The density and distribution of *Lingula* sp. in Aceh Northern Shore

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Abstract. The information of the density and distribution pattern of *Lingula* sp. in Aceh Shore is infrequently recorded. Since *Lingula* sp. has important roles in ecosystem, the study of species density of *Lingula* sp. and its distribution pattern was conducted in two sites of Aceh northern shore which were Ujong Pancu Beach and Syiah Kuala Beach. The aim of this study was to figure out the density and distribution pattern of *Lingula* sp. Sampling was carried out by designing nine 1 x 1 m plots at each station during April – May 2018. Results of study revealed that *Lingula* sp. at Ujong Pancu Beach is less denser than at Syiah Kuala Beach. The density range of *Lingula* sp. at Ujong Pancu Beach was 1.56-2.89 ind/m² while the density of *Lingula* sp. at the Syiah Kuala Beach was 3.78-5.44 ind/m². The distribution pattern of *Lingula* sp. at both stations was found as uniform distribution.

1. Introduction

*Lingula* sp. is renowned as a primitive member of Brachiopods appearing at the late of Cambrian period. *Living fossil* is another name of *Lingula* sp. because of its long – term morphological conservatism and survival tracing back to Cambrian period [1]. It has blue – green colour and bilateral symmetrical valves (Figure 1a). This species inhabit in the sandy substrate and burrow vertically leaving a small-hole opening at the surface (Fig.1b). Their pedicle contracts rapidly that helps this animal move to the surface.

The study about *Lingula* sp. is a few reported. The population of *Lingula* sp. has been found in Kaneohe Bay, Oahu, Hawaii, Queensland, Western Siberia, Bay of Bengal and Southern Japan [2], [3], [4], [5]. A distinctive decrease of *Lingula* sp. of 0.94 ind/m² was surveyed in Kaneohe Bay in 2007 [3]. In Indonesia, *Lingula* sp. was found in Ambon but there is no report about the density and distribution of *Lingula* sp. in Aceh beaches. However, *Lingula* sp. has been being consumed as delicious...
seafood by people living in northern shore of Aceh beaches. Therefore, this study was conducted to figure out the density and distribution pattern of *Lingula* *sp.* in Aceh northern shore.

![Lingula sp. and its surface hole](image1)

**Figure 1.** *Lingula* *sp.* (a) and its surface hole (red square, b).

2. **Materials and Method**
Surveys were carried out at two beaches in Aceh northern shore which were UjongPancu beach and Syiah Kuala beach (Fig.2) during April – May 2018. Nine plots of 1 m x 1 m quadratic transects were designed to observe the presence of *Lingula* *sp.* at each sampling beach. A specific small – hole at the sand surface was used to identify the presence of *Lingula* *sp.* A shovel was used to dig the substrate and take the sample out of the sediment.

![Sampling sites](image2)

**Figure 2.** Sampling sites

The identification was conducted at Marine Biology Laboratory, Marine and Fisheries Faculty, Syiah Kuala University. The density (eq.1) and distribution pattern (eq. 2) of *Lingula* *sp.* were calculated by following formulas:

\[
D = \frac{N_i}{A}
\]

\[
I_d = \frac{\sum N_i^2 - N}{N(N-1)}
\]

(eq. 1)

(eq. 2)
Where D is density, Ni is number of *Lingula* sp. were found, A is the area of sampling (m$^2$), $I_d$ is index of distribution, and N is the sum of *Lingula* sp.

3. Results and Discussion

Field survey of *Lingula* sp. at UjongPancu and Syiah Kuala beaches was conducted 4 times during April until May 2018. The total number of *Lingula* sp. collected at the sampling sites was 75 individuals at UjongPancu and 171 individuals at Syiah Kuala.

