



## Density of Clams (*Polymesoda* sp.) in the Mangrove Ecosystem of Pinotu Village, Toribulu District, Parigi Moutong Regency

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**Abstract:** This study aimed to assess the density of *Polymesoda* sp. in the mangrove ecosystem of Pinotu Village, Toribulu District, Parigi Moutong Regency, an area experiencing habitat pressure due to environmental change. A quantitative descriptive approach was applied using purposive sampling across three stations: Station 1 behind the residential area, Station 2 in the central mangrove zone, and Station 3 near shrimp ponds. Sampling was conducted at low tide using a line transect method with zigzag plots. Each station consisted of three 25 m transects spaced 10 m apart, with five 1 m<sup>2</sup> plots established along each transect, yielding a total of 45 observation plots. Environmental parameters measured included temperature, salinity, and pH. The highest density of *Polymesoda* sp. was recorded at Station 2 (2.93 ind/m<sup>2</sup>), followed by Station 1 (1.87 ind/m<sup>2</sup>), whereas the lowest density was observed at Station 3 (0.87 ind/m<sup>2</sup>). Differences in density were associated with habitat variation, particularly mangrove vegetation density, substrate characteristics, and environmental physical and chemical conditions. These findings indicate that more stable and better-preserved mangrove habitats support higher densities of *Polymesoda* sp., highlighting the importance of habitat quality in sustaining its population.

**Keywords:** Density; *Polymesoda* sp.; mangrove ecosystem

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### INTRODUCTION

Mangrove ecosystems are among the most important coastal ecosystems due to their substantial ecological functions and roles, serving as feeding grounds, spawning grounds, and nursery grounds for a wide range of aquatic organisms, while also maintaining the stability of coastal environmental quality (Bengen et al., 2022). According to data from the Indonesian Ministry of Environment and Forestry, as reported in Press Release No. SP.290/HUMAS/PPIP/HMS.3/09/2023, Indonesia possesses approximately 3.36 million hectares of mangrove forests, accounting for around 24% of the world's total mangrove area. Nevertheless, mangrove ecosystems continue to experience severe pressure from human activities. Indonesia is reported to lose approximately 52,000 hectares of mangroves annually, primarily due to land conversion for settlements and aquaculture ponds, which may reduce coastal environmental quality and affect the various organisms inhabiting these ecosystems (Apriansya et al., 2025). One of the organisms that lives in and depends on mangrove ecosystems is *Polymesoda* sp., which is commonly found among mangrove roots on muddy and sandy-mud substrates, as well as within mangrove litter in the intertidal zone (Wanimbo & Kalor, 2018).

*Polymesoda* sp. is an infaunal organism that lives by burrowing into bottom substrates; consequently, its presence is strongly influenced by the physical and chemical conditions of the mangrove environment (Yahya et al., 2018). Morphologically, *Polymesoda* sp. has a shell composed of two symmetrical valves

connected by a hinge ligament and adductor muscles that function to open and close the shell (Deni et al., 2020). In addition, *Polymesoda* sp. is considered one of the bivalves that is highly sensitive to environmental change because it is sessile and obtains food by filtering particles transported by water currents. This characteristic makes it potentially useful as a bioindicator of aquatic environmental pollution (Apriyanti, 2018). On the other hand, this clam also has important economic value, as it is widely utilized by coastal communities as a food source and a means of livelihood, giving it both ecological and economic significance (Jannati et al., 2022).

The dependence of *Polymesoda* sp. on mangrove ecosystems means that its occurrence is highly affected by environmental changes in the surrounding area. In Pinotu Village, *Polymesoda* sp. has long been utilized by local communities as a source of food and income. However, the reduction in mangrove vegetation cover due to land conversion into shrimp ponds by a private company has directly affected the natural habitat of *Polymesoda* sp., which relies heavily on muddy substrates and mangrove litter as food sources. This condition was identified during preliminary observations at the study site, where local residents who regularly collect these clams reported that the reduction in habitat area has made them increasingly difficult to find. Furthermore, although local people generally sort the clams by size, continuous harvesting may still reduce natural population abundance. Excessive utilization, including overexploitation of biological resources, can disrupt ecosystem balance (Sabran et al., 2022).

