Community Structure of Macrozoobenthos Mollusks in Several Coastal Waters of Banten Bay, Indonesia

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Abstract. The coastal waters of Banten Bay have a fairly high potential for fishery resources. The purpose of this study was to determine the community structure of macrozoobenthos mollusks in several coastal waters spread from the west to the east of the bay area (Margari, Bojonegara, Cengkok, Kemayungan-Linduk and Domas beaches). Research activities on the structure of the macrozoobenthos community were carried out from May 2019 to March 2022 in these 5 coastal areas. Data analysis was carried out on the index of density, diversity, evenness, and dominance. Based on the research results, there are 85 genera of macrozoobenthos mollusks from two classes, namely Bivalvia (25 genera) and Gastropods (60 genera). Timoclea sp., Anadara sp., and Codakia sp. is a genus of macrozoobenthos mollusks that are found quite a lot. Based on the calculation results, the density varies from 0.1 to 450 ind/m2. The index values of diversity, uniformity, and dominance in each region varied from 1,449 - 3,538, 0,282 - 0,728, and 0,138 - 0,675. Based on this value, the condition of the coastal water ecosystem has moderate-hight diversity, low-high evenness, and low-high dominant index.

Keywords: Community, marine environment, macrozoobenthos, Banten Bay

1. Introduction

Indonesia as an archipelagic country has many potential marine resources and one of them is coastal waters, which include bay waters. One of the bay areas that has potential for fisheries and tourism is Banten Bay, including underwater ecosystems such as seaweed fields, coral reefs, and major international bird sanctuaries. Banten Bay is a water area located north of Cilegon City, Serang Regency, and Serang City, this bay has an area of ±150 km2 and is relatively shallow water [1]. Topographically, the coastal area of Banten Bay is shallow waters, generally has a depth of less than 50 meters, and is located on the north coast of Java Island and the eastern edge of Jakarta Bay [2]. Banten Bay has characteristics including Muddy sandy beaches with soil material consisting of mud, clay, silt, and sand; The temperature of Banten Bay waters ranges from 29 to 30.4oC in general, not much different from the temperature of tropical sea waters; The ebb and flow of waters generally occurs twice the maximum sea level (high tide) and twice the minimum (low tide) in a day; Ocean currents generally have a speed of up to 35 cm/second, showing a direction to the east during the west season and the east season the current direction changes to the west; Banten Bay has relatively small coastal waves, namely less than 1 m high. According to [3], it is estimated that rainfall in the northern part of Serang Regency is normal and below normal occurs in the southern part of Serang Regency.

Serang has a six-month rainy season (November-April) and a six-month dry season (May-October). Banten Bay has quite potential fisheries potential, both from fish commodities and other fisheries commodities such as shellfish and seaweed. The fish resources in this bay are very varied, both demersal fish, pelagic fish, and reef fish. The geographical location of the Banten Bay waters which are in the Monsoon Wind system causes oceanographic conditions in these waters to be influenced by the Monsoon Wind system [4]. The Banten Bay area is busy with various fishing activities, transportation, coastal development for settlements, and industry [5]. This causes changes in land use and changes in the coastline, pollution from land, and coastal abrasion. Limited land for industrial interests has encouraged coastal reclamation on the Banten Bay coastline, especially in the Puloampel and Bojonegara Districts. Several reclamation locations are suspected of having damaged or even eliminated green areas (mangrove forests) along the coast. Reclamation activities are not only a threat to mangrove habitats but are also thought to have changed the characteristics and dynamics of the Banten Bay current. This is indicated by the presence of coastal areas eroded by waves (abrasion) starting from the Tonjong area of Terate Village to Banten Village, with an estimated area lost reaching 50 ha over 10 years [6].

The rapid economic growth in coastal areas marked by an explosion in population growth has created a need for more space. This is a major problem for big cities around the world. Within the framework of urban spatial planning and meeting the need for new space in coastal areas, it is very difficult to add land to the land, so coastal area reclamation is the main option that must be taken. The need for fill material for reclamation activities on a small scale can be met on land, but for a large scale, a very large volume of fill material is required, so sea sand as fill material is the main option [7]. Related to the increasingly rapid development of the area, Banten Bay is under pressure from the surrounding environment.

