The density and distribution of Pacific Oyster (*Crassostrea gigas*) in Krueng Cut, Aceh Besar

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Abstract. *Crassostrea gigas* is a Pacific oyster that has the largest size among the other oysters. This oyster is most often found because of its ability to adapt to a variety of environments. Krueng Cut is an estuary area that gets a lot of nutrient input from sea water because it is directly adjacent to the ocean. This condition makes this area has a high abundance of oysters with high fishing and anthropogenic activities as well. The purpose of this study was to determine the density and distribution of the oyster population from 3 representative stations along the estuary area of Krueng Cut. The method used in this study is random sampling using a quadratic transect. The results show that the highest density is indicated by station 3 with 55.67 ind/m² and the lowest density is indicated by station 1 is 40.33 ind/m². These results indicate that the activities of residents, the entry of contaminants from anthropogenic affect the density of oysters. The distribution of oysters from the three stations showed similarities, namely they tended to grouping. The aquatic environment at the three research stations still supports the growth of oysters. This study confirms that there has been a decline in the population, which is characterized by a decrease in the number of catches and a smaller size of oysters.

1. Introduction
Krueng Cut is an estuary location with high sea levels and variations in temperature and daily salinity, and dynamic water dynamics. The flow of water from the upper Krueng Aceh River is built up in these waters because the flow of the water is located right close to the Alue Naga waters. This feature makes it a home of macrozoobenthos biota with ample nutrients. However, due to intensive upstream activity such as towns, farming, and transportation routes, these waterways are sensitive to home garbage and industrial waste inputs.

One of the most widely found macrozoobenthos animals is oysters, especially the *Crassostrea Gigas* species. This species has a fairly wide distribution. Crassostrea is a native oyster of the Pacific Ocean that dominates the waters of Aceh because it has a wide range of larvae [1]. Oysters are sessile animals whose lives are spent mainly by sticking to the substrate by having feeder filter properties. This characteristic makes oyster life strongly influenced by water quality and makes oysters bioindicators of environmental health.

Oysters have long been a living supply for the Aceh coastal communities. Therefore, oyster catches are continually conducted without seeing this biota's sustainable resources [2]. High protein content and excellent savor make oysters one of the most economically valuable and market-leading bivalves.
Oysters are environmentally sensitive creatures [3,4]. It has a solid physical defense against extreme conditions and predators. However, anthropogenic pollution and high catching activity are the main threats to the density and abundance of oysters in nature. Research on the density and distribution of oysters in the Krueng cut area is still very minimal. Some of the studies that have been reported include [1,2,5]. Therefore, research is needed on the oyster meat population (Ostreidae) in the Lamnyong River and Krueng Cut, Syiah Kuala District, Banda Aceh City. The results of this study are expected to contribute in the form of information to the public about the structure of oyster meat populations and support efforts to develop conservation and cultivation of oyster meat in Aceh in the future.

2. Material and Method

2.1. Time and Site
The research was conducted in October – November 2020 in the Krueng Cut waters, Syiah Kuala District, Banda Aceh City. Oyster sampling is done at three stations using a random sampling method with three repetitions per station (Figure 1). Sampling was performed at the lowest receding with locations that have been limited to 1x1 m² transect. Oyster samples were taken by fingering the bottom of the water using footwear-coated feet first, then gouged with a knife so that the oysters that stick out can be taken. Samples of the acquired meat oysters were then taken to the Marine Biology laboratory of the Faculty of Marine Affairs and Fisheries of Syiah Kuala University for further identification.

The water quality parameters tested consisted of temperature, pH, salinity, and (Dissolved Oxygen (DO) were measured in situ. The follow-up was to determine the type of substrate using the pipette method [6]. Substrate samples taken using a water pipe diameter of 5 cm at a predetermined point with a depth of 30 cm were done as many as three repetitions at each station. Substrate samples were included in plastic bags and analyzed at the Soil Chemistry Laboratory of the Agriculture Faculty of Syiah Kuala University.

![Figure 1. Research map location](image)

2.2. Data Analysis

2.2.1. Density
Density is the number of individuals in the broad association [7] using the following formula:

\[ D = \frac{N}{A} \]
Statement: D = Density of the Bivalve (ind/m²); N = Total number of individuals; A = Sampling of the plot area (m²).

2.2.2. Distribution Pattern

A distribution pattern is the total number of individuals in an area that can be determined by linking water quality factors and substrates. The reference formula used based [7] can be seen below:

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

Descriptions: \( I_d \) = Morisita Index; \( N_i \) = Number of individuals (Ind); \( N \) = Total individual (Ind).

After analyzing, the above formula will then be grouped based on the sum of its \( I_d \) value. The value of \( I_d < 1 \) grouped the individual is uniform, while the value of \( I_d > 1 \) is defined as an individual grouping.

2.2.3. Texture Substrate

Texture substrates are analyzed using a formula of percent weight [8]. Furthermore, the criteria for substrate samples are determined based on the triangle of soil texture.

weight percentage = \( \frac{\text{Weight fraction of } i \text{ sediment}}{\text{Total weight of sediment}} \times 100\% \)

Description: The weight fraction of sediment = Weight of each item size (g).

