Invertebrate Diversity in the Intertidal Zone of Tabanio Beach, Tanah Laut, South Kalimantan

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Abstract
Invertebrates play an important role in maintaining ecosystem balance through their contribution to the food chain, nutrient cycle, and ecosystem dynamics. The presence of invertebrates is influenced by physical, chemical, and biological factors, as well as human activities such as tourism, which can disrupt ecosystem stability. This study aims to describe and evaluate the richness of invertebrate species at Tabanio Beach, Tanah Laut, South Kalimantan. Sampling was carried out using a purposive sampling method on three different types of substrates: sand, mud, and rock. Samples were collected using a hand sampling method and then preserved in 70% alcohol. Identification was based on morphological characteristics, and data were analyzed descriptively. The results showed that 15 invertebrate species were found belonging to 14 families, including the Coelenterata Phylum, Arthropoda Phylum, Mollusca Phylum, and Echinodermata Phylum. Thus, Tabanio Beach has the potential to be a habitat for various invertebrates and can be studied further.

Keywords: Tabanio Beach, invertebrate, intertidal zone, South Kalimantan

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INTRODUCTION

The coast is the boundary between land and sea, influenced by the ebb and flow of water. This line forms the boundary between land and sea, measured by the highest and lowest tides. Coastal areas are influenced by the physical conditions of the sea, with their land boundaries determined by natural processes and human activities in the terrestrial environment. Coasts harbor a rich aquatic biodiversity, primarily dominated by invertebrates (Rashid, 2019; Collier et al, 2016). The presence of invertebrates in marine waters is known to be very diverse, including members of the phyla Porifera, Platyhelminthes, Nematoda, Mollusca, and Crustacea (Appeltans et al, 2012).

The invertebrate diversity of a body of water is greatly influenced by habitat conditions. One such habitat condition is the substrate. Pieroni et al. (2021) stated in their research that the substrate is one of the biggest factors determining invertebrate diversity in a body of water. The type of substrate in a body of water will influence organism mobility, trophic webs, and biogenic transformation of invertebrate habitats (Reise, 2002). Furthermore, the type of substrate in a body of water will also determine the organic matter content within it, which acts as a nutritional buffer for its fauna inhabitants. The smaller the substrate particles that make up a habitat, the greater the organic matter and nutrient content (Taqwa et al. 2014). Based on research conducted by Nagelkerken et al, (2000) and Handayani (2017), there are differences in the abundance of marine invertebrates in different habitats (substrates). Therefore, the greater the variety of substrates in a body of water, the higher the potential for the presence of various invertebrate species (Bloomfield and Gillanders, 2005).

South Kalimantan is known as the province of a thousand rivers. In addition to its diverse and numerous river topologies, South Kalimantan also holds potential marine resources that are rarely accessed and studied. One of the waters or beaches in South Kalimantan that has the potential to be accessed and studied is Tabanio Beach. Tabanio Beach has three varied substrates. The substrates are muddy, sandy, and rocky. The existence of substrate variations indicates a richness of diverse invertebrate species. There is no specific research data regarding the types of invertebrates found at

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Tabanio Beach. The purpose of this study is to describe and evaluate the richness of invertebrate species at Tabanio Beach, Tanah Laut Regency, South Kalimantan.

MATERIALS AND METHODS

This research was conducted in November 2024 at Tabanio Beach, Tanah Laut Regency, South Kalimantan (**Figure 1**). Sampling was carried out at the lowest tide. Sampling was conducted at three predetermined stations. Each station represented a substrate type found at Tabanio Beach. The substrates are mud, sand, and rock. The tools and materials used in this study included a shovel, tweezers, a tray, a camera, writing instruments, and 70% alcohol. Data collection was carried out by conducting a survey at the three predetermined stations. Initial data were obtained by observing and documenting invertebrates encountered during the survey. In addition, 2-3 invertebrates were collected using hand sampling. The initial data were then used to identify, classify, and describe the species found. Invertebrate identification and description techniques were based on morphological characteristics.

