Length-weight relationship of *Metapenaeus ensis* in Aceh utara waters, lhokseumawe city, Indonesia

A A Muhammadar1*, M A Sarong2, M Ulfa1, D F Putra1, Z Zulfahmi1
1Department of Aquaculture, Faculty of Marine and Fisheries, Universitas Syiah Kuala Darussalam 23111, Banda Aceh, Indonesia
1Department of Biology Education, Faculty of Teacher Training and Education, Universitas Syiah Kuala Darussalam 23111, Banda Aceh, Indonesia
*Email: muhammadar@unsyiah.ac.id

Abstract. Eastern coast Aceh province has a rich of diversity in the marine crustacean sector. One of them is *Metapenaeus ensis* shrimp. *Metapenaeus ensis* shrimp is one of the shrimp that has important economic value in the waters of Lhokseumawe city, Indonesia. Excessive use of fishery resources can threaten the preservation of these shrimp *Metapenaeus ensis* resources. Therefore, the purpose of this study was to determine the length-weight relationship of shrimp caught in the waters of Lhokseumawe city. This research is expected to be able to add information on the existence of *Metapenaeus ensis* shrimp and sustainable resource management later for farmers. The research method used is a simple random withdrawal method by taking shrimp samples randomly from a basket of fishermen's catch in one sail. Shrimp samples taken 10% of the total catch of fishermen then measured length and weighed. Sampling was carried out in July 2019 at TPI Pusong Lama, Lhokseumawe City. Carapace length and weight of shrimps both male and female ranging from 22 mm to 64 mm and weighing around 2.69 grams to 35.48 grams. Growth patterns of Shrimp *Metapenaeus ensis* both male and female are allometric negative. Comparison of male and female genital ratio obtained 1: 0.41.

1. Introduction
Indonesia is endowed with an abundant of fish and edible crustacean [1, 2]. Eastern coast Aceh province has a rich of diversity in the marine crustacean sector. One of them is *Metapenaeus ensis* shrimp. *Metapenaeus ensis* shrimp is one of the shrimp that has important economic value in the waters of North Aceh, Lhokseumawe. Excessive use of fishery resources can threaten the preservation of these shrimp *Metapenaeus ensis* resources. Shrimps are known as important commodities from the fisheries sector, because they have high nutritional value [3]. There are many research about fish and shrimp including nutrition, shrimp immunity, and diversity [2, 4, 5, 6, 7, 8, 9, 10, 11]. Shrimp fishing as a target encourages an increase in continuous fishing efforts. This is caused by the increasing market demand for shrimp. Therefore, the purpose of this study was to determine the length-weight relationship of marine shrimp in the waters of Lhokseumawe regency. This research is expected to be able to add information on the existence of *Metapenaeus ensis* shrimp and sustainable resource management of crustacean fisheries for farmers.

2. Materials and Methods
2.1 Sampling
Sampling of *Metapenaeus ensis* shrimp was conducted in July 2019 at TPI Pusong Lama, Lhokseumawe City. Based on a preliminary survey of the many fishermen who landed the trawl catch at the TPI. The
sampling method uses a simple random sampling method, namely by taking random samples of shrimp from a basket of fishermen's catch in one sail. Shrimp samples taken 10% of the total catch of fishermen then measured in length and weighed.

2.2 Research parameter
The length-weight relationship were calculated using a formula [11, 12].

\[ W = a \times L^b. \]

Where:
- \( W \): total weight (gr);
- \( L \): shrimp carapace length (cm);
- \( a \): intercept
- \( b \): Constant

Values \( a \) and \( b \) are constants obtained from the results of length and weight regression analysis. To find out that the value of \( b \) is significantly different or not with 3, the t-test is used according to the equation [13]. Hypothesis testing, namely:

- \( H_0 \): there aren’t significant differences between the weights of male and female shrimp
- \( H_1 \): there are significant differences between the lengths of male and female shrimp

If: \( T_{count} < T_{table}(\alpha; n-1) \), then \( H_0 \) is accepted and \( H_1 \) is rejected, and 
\( T_{count} < T_{table}(\alpha; n-1) \), then \( H_0 \) is rejected and \( H_1 \) is accepted.

