

PAPER • OPEN ACCESS

## Condition Factor and Exploitation Rates of *Scylla serrata* in Karang Gading Sumatera Utara

To cite this article: Miswar Budi Mulya 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **305** 012035

View the [article online](#) for updates and enhancements.

# Condition Factor and Exploitation Rates of *Scylla serrata* in Karang Gading Sumatera Utara

**Miswar Budi Mulya**

Department of Biology, Faculty of Mathematics and Natural Sciences,  
Universitas Sumatera Utara, Medan, Indonesia

Email: miswarbm\_ikl@yahoo.com

**Abstract.** Research about the condition factor and exploitation rates of *Scylla serrata* in Karang Gading Sumatera Utara has been done. The aims of the research are to measure and determine of *S. serrata* growth patterns, condition factors, the time needed for *S. serrata* to reach the maximum carapace width, and exploitation rates of *S. serrata* in Karang Gading Sumatera Utara. This research uses purposive sampling methods. Sampling of *S. serrata* use bubu, and data analysis use *Fish Stock Assessment Tool* (FISAT II). The study found that the growth pattern of *S. serrata* is allometric negative, meaning that the increase in body length is faster than weight gain. Based on the value of the condition factors, *S. serrata* in Karang Gading Sumatera Utara have a thin body. *S. serrata* of male take 5 months to reach a maximum carapace width of 13.2 cm, while female crab take 6 months to reach a maximum carapace width of 14.8 cm. The rate of exploitation of *S. serrata* in Karang Gading Sumatera Utara is still underfishing.

## 1. Introduction

The mud crab (*S. serrata*) belongs to Crustacean, order Decapoda and family Portunidae [1]. *Scylla serrata* is a species of mangrove crab that is more commonly found in mangrove ecosystems than other types, such as: *S. tranquebarica*, *S. oceanica*, dan *S. paramamosin*. There are many *S. serrata* in the mangrove ecosystem, according to [2] because this ecosystem is a place to feeding ground and nursery ground, because of the abundant availability of food (detritus, plankton and benthic organisms). The growth of *S. serrata* is getting faster if enough natural feed is available. [3] stated that *S. serrata* can experience weight gain of 2.5 g, and carapace width increase of 0.271 mm through adequate feeding.

Karang Gading is a mangrove ecosystem located on the east coast of Sumatera Utara. In the Karang Gading area, there are many fishermen and communities who catch *S. serrata* in nature. This is because the fulfillment of market demand for this commodity is still sourced from nature. The capture of this biota was generally carried out by increasing the fishing gear, and extending the fishing time. The use of fishing equipment that is not environmentally friendly, can cause *S. serrata* deaths in nature. [4] states that the use of gillnet fishing equipment can cause the mortality of male *S. serrata* by 1.2% and females 1.78%.

In addition, the intensification of high catches and the absence of fishing rules for these biota can also affect the growth and stock of biota in nature. Growth is closely related to conditions, while stock is related to the rate of exploitation. Until now, data and information about the condition factors and



the exploitation rates of *S. serrata* in Karang Gading have never been obtained, for this reason, research is needed.

## 2. Materials and Methods

The study was conducted at 4 stations, in the Karang Gading. Station 1 in the mangrove area, Station 2 in river channel, Station 3 in the upstream, and station 4 in the downstream part of the estuary. Sampling was done using a bubu, which has a diameter of 42 cm and a length of 20 cm. The growth patterns, condition factors, and exploitation rates of *S. serrata* in Karang Gading Sumatera Utara were analyzed using the Electronic Length Frequency Assessment Methods, in the FAO-ICLARM Fish Stock Assessment Tool Programs [5].

## 3. Results and Discussion

### 3.1. The Growth Pattern

The results of the study, obtained 338 *S. serrata*, consisted of 146 male crabs and 192 female crabs. The width of male crab carapace ranges from 6.2 cm-12 cm, weight 57 g-112 g, while for female crabs 6.5 cm-13.2 cm and 59 g-125 g, which can be seen in table 1.

Table 1. Carapace width and body weight of *S. serrata*

<i>S. serrata</i>	N (Individu)	Carapace width (cm)	Body weight (g)
Male	146	6.2-12	57-112
Female	192	6.5-13.2	59-125

Linear regression equation between carapace width and body weight of male crab is:  $\log Y = 0,0791 + 3,144 \log L$  or in exponential form  $Y = 0.0791L^{3,144}$ , with coefficient of determination ( $R^2$ ) = 0,8858, shown in figure 1.