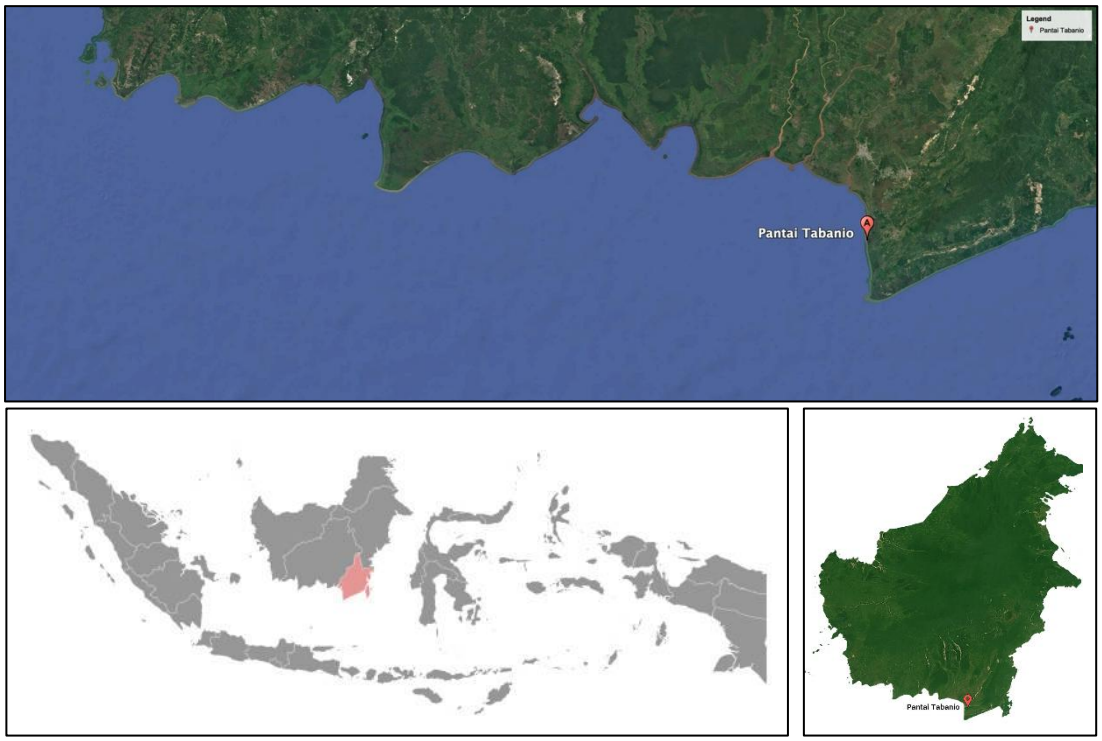


Figure 1. Sampling location: Tabanio Beach, Tanah Laut Regency

RESULTS

Invertebrates comprise the largest fauna in aquatic ecosystems compared to vertebrates. Research conducted at Tabaio Beach, Tanah Laut Regency, South Kalimantan, revealed 15 invertebrate species belonging to 14 families, including members of the Coelenterata, Arthropoda, Mollusca, and Echinodermata phyla (**Table 1)**. These 15 species were found on three different substrate types: sand, mud, and rock. Analysis of the number of species encountered revealed that sand had the highest number of invertebrates compared to other substrates (**Figure 2**).

Table 1. Invertebrates found on Tabanio Beach, South Kalimantan

No.	Phylum	Class	Family	Spesies	Local Name	Substrate
1.	Coelenterata	Anthozoa	Actiniidae	*Actinaria* sp.	Anemon Laut	1
2.		Scyphozoa	Ulmaridae	*Aurelia* sp.	Ubur-ubur	1 and 2
3.	Arthropoda	Merostomata	Limulidae	*Carcinoscorpius rotundicauda*	Belangkas	1 and 2
4.		Malacostraca	Portunidae	*Thalamita* sp.	Kepiting	1, 2, and 3
5.				*Scylla serrata*	Kepiting	2
6.			Matutidae	*Ashtoret lunaris*	Kepiting	1, 2, and 3
7.			Ocypodidae	*Ocypode* sp.	Kepiting	1, 2, and 3
8.			Paguridae	*Pagurus* sp.	Kelomang	1, 2, and 3
9.	Molllusca	Bivalvia	Veneridae	*Meretrix* sp.	Kerang Dara	1
10.			Mactridae	*Mactra* sp.	Kerang Tahu	1 and 2
11.		Gastropoda	Muricidae	*Tenguella* sp.	Siput Laut	1, 2, and 3
12.			Nassariidae	*Nassarius* sp.	Siput Laut	1, 2, and 3
13.	Echinodermata	Holothuroidea	Holothuriidae	*Holothuria* sp.	Teripang	1, 2, and 3
14.		Asteroidea	Astropectinidae	*Astropecten* sp.	Bintang Laut	1 and 3
15.		Echinoidea	Toxopneustidae	*Tripneustes Gratilla*	Bulu Babi	1

