The population and mortality characteristics of mangrove crab (Scylla serrata) in the mangrove ecosystem of Tarakan City, Indonesia

by Agus Indarjo

The population and mortality characteristics of mangrove crab (*Scylla serrata*) in the mangrove ecosystem of Tarakan City, Indonesia

AGUS INDARJO[1], GAZALI SALIM[2,♥], MUFRIDA ZEIN[3], DODDY SEPTIAN[2], STEPHANIE BIJA[4]

[1]Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Diponegoro. Jl. Prof. H. Soedarto, S.H. Tembalang, Semarang 50275, Central Java, Indonesia
[2]Department of Waters Resources Management, Faculty of Fisheries and Marine Science, Universitas Borneo Tarakan. Jl. Amal Lama No. 1, North Kalimantan, Indonesia. Tel.: +62-1153011775, Fax.: +62-551-2052558, ♥email: axza_oke@yahoo.com
[3]Department of Accounting, Politeknik Negeri Tanah Laut. Jl. A. Yani Km. 6, Tanah Laut 70815, South Kalimantan, Indonesia
[4]Department of Fisheries Product Technology, Universitas Borneo Tarakan. Jl. Amal Lama No. 1, North Kalimantan, Indonesia

Abstract. *Indarjo A, Salim G, Zein M, Septian D, Bija S. 2020. The population and mortality characteristics of mangrove crab (*Scylla serrata*) in the mangrove ecosystem of Tarakan City, Indonesia. Biodiversitas 21: 3856-3866.* The mangrove crab is an iconic species of Tarakan City and is often is used as a souvenir. However, the high demand for this species can cause its population to decline. This study aimed to characterize the mangrove crab (*Scylla serrata*) population in the mangrove ecosystem of Tarakan City, North Kalimantan, Indonesia. This study was designed using a quantitative descriptive method with a case study model. The samples of mangrove crabs were obtained from 6 different stations using a purposive sampling method. The mangrove crab specimens were caught using 35-50 units of crab traps known as the ambau brackets. The primary data included carapace length, carapace width, carapace thickness, sex, and the total weight of each mangrove crab specimen. The results showed that male mangrove crabs have positive allometric growth when the condition index was fat. However, female crabs exhibited negative allometric growth when the condition index was thin. The Von Bertalanffy growth model analysis showed that the maximum carapace length of male mangrove crab in the mangrove ecosystem of Tarakan City was approximately 11.1118 cm for 189 days, while the female length was 9.6474 cm for 80 days. The total mortality value of male and female crabs was 120.01% and 154.94%, the mortality due to fishing was 84.69% and 135.75%, and natural mortality was 35.32% and 19.2%, respectively. The estimated rate of exploitation of both male and female crabs was 70.57% and 87.61%, respectively. The exploitation of *S. serrata* in the mangrove ecosystem of Tarakan City was evident, hence, conservation efforts are urgently required.

Keywords: Condition index, growth, mortality, population, *Scylla serrata*

INTRODUCTION

Tarakan is a coastal area with a large number of biological resources, including marine biota of sandy and muddy coastal ecosystems, coral reef, seagrass, marine, estuary (Nirmale et al. 2012), and mangrove ecosystems (Quinitio et al. 2011; Salim et al. 2018). Mangrove ecosystems not only protect the coastal area from abrasion, wind, and waves (Talib 2008) but also serve as an ecological habitat for many aquatic biotas, especially crustaceans (Nirmale et al. 2012). Mangrove ecosystems provide habitats, spawning grounds, shelters, and food to many marine animals (Fawwaz et al. 2019), including glodok fish, shrimp, uca-uca crabs, stone crabs, and mangrove crabs (Salim et al. 2018). Salim et al. (2018) reported three genera of crabs available in the Tarakan Mangrove Ecosystem, which are *Uca* sp., *Menippe* sp., and *Scylla* sp. The *Scylla* sp is also known as the mangrove crab because of its habitat within the mangrove ecosystem. This crab has become the icon of the Tarakan City as it is popular with both locals and tourists. Mangrove crabs are also one of the important commodities with high economic value that can still be obtained from the natural environment (Muchlisin and Azwir 2004; Muchlisin et al.

2006). According to Afrianto and Liviawaty (1993), 100 grams of mangrove crab meat (*Scylla serrata*) contained 13.6 grams protein, 3.8 grams fat, 14.1 grams carbohydrate and 68.1 grams of water. (Fujaya et al. 2001) noted that the high protein content (62.72%) caused the meat to taste good (Suprapto et al. 2014).

According to Sentosa and Syam (2011), the needs of mangrove crabs are derived from catches in nature that are fluctuating largely. According to Dumas et al. (2012) and Salim et al. (2018), the high demand for mangrove crabs, both in Tarakan City and elsewhere, has a significant impact to the natural *S. serrata* population. The preservation of natural mangrove crabs can have a serious impact on its population (Le Vay 2001; Sentosa and Syam 2011). The Government of Tarakan City Fisheries Marine Official (2016) recorded a significant increase in *S. serrata* catches for three consecutive years from 2014, 2015, and 2016 to be 180.1 tons, 1725 tons, and 1568 tons, respectively. High demand results in population decline (Agus 2008). The central government's Ministry of Maritime Affairs and Fisheries of the Republic of Indonesia, which was in PERMEN-KP No.1 of 2015, regulates the re-release of mangrove crabs. The ministry reported that mangrove crab sizes were below the catchable

standards of > 150 mm and for females that had mature gonads (mangrove crab lay eggs (Fitri et al. 2017, Siringoringo et al. 2017). A study to analyze the growth trait model and condition index of mangrove crabs (*Scylla serrata*) originating from estuary waters of Tarakan City (Salim et al. 2018) was previously conducted, and the results showed that the crabs exhibited negative allometric growth. The condition index, expressed in term of shell dimensions (carapace length) and total weight for males and females, was dominated by fat body shape, while the condition index between shell dimensions (width and thickness of carapace) with the total weight for males was dominated by thin body shape. The sex ratio analysis revealed there were more females than males. At present, no study on Von Bertalanffy allometric models on the mangrove crabs (*Scylla serrata*) population in the coastal area of Tarakan conducted. Hence, this study was conducted to determine the natural growth condition of mangrove crabs in the coastal area of the Tarakan Mangrove Ecosystem and estimate the level of exploitation based on the mortality rate.

MATERIALS AND METHODS

Sampling site and duration

This study was conducted in the Tarakan Mangrove Ecosystem of Tarakan City, North Kalimantan, Indonesia

for four months, from November 2017 to February 2018. The sampling site was divided into six stations: Station 1 was located in plot 1 (Mangrove of Pamusian river), Station 2 was located in plot 2 (the mangrove area behind the Juata International Airport), Station 3 was located in plot 3 (the mangrove ecosystem behind Bank Rakyat Indonesia), Station 4 was located in plot 7 (upstream mangrove river estuary), Station 5 was located in plots 4, 5, 6, 8, 10 (mangrove conservation area), and Station 6 was located in plot 9 (downstream of the mangrove river estuary). The stations were designed according to the purposive sampling method (Figure 1).

