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DISTRIBUTION AND DIVERSITY OF BIVALVIANS IN THE INTERTIDAL ZONE REGION OF VILLAGE ANAK SETATAH, KEPULAUAN MERANTI REGENCY

Khairuw Wafa[1]*, Thamrin[1], Syafruddin Nasution[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine,
Universitas Riau, Pekanbaru 28293 Indonesia
*khairuw.wafa4113@student.unri.ac.id

ABSTRACT

This study was conducted from May to June 2022 to know the species, abundance, diversity, and distribution patterns in the tidal areas of Anak Setatah Village. As supporting data in this study, several environmental parameters were also measured, including water quality, sediment type, and sediment organic matter content. The study method was a survey method, where sampling used the quadrat transect method. The results found that there were three species of bivalves. Where the abundance among stations ranged from 0.49 to 0.74 and/m^2. The value of the species diversity index ranged from 0.91 to 1.41, which was classified as moderate, and the matter of the distribution pattern ranged from 6.28 to 9.71 with a clumped distribution pattern.

Keywords: Diversity, Bivalvia, Anak Setatah Village.

1. INTRODUCTION

The intertidal zone is a zone that experiences high and low tides. This zone is a transitional area between marine and terrestrial ecosystems, the narrowest area of all regions in the world's oceans. Although this area is minimal compared to other marine parts, the intertidal zone has a high diversity of aquatic biota, including clams or bivalves[1].

Bivalves are one of the constituents of the invertebrate community in the intertidal area. Two symmetrical shells characterize bivalves (clams). The two shells are joined by an elastic joint called a ligament on the dorsal surface. In ecological aspects, bivalves are a vital fauna in aquatic ecosystems because they reduce the risk of environmental degradation and provide food for various other species in the food chain. Bivalves can be found in multiple waters, especially in diverse shallow water ecosystems, such as the Anak Setatah Village's Intertidal Zone.

Anak Setatah Village is directly adjacent to the Malacca Strait and the East Coast of Sumatra, with large waves and muddy beach contours. This dirty beach condition is very suitable for Bivalve habitat. Many ecological factors, including temperature, wave movement, and salinity, influence Bivalves' existence in the coastal area of Anak Setatah Village. The presence of Bivalves is directly or indirectly affected by heat and different light intensities at low tide.

The existence of these various physical-chemical factors requires a biota, namely Bivalves, to have the ability to survive and develop despite unfavorable conditions. Bivalves generally have a tolerance limit to existing abiotic environmental conditions. If the requirements have crossed the tolerance threshold, their development will be disrupted and sometimes even have a lethal effect or death. Ecological factors that significantly affect the life of clams are temperature and salinity. The two

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ecological factors above strongly influence various processes that occur in Bivalves, such as spawning, larval phase, development, and growth.

Diversity, in general, is the total or overall diversity of an area's genetics, species, and ecosystems. Bivalve diversity in this study is all bivalve species found at the research site in the intertidal zone of Anak Setatah Village. Bivalve diversity is often used as a bioindicator to predict water quality, and it is a community with high diversity. Many studies on the Distribution and diversity of Bivalves have been conducted, including Pancawati et al.[2] in Wiso Jepara River and Azizah et al.[3] in Segara Anakan Cilacap.

Based on the description above, the author is interested in researching the distribution and diversity of bivalves. There have been many studies entitled distribution and diversity of bivalves. Still, for the tidal area of Anak Setatah Village, information needs to be found about the distribution and diversity of bivalves. Therefore, the author wants to research this area because there is no known research.

2. RESEARCH METHOD

Time and Place

This research was conducted in May - June 2022. The research location was in the intertidal zone of Anak Setatah Village, Meranti Islands Regency (Figure 1). Bivalve identification and counting activities and sediment sample analysis were conducted at the Marine Biology Laboratory, Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Method

The method used in this study is a survey method, namely direct observation of the research area and sampling and measurement of water quality parameters in the field. Parameters measured include bivalve species, abundance, diversity, uniformity, distribution patterns, water temperature, salinity, acidity, suspended solids, total organic matter, and sediment type. Furthermore, the samples were identified and analyzed at the Marine Biology Laboratory of the Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

Procedure

The research station was determined using a purposive sampling technique, and the research sampling represented the environmental characteristics in Anak Setatah Village, Kepulauan Meranti Regency, as the research location. Each research station is divided into three sub-zones: 1) lower intertidal zone, 2) middle intertidal zone, and 3) upper intertidal zone. Each research station has five transects with a distance of 50 m between transects; each transect consists of 3 plots with a quadratic plot size of 5x5 m with a distance of 20 m between plots. Furthermore, water quality parameters include temperature, pH, and salinity.

