Diversity and Ecological Index of Penaeid Shrimp Collected from Mangrove Area of Kuala Langsa, Aceh, Indonesia

A A Muhammadar¹,³, D F Putra¹,², W Widari³

¹Department of Aquaculture, Faculty of Marine and Fisheries, University Syiah Kuala, Indonesia
²Marine and Fisheries Research Center, Universitas Syiah Kuala, Indonesia
³Laboratory of Histology and Fish Nutrition, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Indonesia

*Corresponding author: muhammadar@unsyiah.ac.id

Abstract. Shrimp is a fishery product that has high economic value. However, information of diversity and ecological index of penaeid shrimp Kuala Langsa was not well reported. Thus, this study aims to determine the species, analyze the ecological index and analyze the long relationship in penaeid shrimp caught in the Kuala Langsa mangrove waters. This study used purposive sampling method, for sampling was carried out with three locations and three repetitions. The results of the identification research found three species of the Penaeus genus with a total of 144 individuals consisting of P. monodon, P. indicus and P. merguiensis species with an average abundance value per station of 0.18, 0.09 and 0.21 ind/m², the diversity index with an average number of 0.98 is categorized as low, the uniformity index 0.9 is categorized as high and the dominance index 0.37 is categorized as low. The length and weight relationship of male and female P. monodon species showed positive and negative allometric patterns, male and female P. indicus showed the same pattern, namely negative allometric and male and female P. merguiensis showed isometric and negative allometric patterns.

1. Introduction
Shrimp is a fishery product that has high economic value. One of the shrimp-producing areas in Indonesia is Aceh Province [4, 20]. Aceh Province is a Fisheries Management area due to the geographical location of the coast with high tides such as the East coast of Pidie, Langsa and Lhokseumawe (WPP). Langsa City has a village near the coast called Kuala Langsa. Geographically, the entire area is a coast covered with mangrove forests with land affected by tides.

Shrimp fishing in the Aceh area is growing day by day due to increasing market demand and as the largest export fishery resource in Aceh (Muhammadar et al., 2019) [1]. Research on the relationship between length and weight has not previously been investigated in the waters of the Kuala Langsa Mangrove. Therefore, the purpose of this study was to identify species, analyze the ecological index and analyze the relationship between the length and weight of Penaeid shrimp caught in the mangrove waters of Kuala Langsa.
2. Materials and Methods

2.1 Time and Place
This research was conducted from January to March 2021 in the mangrove waters of Kuala Langsa.

![Research Locations](image)

Figure 1. Research Locations

2.2 Methods

2.2.1 Sampling
This research was conducted in the mangrove waters of Kuala Langsa. Determination of sampling points using purposive sampling method and determined three sampling stations with three repetitions at low tide at night. The sampling location was divided into three mangrove points with different environmental characteristics. Station 1, the Lanang stream, which has dense mangrove vegetation. Station 2, Simpang Lhee channel where the mangrove vegetation is not too thick. Station 3, Cane channel which is far from community activities. Catching using fishing gear with a length of 2 meters and a width of 3 meters left and right with a mesh size of 1 cm.

2.2.2 Length Weight Relationship
Analysis of the relationship between length and weight refers to the formula Jennings et al., (2001) [5] as follows:

\[ W = aL^b \]

Where W is body weight (gr), L is carapace length (mm) and A is intercept.

2.2.3 Abundance
Abundance is the sum of each species from all individuals. The shrimp abundance formula is calculated by the formula (Odum and Barrett, 2004) [15] as follow:

\[ A = x_i / n_i \]

Where A is abundance (ind/m), xi is the number of individual species -i, and ni is the area of the sampling site used (10 m x 10 m).

2.2.4 Diversity Index.
The diversity index used is the Shannon-Weiner index (Odum, 1971) equation as follow [14]:

\[ H = -\sum_{i=1}^{n} \left( P_i \cdot \ln(P_i) \right) \]
\[ H' = \sum_{i=1}^{s} P_i \ln P_i \]

Where \( H' \) is the Shannon-Weiner diversity index, \( N_i \) is the number of individuals of a species and \( N \) is the total number of individuals of all species. Similarity index (E) describes the number of individuals between species in a community. The formula used is (Odum, 1971) as follow [14]:

\[ E' = \frac{H'}{H'_{\text{max}}} \]

Where \( E \) is the similarity index, \( H' \) is the diversity index and \( S \) is the number of species found. The dominance index formula is (Odum, 1971) as follow [14]:

\[ C = \sum_{i=1}^{s} P_i i^2 \]

Where \( C \) is the dominance index, \( P_i \) is the proportion of the number of individuals in the species and \( i \) is the proportion of the number of individuals of all species.

