Advances in Tropical Biodiversity and Environmental Sciences
9(1): 53-61, February, 2025
e-ISSN:2622-0628
DOI: 10.24843/ATBES.2025.v09.i01.p09
Available online at: https://ejournal1.unud.ac.id/index.php/atbes/article/view/1240

Population Density and Diversity of Macrozoobenthos in Seagrass Ecosystems in the Coastal Area of Tablolong Village

Chaterina A. Paulus*[1], Aludin Al Ayubi[1], Lebrina I. Boikh[1], Suprabadevi A. Saraswati[2], Emil Azmanajaya[3]

[1] Department of Aquatic Resource Management, Nusa Cendana University
Jalan Adisucipto – Penfui, Kupang, NTT
[2] Udayana University
Jalan Raya Kampus UNUD, Bukit Jimbaran, Kuta Selatan, Badung, Bali
[3] Department of Civil Engineering, Balikpapan State Polytechnic
Jalan Soekarno Hatta Km. 8, Kota Balikpapan, Kalimantan Timur
*Corresponding author: chatepaulus@undana.ac.id

Abstract. The presence of macrozoobenthos associated with seagrass ecosystems plays an important role in ecological systems and bioindicators for water quality assessment. This study aims to determine the density and diversity of macrozoobenthos populations in seagrass ecosystems in the tourism area in the coastal area of Tablolong village, West Kupang district, Kupang regency. The data collection method in this study was the observation method using the quadrant transect technique. The data collected in this study were analyzed using qualitative and quantitative descriptive analysis. The findings of this study revealed 38 macrozoobenthos species including *Hemicantrotus pulcherimus, Tripneustes gratilla, Echinotrix* sp, *Echinometra* sp, *Diadema setosum, Holthuria atra, Synapta macullata, Holothuria edulis, Archaster typicus, Protoreaster nodosus, Heniricia* sp, *Ophiotrix* sp, *Paguristes cadenati, Coenobita rugosus, Portunus* sp, *Eurynoma aspera, Calappa hepatica, Trocus* sp, *Strombus luhuanus, Lambis-lambis, Strombus gibherulis, Strombus urceus, Strombus costatus, Cypraea trigis, Cypraea errones, Euspira* sp, *Cymatium* sp, *Vexillum* sp, *Amoria* sp, *Conus marmoreus, Conus colubrinus, Jorunna parva, Fragrum* sp, *Frachycardium* sp, *Maetra* sp, *Pina* sp, *Xenophora* sp, and *Andara antiquate*, then population densities between 25.47-59.93 ind/m² with an average value of 44.0 ind/m² or in the low category, as well as the diversity value ranging from 0.317-0.368 with an average value of 0.348 or also in the low category.

Keywords: coastal area, density, diversity, macrozoobenthos, seagrass ecosystem.

I. INTRODUCTION

Indonesia is a country that has the largest wealth of marine biological resources in the world, spread in various coastal ecosystems, one of which is the seagrass ecosystem. Seagrass ecosystems are part of marine ecosystems that have versatile functions, including as a place for the development of marine biota, a place for the development of flora and fauna, and are often used as an ecotourism area [1]. Some types of fauna that live in this ecosystem include macrozoobenthos.

Macrozoobenthos is an aquatic resource that has a high diversity of species, among other invertebrate animals [2]. Macrozoobenthos also has an important economic value because it can be used as food serves as a bioindicator of the aquatic environment and is an important component in the food chain that circulates substances suspended in water to obtain food [3]. Such is the case with seagrass ecosystems in the coastal area of Tablolong village, west Kupang district, Kupang regency. Seagrass ecosystems are habitats for various marine biota or organisms such as certain types of fish and various other biota including

Advances in Tropical Biodiversity and Environmental Sciences 9(1): 53-61, February, 2025 e-ISSN:2622-0628
DOI: 10.24843/ATBES.2025.v09.i01.p09 Available online at: https://ejournal1.unud.ac.id/index.php/atbes/article/view/1240

macrozoobenthos to survive and grow. However, the growth and survival of macrozoobenthos in this ecosystem are greatly influenced by multiple human activities, such as tourism activities, aquaculture activities, residential areas, and fishing boat anchorage areas [4].