Crab sampling

This study used quantitative descriptive methods with a case study model.he mangrove samplings were conducted in the 6 predetermined sampling stations. The coordinates of the sampling stations were recorded by a global positioning system. The mangrove crabs were captured using 35-50 units *ambau* brackets baited with eel. The carapace length, carapace width, and carapace thickness were measured by vernier caliper. The mangrove crabs' weights were recorded using an electrical balance. The sex of the crabs was determined by looking at the abdomen (apron).
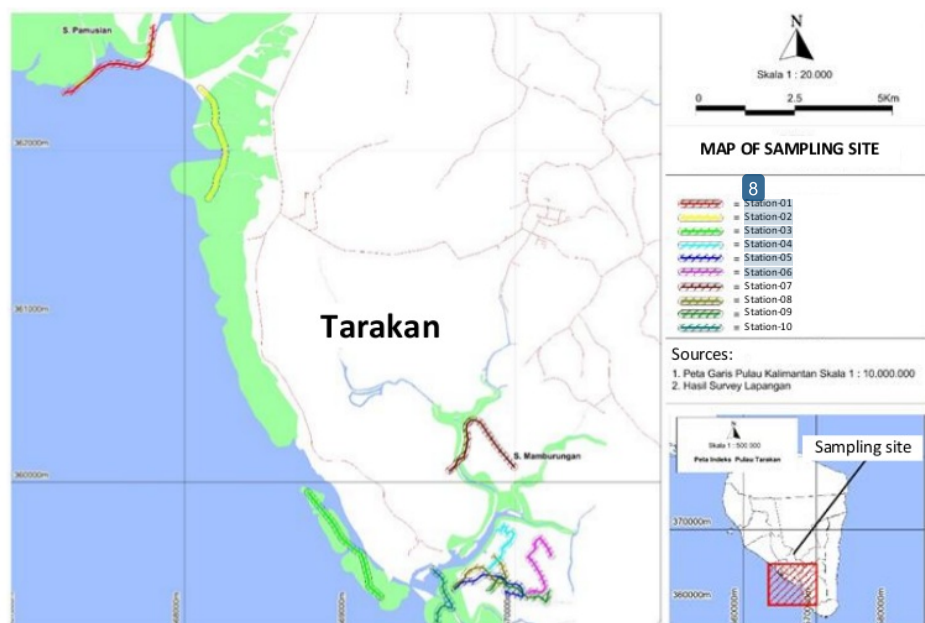

Figure 1. Sampling stations for the *Scylla serrata* within the Tarakan Mangeove Ecosystem, East Kalimantan, Indonesia

Data analysis

The data were analyzed following Gosling et al. (2002) and Effendie (2002). The analysis of every parameter is shown below:

Correlation of carapace dimension and total weight

The correlation of carapace dimension (length, width, thickness) and total weight was established following (Effendie 1979).

$$Y = a \pm X^b; \text{ or } \log Y = \log a \pm b \log X$$

Where;
Y: total weight (gram),
X: carapace dimension (length, width, and thickness) (mm),
a and b: Constant (*intercep*).

Condition index

Condition index of the crustacea can be caraterized into five criteria i.e. Very thin body shape (0.01-0.50), Thin body shape (0.51-0.99), Proportional/ideal shape (1), Fat body shape (1.01-1.50), and Very fat body shape (>1.50) (Salim 2013, Firdaus et al. 2018 , Firdaus et al. 2020).

The allometric growth was evaluated following Weatherley (1972), For isometric growth, methods suggested by Lagler (1949) and Effendie (1979) were used.

$$K_{(TI)} = 10^5 x \frac{W}{L^3}$$

Where:
W: total weight (gram),
L: total length (mm),
10^5: the equation was taken, so $K_{(TI)}$ value is close to 1.

The crab condition factor with allometric characteristic was obtained using equation (Weatherley, 1972) as follow:

$$Kn = \frac{\hat{W}}{W}$$

Where:
W: total weight (gram),
$\hat{w}$: logarithm of total weight (gram),
W: a L^b obtained using the regression equation of length-weightcorrelation.

Absolute growth

The absolute growth was determined following Von Bertalanffy model (Sparre and Vename 1999).

$$Lt = L\infty \left(1 - e^{-k\,(t-t0)}\right)$$

Where:
Lt: Length of *S. serrata* when t age (time),
L∞: Asymptotic length of *S. serrata*,
K: Growth coefficient of *S. serrata* (each of time),
t_0: Theoritical age of *S. serrata* when length equals zero

Age structure

The age structure was estimated using the shift mode class that correlate with Von Bertalanffy model (Sparre and Vename 1999) as follow:

$$(\Delta L/\Delta t) = (L_2 . L_1)/(t_2 - t_1)$$
$$L_{(t)} = (L_2 \pm L_1)$$

Where:
ΔL/Δt: Relative growth of *S. serrata*,
ΔL: Length of *S. serrata*,
Δt: Time range in sampling of *S. serrata*,
$L_{(t)}$: Average length of mode

The results calculation by using the age structure variable of *S. serrata* by plotting the values of $L_{(t)}$ dan $(\Delta L/\Delta t)$ to obtain the following linear line equation:

$$Y = a \pm bx$$

Where:
a: $((\sum y/n) - (b\,(\sum x/n)))$
b: $(n\sum (xy) - (\sum x)\,(\sum y))/(n\sum x^2 - (\sum x)^2)$

The average length value of the long mode uses the linear regression equation method to calculate the asymptotic length (L∞) of *S. serrata* which is -a/b, while the growth coefficient (K) of *S. serrata* b.

The theoretical age of *S. serrata* when the length is equal to zero can be estimated separately using the empirical equation (Sparre and Vename 1999).

$$\log(-t_0) = 0,3922 - 0,275\,(\log L\infty 1,038\,(\log K)$$

Where:
L∞: asymptotic length of *S. serrata* (cm),
K: Growth rate coefficient of *S. serrata*,
t_0: Theoritical age of *S. serrata* when the length equals to zero (year)

Mortality

Natural mortality (M) of *S. serrata* was estimated using Pauly's empirical formula (Pauly, 1984), where:

$$\log M = 0.152 - (0.279 \log L\infty \pm 0.6543 \log K \pm 0.4634 \log T$$

Total mortality (Z) of *S. serrata* was estimated using the Beverton and Holt formula (Sparre and Venema 1998, 1999) as follows:

$$Z = K \cdot \left[\frac{L_\infty - \bar{L}}{\bar{L} - L'}\right]$$

Mortality capture (F) of *S. serrata* as follows:

$$F = Z - M$$

The exploitation rate (E) of *S. serrata* used the formulation of Baranov (Sparre and Venema 1998, 1999) as follows:

$$E = \left[\frac{F}{F+M}\right] \cdot \left[\frac{F}{Z}\right]$$

Where:
E: Rate of exploitation *S. serrata*,
Z: Total mortality *S. serrata*,
F: Capture mortality *S. serrata*,
M: Natural mortality *S. serrata*

Table 1. Correlation growth criteria between carapace dimension and total weight

No.	Correlation value	Correlation criteria
1	0	No correlation
2	>0-0.25	Very weak correlation
3	>0.25-0.5	Sufficient correlation
4	>0.5-0.75	Strong correlation
5	>0.75-0.99	Very strong correlation
6	1	Perfect correlation

RESULTS AND DISCUSSION

The mangrove crab (*Scylla serrata*) survey in the coastal mangrove ecosystem of Tarakan City obtained 199 male and 164 female crabs, representing 54.82 % and 45.18% (Figure 2) of the total mangrove crabs catch, respectively. The ratio of male and female crabs is 1.21: 1. This finding agrees with the study of Firdaus et al. (2020), who found there more male than female crabs in both the December (2018) catch (1.65: 1) January 2019 (1.21: 1) catches, respectively. The male and female crabs were divided into 10 carapace length classes (Figure 2). According to Tahmid and Fahrudin (2015) and Tahmid et al. (2015), in terms of size, the crabs collected from Kahayan Delta was smaller than that from Tibi Island. This phenomenon might be caused by the discrepancies of habitat conditions in both locations. A similar result was also found in east Kutai (Wijaya 2010), that have crabs size smaller than in mangrove habitat or the sea (Widigdo et al. 2017).

The carapace lengths of the *S. serrata* were distributed quite evenly according to sexes. Figure 2 shows the percentage of each length class for both male and female crabs. The analysis showed that male crabs having carapace length ranged from 52.5 mm to 91 mm had matured. This agrees with the finding of (Agus 2008) who found male mangrove crabs matured when the carapace width is 100 ± 10 mm. Based on the size of the claws, it has a carapace width range of 150 ± 10 mm.