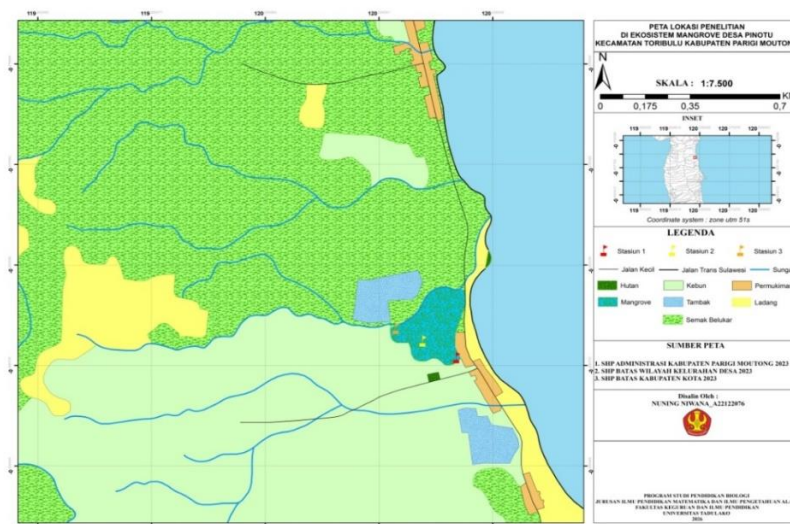
This situation becomes more serious because habitat degradation reduces the environmental carrying capacity necessary for the survival of the species. Similar problems have been reported in various coastal regions of Indonesia, where mangrove degradation has contributed to declines in bivalve density. This is consistent with a study conducted in Kendari Bay, which showed that the density of *Polymesoda erosa* was higher in areas with good mangrove density, indicating that mangrove damage may significantly reduce clam populations (Sanda et al., 2021). Similarly, research in West Kalimantan demonstrated that substrate conditions and environmental quality strongly influence the density of *Polymesoda erosa* (Deni et al., 2020).

The decline in *Polymesoda* sp. populations due to mangrove habitat degradation and harvesting pressure indicates a gap in information regarding the current density of this clam in the mangrove ecosystem of Pinotu Village. To date, community utilization of *Polymesoda* sp. has occurred without adequate quantitative data on population density and environmental carrying capacity, despite the considerable environmental pressure experienced by this area as a result of land conversion. Although several studies have investigated the density of *Polymesoda* sp. in various mangrove areas across Indonesia, specific data for the mangrove ecosystem of Pinotu Village remain unavailable. Therefore, a field-based study is needed to describe the population condition of this clam based on habitat characteristics and local environmental parameters.

This study aims to describe the density of *Polymesoda* sp. in the mangrove ecosystem of Pinotu Village, Toribulu District, Parigi Moutong Regency, while considering habitat conditions currently under pressure from human activities. The findings are expected to provide scientific contributions in the form of baseline data on the density of *Polymesoda* sp. in degraded mangrove areas, enrich the development of scientific knowledge and environmental education, and serve as a basis for the sustainable management and conservation of mangrove ecosystems.

## METHOD

This study employed a descriptive quantitative approach. Descriptive quantitative research focuses on presenting facts as they are, which are then systematically described and analyzed to provide an understanding of the actual condition of the object under investigation (Sulistiyawati et al., 2022). The study was conducted in the mangrove ecosystem area of Pinotu Village, Toribulu District, Parigi Moutong Regency (Figure 1). The study sites were determined using purposive sampling by dividing the area into three stations. Station 1 was located behind the residential area and was influenced by human activities. Station 2 was situated in the central part of the mangrove area, characterized by relatively dense vegetation cover. Station 3 was located near a shrimp pond area, where mangrove vegetation was sparse.



**Figure 1.** Sampling location

The object of this study comprised all individuals of *Polymesoda* sp. found within the mangrove ecosystem of Pinotu Village. Fieldwork was conducted in December 2025, with sample collection carried out from 08:00 to 12:00 Central Indonesia Time (WITA). Sampling was performed during low tide using the line transect method with a zigzag plot design. At each station, three parallel transects of 25 m in length were established, with 10 m spacing between transects. Along each transect, five 1 m<sup>2</sup> observation plots were placed in a zigzag arrangement at 5 m intervals, resulting in a total of 45 observation plots.

Transects and plots were established using stakes and raffia string according to the predetermined dimensions. Observations were conducted in each plot by excavating the substrate with a small shovel to a depth of approximately 15 cm to collect *Polymesoda* sp. individuals. In addition, environmental parameters were measured directly in the field at each station, including temperature using a thermometer, pH using a pH meter, and salinity using a refractometer.

