ALLOMETRIC RELATIONSHIP OF CARAPACE WIDTH AND BODY WEIGHT OF MUD CRAB (*Scylla serrata*) IN PANGUIL BAY, PHILIPPINES

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ABSTRACT

This study is designed to carry out a primary test on the logarithmic relationship of carapace width and body weight of mud crab (Scylla serrata) in Panguil Bay, Philippines. The study made use of descriptive type of research, stratified random sampling and standard measurement for sizing and biomass configuration. The result showed a direct proportion of growth pattern and significant relationships were found between the carapace width and body weight of the mud crab S. serrata collected from the Panguil Bay. The results implicate that the growth of the carapace width of mud crab (Scylla serrata) is influenced by the growth of its body weight or vice versa. However, male mud crab is heavier than female based on its computed logarithmic equations.

Keywords: *Scylla serrata, Allometry, Logarithm*

1.0 Introduction

The mud crab *Scylla serrata* are found in the coastal waters with 15-30 ppt salinity and usually dominates the mangrove fauna (Ali, et. al., 2004). In the Philippines, mud crab species is distributed in the brackish water environment which includes the Panguil Bay. Recent observations reported that mud crab *S. serrata* has been attributed as overexploited in Panguil Bay and has widely continued over the years, causing a perceptible decline of this marine species or even possible extinction. Presently, fishing practices of the fisher folks posed a negative impact on both biodiversity and productivity of aquatic ecosystems. The mud crab is found to be as one of the top export earning aqua-resources in the Province of Misamis Occidental due to its high demand and good price. The export of mud crab from the Panguil Bay has widely increased over time due to its huge availability and high demand in the market in live condition.

In the year 2016, a wide implementation of fishing ban in the Panguil Bay has been regulated by the entire Province of Misamis Occidental in order to minimize the spontaneous catch of marine resources, especially the mud crab *S. serrata.*

Allometry has been used widely by scientists in measuring the body parts of biological organisms (Brown, 2000; Roughgarden, 1998) Allometry, in its broadest sense, describes how the characteristics of living things change with size. Shingleton (2010) defined allometry as scaling relationship between the size of a body part and the size of the body as a whole, as both grow during development. In the recent case, allometry has been widely expanded which includes scaling of biological relationships such as morphological traits (e.g. brain size and body size), physiological traits (metabolic rates and body sizes in animals), and ecological traits (wing size of birds and their flight performance). The systematic allometric study was first documented when Huxley and Tessier (1936) investigated the growth pattern of various parts of the body of a crab *Uca pugnax* to explain the extraordinary developments of the sizes of their claws (chela). To date, studies about allometry are only limited to the species of the mud crab *Scylla serrata* and many are still to be done in order to understand this species which could be found in the Philippines.

In the case of crustaceans, as growth progresses, certain dimension of the animal's body may grow much more than others, resulting in the phenomenon known as relative growth (Hartnoll, 1974 as cited by Gayathre, et. al., 2016). Knowledge of these distinguishing characters and size relationships in sexually mature individuals are of particular importance in the study of commercially important crustaceans. Basis on the studies of relative growth are used to determine changes in the form and size of the abdomen, pleopods or chelipeds during ontogeny.

Lapinig et., al (2016) found that if a static allometric relationship is obtained from measurements of traits of biological organisms, then the first principal component of these measured traits can be used to construct a single numerical allometric index.

The study of the width - weight relationship in aquatic animals has a wide application in showing their growth patterns during their developmental stages (Bagenal, 1978). The width-weight relationships are considered as more suitable in evaluating crustacean populations (Atar& Sector, 2003; Gorce et al., 2006, Sangun et al., 2009). Estimating the relationships of particular parts of the organisms is a useful tool to determine the variations in expected weight from the known length groups which are in turn the indication of its fatness, breeding and feeding states and even fecundity. However, information available on the mud crab is mostly restricted to *Scylla serrata* (Nandi, et. al.,2006, Sangun, et., al., 2009). In order to promote proper conservation and management practices of mud crab, a proper knowledge of its biology is crucial. At present, there are no management policies or regulations of this species (Ali, et. al., 2004).

To date, studies on allometry of the mud crab species found in Panguil Bay are very limited which in fact must be taken consideration for the sustainability of its biodiversity and future conservation. This study is designed to carry out a primary investigation of the

allometric relationship between the carapace width and body weight of the mud crab *Scylla serrata* in the Panguil Bay of Misamis Occidental, Philippines.