3. Results and Discussion

3.1. Length weight relationship

Results of the study from the picture above, the male \( P. monodon \) showed positive allometric while in \( P. monodon \) allometric negative. The nature of this growth is the same as the growth pattern in the waters of East Aceh (Suryandari et al., 2018) [12] and in the waters of Sebatik (Tirtadaru and Chodrijah, 2020) [13]. The difference in growth of male and female \( P. monodon \) shrimp in this study was thought to be related to age, male and female \( P. indicus \) species showed the same growth pattern, namely negative allometric. The nature of this growth is similar to research in the waters of the Belawan Mangrove ecosystem, North Sumatra (Dimenta and Machrizal, 2017) [3] in the waters of Melaboh (Yusuf et al., 2017) [19], and in the waters of East Aceh (Pane and Widiyastuti, 2017) [9]. and the growth pattern of \( P. marguensis \) is isometric and in females allometric is negative. The nature of this growth is the same as the growth pattern in the waters of West Aceh (Putra et al., 2018) [16], in the waters of Nagan Raya (Putra et al., 2020) [17] and the waters of Segara Anakan (Wagiyo et al., 2018) [18].
Figure 2. Length and weight of (a) male and (b) female (*Penaeus indicus*) shrimp caught in Kuala Langsa waters.

![Graph A](image1)

![Graph B](image2)

Figure 3. Length and weight of (a) male and (b) female (*Penaeus merguensis*) shrimp caught in Kuala Langsa waters.

3.2. Abundance

Table 2 shows that the highest average number of abundance is at station three, which is 0.21 ind/m². This is because station 3 is a station far from fishermen's activities in catching shrimp and mangrove vegetation that supports shrimp growth.

| Species          | Station 1 | Station 2 | Station 3 | Average |
|------------------|-----------|-----------|-----------|---------|
| *Penaeus monodon*| 0.14      | 0.07      | 0.11      | 0.11    |
| *Penaeus indicus*| 0.10      | 0.09      | 0.11      | 0.10    |
| *Penaeus merguensis* | 0.30 | 0.12      | 0.40      | 0.27    |
| Average          | 0.18      | 0.09      | 0.21      | 0.16    |

3.3. Diversity Index, Uniformity Index and Dominance Index.

Table 3. Shows the results of the analysis of the diversity index data categorized as low with a range between 0.90 – 1.07. The results of this study are the same in Kumbe Beach and Kaiburse coastal waters, Malind District, Merauke Lantang et al., (2020) [7] where the diversity index value in Kumbe waters is 0.47 and Kaiburse waters is 0.48. This low diversity may be caused by environmental factors that do not support the existence of shrimp. Salinity is also very influential on the presence of shrimp in the waters, this is related to the process of osmoregulation in the body. If the water conditions are not suitable, the organism cannot regulate the osmoregulation process in its body and moves away from the place (Lantang and Merly, 2017) [8]. The uniformity index shows a high category with a range between 0.82 – 0.98 and the dominance index shows a low category with a range of 0.35 - 0.41. The results of this study are the same as research in Coastal Waters, Siantan District, Anabas Islands Regency, Riau Islands Province with dominance index values of 0.17, 0.31 and 0.22 which are categorized as low (Puspita and Nita, 2014) [11]. A low dominance value indicates that there is no dominant species.
3.4. Water quality
The results of the measurement of water quality, the pH obtained is 7. This value is categorized as normal for shrimp growth in the Kuala Langsa mangrove waters. This value is the same as the pH in the Lantang study, (2019) [6] in the Maro River Estuary with a pH of 7 – 7.07. The salinity measurement results obtained ranged from 27.5 to 28 ppt. Dede et al., (2014) [2] said that good salinity for Penaeid shrimp is 12 – 20 ppt. The temperature measurement results obtained ranged from 28 - 28.5 The temperature value was optimum for shrimp life.

| Diversity Index | St 1 Category | St 2 Category | St 3 Category | Mean | Category |
|-----------------|--------------|--------------|--------------|------|----------|
| H'              | 0.99         | Low          | 1.07         | Medium         | 0.90    | Low      |
| E               | 0.9          | High         | 0.98         | High | 0.82     | High     |
| C               | 0.41         | Low          | 0.35         | Low | 0.37     | Low      |

4. Conclusion
The length and weight relationship of male and female P. monodon species showed positive and negative allometric patterns, male and female P. indicus showed the same pattern, namely negative allometric and male and female P. merguiensis showed isometric and negative allometric patterns. Shrimp is a fishery product that has high economic value.

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