Figure 2 shows the smallest class size (60.3 ± 1.3 mm). There are five female crabs in 3% (Figure 3), and the three largest (90 ± 2.0 mm) crabs in 1.8% (Figure 3). The highest distribution found 36 *S. serrata* crabs (Figure 2) with a standard deviation of 2 different sizes, which was 72 ± 1.6 mm and $75,3\pm1.6$ mm. According to Sara (2010), juvenile crabs have a carapace width of <70 mm, The juvenile mangrove crab has a carapace width with a size of 70-120 mm (95 ± 25 mm), The adult phase of mangrove crabs have larger carapace widths of > 120 mm. According to Agus (2008), the carapace widths of female crabs range between 100 ± 20 mm in the mature gonad category. The different sizes of male and female mangrove crabs found in waters around Tarakan City could be due to the abundance of food in the mangrove ecosystem. Hill (1982) stated that the growth continuity of mangrove crabs is influenced by its reproductive biological process and the availability of natural foods.

Figure 4 shows the carapace length size standard deviation of male and female *S. serrata* obtained three different class sizes using the class division formula. Males that were 57.7 ± 5.2 mm were small (as many as 72 crabs, or 36.18%)(Figure 5). The adult size with a mature gonad was 69.4 ± 6.3 mm (91 crabs, or 45.73% (Figure 5). The oldest, largest crabs had a carapace length of 83.4 ± 7.4 mm (as many as 36 crabs, or 18.09% (Figure 5). Most of the dominant catches of males in the natural waters were mature. This finding is consistent with the studies shown in Figures 3 and 4, which explained that both males and females are, on average, medium size. The standard length deviation for adult male crabs was 63.6 ± 1.7 mm as many as 28 crabs (Figure 2), or 14.1% (Figure 3), the largest size was 67.2 ± 1.8 mm ((34 crabs (Figure 2), or 17.1% (Figure 3) and the size was 71.0 ± 1.9 mm as many as 28 crabs (Figure 2) with 14.1% (Figure 3). However, based on the research from (Agus 2008, Bonine et al. 2008), mature male crabs have a carapace width of 100 ± 10 mm.

The female crabs have the same results as the male crabs. Figures 4 and 5 show that there were three different classes for female sizes as well. The small size class was 63.7 ± 4.7 mm (as many as 37 crabs, or 22.56%), the length of adult or mature carapace was 73.8 ± 5.4 mm (108 crabs, or 65.85%), and the oldest, largest crabs were 85.6 ± 6.3 mm (19 crabs, or 11.59%). The results for female crabs predominantly found in adult or moderate size. This finding is follows Figures 2 and 3. For female crabs, the carapace length for 29 crabs (17.1%) was 68.9 ± 1.5 mm, for as many as 36 crabs (22%), the size was 72 ± 1.6 mm, and 36 crabs (22%) were 75.3 ± 1.6 mm. However, according to Agus (2008) and Bonine et al. (2008) adult female crabs with mature gonads had carapace widths from 80 to 120 mm (100 ± 20 mm).

Figures 4 and 5 showed that the ambau fishing gear is not a selective fishing gear category. However, it was environmentally friendly because there is a dominant measure of growth undergoing a mature process gonad or adult so that it can disrupt the ability to recruit and capture or change natural selection.

Results of allometry growth

The mangrove crab studies in the coastal area of Tarakan City sampled 363 crabs, including 199 male and 164 female crabs. Theere were 10 sample collection locations in 6 different stations. Station 1 was in the mangrove ecosystem of the Pamusian river area. Station 2 was in the mangrove area behind the Juata International Airport. Station 3 was in the mangrove area behind Bank Rakyat Indonesia. Station 4 was in the upstream mangrove ecosystem of Mamburungan. Station 5 was in the mangrove conservation area of Mamburungan. Station 6 was downstream of the mangrove ecosystem of Mamburungan. The results of research on the growth of allometry from six different stations are illustrated in Table 3.

Table 3 compares allometric growth models for male and female crabs in nature. The male crabs had positive allometric growth at Station 1, Station 2, Station 4, and Station 5. However, at Station 3 and Station 6, male crabs had negative allometric growth. There may have been

large-scale catches or exploitation for male crabs at Station 3 and Station 6, causing pressure on the large-sized crab population due to market preference for male crabs. The locations of Station 3 and station 6 are in residential areas, which are likely fishing grounds for mangrove crabs.

However, the growth models of male crab allometry show that Station 1, Station 2, Station 4, and Station 5 are ecologically preferable habitats for male mangrove crab growth in terms of body weight or body size. The male mangrove crab in those areas has a positive allometric body shape where the weight growth exceeds size growth. The environmental conditions for Station 1, Station 2, Station 4, and Station 5 are mangrove swamps with no human settlements. Male crabs are rarely caught because of low market value due to no egg production.
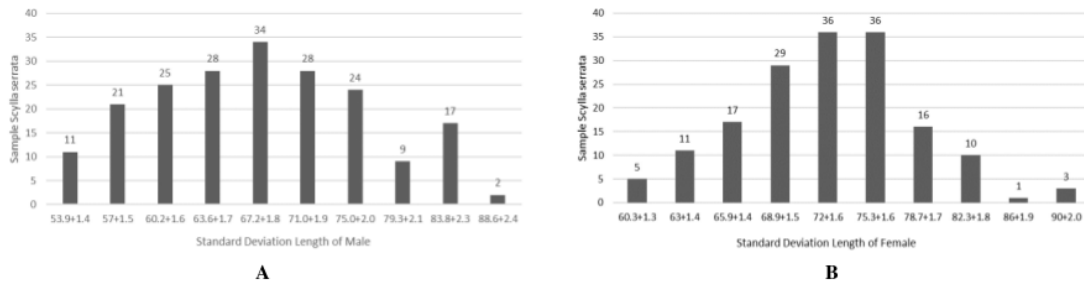

Figure 2. Carapace Length deviation standard of male (A) and female (B) *Scylla serrata*
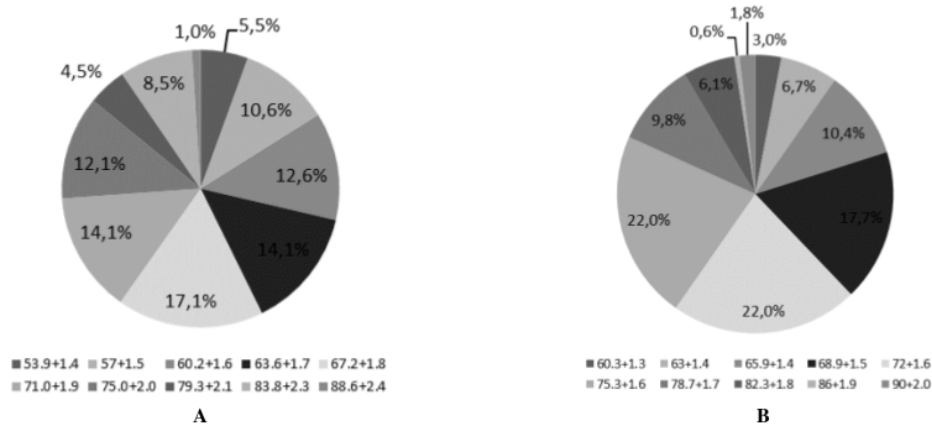

Figure 3. Distribution of length classes in male (A) and female (B) *Scylla serrata* caught in mangrove ecosystem of Tarakan city
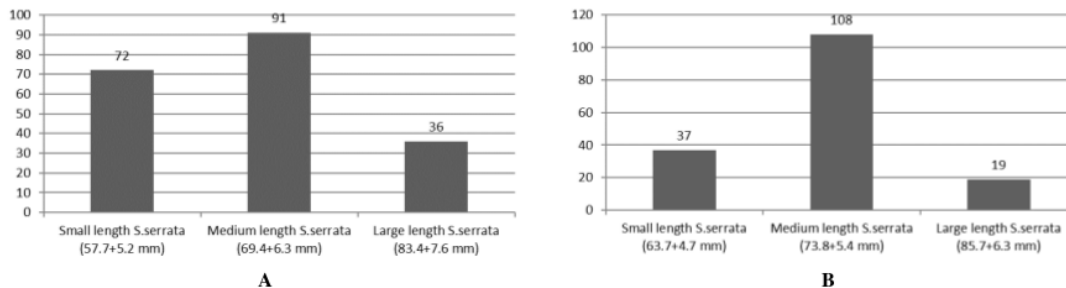

