

DENSITY ANALYSIS AND DISTRIBUTION PATTERN OF THE RANGA SNAIL (SPIDER CONCH) LAMBIS LAMBIS AND UTILIZATION BY THE COMMUNITY IN THE WATERS OF ABANG ISLAND, BATAM.

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Abstract

This study aims to examine the population structure, density, and distribution pattern of Lambis lambis as well as its utilization by the local fishing community on Abang Island, Batam. Data were collected using a 50-meter transect with 5×5 m quadrat plots, accompanied by measurements of key environmental parameters including dissolved oxygen (DO), temperature, and salinity. The results show that Lambis lambis exhibits low population densities (0.012–0.028 ind/m²) and a clumped distribution pattern indicated by a Morisita Index greater than 1. DO demonstrated a positive correlation with density, whereas higher temperatures were negatively correlated, suggesting sensitivity of the species to thermal fluctuations. Interviews with fishers indicated that harvesting pressure contributes to shifts in abundance and spatial patterns. These findings highlight the influence of environmental stress and exploitation on Lambis lambis populations and provide scientific considerations for community-based management, sustainable harvesting, and conservation planning on Abang Island.

Keywords : Lambis lambis , density, distribution pattern, environmental parameters, Abang Island

INTRODUCTION

The waters of Abang Island, located south of Batam City in the Riau Islands Province, are known for their clear beaches, coral reefs, and high biodiversity, making the area a priority for marine tourism development by the Batam City government (Efendi et al., 2024). The well-preserved coral ecosystems support the growth of various marine organisms, including the spider conch *Lambis lambis*, locally called “ranga,” which is one of the prominent gastropod species found in the intertidal and shallow subtidal zones of the island.

Lambis lambis is a member of the Strombidae family and is widely distributed across the Indo-Pacific region. This species typically inhabits sandy and coral substrates between rocks from the intertidal zone to depths of around 20 meters (Hamel & Mercier, 2006). It exhibits sexual dimorphism, where adult females develop longer digit-like projections than males, a characteristic that appears only after reaching maturity (Tsuji, 2020). Ecologically, *Lambis lambis* plays an

important role as a detritus consumer contributing to nutrient cycling and decomposition processes in shallow marine ecosystems (Laraswati et al., 2020). Its diet also includes polychaetes, small crustaceans, and bivalve mollusks, illustrating that its role in the food web is more complex than previously assumed (Siraimetan et al., 1988).

Beyond its ecological function, *Lambis lambis* holds economic importance for coastal communities, where it is harvested as a food source, handicraft material, and local trade commodity (Kasim et al., 2022). Studies conducted in Banda (Central Maluku) and the Ayah mangrove forest in Kebumen show that this species contributes to local food security and supports sustainable coastal livelihoods (Ansyar et al., 2025). However, increasing exploitation, tourism pressure, and habitat degradation raise concerns about population decline and long-term species sustainability. Despite its ecological and socioeconomic relevance, scientific data on the population characteristics of *Lambis lambis* in Abang Island remain limited, and previous studies in Indonesia rarely integrate ecological parameters with community utilization—indicating a clear gap that needs to be addressed.

To respond to these challenges, research that simultaneously examines population structure, density, spatial distribution patterns, and environmental influences is needed to understand the condition of *Lambis lambis* in natural habitats. In addition, documenting extraction methods and utilization patterns by local fishers provides important insights into anthropogenic pressures that may affect the species' sustainability.

This study aims to analyze the population structure of *Lambis lambis* in the intertidal waters of Abang Island by examining its density, distribution pattern, and their relationship with environmental parameters while also exploring how the species is utilized by local fishing communities. The results of this research are expected to generate baseline data for marine resource management, support community-based conservation strategies, and contribute to scientific understanding of coastal gastropod ecology.

METHODOLOGY

Research Design and Study Area

This research is a quantitative descriptive study aimed at analyzing the population density, distribution pattern, and environmental relationships of *Lambis lambis* in the littoral zone of Abang Island, Batam. The study was conducted in August 2025 at five observation stations selected through purposive sampling based on the presence of *Lambis lambis* and accessibility during low tide. Each station consisted of a 50-meter transect line placed perpendicular to the shoreline. A map of the study location is presented in Figure 1.

Population and Sampling Procedure

The population in this study comprises individuals of *Lambis lambis* inhabiting the intertidal area of Abang Island. Sampling was carried out using a quadrat transect method, where each transect contained ten quadrat plots measuring 5 m × 5 m. This technique allows systematic enumeration of individuals within a defined area and provides reliable estimates of population density and distribution.