This study aims to analyze the structure of the macrozoobenthos community in the waters of Banten Bay and its relationship to the physical and chemical parameters of the water. The information obtained is very important as a basis for better management of the Bay Area.

2. Materials and Method

2.1. Time and Location

This research was conducted in January 2019 - February 2022. The determination of stations was purposive, based on the geographical distribution position from the western waters (where there is quite a lot of industry) to the eastern region (where there are quite a lot of rice fields and fish farms). The research was conducted in 5 regions or zones or locations consisting of the Margagiri-Grenyang (M), Bojonegara-Wadas (B), Cengkok (C), Kemayungan-Linduk (KL) and Domas (D) areas. In each of these areas, 5-6 station points were taken (Figure 1).

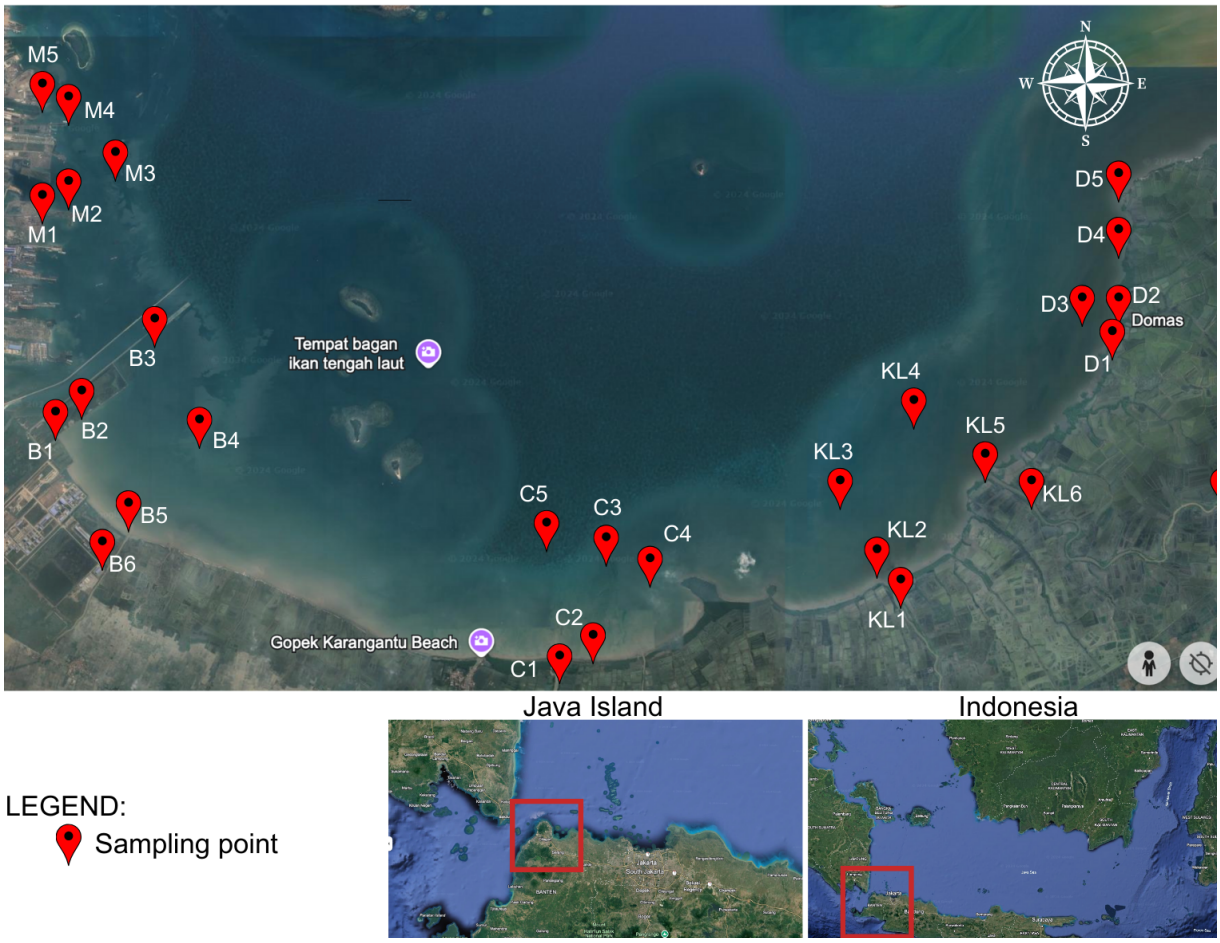

Figure 1. Sampling locations map for benthic mollusks in Banten Bay.

2.2. Data Collection

Data collection activities were carried out by taking macrobenthos samples, which were carried out monthly for 2-5 months. Macrobenthos mollusks were analyzed at the Micro Biology Laboratory 1, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, IPB University.

A macrobenthos mollusk was sampled using a Petersen Grab with an opening area of 13 x 26 cm. Macrobenthos samples were used for species identification. Macrobenthos samples were taken three times at each observation station using random sampling. Macrobenthos samples were separated from the sediment using a 1 mm mesh sieve. The macrobenthos mollusk samples were then put into sample bottles and preserved in 5% formalin solution and rose bengal solution was added. The sample bottles used were labeled according to the station number and sampling date. The filtered macrobenthos samples were then placed in a petri dish to be sorted or separated from the litter using tweezers.

The sorted macrozoobenthos were stored back in the sample bottle and preserved with 5% formalin for identification. Examples of macrozoobenthos were identified using an identification book and the aid of a compound microscope and a stereo microscope. Identification of macrozoobenthos refers to the identification books [8], [9], and [10].