Various activities such as picnics and population activities that produce garbage and household waste will be carried into the sea, coupled with continuous oil spills every day from fishing boat docking activities can add to the negative impact on seagrass ecosystems which affect the lower value of population density and decreased diversity of macrozoobenthos biota in it [5].

Referring to the description above, management efforts are needed to stimulate the negative effects caused in order to support the sustainability of ecosystems and aquatic resources including macrozoobenthos populations in the future. However, carrying out efforts to manage ecosystems and marine resources must be based on basic information related to the presence and condition of macrozoobenthos in the local area, so it is necessary to conduct a study related to the density and diversity of macrozoobenthos populations in seagrass ecosystems in the coastal area of Tablolong Village.

II. METHODS

Sampling sites for macrozoobenthos populations in seagrass ecosystems in coastal Tablolong Village, West Kupang District, Kupang Regency are divided into 3 stations. Station 1 is located at the following coordinates S=10°19'37.92' and E=123°27'39.42', Station 2 at S=10°19'16.59' and E=123°27'54.11', Station 3 at S=10°19'5.90' and E=123°28'17.30'.

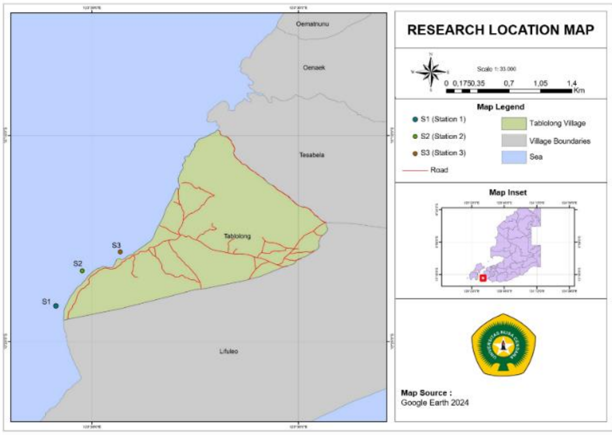

Fig.1 Research Location

The data collection method in this study is the observation method using the quadrant transect technique with stages referring to Bengen (2002) in Al Ayubi et al. (2015), namely at the research location in the coastal area will set stations and observation points that represent the study location. The number of stations observed was 3 stations with the number of points at each station as many as 3 points with a distance of 50 m between points, then at each observation point a transect line was laid in a perpendicular direction from the shoreline along 50 m, then a transect quadrant (square) with a size of 1x1 m2 was set on the transect line as many as 5 quadrants. The distance between quadrants is 10 m. Furthermore, in each quadrant, determination and sampling of each type of macrozoobenthos present, then count the number of individuals of each type [6]. The determination of these types of macrozoobenthos used by referring to the identification instructions and references to several studies such as Abbott and Dance (2000), Sugianti et al. (2014), and Al Ayubi et al. (2021) [7,8,9].

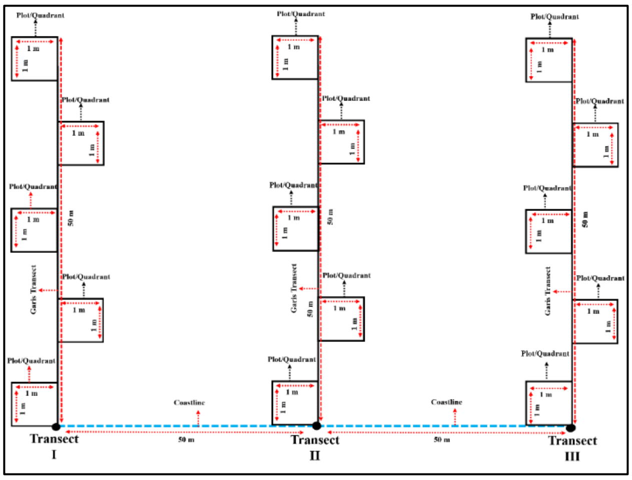

Fig. 2 Illustration of the placement of transect lines and sampling plots/quadrants.

