Distribution of three species of *Penaeus* in mangrove ecosystem area of Langsa, Aceh, Indonesia

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Abstract. Conservation efforts of shrimp species in their care areas that are classified as critical habitats in the juvenile phase of shrimp need to be done, one of which is by examining the distribution of three main economically species of the genus *Penaeus*: *Penaeus monodon*, *Fenneropenaeus merguiensis*, and *Fenneropenaeus indicus*. Research has been carried out at nine stations in the Langsa City mangrove ecosystem with the stratified random sampling method. Shrimp sample collection is taken by *phok* which is a fishing gear for local fishermen. *Phok* is used by shading an area of ± 200 meters horizontally with a net with a size of 1.5 inch mesh. A total of 122 penaeid shrimp were found in the mangrove ecosystem of Langsa City. Arusan Bupati Station has the highest percentage of penaeid shrimp found at 21.31%. The penaeid shrimp that was found was dominated by three species, namely *F. indicus* at 70.49%, *F. merguiensis* at 25.41%, and *P. monodon* at 4.09%. The highest percentage of *F. indicus* was found at Simpang Buloh station at 19.77%. The highest percentage of *F. merguiensis* was found at Alue Tirom station at 51.61%. The highest percentage of *P. monodon* was found by the Arusan Bupati station by 60%.

1. Introduction
Malacca Strait is one of the main penaeid shrimp fishing ground in Indonesia. This is related to the character of the east coast of Sumatera which is dominated by mangrove ecosystems and muddy beaches which are the main habitat of various types of penaeid shrimp. The high economic value of penaeid shrimp has led to increased fishing pressure on this commodity. This condition will cause a decrease in the stock in nature if there are no good management efforts. Status of penaeid shrimp resource stocks in Fisheries Management Areas (FMA) 571 The Malacca Strait is in a condition of over-exploited [1].
The condition of mangrove ecosystems on the east coast of Sumatra which continues to decline is also one of the causes of reduced penaeid shrimp stock in this region and this condition has occurred in the Langsa City mangrove ecosystem [2]. The real impact of this degradation is a decrease in catch of black tiger shrimp (*Penaeus monodon*) of 10-13% in East Aceh waters [3]. Another cause is the large number of juvenile-adult stage shrimp were caught in the coastal area with mini bottom trawls. Biological studies of species in estuarine areas can be used as indicators of the health of coastal areas [4].

One option for sustainable management of penaeid shrimp resources, especially the genus *Penaeus*, in Langsa City is species conservation, especially in the nursery ground that are classified as critical habitat for penaeid shrimp in the juvenile stage [5]. Penaeid shrimp juveniles for certain species have different habitat preferences [6, 7]. Therefore, the basic data needed for the management and conservation of penaeid shrimp are their biodiversity and distribution. This study aims to examine the temporal distribution of three species of penaeid shrimp from the genus *Penaeus* in the mangrove ecosystem area of Langsa. Research on the temporal distribution and size structure of penaeid shrimp has been carried out in Segara Anakan in Cilacap, Persian Gulf in Iran, East Aceh, and Kubu Raya in West Kalimantan [3, 6, 7, 8, 9].

### 2. Materials and Methods

#### 2.1. Site and Time

This research was conducted on 13-14 November 2018 at nine stations in the mangrove ecosystem area of Langsa (Figure 1). The sampling locations were selected by stratified random sampling, where locations were chosen based on three criteria: the inner, middle and outer zones of the mangrove ecosystem area of Langsa. Arusan Bupati, Simpang Buloh, and Alue Lhong are inner zone. Arusan Air, Rantau Sangkai, and Alue Raya are middle zone. Lhok Banie, Alue Tirom, and Telaga Tujoh are outer zone.

![Figure 1. Research sites in Langsa, Aceh, Indonesia.](image-url)
2.2. Data Collection
Shrimp sample was carried out with a fishing gear used by local fishermen, namely phok. Phok is used actively in small rivers by sweeping ± 200 meters of the area with a net with a mesh size of 1.5 inch, more selective in catch shrimp where fishermen usually only catch large-size shrimp.

Shrimp samples obtained with phok were obtained by following the local fishermen fishing trip. The fishing trips are operated at night. Shrimp caught are placed in a storage box for the species identification. The carapace length of each shrimp was measured by digital calipers (accuracy of 1 mm).