2.3. Data analysis

2.3.3. Species Density

The density of macrobenthos mollusks is the number of macrobenthos individuals per unit area. The following is the formula for calculating species density [11]:

$$K = \frac{10000a}{b}$$

Description:

K = Density of macrozoobenthos (Ind/m^2)

a = Number of individuals of the i-th species obtained (Ind)

b = Area of the tool mouth opening (cm^2)

10,000 is the conversion value of individuals from cm^2 to m^2

2.3.4. Diversity index (H')

Diversity shows the diversity of biota types. The diversity index of macrozoobenthos mollusks can be analyzed using the Shannon-Wiener Index with the following formula [12]:

$$H' = -\sum_{i=1}^{s} P_i \log_2 P_i$$

Description:

H' = Diversity index

Pi = Proportion of i-th species

ni = Number of individuals of i-th species

N = Total number of individuals

2.3.5. Uniformity index (E)

The uniformity index is used to determine how similar the distribution of the number of individuals of each type is. The uniformity index is analyzed using the formula [12] as follows:

$$E = \frac{H'}{H_{max}}$$

Description:

E = Evenness index

Hmaks = Maximum diversity

S = Number of taxa

2.3.6. Dominance Index

The dominance index is used to determine the presence or absence of macrozoobenthos organisms that dominate a body of water. The following is the formula used [12]:

$$C = \sum \left(\frac{n_i}{N}\right)^2$$

Description:

D = Dominance index

ni = Number of individuals of the i-th species,

N = Total number of individuals of all species

3. Result and Discussion

3.1. Results

3.1.1. Types and density of macrozoobenthos mollusks

The types of macrozoobenthos in the waters of Banten Bay were found to consist of 2 classes (Bivalva, Gastropoda), and 85 genera. The Bivalvia class consists of 25 genera, while the Gastropoda class consists of 60 genera (Table 3). The most abundant types of macrozoobenthos molluscs found in the waters of Banten Bay were Timoclea sp., Anadara sp., and Codakia sp., (451, 216, and 99 ind./m2 respectively), while the types that were rarely found were Leptolema sp. Morula sp., and Cyclotus sp. (1 ind./10m2 each).