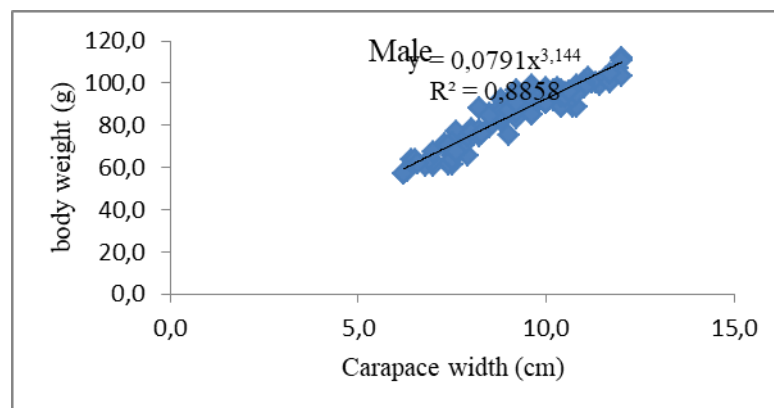


Figure 1. Relationship between carapace width and body weight of male crab

Whereas for females:  $Y = 0,062 + 3.183$  or in exponential form  $Y = 0.062L^{3,183}$ , with coefficient of determination ( $R^2$ ) = 0,9411, which can be seen in figure 2.

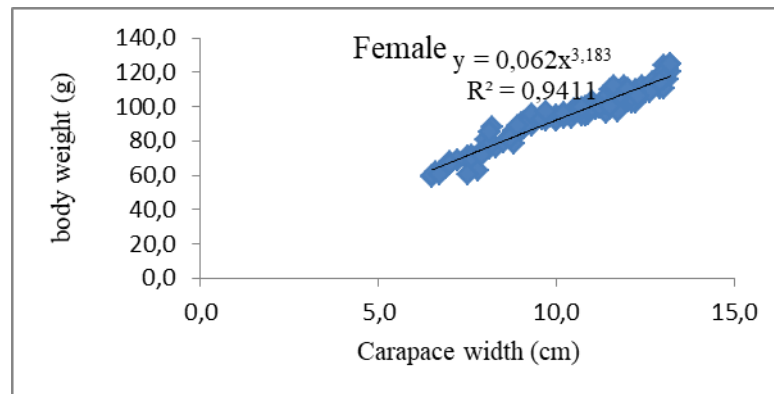


Figure 2. Relationship between carapace width and body weight of female crab

The value of  $b$  illustrates the growth pattern of the *S. serrata*, while the closeness of the relationship between the width of the carapace of the *S. serrata* and body weight can be known through the coefficient of determination, so that through this equation can be determined whether the individu of *S. serrata* population at the study site can be estimated body weight through the size of the carapace width.

The results showed that the growth of *S. serrata* was positive allometric with  $b > 3$ . Based on the value of  $b$ , it can be said that the increase in the weight of *S. serrata* was faster than the increase in carapace width. [8] states that if the value of  $b = 3$ , then the growth is said to be isometric or increase in the width of the carapace is equal to the increase in body weight, whereas if the value of  $b$  is greater or less than 3, the growth is said to be alometric or the width of the carapace increases not equal to body weight. The same opinion is expressed by [6] which states positive allometric growth when the value  $b > 3$ , which illustrates that weight gain is faster than the increase in carapace width, while the growth of allometric is negative when the value of  $b < 3$ , which indicates that the increase in carapace width is faster than body weight.

### 3.2. Condition Factor

The results of the analysis based on growth patterns, found that the condition factors for male and female crab, as shown in figures 3 and 4.