Data Collection Techniques

Field observations were conducted during low tide to ensure maximum visibility and accessibility of the species. All *Lambis lambis* individuals present within each quadrat were recorded through a complete census. In addition to biological data, measurements of water quality parameters—temperature, salinity, pH, and dissolved oxygen (DO)—were collected in situ at each station using portable water quality meters. These parameters were selected to analyze their potential influence on the spatial distribution and density of *Lambis lambis*.

Research Instruments

The instruments used in this study included 50-meter transect lines, 5 × 5 m quadrat frames, a GPS device, a thermometer, a refractometer for salinity measurement, a portable pH meter, and a DO meter. These instruments enabled the collection of both biophysical and environmental data in a standardized and replicable manner.

RESULT AND DISCUSSION

Population Density of *Lambis lambis*

Population density of *Lambis lambis* in the five transects of Abang Island ranged from **0.012 to 0.028 ind/m²** (Table 1). Transect 3 showed the highest density, while Transect 4 recorded the lowest value.

Table 1. Population Density of *Lambis lambis* per Transect

Transect	Number of Individuals	Number of Plots	Total Plot Area (m ²)	Density (ind/m ²)
Transect 1	5	10	250	0.020
Transect 2	4	10	250	0.016
Transect 3	7	10	250	0.028
Transect 4	3	10	250	0.012
Transect 5	5	10	250	0.020

The variation in density suggests that microhabitat characteristics differ among transects. Higher densities (e.g., Transect 3) may be associated with coral sand substrates, macroalgae presence, and stable water conditions, while lower densities may indicate anthropogenic pressure and substrate instability. Similar findings were reported by Rizkya et al. (2012) on Pramuka Island and Toby et al. (2017) in NTT, showing that substrate type and disturbance levels significantly affect gastropod abundance.

These results provide preliminary indications of ecosystem condition and can be used for identifying priority zones for conservation or further habitat assessment.

Distribution Pattern of *Lambis lambis*

The distribution pattern calculated using the Morisita Index showed that all transects had $I_d > 1$, indicating a **clumped distribution** (Table 2). The highest clustering occurred in Transect 4 ($I_d = 2.22$).

Table 2. Distribution Pattern of *Lambis lambis* Based on Morisita Index

Transect	Number of Plots (n)	Total Individuals (N)	$\sum x(x-1)$	Morisita Index (I_d)	Distribution Pattern
Transect 1	10	5	4	1.6	Grouping
Transect 2	10	4	2	1.67	Grouping
Transect 3	10	7	6	1.71	Grouping
Transect 4	10	3	2	2.22	Grouping
Transect 5	10	5	4	1.6	Grouping

A clumped distribution is commonly found in gastropod populations and is influenced by habitat preference, food availability, predator avoidance, and substrate suitability. Studies by Konzewitsch & Evans (2020), Alman et al. (2015) and Deviana et al. (2015) also observed clumped patterns in gastropods inhabiting sandy, coral, and seagrass habitats.

These results indicate that *Lambis lambis* tends to aggregate in areas that provide optimal conditions, such as coarse sand, coral fragments, or areas with macroalgae. Such clustering can also increase vulnerability to harvesting, as fishermen usually target dense aggregations.

Correlation of Density with Environmental Parameters

Correlation analysis showed that *Lambis lambis* density had a strong positive correlation with dissolved oxygen (DO) ($r = 0.82$) and a strong negative correlation with temperature ($r = -0.76$). Salinity showed a weak correlation, while pH remained within normal conditions and did not significantly affect density (Figure 2).