Table 3. Diversity of mollusc zoobenthos in the waters of Banten Bay

BIVALVES	*Tellina* sp.	*Cyclotus sp.*	*Natica sp*
Anadara sp.	*Timoclea ovata*	*Dentalium* sp.	*Oliva* sp.
cf *Brachidontes*	*Timoclea* sp	*Eglisia* sp.	*Pleuroploca sp.*
Codakia sp.	*Vasticardium* sp.	*Epitonium* sp	*Phenacovolva* sp.
Corbula sp	Veneridae	*Filopaludina* sp.	Planorbidae
Donax sp		*Gyraulus* sp	*Polinices* sp
Dosinia sp	**GASTROPODA**	*Hastula sp.*	*Pomacea* sp.
Gafrarium sp.	*Aliculastrum sp.*	*Hemifusus* sp.	Pomatiopsidae
Gari sp	*Aliculastrum sp.*	*Iravadia* sp	*Pterygea sp*
Lutraria sp.	*Ancilla sp.*	Iravadidae	*Pyramidella* sp.
Mactra sp	*Asperitas* sp.	*Laevindentalium* sp	*Retusa* sp.
Modiolus sp.	Assimineidae	*Latilus* sp	*Rissoina* sp
Mytilus sp	*Astralium* sp	*Leptopoma sp.*	*Scalpia* sp
Nuculana sp	*Cerahidea* sp	*Littoria* sp	*Stenomelania* sp
Paphia sp.	*Cerithium* sp 1	*Lutraria* sp.	*Strombus* sp.
Perna sp.	*Cerithium* sp 2	*Macoma* sp	*Tarebia* sp.
Placamen sp.	cf Alvania	*Melanoides* sp.	*Terebralia* sp
Placuna sp.	cf Indoplanorbis	*Melanopsis* sp	*Terebra* sp
Septifer sp.	cf Stenothyra	*Morula* sp.	*Thais* sp
Siliqua sp	*Clea* sp.	*Mitra* sp.	*Trochus* sp.
Soletellina sp.	*Clypeomorus* sp.	*Murex* sp.	*Turricula* sp.
Sunetta sp.	*Conus* sp.	*Nassaria* sp.	*Turridrupa* sp.
Tapes sp.	*Crassispira* sp	*Nassarius* sp.	*Turritella* sp.
			Vexillum sp.

The density of macrozoobenthos mollusks has an average value that varies based on the observation area (Figure 2). A fairly high average value was found in the waters of Kemayungan-

Linduk and Cengkok 6 (1831 and 1687 ind./m2 respectively), while a fairly low density was found in the waters of Bojonegara and Margagiri (170 and 555 ind./m2 respectively).

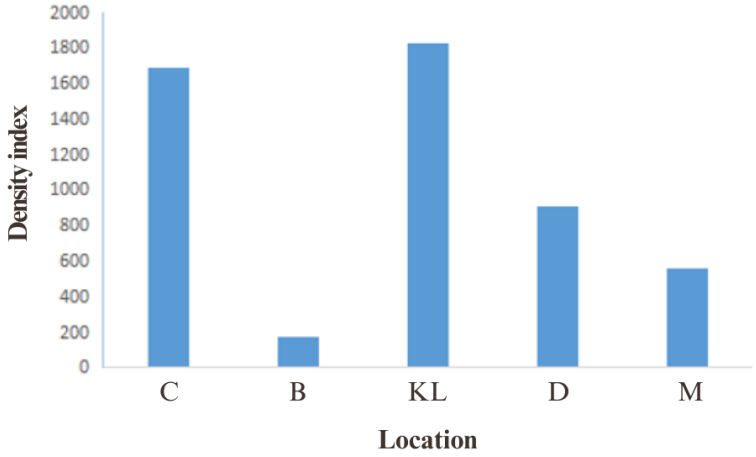

Figure 2. The average density value of macrozoobenthos mollusks in five water areas of Banten Bay

3.1.2. Diversity index (H')

The value of the macrobenthos mollusk diversity index varies quite a bit in each observation area (Figure 3). Based on the observation area, a fairly high average value was found in the Margagiri and Domas areas (3.538 and 3.062 respectively), while a fairly low diversity value was found in the Kemayungan-Linduk and Bojonegara waters (1.499 and 2.130 respectively).