2.0 Conceptual Framework

The study was conducted at Brgy. Migpange Bonifacio, Misamis Occidental. Five hundred (500) sample species *of S. serrata* were collected in the study site, categorized into male and female sexes and were individually measured and weighed. Carapace width-weight relationship is calculated using the logarithmic function of weight ($W= aL^b$). The resulting value of the width-weight relationship will determine the level of significance between the two variables.

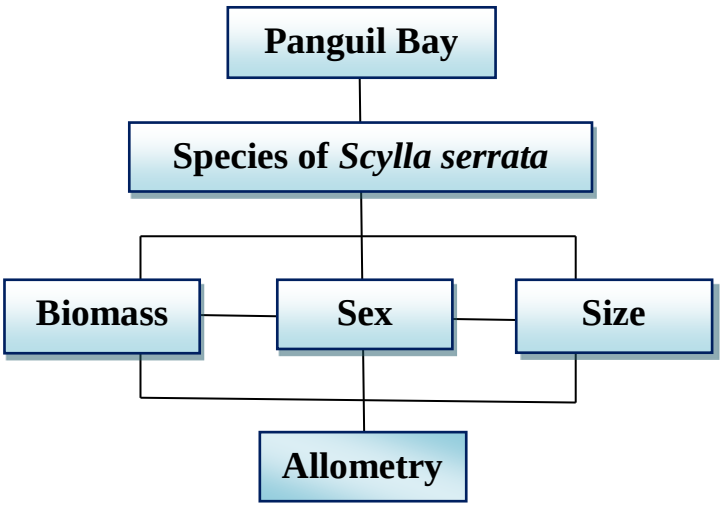

Figure1. Research Paradigm

3.0 Methods and Design

The study made use of a descriptive type of research, stratified random sampling and standard measurement for sizing and biomass configuration. There are 200 samples of female *S. serrata* and 300 males collected from Brgy. Migpange, Bonifacio Misamis Occidental, the primary producer of mud crab in the whole province. *Syclla serrata* was individually weighed using a weighing balance and measured using tape measure. The results were grouped according to the measurement of carapace and the equivalent weight was calculated by getting their average (total weight for the same measurement of carapace).

The relationship of carapace width and weight were computed. All materials were analyzed in fresh condition. The carapace width-weight relationship was estimated using the log form of the allometric growth equation $\mathbf{W= aL^b}$ (Rickter, 1973 as cited by Gayathre et. al. 2016), where **W**= expected weight**, L**= total carapace width, **a**= 'y'- intercept or the initial growth coefficient and **b**= the slope or growth coefficient. The value of constants of **'a'** and **'b'** were calculated by the least square method. The differences in the carapace width-weight relationship of the two sexes was tested by Regression Analysis.

4.0 Results and Discussions

The sex ratio of male as to female is 150:100 which was derived by dividing the total number of male by the total number of female mud crab multiplied by 100. This implies that there is a difference between the populations of the two sexes. The female mud crab has a lower population, compared to the male mud crab because of its high market demand containing high fecundity level. This also implies that the female *S. serrata* is widely caught along the Panguil Bay area compared to the male *S. serrata*.

A scatter diagram, each for male and female in respect to *S. serrata* was obtained by plotting the carapace width and the body weight of individual crabs (figure 3 to 4). Based on the parabolic nature of the plot, relationship exist between the variables indicating a suitability fitting with the exponential formula, $\mathbf{W= aL^b}$ to the data.

The logarithmic equations derived are,

Females (carapace width and body width) : - 1.21 + 2.72
Males (carapace with and body weight) : - 1.96 + 3.16