The density of *Lingula* sp. at both sites was presented in Table 1. The data revealed density of *Lingula* sp. ranging from 1.56 to 2.89 ind/m$^2$ with a mean observed density of 2.08 ind/m$^2$ at UjongPancu beach. At Syiah Kuala beach, density of *Lingula* sp. was obtained slightly higher ranging from 3.78 to 5.44 ind/m$^2$ with a mean density of 4.75 ind/m$^2$. The substantial decrease was occurred in comparison to previous study. The study at Kaneohe Bay reported that during 1969 – 2014, the density of *Lingula* sp. decrease from 500 ind/m$^2$ to 0.015 ind/m$^2$. It was reported that there was no significant relationship between the decrease and the environmental parameters, such as temperature, salinity, pH, and sediment grain size [6]. Although the temperature at UjongPancu (31 – 38°C) was found higher than Syiah Kuala site (30 – 34°C), the data of this study did not fulfill the statistical requirements to prove relationship between temperature and the density of *Lingula* sp.

**Table 1. Density of *Lingula* sp. at UjongPancu and Syiah Kuala beaches**

| Week of sampling | Density of *Lingula* sp. (ind/m$^2$) |
|------------------|-------------------------------------|
|                  | Ujong Pancu | Syiah Kuala |
| 1$^{st}$         | 2.89        | 5.33        |
| 2$^{nd}$         | 1.78        | 4.44        |
| 3$^{rd}$         | 2.11        | 5.44        |
| 4$^{th}$         | 1.56        | 3.78        |
| Mean             | 2.08        | 4.75        |

The distribution pattern results from the habitat differences, environmental changes, reproductive pattern, social behaviour, and daily and seasonal weather. The distribution is divided into three categories: random, uniform, and clump distribution based on Index of distribution ($I_d$). If the $I_d < 1$, it is considered as uniform distribution, $I_d = 1$ as random distribution, and $I_d > 1$ as clumped distribution. The distribution of *Lingula* sp. in Aceh northern shore was considered uniform pattern. The individuals of *Lingula* sp. was evenly distributed in the mud - sandy beach. *Lingula* sp. found in LubukDamar, Aceh Tamiang, Indonesia was found with evenly density on intertidal muddy area [7].

**Table 2. Distribution index of *Lingula* sp. at UjongPancu and Syiah Kuala beaches**

| Sites            | $I_d$ | Distribution pattern |
|------------------|-------|----------------------|
| Ujong Pancu      | 0.254 |                       |
| Syiah Kuala      | 0.250 | Uniform              |

4. Conclusions

*Lingula* sp. at UjongPancu Beach is less denser than at Syiah Kuala Beach. The density range of *Lingula* sp. at UjongPancu Beach was 1.56 ind/m$^2$ - 2.89 ind/m$^2$ while the density of *Lingula* sp. at the Syiah Kuala Beach was 3.78 ind/m$^2$ - 5.44 ind/m$^2$. The distribution pattern of *Lingula* sp. at both stations was found as uniform distribution.

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References
[1] S Yang, X Lai, G Sheng, S Wang 2013 *J. Paleontol.* **87**(5): 902–908
[2] R A Kenchington, L S Hammond 1978 *J. Zool.* **184**(1): 63–81
[3] C L Hunter, E Krause, J Fitzpatrick, J. Kennedy, 2008 *Mar. Biol* **155**(2): 205–210
[4] T N Smirnova, G T Ushatinskaya, E A Zhegallo, I V Panchenko, 2015 *Paleontol. J.* **49**(2): 125–133
[5] S Samanta, A Choudhury, S K Chakraborty, 2015 *J. Mar. Biol. Assoc. India*, **57**(1): 41–46
[6] A Barlow, M Desjardins, M Duncan, W Keller, C Leos, J Murphy, J Nash, A Nordschow, C Runyon 2015 Distribution analysis of *Lingula reevii* abundance throughout Kaneohe Bay, Oahu, Hawaii Technical Report
[7] A S Darmarini, Y Wardiatno, T Prartono, K. Soewardi, 2017 *Biodiversitas*, **18**(4): 1438–1444