Figure 4. Carapace length size deviation standard of male (A) and female (B) *Scylla serrata*
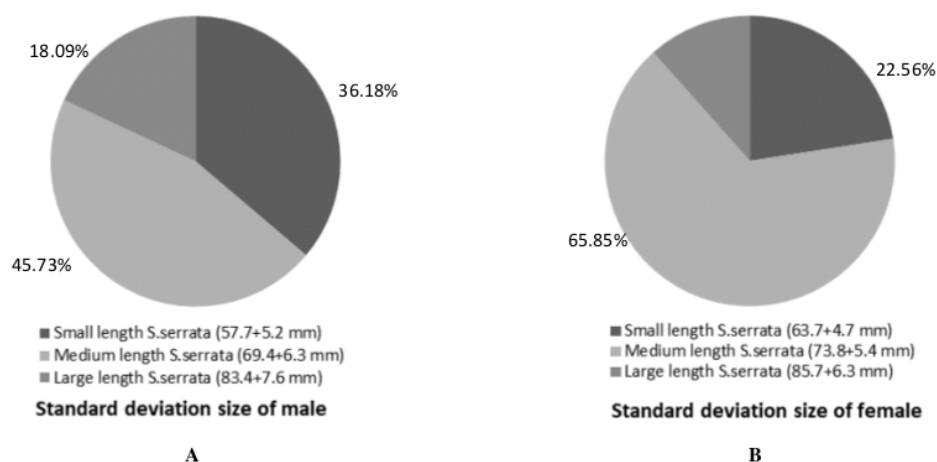
Figure 5. Percentage of standard size deviation of male (A) and female (B) *Scylla serrata*

Table 2 explains the allometric growth models of mangrove crabs. This study indicated that females exhibited negative allometric growth. Station 6 had smaller crabs, possibly because of the massive exploitation of female crabs due to higher demand and better market prices over male crabs. If this is done continuously without proper management (cultivation), mangrove crab populations in the mangrove ecosystem of Tarakan City will soon be depleted.

The allometric growth model between male and female crabs indicated that mangrove crabs are more sought after by fishermen or the community around the sampling station. The female mangrove crabs supplement the fishermen's livelihoods due to the better market price and because of the protein content from eggs. Also, female crab populations are likely to decline, which is consistent with this study's results in terms of the number of catches. The overall catches showed that male crabs dominate (199 male and 164 female crabs). If this is allowed, it will affect mangrove crab degradation by causing exploitation pressure that affects the growth of females in nature. Meanwhile, the reason for female exploitation was weight, the highest total weight for females reaches 365 grams, compared to 528 grams for males.

Based on the study results in Table 3, the average allometric growth of male mangrove crabs is positive because they have an average value of b over 3. According to Effendie (2002), who stated that if the value of b > 3, then the growth of male mangrove crabs was positive. A higher b value of male crabs was observed in other research of *S. serrata* in India (Mohapatra et al. 2010), Philippines (Cagayan, Camarines, Samar, and Surigao (Quinitio et al. 2011), Mozambique (Toivio 2015), Bengkulu (Herliany 2015), and in Bulungan District, North Kalimantan, Indonesia (Widigdo et al. 2017). This result is different from that of female mangrove crabs, which have negative allometric growth properties (Table 3) due to the value of b less than 3. The negative growth of female mangrove crabs was observed in other research of *S. serrata* in the mangrove forest, Village of Belawan Sicanang, Sub-district of Medan Belawan, Province of North Sumatra

(Siringoringo et al. 2017). Effendie (2002) stated that if the value of b < 3, then the growth of female mangrove crabs has negative allometry. Other brachyuran species had estimated to have higher b value in males than females (Josileen 2011; Araújo and Lira 2012). This biological character was also discovered in *S. tranquebarica*. The b value of males in *S. tranquebarica* was higher than that in females in India (Mohapatra et al. 2010; Thirunavukkarasu and Shanmugam 2011).

Condition index

Effendie (2002), Lagler et al. (1962), and Salim (2010) explained that the condition index is the growth used to obtain an analysis of fish species population data by knowing the body shape of fish. According to Salim (2013), a condition index is a number that shows the part of growth both in terms of length, thickness, and width of carapace with a total weight that cannot be separated from the linear regression model between length and weight growth (allometric growth), by obtaining a number that described the individual body shape of each species (Salim 2013). According to Effendi (2003), the condition index can be divided into 5 categories as follows: (i) CI (Condition Index) 0.01-0.49 indicate very flat body shape, (ii) CI values ranging from 0.50 to 0.99 indicate that the body shape is flat, (iii) CI values ranging from 1.00 indicate that body shape is proportional, (iv). CI values ranging from 1.01-1.50 indicate that the body shape is fat, 5) CI values ranging from > 1.51 indicate that the body shape is very fat.

Table 2. Modification of Condition Index from Effendi (2003)

No.	Value range CI (Condition Index)	Body shape Crustacea
1	0.01-0.49	Very flat/lean
2	0.50-0.99	Flat/lean
3	1.00	Proportional/ideal
4	1.01-1.50	Fat
5	>1.50	Very fat

Table 3. The comparison of allometry growth model for male and female crabs *Scylla serrata*

No. Stasiun	Allometry growth model of male mangrove crabs				Allometry growth of female mangrove crabs			
	Amount	Carapace length-total weight	Carapace width-total weight	High carapace-total weight	Amount	Carapace length-total weight	Carapace width-total weight	High carapace-total weight
1	20	3.7621	3.5597	3.4937	15	2.2326*	2.2984*	2.0576*
2	17	3.6646	3.6605	3.5040	20	2.1836*	2.2716*	2.2599*
3	21	0.9623*	1.5983*	1.6237*	17	2.5947*	0.8211*	2.3818*
4	24	3.2809	3.4478	3.0189	15	2.2738*	2.2489*	2.209*
5	17	3.4688	3.4741	3.0943	23	2.5527*	1.6933*	2.6681*
6	100	2.956*	2.9642*	2.5863*	74	2.0396*	1.353*	2.109*

Note: *: negative allometry

Based on the research data from different locations of male mangrove crabs [5] obtained four sizes of body shape in Figure 6, they are thin body, ideal body, fat body, and very fat body shape. However, the condition index of male mangrove crabs in each location was dominated by fat body in the range of 50-60% (55.5±5%). According to Salim et al. (2018) the fat body shape was found about 52%. There are three body shapes in female mangrove crabs (Figure 6), that was thin body, ideal body, and fat body shape. However, based on Figure 6, the dominant body shape in each sampling station was the thin body with a range of percentage values of 20-70.6% (45.3±25.3%). Meanwhile, it was different from the study of (Salim et al. 2018), who found the dominant female body shape was fat at 50% percentage.

Based on the results, male growth is better than females (see Figure 6). This could be due to the behavior of male mangrove crabs, which are more aggressive in finding food in the environment. The female crab, on the other hand, grew faster (see Figure 4), but the body shape was thin (see Figure 6) because more energy was used for gonad development. This is consistent with the finding of (Tahya et al. 2016), who noted that male mangrove crabs have higher levels of aggressiveness than females in the movement of food intake. In physiology, energy is good for molting preparation. Still, it was not for the growth of eggs (gonads), so the greater amount of energy meant male crabs would be heavier than female crabs.

Absolute growth

The current study revealed male crabs had carapace lengths ranging between 52.5 and 91 cm, with weight ranges 105-528 grams. Female crabs had carapace lengths that ranged between 59 and 92 cm with weight ranges from 129 to 365 grams. The observation from the body shape revealed that the mangrove crabs had enough food, but much energy is used for growth. The condition indices reflect the interactions between biotic and abiotic factors that influence the physiological processes in fish (Rahman et al. 2012). According to Warsiati (2003), growth is influenced by several factors, both biotic and abiotic. The biotic factors such as age, size, sex, availability of food, activities around the habitat, and population influences, abiotic factors include temperature, light, salinity, and water quality.