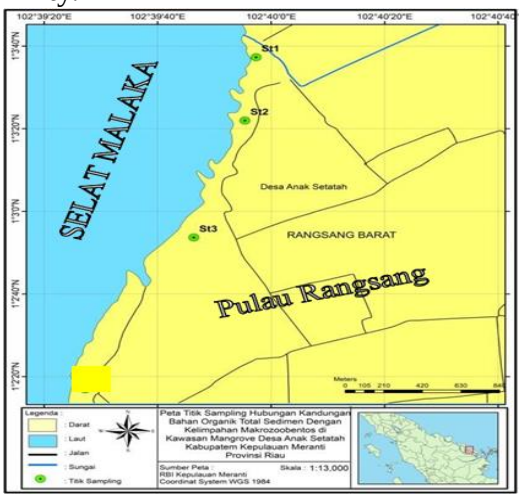

Figure 1. Map of the research location

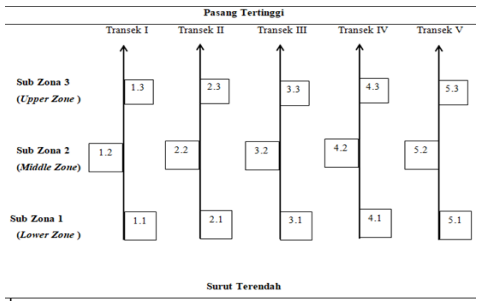

Figure 2. Schematic of transect and plot placement in the intertidal zone of Anak Setatah Beach

In this study, sediment samples were also taken to measure organic matter and sediment fraction. Sediment samples were taken using a 10 cm diameter pipe stuck to a depth of 15 cm.

Data Analysis

Bivalve samples brought to the laboratory were washed with fresh water, and then the bivalves were identified and grouped into trays labeled according to the station point. Specimens were identified based on the shape obtained using the identification book[4]. Furthermore, the number of species obtained was calculated.

Bivalve Abundance

The species abundance index was calculated using the formula[5]:

$$K = \frac{N}{A}$$

Description:
K = Species abundance (ind/m^2)
N = Number of individuals found
A = Plot Area (m^2)

Bivalve Diversity Index

Bivalve species diversity index based on the Shannon Wienner formula[6]:

$$H' = - \sum_{i-1}^{s} pi \, (log2 \; pi)$$

Description:
H' = Species diversity index pi = ni/N
ni = Number of individuals in the i-th species
N = Total number of individuals
s = Number of species captured

Bivalve Distribution Pattern

To determine the distribution pattern of Bivalves, the distribution index was calculated as follows:

$$Id = \frac{n \, (\sum x2) - n}{N \, (N-1)}$$

Description:
Id : Morisita n dispersal index: number of plots
N : Total number of individuals
$\sum x^2$: Number of Individuals per plot squared

Sediment Fraction and Total Organic Matter

Two methods were used to analyze the sediment fraction: the wet sieving method and the pipette method. The graded sieve method was used to obtain Ø-1 - Ø4, while for the pipette method, a volumetric pipette was used to obtain Ø5 - Ø7. Rifardi[7] was used to analyze the sediment fraction type. The concentration of total organic matter in the sediment was carried out with a formula referring to Heiri *in* Prasetia et al.[8], as follows:

$$BOT = \frac{(Wt - C) - (Wa - C)}{Wt - C} \times 100\%$$

Description:
Wt = the total weight (crucible + sample) before burning,
Wa = the total weight (crucible + sample) after burning, and
C = weight of the empty crucible

3. RESULT AND DISCUSSION

Water Quality

Both physical and chemical water quality parameters are measured to see whether the environment is still good. The measured water parameters include salinity, pH, and temperature. Water quality parameters were measured at each research sampling point for three repetitions. The results of water quality measurements in Anak Setatah Village can be seen in Table 1.

Table 1. Average results of water quality measurements of Anak Setatah Village

Station	pH	Temperature (^{O}C)	Salinity (‰)
I	7,3	29	30
II	7	29	30
III	7	28	29

The waters of Anak Setatah Village have a temperature of around 28-290 C, a normal condition for bivalve life. This is based on the statement of Sitorus[9], which states that the optimal temperature for bivalve growth ranges from 25-31^0 C. The

salinity obtained in the study was around 29-30 ppm. The salinity value obtained is still in good condition for clam growth. This is based on the statement of Widasari[10], which states that the average salinity of 25-30 ppt is the value of salinity by the habitat of clams. The value of the salinity range of clams can survive. The average pH value of Anak Setatah Village Waters is 7. This value is still classified as suitable for clam life. Pakaya et al.[11] explain that it supports marine life, including bivalves. pH is a limiting factor for organisms living in a body of water. Waters with too high or low pH will affect the survival of organisms that live in them.