Macrozoobenthos population density data collected in this study will be analyzed using quantitative descriptive analysis carried out analyzing the formula according to Umar, (2013) in Al Ayubi et al., (2015) as follows [6].

$$D = ni/A$$

where: D = population density, ni = a number of macrozoobenthos individuals, and A = sampling area; while macrozoobenthos diversity can also be analyzed using quantitative descriptive analysis through the Shanon-Winner Diversity index formula referred to by Odum, 1993; Soegianto, 1994 in Al Ayubi et al (2015) as follows [6].

$$H' = - \sum pi \ln pi$$

where: H' = species diversity index, pi = ni/N, ni = Number of individuals of the i species, N = total number of individuals, with criteria: if H' < 1, then the value of species diversity is low, if H' > 1 - 3, then the value of species diversity is moderate and if H' > 3, then the value of species diversity is high.

III. RESULTS AND DISCUSSION

Types of Macrozoobenthos Found

The macrozoobenthos species found at the research site both at station I, station II, and station III in the coastal area of Tablolong village based on the results of identification regarding identification instructions and references to several studies such as Abbott and Dance (2000), Sugianti et al. (2014) and Al Ayubi et al. (2021) are 38 species which are divided into 3 phyla, 7 classes, and 28 families, with a classification model in taxonomy can be detailed through Table 1 [7,8,9].

TABLE 1.
CLASSIFICATION OF MACROZOOBENTHOS SPECIES FOUND AT THE STUDY SITE

Phylum	Class	Family	Species	Local Name
Echinodermata	Echinoidea	Strongylocentrotidae	*Hemicantrotus pulcherimus*	Bulubabi
		Toxopeneustidae	*Tripneustes gratilla*	Bulubabi
		Diadematidae	*Echinotrix sp*	Bulubabi
			Diadema setosum	Bulubabi Duri Hitam/Panjang
		Echinometridae	*Echinometra sp*	Bulubabi
	Hlothuroidea	Holothuriidae	*Holthuria atra*	Teripang Hitam/darah
			Holothuria edulis	Teripang Merah
		Sinaptidae	*Synapta macullata*	Teripang Ular
	Asteroidea	Archasteridae	*Archaster typicus*	Bintang Pasir
		Oreasteridae	*Protoreaster nodosus*	Bintang Laut Bertanduk
		Echinasteridae	*Henimicia sp*	Bintang Laut Merah
	Ophiuroidea	Ophiuridae	*Ophiotrix sp*	Bintang Ular
Arthropoda	Malacostraca	Diogenidae	*Paguristes cadenati*	Kelomang Merah
			Coenobita rugosus	Kelomang Keriput
		Portunidae	*Portunus sp*	Kepiting Rajungan
		Majidae	*Eurynoma aspera*	Kepiting Hias
		Calappidae	*Calappa hepatica*	Kepiting Kotak/Muka Malu
Mollusca	Gastrophoda	Trochidae	*Trocus sp*	Siput Lola
		Strombidae	*Strombus luhuanus*	Siput Gonggong
			Lambis-lambis	Siput Ranga
			Strombus gibherulis	Siput Gonggong
			Strombus urceus	Siput Gonggong
			Strombus costatus	Siput Ranga
		Cypraeidae	*Cypraea trigis*	Keong Tutul
			Cypraea errones	Keong Tutul
		Naticidae	*Euspira sp*	Siput Bulan
		Cymatidae	*Cymatium sp*	Siput Predator Kecil
		Muricidae	*Vexillum sp*	Siput
		Volutidae	*Amoria sp*	Siput
		Conidae	*Conus marmoreus*	Siput Kerucut
			Conus colubrinus	Siput
		Discodorididae	*Jorunna parva*	Kelinci Laut
		Xenophoridae	*Xenophora sp*	Siput
	Bivalvia	Cardiidae	*Fragrum sp*	Kerang
			Frachycardium sp	Kerang
		Maetridae	*Maetra sp*	Kerang
		Pinnidae	*Pina sp*	Kerang Kapak
		Arcidae	*Andara antiquata*	Kerang Bulu