3.1.3. Uniformity index (E)

The distribution of macrobenthos uniformity index data is shown in Figure 4. Based on the observation area, a fairly high average value was found in the Margagiri and Domas areas (0.728 and 0.572 respectively), while a fairly low uniformity index value was found in the Kemayungan-Linduk and Cengkok waters (0.282 and 0.479 respectively).

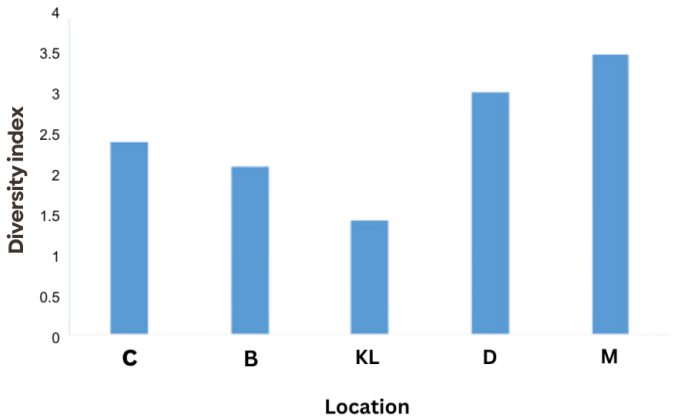

Figure 3. The average value of macrozoobenthos diversity index of mollusks in five areas of Banten Bay waters

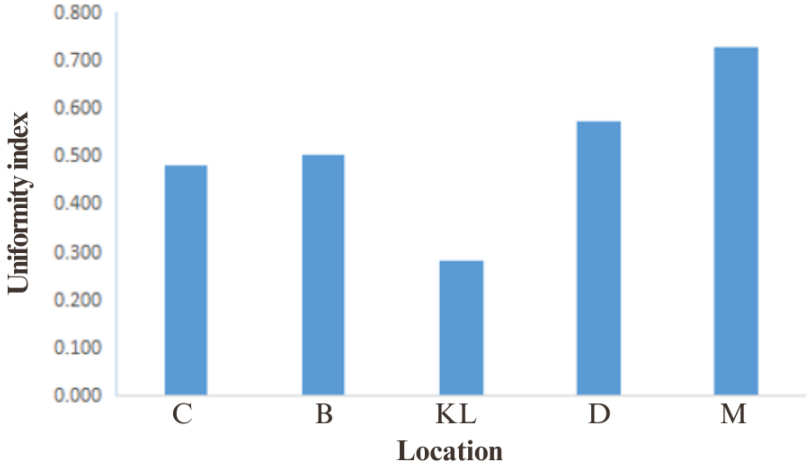

Figure 4. The average value of the macrozoobenthos uniformity index of mollusks in five water areas of Banten Bay

3.1.4. Dominance index (D)

The distribution of macrobenthic mollusk dominance index data during the study is shown in Figure 5. The dominance index value indicates the dominance of a species in the community. Different dominance index values indicate the dominance of a different type of macrobenthic species at each observation station. A dominance index value approaching 1 indicates the presence of a dominant species and vice versa. Based on the observation station, a fairly high average value was found in the coastal waters of Kemayungan-Linduk (0.675), while a low average dominance index value was found in the waters of Margagiri (0.138).

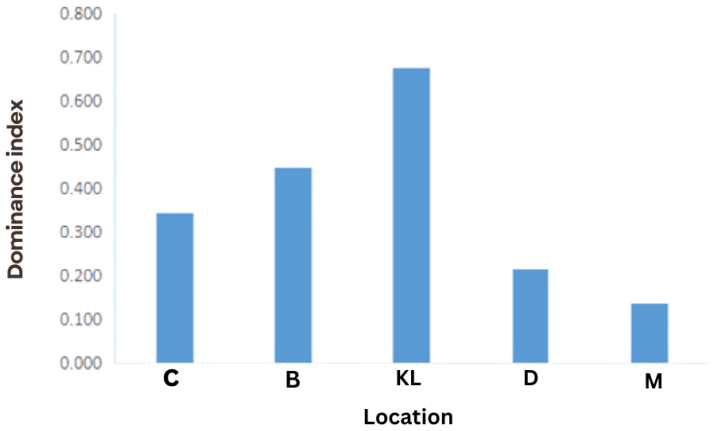

Figure 5. The average value of macrozoobenthos mollusk dominance index in five water areas of Banten Bay