Note: Substrate 1: Sandy
Substrate 2: Muddy
Substrate 3: Rocky

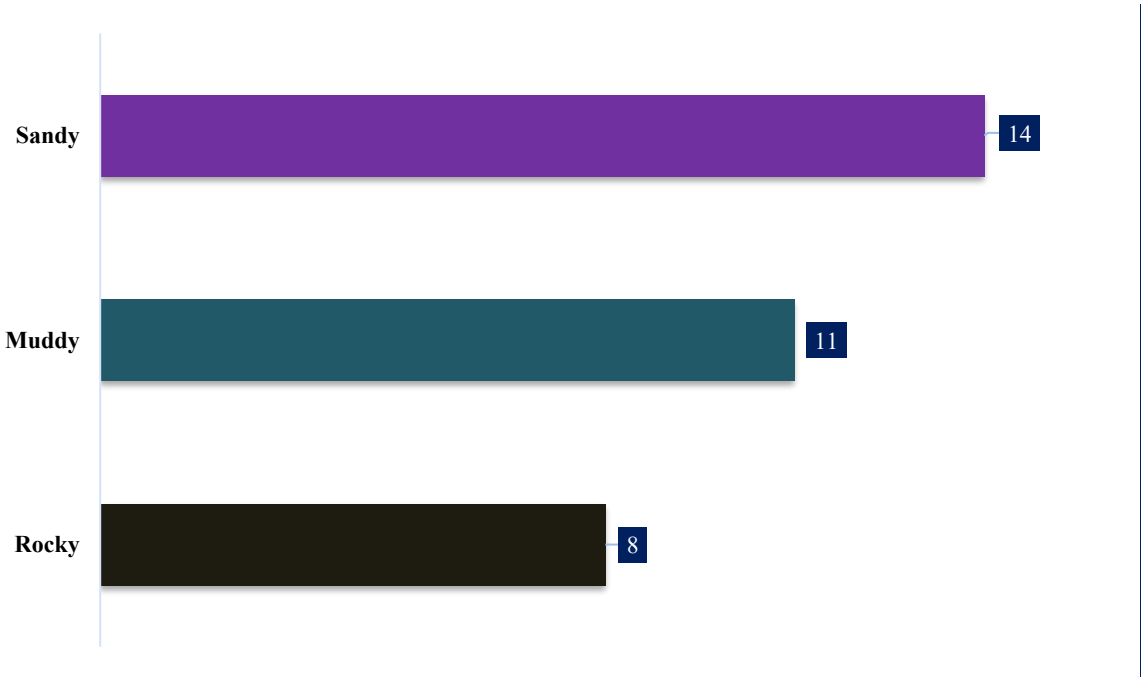


Figure 2. Graph of invertebrate encounter data at Tabanio Beach, South Kalimantan on several different substrate types

DISCUSSION

Invertebrates play a crucial role as the largest constituents of marine ecosystems compared to vertebrates. Marine invertebrates comprise a highly diverse range of taxa, play a central role in food webs and ecosystem services, and are an important economic resource. Invertebrates contribute significantly to global biodiversity and provide key ecosystem functions, including water filtration, habitat creation, organic matter processing, carbon transfer through food webs, and nutrient recycling (Collier et al, 2016). Furthermore, many marine invertebrate species also possess significant intrinsic

value for coastal communities, primarily as a food source (shellfish protein), for health purposes (protection from algal eutrophication), as coastal protection from natural disasters and ocean acidification, through ornamental and recreational value, and in tourism (Sole et al, 2023).

In the research that has been conducted, it was found that there were differences in the number of invertebrate encounters on three types of substrates at the study location. Bahri et al, (2015) stated that the occurrence of differences in invertebrate abundance in a region is generally strongly influenced by fishing activity and current speed. In addition, Mathers et al, (2019) added that factors such as water movement, biological activities such as predation, food availability as seen from the type of substrate, the average diameter of sediment grains, dust and clay content, the presence of dead shells, and substrate stability also affect the number and diversity of invertebrates in a particular substrate.