Classification of macrozoobenthos species mentioned above, when viewed from the level of phylum includes the phylum Echinodermata, Arthropoda, and Mollusca; then at the level of class includes classes Echinoidea, Holothuroidea, Asteroidea, Ophiuroidea, Malacostraca, Gastrophoda and Bivalvia; then, at the family level, Strongylocentrotidae, Toxopeneustidae, Diadematidae, Echinometridae, Holothuriidae, Sinaptidae, Archasteridae, Oreasteridae, Echinasteridae, Ophiuridae, Diogenidae, Portunidae, Majidae, Calappidae, Trochidae, Strombidae, Cypraeidae, Naticidae, Cymatidae, Muricidae, Volutidae, Conidae, Discodorididae, Xenophoridae, Cardiidae, Maetridae, Pinnidae, and Arcidae. The level of the species can be seen in Figure 3.

Figure 3 shows that there are 38 species found in the seagrass ecosystem in Tablolong village. These macrozoobenthos species, when classified in phylum level, for Echinodermata phylum itself consists of 12 species including *Hemicantrotus pulcherimus, Tripneustes gratilla, Echinotrix* sp, *Diadema setosum, Echinometra* sp, *Holthuria* atra, *Holothuria edulis, Synapta macullata, Archaster typicus, Protoreaster nodosus, Heniricia* sp and *Ophiotrix* sp. The Arthropoda phylum consists of 5 species, including *Paguristes cadenati, Coenobita rugosus, Portunus* sp, *Eurynoma aspera* and *Calappa hepatica*.

The phylum Mollusca consists of 12 species including *Trocus* sp, *Strombus luhuanus, Lambis-lambis, Strombus gibherulis, Strombus urceus, Strombus costatus, Cypraea trigis, Cypraea errones, Euspira* sp, *Cymatium* sp, *Vexillum* sp, *Amoria* sp, *Conus marmoreus, Conus colubrinus, Jorunna parva, Xenophora* sp, *Fragrum* sp, *Frachycardium* sp, *Maetra* sp, *Pina* sp and *Andara antiquata.*

Fig.3. Types of Macrozoobenthos found in the seagrass ecosystem at Tablolong Village Beach: (1) *Hemicantrotus pulcherimus*, (2) *Tripneustes gratilla*, (3) *Echinotrix sp*, (4) *Echinometra sp*, (5) *Diadema setosum*, (6) *Holthuria atra*, (7) *Synapta macullata*, (8) *Holothuria edulis*, (9) *Archaster typicus*, (10) *Protoreaster nodosus*, (11) *Heniricia sp*, (12) *Ophiotrix sp*, (13) *Paguristes cadenati*, (14) *Coenobita rugosus*, (15) *Portunus sp*, (16) *Eurynoma aspera*, (17) *Calappa hepatica*, (18) *Trocus sp*, (19) *Strombus luhuanus,* (20) *Lambis-lambis*, (21) *Strombus gibherulis*, (22) *Strombus urceus*, (23) *Strombus costatus*, (24) *Cypraea trigis*, (25) *Cypraea errones*, (26) *Euspira sp*, (27) *Cymatium sp*, (28) *Vexillum sp*, (29) *Amoria sp*, (30) *Conus marmoreus*, (31) *Conus colubrinus,* (32) *Jorunna parva*, (33) *Xenophora sp*, (34) *Fragrum sp*, (35) *Frachycardium sp*, (36) *Maetra sp*, (37) *Pina sp*, (38) *Andara antiquate*.

Macrozoobenthos Population Density

The population density of macrozoobenthos at the research site, both at Station I, Station II, and Station III in the coastal tourist area of Tablolong village based on the results of the analysis can be detailed in Table 2.

Table 2 shows that the macroinvertebrate population densities at the study site ranged from 25,47 to 59,93 ind/m2, with details between stations, namely for Station I 25,47 ind/m2, Station II 46,60 ind/m2, and Station III 59,93 ind/m2, with a mean value 44,00 ind/m2. In addition, the population density values also showed differences in high and low values between stations, as shown in Figure 4.