3.1.5. Grouping of areas based on the density of macrozoobenthos mollusks

Grouping of areas was carried out to determine the similarities between areas (places) where macrozoobenthos mollusks were sampled. Grouping of stations was carried out using the Canberra Index with the help of Minitab 16 software. The grouping obtained in this study was based

on the density parameters of macrozoobenthos mollusks. The results of observations using a similarity level of 50% showed three groups of water areas (Figure 6). The first group is represented by the Bojonegara area, the second group represents the Kemayungan-Linduk area, and the third group consists of the Domas, Margagiri, and Cengkok areas.

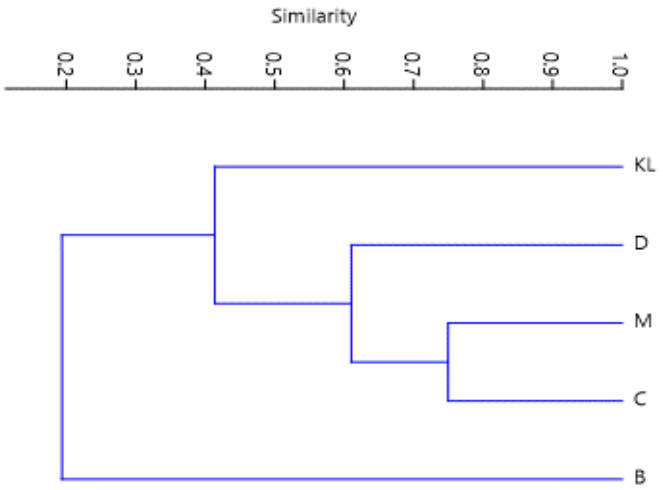

Figure 6. Similarities between regions based on the density of macrozoobenthos mollusks found in Banten Bay.

3..2. Discussions

The macrozoobenthos mollusks that dominate the station are Bivalvia and Gastropoda. However, the types of Bivalvia were found in greater numbers compared to Gastropoda. The types of Bivalvia found in quite large numbers are *Timoclea sp., Anadara sp.,* and *Codakia sp.* This condition is similar to the results of a study conducted by [13] on the coast of Lamong Bay (Surabaya, East Java), which found 2 types of Molluscs (Bivalvia and Gastropoda) in these waters. However, the types that were found in quite large numbers were different from the types found in Banten Bay (namely *Modiolus sp, Tellina sp,* and *Mactra sp*). Although the three types of benthic mollusks were also found in the waters of Banten Bay, they were not included in the ones that were quite numerous compared to the types of Anadara sp, Timoclea sp, and Codakia sp. However, it can be said that these types are groups of Molluscs that are commonly found in coastal waters.

[14] presented the results of research on Molas Beach (Manado Bay). The study also found Bivalvia (2 species) and Gastropoda (34 species). The families that were found quite a lot were Cerithidae, Dialedae, and Rissoellidae. [15] who conducted research activities at the Wulan River estuary (Demak, Central Java), also stated that the mollusks commonly found in coastal waters were Gastropoda and Bivalvia. However, the types that were found quite a lot in these waters were different from those found in Banten Bay (namely *Anadara sp., Meretrix sp*., and *Paphia sp*). [16] conducted research activities related to macrozoobenthos at the Jeneberang River estuary (South Sulawesi). Based on the results of observations, it was also found that the types of mollusks that were common in the estuary were Bivalvia and Gastropoda. Meanwhile, the types that were commonly found were also different from those usually found in Banten Bay (namely *Terebralia sp* and *Pseudodon sp*). The results of observations conducted in the waters of Banten Bay are the results of research by [18] which stated that mollusks are macrozoobenthos biota that are quite commonly found.