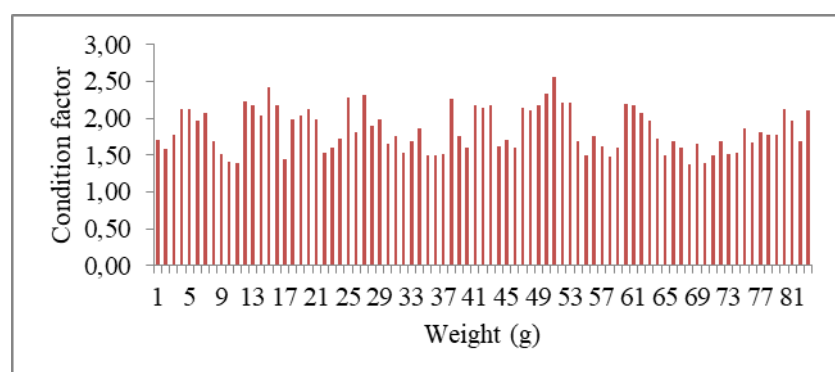


Figure 3. Condition factor of male crab

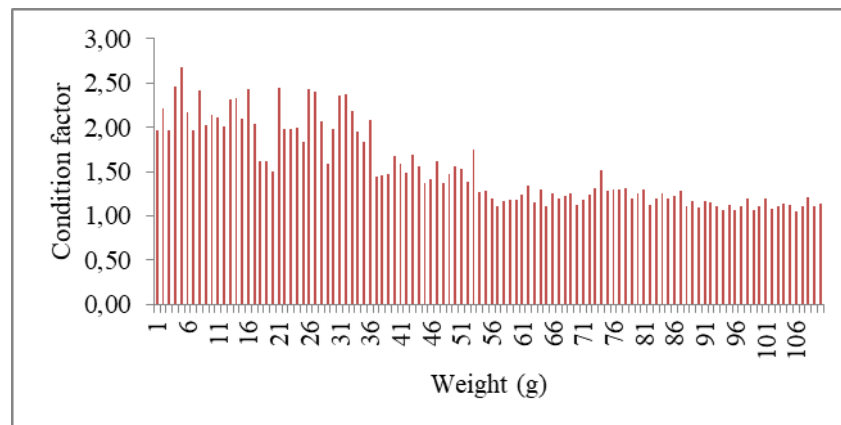


Figure 4. Condition factor of female crab

The results showed that the condition factor values of male *S. serrata* range from 1.37 to 2.56 with an average of 1.84, and for female crab range from 1.05-2.68 with an average of 1.54. This value illustrates that male and female *S. serrata* in the Karang Gading Sumatera Utara have a thin body shape. [7] states that if the condition factor values range from 2 to 4 describe a thin body shape, whereas if it ranges from 1-2 describes a fat body shape.

### 3.3. Frequency distribution of carapace width

The results of the frequency distribution analysis of the width of the carapace of *S. serrata* based on the class interval (Table 2) showed that *S. serrata* with carapace width range from 6.00 cm - 6.89 cm were only found at stations 1, 2 and 3, with 17 tails (station 1), 8 tails (station 2) and 2 tails (station 3). *S. serrata* with a size of carapace width 6.90 cm - 7.79 cm, at station 1 there are 31 tails, station 2 as many as 26 tails, and at station 3 as many as 14 tails. *S. serrata* with a size of carapace width 7.80 cm - 8.69 cm were found at each station, each with 32 tails at station 1, 17 tails at station 2, 19 tails at station 3, and 2 tails at station 4.

Table 2. Frequency distribution of *S. serrata* carapaces width at each station

LCH	UCH	Xi	F1	F2	F3	F4
6.00	6.89	6.45	17	8	2	0
6.90	7.79	7.35	31	26	14	0
7.80	8.69	8.25	32	17	19	2
8.70	9.59	9.15	18	33	19	10
9.60	10.49	10.05	22	28	27	17
10.50	11.39	10.95	10	21	30	24
11.40	12.29	11.85	14	7	33	26
12.30	13.19	12.75	1	0	10	17
13.20	14.09	13.65	1	0	4	21
14.10	14.99	14.55	0	0	0	11

Notes:

LCH : lower class hose

ACH : upper class hose

F : frequency

Xi : average

*S. serrata* with a size of carapace width 8.70 cm – 9.59 cm were found at station 1 as many as 18 tails, station 2 as many as 33 tails, station 3 as many as 19 tails and at station 4 as many as 10 tails. *S. serrata* with a size of carapace width range from 9.60 cm – 10.49 cm were found at station 1 as many as 22 tails, station 2 as many as 28 tails, station 3 as many as 27 tails and at station 4 as many as 17 tails. *S. serrata* with a size of carapace width range from 10.50 cm – 11.39 cm were found at station 1 as many as 10 tails, station 2 as many as 21 tails, station 3 as many as 30 tails and at station 4 as many as 24 tails. *S. serrata* with a size of carapace width range from 11.40 cm – 12.29 cm were found at station 1 as many as 14 tails, station 2 as many as 7 tails, station 3 as many as 33 tails and at station 4 as many as 26 tails.