2.3. Data Analysis
One-way ANOVA statistical test was conducted to determine the difference in size of carapace length at each shrimp capture station. A total of 122 samples of penaeid shrimp were taken randomly to be tested in each zone of their respective zones. The Post Hoc Tukey Highly Significant Different (HSD) test was used to find a significant size difference (p-value <0.001) in each habitat zone.

3. Results and Discussions
3.1. Spatial Distribution
A total of 122 penaeid shrimp were found in the mangrove ecosystem area of Langsa. Arusan Bupati Station has the highest percentage of penaeid shrimp found at 21.31%, followed by Telaga Tujoh station at 15.57%, and Save Buloh and Alue Tirom stations at 14.75%, respectively. Other stations have a percentage below 12% (Figure 2).

![Figure 2](image-url)

Figure 2. The percentage of caught shrimp based on the sampling station.

The penaeid shrimp found was dominated by three species, namely *Fenneropeneaus indicus* at 70.49%, *Fenneropeneaus merguiensis* at 25.41%, and *Penaeus monodon* at 4.09% (Figure 3).
The percentage of penaeid shrimp species at each station can be seen in Table 1 and *F. indicus* found at all sampling stations. The highest percentage of *F. indicus* is at Simpang Buloh station at 19.77%, while the lowest is found at Alue Tirom station at 1.16%. *F. merguiensis* was only found in five stations, namely Arusan Bupati, Alue Tirom, Alue Lhong, Alue Raya, and Telaga Tujoh. The highest percentage of *F. merguiensis* was found at Alue Tirom station at 51.61%. *P. monodon* was only found in three stations, namely Buloh, Arusan Bupati, and Alue Tirom. The highest percentage of *P. monodon* was found by Arusan Bupati station by 60%.

The juvenile of black tiger shrimp and almost all Penaeidae shrimp uses the estuary area and mangrove area as nursery grounds [10, 11, 12]. They requires freshwater in their habitat [13, 14]. The nursery ground of black tiger shrimp juvenile has a wide range of habitat characteristics covering the estuary area with brackish waters, mangrove forest ecosystem areas, and protected bay waters [15].

![Figure 3](Image)

**Figure 3.** The percentage of caught shrimp based on the species.

| Station        | *Fenneropenaeus indicus* | *Fenneropenaeus merguiensis* | *Penaeus monodon* |
|----------------|--------------------------|-----------------------------|-------------------|
| Simpang Buloh  | 19.77                    | 0                           | 20                |
| Arusan Air     | 16.28                    | 0                           | 0                 |
| Arusan Bupati  | 15.12                    | 32.26                       | 60                |
| Lhok Banie     | 10.47                    | 0                           | 0                 |
| Rantau Sangkai | 8.14                     | 0                           | 0                 |
| Alue Tirom     | 1.16                     | 51.61                       | 20                |
| Alue Lhong     | 4.65                     | 6.45                        | 0                 |
| Alue Raya      | 4.65                     | 3.23                        | 0                 |
| Telaga Tujoh   | 19.77                    | 6.45                        | 0                 |
| **Total**      | **100**                  | **100**                     | **100**           |
Furthermore, the juvenile is more commonly caught in the estuary region which has a mixed-dynamic of freshwater and seawater [16].

### 3.2. Carapace Length Comparison

The results of the One-Way ANOVA statistical test concluded that there were significant differences between shrimp carapace length and shrimp habitat zones \( (p < 0.001) \). The mean of carapace length with the standard deviation \( (\text{mean} \pm \text{SD}) \) in the inner zone is \( 17.62 \pm 1.35 \) mm, the middle zone is \( 19.51 \pm 2.60 \) mm, and the outer zone is \( 16.90 \pm 2.09 \) mm. Further testing with Post Hoc Tukey Highly Significant Different (HSD) showed that the middle zone indicated a significant difference in the carapace length of the shrimp to the inner and outer zones \( (p < 0.001) \). However, the results of further tests show that the inner and outer zones do not have significant differences \( (p > 0.05) \) (Figure 4).

![Figure 4](image1.png)

**Figure 4.** The mean of shrimp carapace length in each zone (connected lines indicate no significant differences between zones).

The minimum catch size regulations needs to be implemented in the mangrove ecosystem area. Another related and important thing to do is the improvement of fishing efforts. The combination of estimating population parameters hypothetically based on length frequency with verification on each fishing business actor in the sufficient time series and catch data is important to be done in a fisheries improvement program [17].

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