TABLE 2
POPULATION DENSITY OF THE MACROZOOBENTHOS FOUND AT THE SITE OF THE STUDY

Station	Number of Individuals (ni)	Density (ind/m²)
I	382	25.47
II	699	46.60
III	899	59.93
Total	1980	132
Average	660	44.00

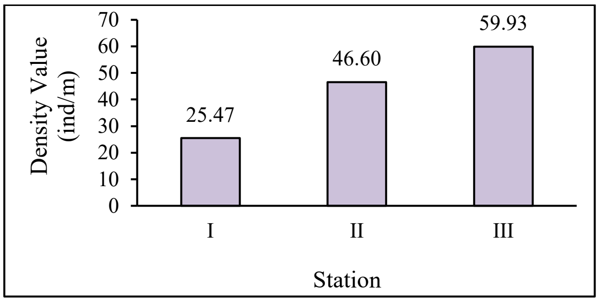

Fig. 4. Distribution diagram of the population density of macrozoobenthos

Figure 4 shows that there are differences in the high and low values of macrozoobenthos population density between stations at the research site, in this case the tourist area on the coast of Tablolong village, where the highest population density value is found at station III, followed by station II and the lowest is found at station I. The high and low values of macrozoobenthos population density at the research site may be due to certain factors. The high and low values of the macrozoobenthos population density at the site of this study may be caused by certain factors.

One of the factors influencing the high and low population density of macrozoobenthos biota in seagrass ecosystems is the association factor of macrozoobenthos biota with seagrass ecosystems in the local area, where the association between macrozoobenthos density and seagrass cover shows a positive relationship, namely an increase in seagrass cover followed by an increase in macrozoobenthos density [10].

From this description, it is clear that the higher density of macrozoobenthos at station III is due to one of the factors in the form of macrozoobenthos association with seagrass ecosystems as their habitat, which visually shows that the seagrass ecosystem at station III is in a thicker or denser condition compared to station II and station I. This statement is supported by the findings of Ira (2011) and Ira (2011). This statement is supported by the findings of Ira (2011) and Jumadi, et al. (2023) that high seagrass density increases total organic matter, thus increasing the abundance of associated macrozoobenthos [11,12]. In line with this, Irawan (2003) found that the density of seagrass cover plays a role in increasing the diversity of macrozoobenthos [13].

Another description related to the higher population density of macrozoobenthos in Transect III, when compared with the findings of Jumadi et al. (2023) who found the population density of macrozoobenthos in the ecosystem in the tourist area on the coast of Balauring Village, Lembata Regency with an average density value of 11.80 ind/m², then the value of macrozoobenthos population density in the tourist area on the coast of Tablolong Village is still relatively higher [12]. However, contrary to the findings of several researchers in other regions of Indonesia, for example, Wahab et al. (2019), the value of macrozoobenthos population density in seagrass ecosystems in Panggang Island, Kepulauan Seribu Jakarta ranged from 18-283 ind/m², Ningsih et al. (2020) reported the density of macrozoobenthos in seagrass beds in the waters of Telaga and Bengkoang Island, Karimunjawa ranged from 44-76 ind/m², and Astutik et al, (2021) reported the density of macrozoobenthos in seagrass ecosystems in Mengiat Beach Waters Nusa Dua, Bali ranged from 57. 2-264 ind/m² [14,15,16]. The population density values from the results of some of these researchers seem to be even higher than the population density found in the coastal areas of the village of Tablolong.

The factors leading to the low population density of benthic invertebrates at the research site can be explained by the findings of several other researchers, e.g. Paulus, et al. (2020), Basahona, et al. (2021), Riantoby, et al. (2021), Paulus, et al. (2022) and Hapsarti, et al. (2023), that the population density of biota, including benthic invertebrates, in aquatic habitats is closely related to the condition of the marine environment, which supports survival and growth. A good ecosystem environment will favor the amount of food available to provide nutrients and energy to support growth and reproduction. Conversely, if the environmental conditions have been under pressure, degraded, or undergone certain changes, it will impact the low supply of food as a source of nutrients and energy for aquatic biota such as macrozoobenthos. Another effect that will occur as a result of the continuation of a damaged / degraded ecosystem is a decrease in the repopulation effort because there is no recruitment of new individuals so a population crisis can occur. This can occur when macrozoobenthos recover to reach maximum density [3,17,18,19,5].