*S. serrata* with carapace width sizes of 12.30 cm - 13.19 cm were not found at station 2, and only 1 tail was found at station 1. At station 3 there are 10 tails and 17 tails at station 4. The same thing happened to *S. serrata* with a size of carapace width of 13.20 cm -14.09 cm which was also not found at station 2, and only 4 were found at station 3, while the highest was found at station 4 with totaling 21. Interesting things can be seen in *S. serrata* with carapace width size of 14.10 cm -14.99 cm, which is only found at station 4 as many as 11 tails and all of them are female crabs. This is because station 4 is a coastal area that has high salinity and is a spawning place for female crab.

#### 3.4. Mortality and exploitation rates

Estimation of the total mortality rate (Z) was analyzed using the Beverton and Holt method [8]. Estimates of the total mortality of *S. serrata* are carried out with a catch yield curve, based on carapace width data. The result of the mud crab total mortality analysis was 1.60 per year, with natural mortality (M) of 0.92 per year and mortality due to arrest (F) of 0.68 per year. The water temperature at the study location is 29°C, so that the rate of exploitation of (E) *S. serrata* is 0.43 per year.

These results illustrate that the death of *S. serrata* in Karang Gading Sumatera Utara is caused by two factors, namely: natural mortality and arrest mortality, but it is greater due to natural mortality. The value of natural mortality has a strong relationship with environmental conditions, in this case the water temperature. Natural mortality is also influenced by predators, disease and age. The rate of exploitation of *S. serrata* in Karang Gading Sumatera Utara is 0.43. The level of *S. serrata* exploitation is still smaller than the optimal value of 0.5 or is still categorized as underfishing.

#### 4. Conclusions

- The growth pattern of *S. serrata* is allometric negative, meaning that the increase in body length is faster than weight gain.
- Based on the value of the condition factor, *S. serrata* in Karang Gading Sumatera Utara have a thin body
- Male *S. serrata* take 5 months to reach a maximum carapace width of 13.2 cm, while female crabs take 6 months to reach a maximum carapace width of 14.8 cm.
- The rate of exploitation of *S. serrata* in Karang Gading Sumatera Utara is still underfishing.

#### References

- [1] Paul B, Md. H. Faruque, R N Mandal, D A Ahsan. 2015. Nutritional Susceptibility to Morphological, Chemical and Microbial Variability: An Investigation on Mud Crab, *Scylla serrata* in Bangladesh. International Journal of Fisheries and Aquatic Studies. 2(6): 313-319.
- [2] Mirera OD. 2011. Trends in Exploitation, Development and Management of Artisanal Mud Crab (*Scylla serrata* – Forsskal - 1775) Fishery and Small-Scale Culture in Kenya: An overview. Marine and Coastal Management Journal. 54 (11): 855-855.
- [3] Morales MI and RB Barba. 2015. Monoculture of Mudcrabs (*Scylla Serrata*) in Brackishwater Ponds Fed With Golden Apple Snail (*Pomacea canaliculata*). Agriculture Journal. 4 (8): 551-553.
- [4] Sara L. 2010. Study On The Size Structure And Population Parameters of Mud Crab *Scylla serrata* in Lawele Bay, Southeast Sulawesi, Indonesia. Journal of Coastal Development. 3

- (2): 133-147.
- [5] Morales MI and RB Barba. 2015. Monoculture of Mudcrabs (*Scylla Serrata*) in Brackishwater Ponds Fed With Golden Apple Snail (*Pomacea canaliculata*). *Agriculture Journal*. 4 (8): 551-553.
  - [6] Jahan H and MS Islam. 2016. Economic Performance of Live Crab (*Scylla serrata*) Business in The Southwest Coastal Region of Bangladesh. *International Fisheries and Aquatic Studies Journal*. 4 (1): 453-457
  - [7] Effendie M.I. 1997. *Fisheries Biology*. Nusatama Library Foundation. Jakarta
  - [8] Sparre P and SC Venema . 1999. *Introduction to the Assessment of Tropical Fish Stock*. Fisheries Research and Development Center, Agricultural Research and Development Agency, Jakarta. p. 172.