Figure 7 shows the regression between the age of male and average factor of carapace length. The maximum growth of male *S. serrata* is estimated to be 118.180 cm. For females, it was estimated to reach a maximum length of 94.474 cm. According to Zafar et al. (2006), the growth rate of the carapace length of mangrove crabs is determined by natural activities such as the molting process.
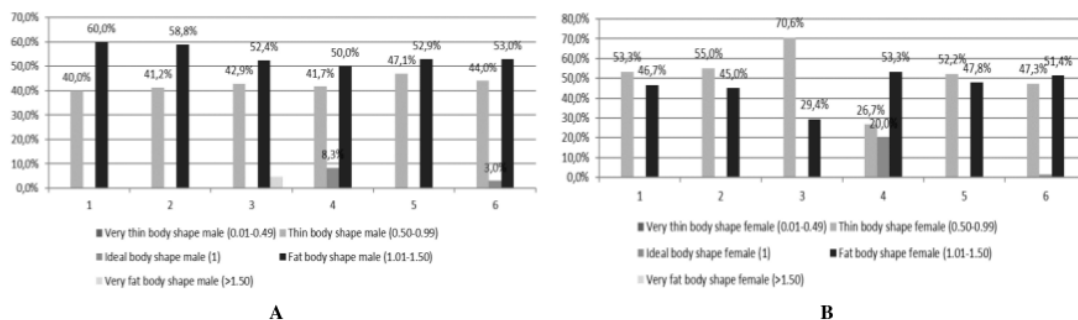
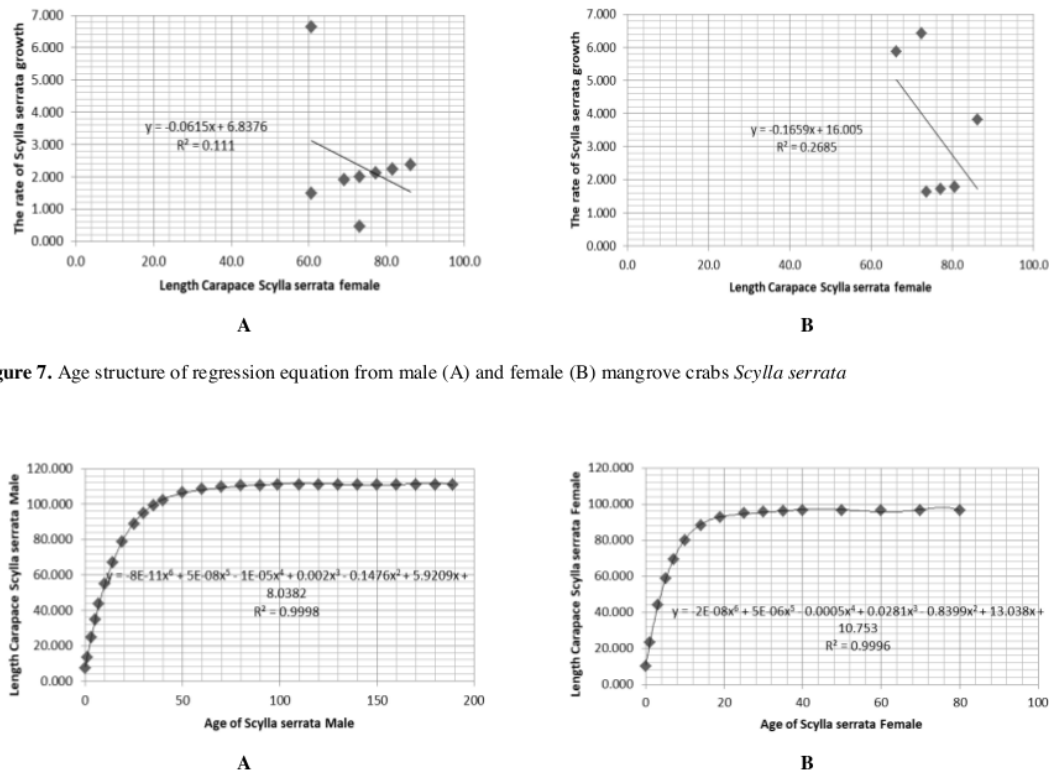**Figure 6.** Criteria of condition index for male (A) and female (B) *Scylla serrata*

Figure 7. Age structure of regression equation from male (A) and female (B) mangrove crabs *Scylla serrata*

Figure 8. Von Bertalanffy model of male (A) and female (B) mangrove crabs *Scylla serrata*

The maximum length growth of mangrove crabs, based on fishermen's catches, showed that male growth is longer than female. However, the maximum growth indicates that the length growth of male mangrove crabs reaches a long maximal carapace compared to females. The figure above explains that the k value of female mangrove crabs is 0.1659/year higher than male crabs of 0.0615/year. It explains that female crabs grow faster than males. This is consistent with the finding of (Zafar et al. 2006), where the growth of female mangrove crabs in Bangladesh was 0.36/year higher than male crab with the values of 0.28/year. (Tahmid et al. 2015) also noted that female crabs grew faster (0.39/year) than male crabs (0.36/year) on Riau Island.

In the opinion of Sparre and Venema (1999), the magnitude of k value coefficient used as a reference in determining the growth rate of mangrove crabs addition in reaching the maximum length/asymptotic (L∞). Based on (Sara 2010) that there was a difference in the coefficient of the k value that occurs in male and female mangrove crabs, especially the sex ratio found in nature, where the growth rate of females was faster than males. Hence, the impact on the number of molting occurs from females, which causes a strong correlation to the growth of crab claws. Wijaya (2011) also said that the growth of mangrove crabs is influenced by the difference of original habitat environmental quality in nature.

In Figure 8 obtained the Von Bertalanffy equation model of male mangrove crab where the orthogonal type 6 polynomial equation is $y = -8E11x^6 \pm 5E\text{-}08x^5\text{-}1E\text{-}05x^4 \pm 0.002x^3\text{-}0.1476x^2 \pm 5.9209x \pm 8.0382$ with a correlation value of 0.999 and a model of 0.999 and 5E-08x5-1E-05x4±0.002x3-0.1476x2±5.9209x±8.0382 with a correlation value of 0.999 and female mangrove crabs get the orthogonal type 6 polynomial equation is $y = -2E\text{-}08x^6 \pm 5E\text{-}06x^5\text{-}0.0005x^4 \pm 0.0281x^3 \pm 13.038x \pm 10.753$ with a correlation value of 0.999.

Figure 8 explains the growth using Von Bertalanffy model that the maximum growth of male was 11,118 cm in an interval of 189 days, where at the beginning of their lives (zero days) have a long growth of 7,186 mm, then Figure 7 describes the maximum carapace length of female was 9,6474 cm for 90 days. Still, the carapace length growth was 0.9949 cm at the beginning.

During the interval of a month (30 days), the growth of male mangrove crabs was 9.4747 cm, while the growth of females reached around 9.5877 cm. If it was compared to female growth, which reaches a maximum length at 80 days with a carapace length was 9.6447 cm, the growth of males at 80 days has a carapace length reach to 11.042 cm.

In terms of marine biological resource management, mangrove crabs can run into changes for carapace length growth, which has an interval of 1 month, where the growth has reached a range between 9.4-9.5 cm in both males and females. However, male growth is faster than females because males are more aggressive in looking for food in their early growth and faster in carapace length compared to female crabs. This is consistent with Sunarti et al. 2016, Tahya et al. 2016), where the activity of male mangrove crab is greater than the females, as supported by physiological mechanisms such as organ performance.

Mortality rate

The mortality rate consists of three parts, i.e., total mortality, natural mortality, and fishing rate mortality. According to Hill (1982), mangrove crabs mostly live in the environment around mangrove ecosystems. This natural habitat provides shelter from predators, foraging opportunities, and nursery areas. The abundance of natural food in the mangrove ecosystem can provide energy for mangrove crabs. If damage or environmental changes occurred, it will affect the carrying capacity of the habitat and deplete the mangrove crab population. According to Siahainenia (2008) degradation of mangrove ecosystems can deplete mangrove crab populations both in quality and quantity.