The collected data were analyzed by counting the number of *Polymesoda* sp. individuals obtained, and population density was calculated using the following formula:

$$D_i = \frac{n_i}{A}$$

Where:

$D_i$  = population density (ind/m<sup>2</sup>)

$n_i$  = number of individuals collected (ind)

$A$  = total sampling area (m<sup>2</sup>)

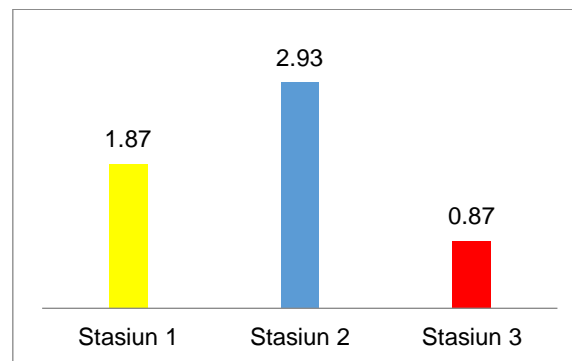
## RESULTS AND DISCUSSION

Based on the survey conducted in the mangrove ecosystem of Pinotu Village, a total of 85 individuals of *Polymesoda* sp. were recorded, comprising 28 individuals at Station 1, 44 individuals at Station 2, and 13 individuals at Station 3. These differences indicate that the distribution of *Polymesoda* sp. was not uniform throughout the mangrove area. This variation was further reflected in the population density values calculated based on the observation plot area. The analysis showed that the highest density was recorded at Station 2, with 2.93 ind/m<sup>2</sup>, followed by Station 1 with 1.87 ind/m<sup>2</sup>, while the lowest density was found at Station 3, with 0.87 ind/m<sup>2</sup>, as presented in Table 1.

**Table 1.** Number of individuals and population density of *Polymesoda* sp. in the mangrove ecosystem of Pinotu Village

No.	Location	Number of Individuals	Population Density (ind/m <sup>2</sup> )
1	Station 1	28	1.87
2	Station 2	44	2.93
3	Station 3	13	0.87

Differences in density among stations were also visually apparent in the population density graph of *Polymesoda* sp. (Figure 2).



**Figure 2.** Population density diagram of *Polymesoda* sp. at each station

Based on measurements of environmental parameters at each research station, temperature, salinity, and pH varied among stations. The results of these physical and chemical measurements are presented in Table 2.

**Table 2.** Measurement of physical and chemical environmental parameters

No.	Parameter	Station			Average
		1	2	3	
1	Temperature (°C)	30	30	30	30
2	Salinity (ppt)	30	30	35	31,67
3	pH	6,54	6,40	6,63	6,52

The density of *Polymesoda* sp. at Station 1 was classified as moderate. This condition was influenced by the high level of community activity surrounding the area. Various human activities may disturb the substrate and reduce water quality through the input of domestic waste. In addition, the utilization of *Polymesoda* sp. by local communities also contributed to the reduced number of individuals. The proximity of the mangrove forest zone to residential areas increases the intensity of human activities, which may alter substrate characteristics and increase the accumulation of

fine materials, thereby potentially causing aquatic environmental pollution and reducing the abundance of aquatic biota (Ulfah et al., 2019).

In addition to anthropogenic activity, the physical and chemical conditions at this station also influenced the presence of *Polymesoda* sp. Overall, the environmental conditions at this station were still relatively supportive of the species' survival. Based on the data in Table 2, the water temperature of 30 °C remained within the optimal range for the growth of this species, namely 20–35 °C (Sanda et al., 2021). The salinity value of 30 ppt was also still within the optimal salinity range for *Polymesoda* sp., namely 22–30 ppt (Putri et al., 2021). Meanwhile, the pH value of 6.54 was slightly higher than the reported optimal range for this species, namely 5.35–6.40 (Santos et al., 2023), but it was still within a tolerable range for the organism.

The density of *Polymesoda* sp. at Station 2 was classified as high. This was influenced by the relatively stable habitat conditions and minimal anthropogenic disturbance, as this station was located in the central part of the mangrove area, relatively far from residential settlements, and supported by relatively dense mangrove vegetation cover. The substrate at Station 2 was dominated by fine mud to clay rich in organic matter due to the accumulation of mangrove litter. *Polymesoda* sp. is known to prefer muddy substrates because this texture strongly supports its life as a filter-feeding organism. Fine-textured substrates more easily trap and accumulate organic matter; therefore, muddy substrates are presumed to contain high nutrient levels and to serve as a major food source for macrobenthos (Sanda et al., 2021).