2.3 Sex ratio
According to [14] to test the sex of males and females can use the Chi-square test \((X^2)\) with a confidence level of 95%, with a hypothesis, namely:

- \( H_0 \): there aren’t significant differences between male and female sex ratios
- \( H_1 \): there are significant differences between male and female sex ratios

Formula:

\[ X^2 = \sum \left( \frac{(f_o - f_h)^2}{f_h} \right) \]

If: \( X^2_{count} < X^2_{table}(\alpha; n-1) \), then \( H_0 \) is accepted and \( H_1 \) is rejected
\( X^2_{count} > X^2_{table}(\alpha; n-1) \), then \( H_0 \) is rejected and \( H_1 \) is accepted

Information:
- \( X^2 \): Chi-square
- \( f_o \): The frequency of observed male and female shrimp
- \( f_h \): male and female shrimp frequencies are expected with a hypothesis (1:1)

3. Results and Discussions
Length-weight relationship
The number of Metapenaeus ensis caught during the study were 55, 39 male shrimp and 16 female shrimp. The results of the analysis of the Shrimp Metapenaeus ensis relationship between length and weight can be seen in table 1.

| No | Parameter                  | Male          | Female        |
|----|----------------------------|---------------|---------------|
| 1  | Carapace length range (mm) | 2.58-16.13    | 2.03-35.48    |
| 2  | Body weight (g)            | 2.2-5.6       | 2.4-6.4       |
| 3  | b value                    | 2.253         | 2.801         |
| 4  | Coefficient correlation (r) | 0.95          | 0.94          |
The value of b in table 1 showed that the growth patterns for *Metapenaeus ensis* shrimp, both male and female, are allometrics negative where the length increase is faster than weight. The nature of this growth is similar to the results research of [15] finding the b value of *Metapenaeus ensis* shrimp both male and female including negative allometrics in Kebumen waters of Central Java. The same thing was found [16] in Tanah Laut waters, South Kalimantan growth patterns are allometric negative. Saputra et al [17] also found a value of b for *M. ensis* shrimp including allometric negative, length acceleration is faster than weight. According to Asbar [18] the older the shrimp, the weight gain of the shrimp will increase compared to the increase in length. Based on the results of research that shows shrimp are still in its infancy and efforts need to be made to limit the catching of shrimp net. Young shrimp can still grow and develop.

The results also showed the correlation coefficient (r) of male and female *Metapenaeus ensis* shrimp 0.95 and 0.94 which showed that the relationship between weight gain of shrimp with length increase indicated a strong relationship. The coefficient of determination (R^2) male and female 0.9151 and 0.8963. This means that about 91% and 89% of shrimp weight gain is due to increased shrimp length, while 9% and 11% increase in shrimp weight is caused by other factors such as environmental, age and other factors. High and low values obtained assume that the growth of shrimp length will increase with increasing shrimp weight. If the coefficient of determination (R^2) is close to 1, the length of the shrimp will increase as the shrimp body weight increases [19].
Figure 1. Length-weight of shrimp (a) male and (b) female (*Metapenaeus ensis*) caught at TPI Pusong Lama Lhokseumawe City.

**Sex ratio**
Calculation of sex ratio is calculated based on the comparison of male shrimp and female shrimp presented in the table below.

| No | Sex ratio parameters | Male | Female |
|----|-----------------------|------|--------|
| 1  | Percentage (%)        | 71   | 32     |
| 2  | Sex ratio             | 1    | 0.47   |
| 3  | Test chi square       | 32.3 | 3.84   |

Table 2 showed the percentage of male and female sex of *Metapenaeus ensis* shrimp obtained was 71% and 29%. This shows that shrimp caught in the waters of Lhokseumawe city have fewer opportunities for spawning or mating. Based on the calculation of the sex ratio, the ratio of male and female shrimp is 1: 0.41, where the ratio of males is greater than females. Chi square test value with a confidence level of 95% obtained 32.3 > 3.84 results showed a comparison between male and female genital ratio unbalanced, where H1: there is a real difference between male and female genital ratio.