Figure 9 explains the mortality rate of male and female mangrove crabs in the mangrove ecosystem of Tarakan City. The annual total mortality for females was higher (154.94%) than males (120.01%). The estimated total mortality (Z) of mangrove crab in West Pasaman is 2.09 per year, (Hidayat et al. 2017). This is suspected because local people make female mangrove crabs as one of the main catches because they have a high enough price value compared to male mangrove crabs because they have egg yolks that have additional nutritional value for the human body. According to the research of Haddon (2005) noted that the total mortality rate of *S. serrata* species could not be estimated correctly because of a lack of information about mortality and stock assessments in the tropics.

Figure 9 explains the mortality variable of female mangrove crabs (135.75%) is higher than males (84.69%) for each year, and the exploitation rate of females (87.61%) is higher than males (70.57%) for each year. The exploitation rate (E) was 0.49, was observed in West Pasaman, West Sumatra (Hidayat et al. 2017). According to Syakila (2009), the mortality value was caused by the exploitation rate that increased mortality. Based on the study results of Haddon (2005), fish deaths due to exploitation of catches cannot be estimated accurately. The variable of natural mortality rate for male mangrove crab (35.32%) is higher than female (19.2%) in each year. Natural mortality (M) was 1.06 per year, was observed in West Pasaman (Hidayat et al. 2017). According to Sparre and Venema (1999) regarding the natural mortality rate originating from the population of mangrove crab species, the death is caused due to old age, disease, viruses, bacteria, predation of the food chain naturally even low carrying capacity of the environment, especially for ecosystem habitats that are not in accordance with ecological preferences and extreme environmental changes or even food sources are not fulfilled (Sparre and Venema 1999).
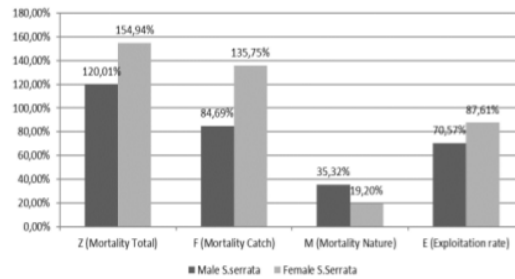

Figure 9. Mortality of male and female *Scylla serrata*

According to Indarjo et al. (2020) also stated that the natural mortality rate was caused by environmental damage, bacteria, viruses, and predators in the food chain. Statement of Yudiati et al. (2020) that the mortality of captured male crabs is higher than female crabs. This postulated that *S. serrata* females tend to caught more easily than males. The female crabs naturally migrate to the sea to spawn. Fishermen in the Mangkang Wetan waters not only catch in the pond area but also on the coast. This coast is the female crabs' route to the sea when they need to manage their offspring and continue their life in the sea. Adult male crabs tend to settle in the mangrove forest area, while female crabs will hatch their eggs and move to take food in deeper marine waters with higher salinity (Alberts-Hubatsch 2015). (Yudiati et al. 2020) explain that the high rate of exploitation of female *S. serrata* at this study site was due to the relatively high capture rate and a large amount of demand, especially the carrying eggs females.

It can be concluded that male *S. serrata* is positive allometry with fat body shape, and females are negative allometry with a thin body shape. The growth rate of *S. serrata* was 11.1118 cm for 189 days (male) and 9,6447 cm for 80 days (female). Total deaths were 1,2001/year (male) and 1,5494/year (female), natural mortality rates were 0.3532/year (male) and 0.192/year (female), deaths due to capture (f) were 0.8469/year (female) male) and 1.3575/year (female). The male exploitation rate reached 0.7057 or 70.57%, while the female exploitation rate was 0.8761, or 87.61%. The level of exploitation of males and females of *S. serrata*, which exceeds 50%, indicates that overexploitation has occurred. Suggest that the susceptible population of *S. serrata* in the waters of the Tarakan Mangrove Ecosystem can be carried out a conservation program in the mangrove ecosystem habitat area.

REFERENCES

Afrianto E, Liviawaty E. 1993. Pemeliharaan Kepiting. Penerbit Kanisius, Yogyakarta. [Indonesian]

Agus M. 2008. Analisis carryng capacity tambak pada sentra budidaya kepiting bakau (*Scylla* sp.) di kabupaten pemalang-jawa tengah. Program Pascasarjana, Universitas Diponegoro, Semarang. [Indonesian]

Alberts-Hubatsch H. 2015. Movement patterns and habitat use of the exploited swimming crab *Scylla serrata* (Forskal, 1775). Universität Bremen, Germany.

Araújo M de SLC, Lira JJPR de. 2012. Condition factor and carapace width versus wet weight relationship in the swimming crab *Callinectes danae* Smith 1869 (Decapoda: Portunidae) at the Santa Cruz Channel, Pernambuco State, Brazil. Nauplius 20 (1): 41-50.

Bonine KM, Bjorkstedt EP, Ewel KC, Palik M. 2008. Population Characteristics of the Mangrove Crab *Scylla serrata* (Decapoda: Portunidae) in Kosrae, Federated States of Micronesia: Effects of harvest and implications for management. Pac Sci 62 (1): 1-19.

Dumas P, Léopold M, Frotté L, Peignon C. 2012. Mud crab ecology encourages site-specific approaches to fishery management. J Sea Res 67 (1): 1-9.

Effendi H. 2003. Telaah kualitas air, bagi pengelolaan sumber daya dan lingkungan perairan. Kanisius, Yogyakarta. [Indonesian]

Effendie MI. 2002. Biologi Perikanan. Yayasan Pustaka Nusatama. Yogyakarta. [Indonesian]

Effendie MI. 1979. Metoda Biologi Perikanan. Yayasan Dewi Sri. Bogor.

Fawwaz M, Vemilia P, Mutmainnah I, Baits M. 2019. *Scylla serrata* Forskal as natural source of glucosamine hydrochloride. J Res Pharm 23 (2): 259-266.

Firdaus M, Salim G, Cahyadi J, Weliyadi E, Bintoro G. 2020. Model and nature of growth of red snapper fish (*Lutjanus argentimaculatus* (Forsskål, 1775)) fishing catch of bottom fish pots in Bunyu waters, North Kalimantan. AACL Bioflux 13 (3):1410-1421.

Firdaus M, Lelono TD, Saleh R, Bintoro G, Salim G. 2018. The expression of the body shape in fish species *Harpadon nehereus* (Hamilton, 1822) in the waters of Juata Laut, Tarakan City, North Kalimantan. AACL Bioflux 11 (3). DOI: 10.5281/zonodo.1250264.

Fitri ADP, Boesono H, Sabdono A, Adlina N. 2017. Resources management strategy for mud crabs (*Scylla* spp.) in Pemalang Regency. IOP Conf Ser Earth Environ Sci 55 (1): 12008. DOI: 10.1088/1755-1307/1/1/012004.

Fujaya Y, Azis HY, Siu A. 2001. The effect of multivitamin enriched live food on the survival rate of the mud crab larvae. Hayati, Bogor. [Indonesia]

Gosling SD, Ko SJ, Mannarelli T, Morris ME. 2002. A room with a cue: personality judgments based on offices and bedrooms. J Personality Soc Psychol 82 (3): 379.

Haddon M. 2005. Review of the Chesapeake Bay blue crab (*Callinectes sapidus*) 2005 stock assessment. National Oceanic and Atmospheric Administration, Chesapeake Bay Office, Annapolis, Maryland.

Hidayat T, Febrianti E, Restiangsih YH. 2017. Pola dan musim pemijahan ikan tongkol komo (*Euthynnus affinis* Cantor, 1850) di Laut Jawa. BAWAL Widya Riset Perikanan Tangkap 8 (2): 101-108.

Hill GW. 1982. Group versus individual performance: Are N+ 1 heads better than one? Psychol Bull 91 (3): 517.

Indarjo A, Salim G, Zein M, Soejarwo PA, Nugraeni CD, Bija S, Pham YTH. 2020. Characteristics of Von Bertalanffy growth, allometric, condition index and mortality of *Periophthalmus barbarus* in mangrove and Bekantan Conservation Area (KKMB), Tarakan, North Kalimantan. Ilmu Kelautan Indon J Mar Sci 25: 1. DOI: 10.14710/ik.ijms.25.1.31-38.