3. Result and Discussion

The density of types can increase over time when the community becomes more stable and should be reduced if the environment is unstable or impaired [9]. The Crassostrea Gigas oyster population in Krueng Cut waters was moderate, with a density range of 40.33 ind/m² – 53.67 ind/m². The highest density value was seen at station 3, leading to the Sea of Alue Naga. The lowest value was found at station 1, where it was very close to residential areas and high oyster catching activities by the surrounding community. The increased activity in the coastal waters of Krueng Cut dramatically affected the quality of the waters that impact food and nutrients for oysters.

The highest density of oysters was in the intertidal area and would be reduced towards the river. It was related to the type of substrate that supports the availability of habitats where this biota was attached. The type of substrate for Krueng Cut water for all three stations was mud. It was a substrate that was highly favored by biota sessiles whose life properties stick like oysters. However, oyster density is also strongly influenced by the process of exploitation, regardless of number and size [10]. Oysters taken by the community ignore the number and size, so the density decreases, and the catch gets smaller. Oysters are one of the bioindicators of environmental quality, so the density of oysters can reference the health of the aquatic environment. Research on oyster density has been conducted previously by [11], which states that the density of oysters in Kuala Gigieng tends to decrease from previous research caused by high catching activity.

High or low-density oysters could also be caused by water pollution caused by the disposal of agricultural waste carried from upstream and pollution caused by household waste.

![Figure 2](image-url) | 40.33 | 43 | 53.67 |
|---|---|---|
| Stasion I | Stasion II | Stasion III |

Figure 2. The density of *Crassostrea gigas* oyster in Krueng Cut
Table 1. Distribution pattern of Crassostrea gigas oyster in Krueng Cut

| Stasion | Distribution Index | Distribution Pattern |
|---------|--------------------|----------------------|
| I       | 1                  | M                    |
| II      | 1                  | M                    |
| III     | 1                  | M                    |

Details: M = Grouping

The water quality is very influential on oyster life due to its sessile nature and feeder filter. Measured water quality includes temperature, salinity, pH, and DO. The results of the water quality measurement can be seen in graph 2. Overall, the results are still optimal enough to support oyster growth. The temperatures shown at all three stations were still reasonable, with an average of 33-34 °C. That is in line with [12] statement that pacific oysters love the environment with temperatures ranging from 3-35 °C. Temperature has a role in controlling the condition of aquatic ecosystems. Temperature is one of the essential parameters in the survival of organisms in water [13] The Krueng Cut water salinity range is still within tolerance limits with an average of 30-33 ppm, thus supporting oyster growth. The pH condition of Krueng Cut water ranges from 8.09-8.13. This result is due to oyster tolerance to environmental pH ranging from 6-9.2 [14,15].

The distribution pattern shown by the three polling stations was grouped. This oyster distribution pattern was a characteristic of oyster life. [16] explained that the formation of a pattern of spread of a shellfish is related to the behavior and life cycle of the shellfish.

4. Conclusion

The density of Crassostrea Gigas oysters in Krueng Cut waters indicated a high yield with a range of 40.33 ind/m2 – 53.67 ind/m2. These results were strongly correlated with the high oyster catching activity at this location and the amount of anthropogenic activity that occurs. Water quality measurements for temperature, salinity, pH, and DO showed that the overall results were still optimal for supporting oyster growth. The distribution pattern shown by the three polling stations is grouped. This oyster distribution pattern was a character of oyster life.

Reference
[1] Ramadhaniaty M, Setyobudiandi I and Madduppa HH 2018 Biodiversitas 19 978-988
[2] Octavina C, Yulianda F and Krisanti M 2014 Depik 108-117.
[3] Sarong MA, Jihan C, Muchlisin ZA, Fadli N and Sugianto S 2015 *AACL Bioflux* **8** 1-6.

[4] Astuti I, Karina S and Dewiyanti I 2016 *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah* **1** 104-113.

[5] Octavina C, Dewiyanti I, Nurfadillah N, Ulfah M, Razi NM, Sakinah R and Agustiar M 2019 *IOP Conference Series: Earth and Environmental Science*

[6] Sarfika M 2012 *Institut Pertanian Bogor. Bogor.*

[7] Brower JE, Zar JH and Ende CN von 1997 *C Brown Publishing* Dubuque

[8] Sheppard EP 1954 *Journal of Sediment and Petrology* **24** (4).

[9] Aryawati R, Ulqodry TZ, Surbakti H and Ningsih EN 2018 *J. Ilmu dan Teknologi Kelautan Tropis* **10** 269-275

[10] Smyth AR, Piehler MF and Grabowski JH 2015 *Journal of Applied Ecology* **52** 716–725.

[11] Octavina C, Purnawan S and Manik AS 2018 *IOP Conference Series: Earth and Environmental Science*

[12] Minchin D 2006 *Springer Berlin Heidelberg New York* 77–97

[13] Boulais M, Chenevert KJ, Demey AT, Darrow ES, Robison MR, Roberts JP and Volety A 2017 *Scientific Reports* **7** 1–9

[14] Fuhrmann M, Richard G, Quéré C, Petton B and Pernet F 2019 *Aquaculture* **503** 167–174

[15] Natan Y 2008 *Disertasi* Institut Pertanian Bogor Bogor p 179