Sand substrates are the substrate with the highest invertebrate sighting data compared to mud and rock substrates in the waters of Tabanio Beach, Tanah Laut, South Kalimantan, with 14 species, including members of the Coelenterata, Arthropoda, Mollusca, and Echinodermata phyla. However, sand substrates provide fewer nutrients and organic matter than mud substrates (Shofiya et al, 2021). Furthermore, sand substrates are less supportive for the survival of some invertebrate species because they lack attachment sites, such as rocks, to protect themselves from waves (Widyartini et al, 2023; Perricone et al, 2023). The high water currents or waves at Tabanio Beach force several invertebrate species to adapt to their environment. Several invertebrate species found on the sand substrate at Tabanio Beach are known to have the ability to bury themselves in the sand when waves hit. This triggers the higher abundance of species found on the sand substrate compared to mud and rock substrates. In addition, indications of competition for nutrients and habitat (predation) in the mud and rock substrate areas can also be one of the causes.

Meanwhile, 11 invertebrate species inhabited the mud substrate. These invertebrates are members of the Coelenterata, Arthropoda, and Mollusca phyla. The results of this study align with those of Ekaningrum et al, (2012); Taqwa et al, (2014); Irawan (2014); Irawan and Yandri (2014, 2015), which stated that many invertebrate species prefer mud as a habitat and feeding ground, particularly members of the Crustaceae, Bivalves, and Gastropoda. Mud substrates provide the highest levels of organic matter compared to sand and rock substrates (Shofiya et al, 2021). This is because mud substrates have the smoothest texture compared to other substrate types. The smoother the texture of the bottom substrate in a body of water, the greater its ability to trap organic matter (Van Colen et al, 2014).

On the other hand, rocky substrates were the substrates with the least invertebrate fauna encountered in this study. Cox and Moore (2005) explained that on coral reef substrates, there is an association with invertebrate fauna from various phyla, namely members of the Protozoa Phylum, Mollusca Phylum, Porifera Phylum, Echinodermata Phylum, Arthropoda Phylum, and Coelenterata Phylum. Furthermore, Mawardi (2002) also added that the types of associated biota are groups of biota that typically inhabit coral reef areas, such as anemones, shrimp, sponges, sea cucumbers, and shellfish families. In this study, on rocky substrates, the presence of invertebrates was dominated by members of the Echinodermata Phylum. The presence of members of the Echinodermata Phylum is for shelter and as a food source (Zhou and Goh, 2025). Ecologically, Echinoderms also have a very important role in rock ecosystems, especially in the food chain (food web), because Echinoderms are generally detritus eaters and predators. In addition, members of the Mollusca phylum, namely the Gastropoda class, are also found on rocky substrates. The presence of Gastropoda members on rocky substrates is known because Gastropoda can adapt to the existing substrate, namely on substrates in the form of sloping rocks with many holes and depressions that will be filled with water at low tide to become a kind of small tidal pool which is an ideal place for Gastropoda to shelter from drought and low tide as well as the pounding of waves (Ira et al, 2015).

In general, the abundance of invertebrates at Tabanio Beach in this study was still very low. The presence of coal barge activity indicates a decline in the ecological health of Tabanio Beach's waters, which is certainly followed by a decline in the diversity of its faunal inhabitants. This is in line with

research conducted by Collier et al, (2016), which stated that several factors causing the decline in biodiversity in marine ecosystems are water pollution, overexploitation, habitat degradation, invasive species, and climate change. Furthermore, more recently, noise and other forms of energy, such as anthropogenic electromagnetic fields, are considered critical stressors for the natural balance of the ocean. These stressors can negatively impact the survival and reproduction of individuals, with consequences for entire populations and species (Van der Graaf et al, 2012; Hutchison et al, 2020; Popper et al, 2020). Recent findings have shown that marine invertebrates are sensitive to anthropogenic noise and indicate that sensitivity may impact marine biodiversity (André et al, 2011; Aguilar de Soto, 2016; Edmonds et al, 2016; Sordello et al, 2020), thus positioning invertebrates as direct indicators of ocean health.

CONCLUSION

Based on the research conducted, it can be concluded that at Tabanio Beach, Tanah Laut District, South Kalimantan, 15 invertebrate species were found belonging to 14 families, including the Coelenterata Phylum, Arthropoda Phylum, Mollusca Phylum, and Echinodermata Phylum. Thus, Tabanio Beach, Tanah Laut District, South Kalimantan, has the potential to be a habitat for various types of invertebrates and can be studied further.

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CONFLICT OF INTEREST

There is no conflict of interest.

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