Josileen J. 2011. Morphometrics and length-weight relationship in the blue swimmer crab, *Portunus pelagicus* (Linnaeus, 1758) (Decapoda, Brachyura) from the Mandapam Coast, India. Crustaceana 84 (14): 1665-1681.

Lagler KF. 1949. Studies in Freshwater Fishery Biology. J.W. Edwards, Ann Arbor, MI.

Lagler KF, Bardach JE, Miller RR. 1962. Ichtiology. Wiley, New York.

Le Vay L. 2001. Ecology and management of mud crab *Scylla* spp. Asian Fish Sci 14 (2): 101-112.

Mirera D. 2013. Capture-based mud crab (*Scylla serrata*) aquaculture and artisanal fishery in East Africa-Practical and ecological perspectives. Linnaeus University Press, Kalmar, Sweden.

Mohapatra M, Mohapatra L, Singh P, Anand S, Mishra BK. 2010. A comparative study on Pb (II), Cd (II), Cu (II), Co (II) adsorption from single and binary aqueous solutions on additive assisted nano-structured goethite. Intl J Eng Sci Technol 2 (8): 89-103.

Muchlisin and Azwir. 2004. Hasil tangkapan kepiting bakau (*Scylla serrata* F) dengan menggunakan beberapa jenis umpan. Jurnal Ilmiah MIPA 7 (1): 57-60. [Indonesian]

Muchlisin ZA, Rudi E, Muhammad M, Setiawan I. 2006. Pengaruh Perbedaan Jenis Pakan dan Ransum Harian Terhadap Pertumbuhan dan Kelangsungan Hidup Kepiting Bakau (*Scylla serrata*). Ilmu Kelautan Indon J Mar Sci 11 (4): 227-233. [Indonesian]

irmale VH, Gangan SS, Yadav BM, Durgale P, Shinde KM. 2012. Traditional knowledge on mud crab, ethnoecology of *Scylla serrata* in Ratnagiri coast, Maharashtra. Indian J Trad Knowl 11 (2): 317-322.

Herliany ZNE. 2015. Hubungan Lebar Karapas Dan Berat Kepiting Bakau (*Scylla* Spp) Hasil Tangkapan Di Desa Kahyapu Pulau Enggano. Jurnal Kelautan 8 (2): 89-94.

Pauly D. 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators (Vol. 8). WorldFish.

Quinitio ET, de la Cruz JJ, Eguia MRR, Parado-Estepa FD, Pates G, Lavilla-Pitogo CR. 2011. Domestication of the mud crab *Scylla serrata*. Aquacult Intl 19 (2): 237-250.

Rahman K, Khan A, Muhammad NM, Jo J, Choi K.-H. 2012. Fine-resolution patterning of copper nanoparticles through electrohydrodynamic jet printing. J Micromechanics Microeng 22 (6): 65012.

Salim G, Rachmawani D, Septian D. 2018. Analisis model sifat pertumbuhan dan indeks kondisi kepiting bakau (*Scylla serrata*) yang berasal dari perairan estuaria Kota Tarakan. Jurnal Borneo Saintek 1 (3): 1-12. DOI: 10.35334/borneo_saintek.v1i3.929. [Indonesian]

Salim, G. 2013. Nilai indeks kondisi dari ikan siganus javus berdasarkan hasil tangkapan nelayan di Perairan Juata Kota Tarakan. Jurnal Harpodon Borneo 8 (1): 37-42. DOI: 10.35334/harpodon.v6i1.99. [Indonesian]

Salim G. 2010. Kajian Pertumbuhan ikan beronang tulis (Siganus javus) menggunakan pendekatan Von Bertalanffy. Jurnal Harpodon Borneo, 3 (1). DOI: 10.35334/harpodon.v3i1.438.

Sara L. 2010. Study on the size structure and population parameters of mud crab *Scylla serrata* in Lawele Bay, Southeast Sulawesi, Indonesia. J Coast Dev 13 (2): 133-147.

Sentosa AA, Syam AR. 2011. Sebaran temporal faktor kondisi kepiting bakau (*Scylla serrata*) di Perairan Pantai Mayangan, Kabupaten Subang, Jawa Barat. Jurnal Perikanan Universitas Gadjah Mada, 13 (1): 35-43. [Indonesian]

Siahainenia L. 2008. Bioekologi Kepiting Bakau (*Scylla* spp) di Ekosistem Mangrove Kabupaten Subang Jawa Barat. [Disertasi]. Sekolah Pascasarjana Institut Pertanian Bogor. Bogor. [Indonesian]

Siringoringo YN, Desrita D, Yunasfi Y. 2017. Kelimpahan dan pola pertumbuhan kepiting bakau (*Scylla serrata*) di hutan mangrove Kelurahan Belawan Sicanang, Kecamatan Medan Belawan, Provinsi Sumatera Utara. Acta Aquatica: Aquatic Sciences Journal 4 (1): 26-32. [Indonesian]

Sparre P, Venema SC. 1999. Introduksi Pengkajian Stok Ikan Tropis 2 : Latihan. Pusat Penelitian dan Pengembangan Perikanan, Jakarta. [Indonesian]

Sparre P, Venema SC. 1998. Introduction to tropical fish stock assessment, Vol. 1. FAO Fisheries Technical Paper, Rome.

Sunarti Y, Soejoedono RD, Mayasari NLPI, Tahya AM. 2016. RNA expression of farnesoic acid O-methyl transferase in mandibular organ of intermolt and premolt mud crabs *Scylla olivacea*. Aquacult Aquar Conserv Legisl 9 (2): 270-275.

Suprapto D, Purnomo PW, Sulardiono B. 2014. Aquatic Productivity Analysis based on The Relationship between Physical and Chemical of Benthic Sediment with NO_3 and PO_4 in the Estuarine of Tuntang River. Saintek Perikanan: Indonesian J Fisheries Science and Technology 10 (1): 56-61.

Syakila S. 2009. Studi Dinamika Stok Ikan Tembang (Sardinella fimbriata) di Perairan Teluk Pelabuhan Ratu, Kabupaten Sukabumi, Provinsi Jawa Barat. Skripsi IPB. Bogor. [Indonesian]

Tahmid M, Fahrudin AWY. 2015. Habitat quality mud crab (Sclla *serrata*) in msngrove ecosystem of Bintan bay, Bintan District, Riau Island. Jurnal Ilmu Dan Teknologi Kelautan Tropis 7 (2): 535-551.

Tahmid M, Fahrudin A, Wardiatno Y. 2015. The assessment of size structure and population parameters of mud crab (*Scylla serrata*) in mangrove ecosystem of Bintan Bay, Riau Islands. Jurnal Biologi Tropis 15 (2): 93-104.

Tahya AM, Zairin Jr M, Boediono A, Artika IM, Suprayudi MA. 2016. Expression of RNA encode FAMeT in mandibular organ of mud crabs *Scylla olivacea*. Intl J PharmTech Res 9 (3): 219-223.

Talib MF. 2008. Struktur dan Pola Zonasi (Sebaran) Mangrove Serta Makrozoobenthos yang Berkoeksistensi di Desa Tanah Merah Dan Oebelo Kecil Kabupaten Kupang [Hon. Thesis] Institut Pertanian, Fakultas Perikanan Dan Ilmu Kelautan, Institut Pertanian Bogor, Bogor. [Indonesian]

Thirunavukkarasu N, Shanmugam A. 2011. Length-weight and width-weight relationships of mud crab *Scylla* tranquebarica (Fabricius, 1798. Eur J Appl Sci 3 (2): 67-70.

Toivio S. 2015. Size, sex and distribution of *Scylla serrata* on Inhaca Island, Mozambique. [Thesis]. University of Gothenburg, Gothenburg, Sweden.

Weatherley AH. 1972. Growth and Ecology of Fish population. Academic Press, New York.