Sediment Type

The sediment type of all stations in the intertidal zone in Anak Setatah Village is mud. The highest percentage of mud sediment fraction is 93.54% in the middle area of station III, and the lowest is 82.81% in the upper zone of station III. The percentage of fraction weight and sediment type are presented in Table 2.

Table 2. Percentage of sediment fraction (%) and sediment type

Station	Sampling Point	% Sediment Fraction			Sediment Type
		Gravel	Sand	Mud	
I	Lower	0,14	12,68	87,18	Mud
	Middle	0,39	6,06	92,75	Mud
	Upper	0,39	10,37	89,24	Mud
II	Lower	0,10	13,01	86,90	Mud
	Middle	0,13	10,87	89,00	Mud
	Upper	0,37	6,66	92,98	Mud
III	Lower	0,50	11.73	87,77	Mud
	Middle	0,33	6,13	93,54	Mud
	Upper	0,43	16,75	82,81	Mud

Table 3. Average sediment organic matter

Station	Sampling point	Ingredients organic (%)	Average content organic matter (%)
I	Lower	7,50 %	7,40 %
	Middle	7,72 %	
	Upper	6,99 %	
II	Lower	4,57 %	9,02 %
	Middle	7,86 %	
	Upper	14,64 %	
III	Lower	6,14 %	6,78 %
	Middle	6,91 %	
	Upper	7,30 %	

Organic matter is an indicator of environmental fertility both on land and in the sea. Organic matter content on the ground reflects soil quality, while organic matter in water can be a quality factor in a water body. Organic matter in a certain amount will be helpful for water, but if the amount that enters exceeds the carrying capacity, it can cause a decrease in water quality[13].

Bivalve Species and Abundance

The results of observations of Bivalve species obtained consisted of three families, three genera, and three species (Table 4).

It can be seen that *Anadara granosa* is the species found at all research stations and has the highest value compared to other species. This indicates that the waters of Anak Setatah are a good habitat for *A.granosa*. The following was stated by Efriyeldi et al.[14]; Efriyeldi and Kurniawan[21]

A.granosa is abundant in the waters of Rangsang Barat with an allometric length-weight relationship.

Anadara species have special adaptations that allow them to survive in areas of physical and chemical stress, such as the intertidal zone. These organisms also have adaptations to withstand currents and waves. However, this species cannot move quickly (motile)[15].

The results of calculating the abundance value of bivalves between stations in the intertidal zone of Anak Setatah Village are high, ranging from 0.49-0.74 ind/m^2. The highest average abundance of bivalves is found at Station II, with a total of 0.74 ind/$m^{2,}$ while the lowest is found at Station III, with a total of 0.49 ind/m^2.

Bivalve abundance between subzones in the waters of Anak Setatah Village was also calculated, where the results obtained were 0.16-0.28 ind/m^2. The highest abundance was found in the Upper subzone, namely 0.28 ind/m^2, and the lowest abundance was found in the Lower subzone, namely 0.16 ind/m^2 (Figure 3).

Table 4. Types of bivalves found

Filum	Family	Genus	Species
Mollusca	Arcidae	Anadara	*Anadara granosa*
	Pharidae	Paphia textile	*Papila textile*
	Cyrenidae	Geloina	*Geloina erosa*

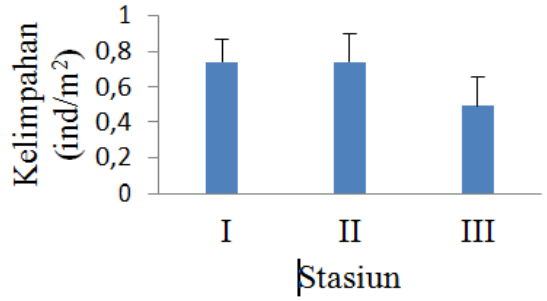

Figure 3. Bivalve Abundance between Stations in the Intertidal Zone of Anak Setatah Village