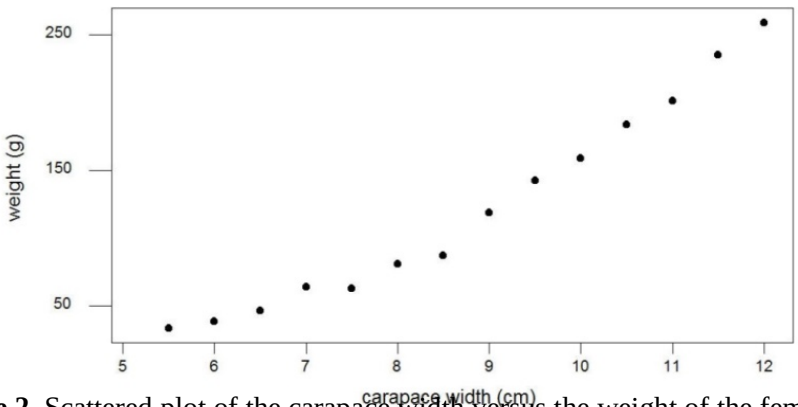

Figure 2. Scattered plot of the carapace width versus the weight of the female

S. serrata

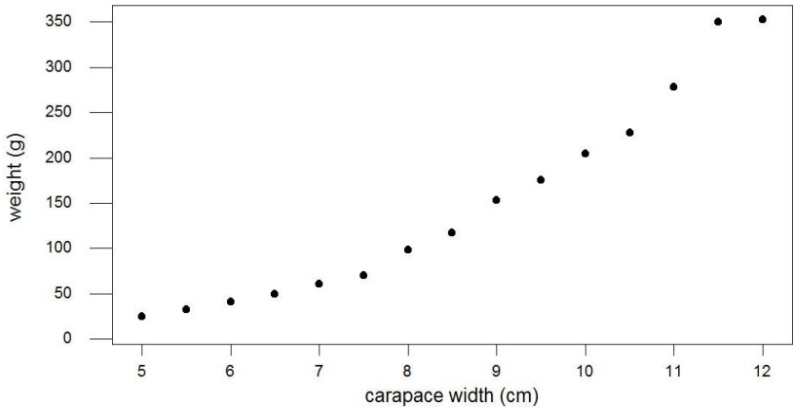

Figure 3. Diagram plot of the carapace width versus the weight of the male *S. serrata*.

The exponential value of (b) of the carapace width of the male and female mud crab *S. serrata* calculated were 2.76 and 3.16, whereas in the body weight of male and female crabs were -1.21 and -1.96, respectively, indicating a closely isometric growth pattern. Furthermore, the 'b' values indicated that the males are heavier than females at a given width and length as affirmed by its significant value ($p < 0.05$). weight in *S. serrata.* The linear plot based on the relationship in width-weight and length-weight suggested that there is a direct relationship in males and females of the animals being studied.

The present results indicate that males are heavier than females in portunid crabs which is in conformity from earlier observations. The slight differences in exponential values may possibly due to differential diet and presumably resulting from size difference, change in weight and cheliped strength, foraging behaviour and metabolic rate of animals (Thirunavukkarasu et. al., 2015).

5.0 Conclusion

The study concludes that the growth of the carapace width of mud crab *(Scylla serrata*) is influenced by the growth of its body weight. However, male mud crab is heavier than female based on its computed logarithmic equations.

References

Jeminez, U. et. al., (2009**)** Panguil Bay Fisheries over the Decades:Status and Management Challenges Journal of Environment and Aquatic Resources. 1(1): 15-31

Bradshaw, C. (2008). Population Ecology:Fecundity.Charles Darwin University, Darwin, NT, Australia C R McMahon, University of Wales Swansea, Swansea, UK[a]2008 Elsevier B.V.

Ali, M. et. al., (2004) Biological Studies of the Mud Crab Scylla serrata (Forksal) of the Sundarbans Mangrove Ecosystem in the Khulna Region of Bangladesh Pakistan Journal of Biological Sciences 7(11): 1981-1987, 2004 ISSN 1028-8880

Brown, J. H. *et al*. (1997). A general model for the origin of allometric scaling laws in biology. *Science* **276**, 122-126 (1997).

Shingleton, A. (2010) Allometry: The Study of Biological Scaling. Nature Education Knowledge 3 (10):2

La Sara et al. (2014) Habitat Characteristics of Mud Crab Scylla serrata in Lawele Bay, Southeast Sulawesi, Indonesia. Department of Fisheries, Haluoleo University KampusBumiTridharmaKendari, 93232, Southeast Sulawesi, Indonesia. Edge J Fish Aqua Sci 31(1):11-18

Novoseltev, N. et al., (2003).What Fecundity Patterns Indicate About Aging and Longevity: Insights From*Drosophila* Studies

Lapinig, V. et., al. (2016). Construction of Allometric Indices by Principal Components Analysis with Application to Biological Classification. Asian Journal, Leceo de Cagayan University.

Thirunavukkarasu N. et. al., (2015). Length-Weight and Width-Weight Relationships of Mud Crab *Scylla tranquebarica*.