Both internal (natural) and external (non-natural) factors, such as pressure from land-based activities or activities originating from the aquatic environment itself, can cause damage to the habitat conditions of macrozoobenthos in a water body [20]. The pressure of activities originating from the land can be in the form of the disposal of garbage and household waste, and of industrial waste or waste from other anthropogenic activities that are directly discharged into the sea. In addition, Indrawan et al. (2016) also reported that the pressure coming from the water itself that can damage the environment as a habitat for macrozoobenthos can be in the form of ship docking activities around the water, marine transport activities such as oil spills that lead directly to the sea, and there are also other activities such as tourism activities, seaweed cultural activities, and low tide fishing activities that are destructive in nature and then will negatively affect the condition of the habitat as a place for macrozoobenthos to live [10].

Among these external factors, tourist activities, which frequently result in the dumping of rubbish into the sea and subsequent exposure to marine litter, low tide marine life search activities, seaweed farming activities, and the activities of the historical fish farm in the vicinity of the tourist areas where this study is conducted, must be considered as other trigger factors affecting the density of macrozoobenthos populations found in this study. Negative impacts caused by tourism activities such as garbage disposal and direct exposure to marine debris will result in sedimentation and will also cover the mouth of seagrass leaves so that it affects disrupting the photosynthesis process of seagrass plants as a habitat for macrozoobenthos for growth and survival, which then affects the death of seagrass and marine biota such as macrozoobenthos associated with it. This will lead to lower macrozoobenthos population densities in the region. Concrete evidence of marine litter entering the macroinvertebrate community at this research site comes from the findings of Paulus et al. (2020) and Paulus et al. (2022), whose research found different types of marine litter exposed to coastal tourism sites where plastic litter was prevalent [3,19]. The impact of plastic debris is also seen in this research site, which undoubtedly causes sedimentation and harms the inhibition of photosynthesis in seaweed plants, which leads to the death of the seaweed the negative effect caused is the damage to the seaweed ecology and the impact on the death of the related macrozoobenthos and then their low population density, as found in this study.

The history of fish farming activities (BBIP) in Tablolong in the past, when aquaculture was still active, is another reason for the low density of macrozoobenthos in this research site, any form of waste disposal will lead to the marine area, which is the habitat of seagrass and also the associated macrozoobenthos biota so that exposure to these wastes will surely cause the death of seagrass and associated macrozoobenthos biota and the resultant effect is the lower macrozoobenthos population that remains to date. In addition, the activities of seaweed farming, which often exploit macrozoobenthos biota that are considered pests by the farmers, and also a history of overexploitation or search for biota, including macrozoobenthos, in ancient times until today, because according to Roy et al, (2003) and Fenberg and Roy (2008), the low population density of biota including macrozoobenthos in a site is common to all vertebrate and invertebrate species living in terrestrial as well as aquatic environments under continuous exploitation [21,22]. In marine environments, the occurrence of reduced biota density has been widely reported for mobile animals including macrozoobenthos [23].

Declining macrozoobenthos densities are particularly evident where there is no resource management, either by the local community or by fisheries institutions [24]. This is also the case for macrozoobenthos in the research site in the seagrass ecosystem in the Tablolong beach area, where there has been no resource management scheme so far, either based on local wisdom or based on the modern science of macrozoobenthos, especially macrozoobenthos consumption in this location. In this situation, traditional fishers tend to consume whatever edible macrozoobenthos they can find, so without fishing restrictions and conservation measures based on such traditional wisdom or science, it is natural that population densities become low with time [25]. This is also evident in the results of the study.