Wulandari et al. (2022) also stated that the life of clams is strongly influenced by the characteristics of the bottom substrate, where sandy clay or muddy substrates with high organic matter content play an important role in increasing food availability. This food source originates from litter falling onto the substrate surface, which subsequently undergoes decomposition by macrobenthos and is further processed by microorganisms into detritus. The greater the amount of litter produced in the mangrove area, the greater the amount of detritus formed; this detritus constitutes a highly nutritious food source for aquatic organisms, including *Polymesoda* sp. (Rauf, 2023). In addition, the physical and chemical conditions at this station also supported the presence of *Polymesoda* sp., with a water temperature of 30 °C still within the species' optimal growth range. The salinity value of 30 ppt corresponded to the optimal salinity range for *Polymesoda* sp., while the pH value of 6.40 was at the upper limit of the optimal pH range for this species (Santos et al., 2023).

The density of *Polymesoda* sp. at Station 3 was classified as low. This was associated with the conversion of mangrove land into aquaculture pond areas. The conversion of mangrove forests for aquaculture activities leads to severe mangrove ecosystem degradation, thereby reducing the ecological function of mangroves as habitat for aquatic organisms (Ahaya et al., 2022). This decline in ecological function adversely affects water quality, which in turn influences the balance of all components within the mangrove ecosystem (Isoni et al., 2023). This condition was reflected in the low density of mangrove vegetation in the area, indicating a high level of disturbance and suggesting that the habitat was no longer in an optimal condition to support aquatic biota (Sanadi et al., 2023). The presence of pond areas replacing mangrove forests also exerts pressure on the sustainability of mangrove ecosystems and their associated biota, particularly benthic organisms living on the bottom substrate, such as *Polymesoda* sp. (Mahmudin et al., 2022). Reduced mangrove cover due to logging activities causes changes in mangrove community structure, which ultimately further decreases the habitat's carrying capacity for aquatic organisms (Paa et al., 2023).

Furthermore, the physical and chemical conditions at this station were also less favorable for the presence of *Polymesoda* sp. This was indicated by the salinity value of 35 ppt, which exceeded the optimal range for *Polymesoda* sp., namely 22–30 ppt (Putri et al., 2021). High salinity may affect the occurrence of *Polymesoda* sp., as the density of this species tends to be lower in waters with elevated salinity levels (Haru et al., 2018). In addition, the pH value of 6.63 was also slightly higher than the optimal range reported for this species. Meanwhile, although the water temperature of 30 °C remained within the optimal temperature range for growth, the less suitable salinity and pH conditions may still have affected the presence of *Polymesoda* sp. at this station.

## CONCLUSION

Based on the results of this study, it can be concluded that the density of *Polymesoda* sp. in the mangrove ecosystem of Pinotu Village varied across the sampling stations. The highest density was recorded at Station 2 (2.93 ind/m<sup>2</sup>), followed by Station 1 (1.87 ind/m<sup>2</sup>), while the lowest density was observed at Station 3 (0.87 ind/m<sup>2</sup>). These differences in density were influenced by habitat conditions and water environmental quality. Station 2 was characterized by relatively dense mangrove vegetation cover, muddy substrate rich in organic matter, and physical and chemical environmental conditions that were relatively optimal for the occurrence of *Polymesoda* sp. In contrast, the lower densities at Stations 1 and 3 were associated with intense human activity and the conversion of mangrove land into aquaculture ponds, which contributed to habitat degradation and reduced environmental carrying capacity. These conditions were further influenced by physical and chemical environmental factors that were less favorable for the presence of *Polymesoda* sp. These findings indicate that mangrove ecosystem condition and water environmental quality play important roles in determining the density of *Polymesoda* sp.; therefore, a decline in the density of this species may serve as an indicator of ecological pressure within mangrove ecosystems.

## RECOMMENDATION

Future studies are recommended to investigate the density of *Polymesoda* sp. by incorporating a wider range of environmental parameters, such as dissolved oxygen and sediment organic matter content, so that the relationship between habitat condition and population density can be analyzed more comprehensively. In addition, further research should be conducted at different times or across different seasons to assess the temporal dynamics of *Polymesoda* sp. populations, as seasonal changes may affect water environmental conditions and the availability of organic matter in the sediment. Several limitations may have influenced the results of this study, including the restricted sampling period, which was conducted during only one observation period, and tidal conditions that may have limited access to the research sites. These factors should therefore be considered in the design of future studies to ensure that the data obtained are more representative. The findings of this study provide an important baseline for degraded mangrove areas and offer an initial indicator of environmental carrying capacity for the presence of *Polymesoda* sp. They may also serve as a useful reference for future research examining mangrove ecosystems in this region.

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