Similar conditions were conveyed by [18], [19], and [20]. This shows that Molluscs (Bivalvia) can adapt and have a wide range of tolerance to environmental changes. By the statements [21], [22], and [23], the Bivalvia class of the Mollusca phylum is resistant to increased erosion and unfavorable

conditions. Macrozoobenthos that can adapt will show an increase in species density while other species experience a decrease in species density.

Different conditions were conveyed by [24], who researched the coast of Teluk Lada (Pandeglang, Banten). In this study, Gastropoda (19 species), Pelecypoda (6 species), and Scaphopoda (1 species) were obtained. Mollusks that are quite abundantly found in these waters are *Haustator sp, Columbella sp, Marginella sp, Hinia sp,* and *Deutalium sp*. This condition is also different from the results [25]. In this study, 13 types of benthic mollusks were found, with the most abundant species being Alvenus sp. The results of a study conducted by [26] also showed different results. In this study, it was found that the composition of the benthic mollusk species consisted of 32 species, with the most abundant species being *Ornopsis sp* and *Cypraea sp.*

According to [27], the Bivalvia class has two valves that are used to cover its body in unfavorable conditions. Bivalves also use their vibrating hairs to select and collect food and take in oxygen. The types of macrobenthos of the Bivalvia class (*Timoclea sp., Anadara sp.,* and *Codakia sp*) are more commonly found in the Kemayungan-Linduk, Cengkok, and Bojonegara areas. According to Nybakken (1988), salinity in coastal areas is influenced by tides, seasons, inland water runoff, and estuary topography. Directly or indirectly, the physical and chemical quality of water and sediments affects the existence of macrobenthos. In general, the values of the diversity, uniformity, and dominance indices vary from 1.499-3.538, 0.282-0.728, and 0.138-0.675. From the results of these observations, it can be seen that the diversity of macrobenthos mollusks in the Banten Bay area ranges from medium to high (with an average of medium). The uniformity of macrozoobenthos mollusks ranges from low to high (with a moderate average value), and dominance ranges from low to high (with a moderate average). The dominance index value approaching 1 indicates the presence of a certain type that dominates [12]. This condition is different from the results of observations conducted by [25].

In this study, the diversity index values were obtained, ranging from 0.03-0.95 (in observations in June) and 0.01-1.08 (in observations in September). While the uniformity value ranged from 0.05-0.69 (in observations in June) and 0.01-1.00 (in observations in September). A different condition was also conveyed by [13]. In this study, the diversity index values were obtained, ranging from 0.802-1.028, and the uniformity index ranged from 0.923-1.00. Furthermore, [14] stated that the biological index of benthic mollusk biota on Molas Beach (Manado) had a diversity index value of 0.67-1.97, a uniformity index of 0.94-1.00, and a dominance index of 0.15-0.52. Different results were also presented by [26], who researched Mengening Beach (Badung, Bali). From the results of this study, the diversity, uniformity, and dominance indices were 3.12, 0.90, and 0.10.

4. Conclusion

The coastal waters of Banten Bay which include several beaches (Margagiri, Bojonegara, Cengkok, Kemayungan-Linduk, and Domas) have quite high potential for fishery resources. Based on research activities on the structure of macrobenthic communities conducted from May 2019 to March 2022 in the 5 coastal areas, it is known that there are 85 genera of macrobenthic mollusks from two classes, namely Bivalvia (25 genera) and Gastropoda (60 genera). *Timoclea sp., Anadara sp.,* and *Codakia sp*. are genera of macrobenthic mollusks that are quite abundant. Based on the calculation results, the density varies from 0.1 - 450 ind/m^2. The values of the diversity, uniformity, and dominance indices in each region vary from 1.449 - 3.538, 0.282 - 0.728, and 0.138 - 0.675. Based on these values, the condition of the coastal water ecosystem has moderate diversity, moderate evenness, and low dominance.

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