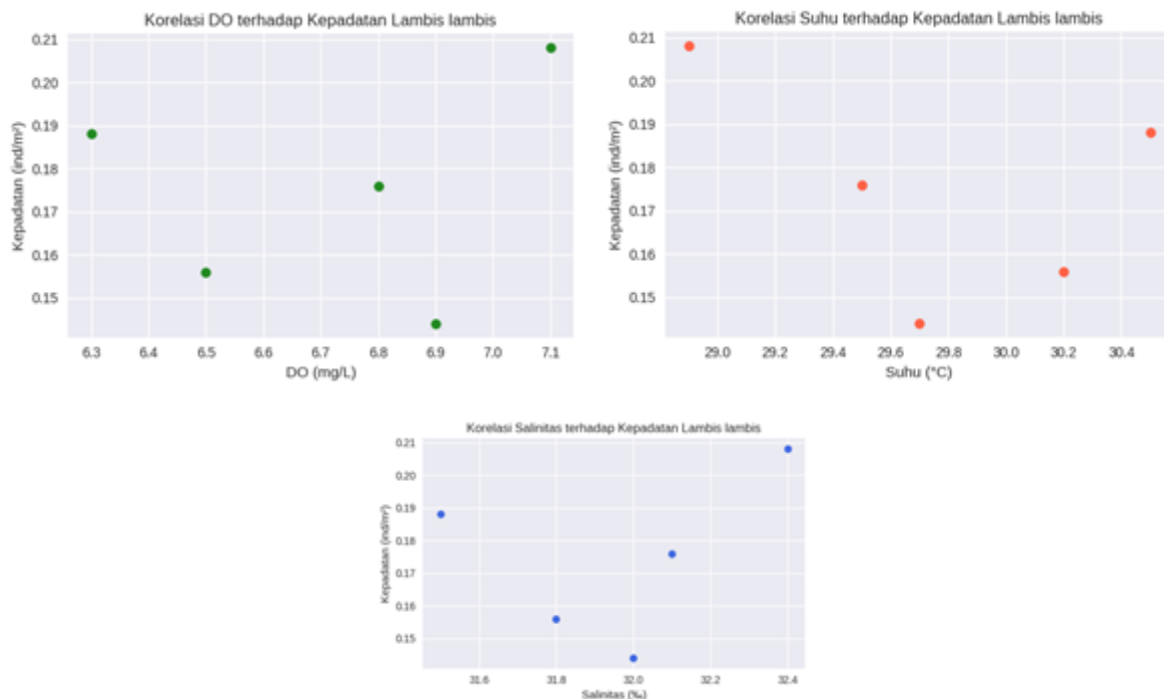


Figure 2. Correlation Analysis of *Lambis lambis* Density with Environmental Parameters

These findings indicate that *Lambis lambis* prefers areas with high DO and stable, lower temperatures, reflecting good water quality. High DO supports metabolic activity and benthic organism survival (Suin, 2003). Similar trends were reported by Farida et al. (2022), who found that gastropod abundance increases in waters with optimal DO and stable temperature conditions.

Although salinity correlation was weak, previous studies (Sari & Fitri, 2015; Nybakken, 1992) state that gastropods have broad salinity tolerance but remain sensitive to extreme fluctuations.

Interestingly, clumped distributions appeared in areas with higher temperature and lower DO, suggesting behavioral aggregation in microhabitats that provide protection or better substrate, despite suboptimal environmental conditions. This aligns with findings by Rahman et al. (2016) and Nurhayati et al. (2017), who reported similar gastropod behavior.

Utilization by the Local Community

Interviews with fishermen revealed that *Lambis lambis* is regularly harvested for consumption and sale, especially in easily accessible areas during low tide. Harvesting activities are concentrated in zones with high individual density, which may create localized exploitation pressure.

The combination of **low population densities**, **clumped distribution**, and **active harvesting** illustrates ecological and socioeconomic pressures on *Lambis lambis*. These findings support the need for **community-based resource management**, including designated protection zones, seasonal harvesting rules, and education programs for sustainable shellfish utilization.

Overall Interpretation

The overall findings show that:

1. *Lambis lambis* density in Abang Island is low (0.012–0.028 ind/m²).
2. The distribution pattern is clumped across all transects.
3. DO and temperature are key environmental parameters influencing distribution and density.
4. Human exploitation increases vulnerability of clustered populations.

These results highlight the ecological sensitivity of *Lambis lambis* and reinforce the importance of conservation monitoring and habitat protection.

CONCLUSION AND SUGGESTION

The results of this research indicate that the population of *Lambis lambis* on Abang Island is characterized by low density and a clumped distribution pattern across all transects. These patterns reflect the combined influence of environmental parameters—particularly dissolved oxygen and temperature—and harvesting activities by the local fishing community. The species was more abundant in areas with higher DO and slightly lower temperatures, suggesting that *Lambis lambis* is sensitive to changes in water quality and thermal fluctuations. The clumped distribution further demonstrates the species' tendency to occupy microhabitats that provide suitable substrates, food resources, and shelter. The findings also show that exploitation pressure has contributed to spatial shifts and reduced abundance in several locations. These ecological and anthropogenic factors together highlight the vulnerability of *Lambis lambis* populations and the need for sustainable management strategies.

The implications of this study suggest that conservation efforts on Abang Island should prioritize habitat protection, particularly in transects showing relatively higher population density. Community-based resource management involving local fishers is essential to minimize harvesting pressure and maintain population stability. The study is limited by the spatial scale of sampling and the temporal scope of data collection, which may not fully capture seasonal variability. Future research is needed to examine long-term population dynamics, reproductive cycles, and the influence of broader environmental stressors such as pollution and climate-induced temperature changes. Integrating ecological monitoring with socio-economic assessments will be important to design effective and sustainable conservation strategies for *Lambis lambis*.

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