**Conclusion**
The total shrimp of *Metapenaeus ensis* was 55 shrimp, 39 males and 16 females. The length of the carapace obtained both male and female from the lowest value of 22 mm to the highest of 64 mm and weight ranges from 2.69 g to 35.48 g. Statistical analysis of the length-weight relationship of male and female shrimps showed that shrimp growth patterns are negative allometric, where length growth was faster than weight gain. Correlation coefficient values indicated that the relationship between weight gain and length gain (male and female) showed a strong relationship. Comparison of male and female sex ratio 1: 0.47 and chi square values obtained by males and females are not balanced.
Acknowledgment

Authors express gratitude to Direktorat Riset dan Pengabdian Masyarakat (DRPM) Direktorat Jenderal Penguatan Riset dan Pengembangan Kementerian Riset, Teknologi, dan Pendidikan Tinggi according to research contract No: 215/SP2H/LT/DPRM/2019 at March, 8 2019 for the financial assistance.

References

[1] Muchlisin Z A, N Nurfadillah, I I Arisa, A Rahmah, D F Putra, M Nazir, A Zulham 2017 Biodiversitas 18(2): 752-757

[2] Rizwan T, T K Nasution, I Dewiyanti, S A E Rahimi, D F Putra 2017 AACL Bioflux 10(5):1180-1185

[3] Pratiwi R 2008 Jurnal Oseana 15-24

[4] Chen Y Y, J C Chen, C M Tayag, H F Li, D F Putra, Y H Kuo, J C Bai, Y H Chang 2016 Fish Shellfish Immunol 55: 690-698

[5] Chen Y Y, J C Chen, Y C Lin, D F Putra, S Kitikiew, C C Li, J F Hsieh, C H Liou, S T Yeh 2014 Fish. Shellfish Immunol. 36:352-366

[6] Kitikiew S, J C Chen, D F Putra, Y C Lin, S T Yeh, C H Liou 2013 Fish. Shellfish Immunol. 34: 280-290.

[7] Lin Y C, J C Chen, W Z W Mori, D F Putra, C L Huang, C C Chang, J F Hsieh 2013 PLoS ONE 8: e69722.

[8] D F Putra et al 2018 IOP Conf. Ser.: Earth Environ. Sci. 216 012005

[9] A A Muhammadar et al 2018 IOP Conf. Ser.: Earth Environ. Sci. 216 012031

[10] F N Baleta, Y C Lin, Y Y Chen, J C Chen, S T Yeh, D F Putra, C L Huang 2013 J. Fish. Soc. Taiwan 40(4): 241-256

[11] D F Putra et al 2018 IOP Conf. Ser.: Earth Environ. Sci. 216 012022

[12] Ricker W E 1975 Computation and interpretation of biological statistics of fish populations, bulletin of fisheries research board of Canada 382pp

[13] Pauly D 1984 A selection of a simple methods for the assessment of the tropical fish stock. FAO Fish Circ. Firm / C. 729

[14] Zar J H 1999 Biostatistical analysis fourth edition prentice-hall new jersey 663p (main text) + 212 pp (Apendices)

[15] Suparjo M N 2005 Potential of dogol shrimp (Metapenaeus ensis) in Kebumen district, Central Java. Semarang 85p

[16] Hasanah A, T Ernawati, A Suman 2017 Some aspects of the biology of Metapenaeus ensis dogol shrimp in the waters of the land of the South Kalimantan Sea. Prosiding simposium nasional crustasea

[17] Saputra S W, A Solichin, W Riskiyana 2013 Journal of management of aquatic resources 2(3): 47-55

[18] Asbar 1994 The relationship between the level of exploitation and population structure and production of tiger penaeus monodon shrimp in Segara tillers. Bogor

[19] Walpole R E 1995 Introduction to statistics, 3rd edition. PT Gramedia Main Library Jakarta.