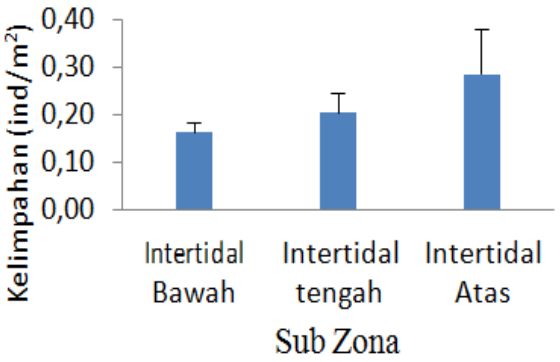

Figure 4. Bivalve Abundance Across Intertidal Subzones of Anak Setatah Village

Bivalve abundance values at each research station varied, and the highest abundance was at station II, with a total of 0.74 ind/m^2, while the lowest average number was at station III, with a total of 0.49 ind/m^2. The high abundance at station II was due to the high content of organic matter contained. According to Ritniasih & Widianingsih[16], the high and low-density values are supported by the percentage of organic matter content in the waters. This is likely because organic matter is essential in providing food sources for bivalve organisms. Widasari[10] says that organic matter in the sediment is a source of organic matter in the deposit and dramatically influences the population of organisms. The abundance of bivalve organisms often supports sediments rich in organic matter.

According to Kolif et al.[17], sediment organic matter significantly influences the population of bivalve organisms because benthic organisms utilize this organic matter for survival. The abundance of bivalve organisms usually supports sediments rich in organic matter. However, if organic matter is excessive, it will interfere with the life of organisms in these waters.

Bivalve Diversity

Based on the analysis conducted, the average value of the bivalve diversity index value between stations in the intertidal zone of Anak Setatah Village is 0.91-1.41, with the highest diversity index value found at station I, namely 1.41 and the lowest diversity index value found at station III, namely 0.91.

Based on the diversity criteria at station I and station II, it can be concluded that the diversity index category at the station is in the medium category, where the index value ranges from $1.0 \leq H' < 3.0$: moderate diversity, sufficient productivity, balanced ecosystem conditions, moderate ecological pressure. An ecosystem can be considered normal if a high level of community diversity characterizes it without any dominant species and the distribution of the number of individuals of each species is relatively uniform.

At station III, it was concluded that the diversity index category was in the low category, where the index value ranged from $H'<1$: Low diversity means that the distribution of individuals is uneven. This means that the aquatic environment has experienced considerable disturbance (pressure), or the structure of the community of organisms in the water is poor.

According to Alfiansyah[18], diversity shows the variety of species in an ecosystem; when an ecosystem has a high diversity index, it tends to be balanced. Conversely, if an ecosystem has a low diversity index, it indicates that the ecosystem is in a depressed or degraded state. Meanwhile, according to Odum[5], species diversity is influenced by the division or distribution of individuals of each species because even though a community has many species, if the distribution of individuals is uneven, species diversity is classified as low to moderate.

Bivalve Distribution Pattern

The distribution pattern (Id) of Bivalves in the intertidal zone in the waters of Anak Setatah Village obtained results ranging from 6.28 to 9.71, with each station clustered. Clustered distribution patterns can occur due to suitable habitat conditions, including food availability, reproductive behavior, predator threats, and other limiting factors[19]. This indicates that the intertidal zone of Anak Setatah Village is a suitable area for bivalve life, as evidenced by the absence of activities that are too risky to disrupt coastal ecosystems, such as offshore mining factory waste disposal. In addition, grouped distribution patterns can also occur due to the ability of individuals to compete with other species so that they tend to dominate and exist in large numbers[20].

4. CONCLUSION

The results of bivalve observations in the intertidal zone of Anak Setatah Village during the study obtained three species from three stations: one phylum (Mollusca), three families (Archidae, Pharidae, and Cyrenidae), and three species, namely *A.granosa*, *P.textile*, and *G.rosac*. During this observation, the abundance of bivalves in the intertidal zone in Anak Setatah Village ranged from 0.49 to 0.74 ind/m^2. Diversity in the intertidal zone of Anak Setatah Village is included in the moderate category H' (1.28), meaning that the diversity is moderate with a moderate distribution of individuals. This means that the waters are experiencing moderate disturbance (pressure) or the structure of the organism community in these waters is moderate. The distribution pattern of bivalves in the intertidal zone of Anak Setatah Village is regular and clustered.

Based on the research conducted, the level of bivalve diversity was moderate, so the researchers suggested that further research could be carried out by adding research areas such as stations and transects to make the types of bivalves obtained more diverse.

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