Widigdo B, Rukisah, Laga A, Hakim AA, Wardiatno Y. 2017. Carapace length-weight and width-weight relationships of *Scylla serrata* in Bulungan District, North Kalimantan, Indonesia. Biodiversitas 18 (4): 1316-1323. DOI: 10.13057/biodiv/d180405

Wijaya H. 2010. Persentase Karkas, Lemak Abdominal, Dan Organ Dalam Ayam Broiler yang Diberi Ransum dengan Penambahan Cassabio. Institut Pertanian Bogor, Bogor. [Indonesian]

Wijaya NI. 2011. Pengelolaan Zona Pemanfaatan Ekosistem Mangrove Melalui Optimasi Pemanfaatan Sumberdaya Kepiting Bakau (*Scylla* serata) di Taman Nasional Kutai Provinsi Kalimantan Timur. [Disertasi]. Institut Pertanian Bogor, Bogor. [Indonesian]

Yudiati E, Fauziah AT, Irwani I, Setyawan A, Insafitri I. 2020. Growth analysis, mortality and exploitation level of mud crab *Scylla serrata*, Forskål 1775, (Malacostraca: Portunidae) in Mangkang Wetan waters, Semarang, Central Java, Indonesia. Jurnal Kelautan Tropis 23 (1): 136-144.

Zafar M, Amin SMN, Rahman MM. 2006. Population dynamics of mud crab (*Scylla serrata*) in the southeastern coastal region of Bangladesh. Asian Fish Sci 19 (1/2): 43.

The population and mortality characteristics of mangrove crab (Scylla serrata) in the mangrove ecosystem of Tarakan City, Indonesia

ABUNDANCE OF SCYLLA SERRATA FORSSKÅL, 1775 IN EMBANKMENT LANE SILVOFISHERY DEVELOPMENT AREA OF MAROS DISTRICT", International Journal of Research -GRANTHAALAYAH, 2020
Publication

4   Miswar Budi Mulya. " Condition Factor and Exploitation Rates of in Karang Gading Sumatera Utara ", IOP Conference Series: Earth and Environmental Science, 2019
Publication   <1%

5   Gazali Salim, Agus Indarjo, Mufrida Zein, Lukman Yudho Prakoso, Suhirwan, GS Achmad Daengs, Rukisah. " The allometric growth and condition index comparison of white shrimp ( ) from fishpond and juata laut waters, Tarakan (Indonesia) ", IOP Conference Series: Earth and Environmental Science, 2020
Publication   <1%

6   Shan, Kun, Lin Li, Xiaoxiao Wang, Yanlong Wu, Lili Hu, Gongliang Yu, and Lirong Song. "Modelling ecosystem structure and trophic interactions in a typical cyanobacterial bloom-dominated shallow Lake Dianchi, China", Ecological Modelling, 2014.
Publication   <1%

7   Sri Redjeki, Retno Hartati, Hadi Endrawati,   <1%

Widianingsih Widianingsih et al. " Growth pattern and Condition factor of Mangrove Crab ( ) in Segara Anakan Cilacap Regency ", E3S Web of Conferences, 2020
Publication

8   Islam Boukhelkhal, Pr. Fatiha Bourbia. "Thermal Comfort Conditions in Outdoor Urban Spaces: Hot Dry Climate -Ghardaia- Algeria", Procedia Engineering, 2016
Publication   <1%

9   Gazali Salim, Pius Bae Kelen. "El Von Bertalanffy and Mortality from Fish Kurau (Polynemustaenitatus) of The Catch Fisherman in Waters Bunyu", INSIST, 2018
Publication   <1%

10   L K Pinandita, I Riniatsih, I Irwani. " The Growth and Mortality Rate of Mullet ( ) on Seagrass Beds of The Teluk Awur Bay, Jepara ", IOP Conference Series: Earth and Environmental Science, 2018
Publication   <1%

11   Thomas Hidayat, Helman Nur Yusuf, Nurulludin Nurulludin, Andina Ramadhani Putri Pane. "PARAMETER POPULASI KEPITING BAKAU (Scylla serrata) DI PERAIRAN PASAMAN BARAT", BAWAL Widya Riset Perikanan Tangkap, 2018
Publication   <1%

12 "Chapter 7 Assembly Line Balancing Models", Springer Science and Business Media LLC, 2008
Publication

<1%

13 Zairion, Fauziyah, E Riani, A A Hakim, A Mashar, H Madduppa, Y Wardiatno. " Morphometric character variation of the blue swimming crab Linnaeus, 1758) population in western and eastern part of Java Sea ", IOP Conference Series: Earth and Environmental Science, 2020
Publication

<1%

14 J M S Tetelepta, Y Lopulalan, J A Pattikawa. " Status of mud crab (sp.) fishery and mangrove ecosystem of Sanleko Village, Buru District, Indonesia ", IOP Conference Series: Earth and Environmental Science, 2019
Publication

<1%

15 Salim Abubakar, Riyadi Subur, Darmawaty Darmawaty, Nebuchadnezzar Akbar, Irmalita Tahir. "KAJIAN KESESUAIAN, DAYA DUKUNG, DAN AKTIVITAS EKOWISATA DI KAWASAN MANGROVE DESA TUADA KECAMATAN JAILOLO KABUPATEN HALMAHERA BARAT", JURNAL ENGGANO, 2019
Publication

<1%

16   Ehsan Kamrani, Reza Naderloo, Razieh Savari, Mohsen Rezaie-Atagholipour. "Preliminary biological information of Scylla serrata (Forskål, 1775) (Brachyura, Portunidae) in the Persian Gulf and Gulf of Oman: a conservation priority", Crustaceana, 2013
Publication

<1%

17   G.D. Akélé, H. Agadjihouèdé, G.A. Mensah, P.A. Lalèyè. " Population dynamics of freshwater oyster (Bivalvia: Etheriidae) in the Pendjari River (Benin-Western Africa) ", Knowledge and Management of Aquatic Ecosystems, 2015
Publication

<1%

18   N Trisyani, Kamarudin. " Population growth and fishery status of the shellfish (sp.) on Pamekasan beaches, Indonesia ", IOP Conference Series: Earth and Environmental Science, 2020
Publication

<1%

19   Agus Indarjo, Gazali Salim, Christine Dyta Nugraeni, Mufrida Zein et al. " The analysis of economic feasibility from Bubu Dasar fishing gear ( ) in Tepian Muara Sembakung, Nunukan (Indonesia) ", IOP Conference Series: Earth and Environmental Science, 2020
Publication

<1%

20   Ali Suman, Ap'idatul Hasanah, Andina Ramadhani Putri Pane, Pratiwi Lestari. "STOCK STATUS OF BLUE SWIMMING CRAB (Portunus pelagicus) IN TANAH LAUT, SOUTH KALIMANTAN, AND ITS ADJACENT WATERS", Indonesian Fisheries Research Journal, 2020
Publication

   <1%

21   L. Roomian, S. Jamili. "Population Dynamics and Stock Assessment of Hilsa Shad, Tenualosa ilisha in Iran (Khuzestan Province)", Journal of Fisheries and Aquatic Science, 2011
Publication

   <1%

22   Sana Sharifian, Vahid Malekzadeh, Ehsan Kamrani, Mohsen Safaie. "Population structure and morphometric variation in the sand-bubbler crab Scopimera crabricauda (Brachyura: Dotillidae)", Animal Biology, 2017
Publication

   <1%

23   Zhu, F.-Y., S.-W. Ye, Z.-J. Li, T.-L. Zhang, J. Yuan, Z.-Q. Guo, J.-F. Tang, and J.-S. Liu. "Growth and reproduction of the non-native icefish Neosalanx taihuensis Chen, 1956 (Salangidae) in a plateau lake, southwestern China", Journal of Applied Ichthyology, 2014.
Publication

   <1%

24   Jose Josileen. "Morphometrics and Length-

Weight Relationship in the Blue Swimmer Crab, Portunus Pelagicus (Linnaeus, 1758) (Decapoda, Brachyura) from the Mandapam Coast, India", Crustaceana, 2011

Publication

<1%

25 Nevarez-Martinez, M.O.. "Growth, mortality, recruitment, and yield of the jumbo squid (Dosidicus gigas) off Guaymas, Mexico", Fisheries Research, 200606

Publication

<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		