Macrozoobenthos Population Diversity

The value of macrozoobenthos diversity in the seagrass ecosystems in the coastal area of Tablolong Village, based on the results of the analysis conducted at the observation site, can be detailed as shown in Table 3. Table 3 shows that the diversity of macrozoobenthos populations at the study site ranges from 0.317 to 0.368 with details between stations, namely for station I at 0.317, station II at 0.368, and station III at 0.358, with an average value of 0.348. Furthermore, as shown in Figure 5, the difference in high and low values between stations can also be seen from the value of macrozoobenthos population diversity.

TABLE 3.
POPULATION DIVERSITY OF MACROZOOBENTHOS

Station	Individual (ni)	Pi	ln(pi)	H′
I	382	0.193	-1.645	0.317
II	699	0.353	-1.041	0.368
III	899	0.454	-0.790	0.358
Total	1980	1	-3.314	1.044
Average	660			0.348

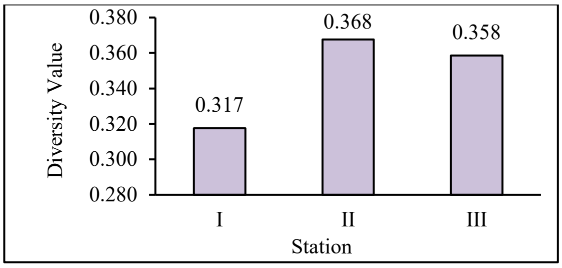

Fig. 5. Macrozoobenthos Population Diversity Diagram

Figure 5 shows that there are differences in the high and low values of macrozoobenthos population diversity between stations at the research site, in this case, the tourist area on the coast of Tablolong village, where the highest value of population diversity is found at station II, followed by station III, and the lowest value is found at station I. With the difference in the value of macrozoobenthos diversity, although the highest value is found at station II, if it is associated with the category of quality standards for the value of the Shanon-Winner diversity index in Krebs et al. With the difference in the value of macrozoobenthos diversity, although the highest value is found at station II, but if it is associated with the category of quality standards for the value of Shanon-Winner diversity index in Krebs et al. (1972) referred to by Brower et al. (1972), referred to by Brower and Zar (1989) in Paulus et al. (2020), which explains that if H' = < 1, indicating a low population diversity condition, the condition of the community structure and aquatic environment is in a depressed state, then if H' = 1 - 3, indicating a moderate population diversity condition, the condition of the community structure and aquatic environment is beginning to be depressed, and if H' = > 3, indicating a large or high population diversity condition, the condition of the community structure and aquatic environment is still good or normal, so that with reference to this explanation, it can be an indication that the condition of macrozoobenthos population diversity in the tourist area on the coast of Tablolong village has been in the low diversity category or which illustrates that the distribution of macrozoobenthos populations in these waters is not uniform or it can be said that the condition of macrozoobenthos community structure in this area has experienced pressure or various disturbances from certain factors encountered in this study [3].

The above explanation is also supported by the findings of several researchers who make macrozoobenthos biota as bioindicators of the quality of aquatic environment as biota habitat, such as Zulkifli and Setiawan (2011), then Rachmawaty (2011) and Rahayu et al. (2015), who reported that macrozoobenthos biota plays a very important role in describing the good and bad condition of an environment or habitat for biota including macrozoobenthos, if the macrozoobenthos diversity index is at a value < 1, the condition of the environment or site is under severe pressure, while the range of diversity values from 1 to 3 indicates that the condition of the environment or site is under moderate pressure or beginning to experience stress. Whereas the range of diversity values >3 indicates that the condition of the environment or habitat is in a stable state [26,27,28].

Several factors, such as tourist activities that often throw garbage into the sea, and then exposure to marine debris, are certainly responsible for the evidence of changes in environmental conditions as a habitat for macrozoobenthos in the coastal tourist area of Tablolong village that have experienced certain disturbance or degradation pressures as described above, a history of exploitation or search for marine biota at low tide that has been carried out from the past to the present, seaweed cultivation activities that often consider macrozoobenthos as cultivation pests, so macrozoobenthos around the cultivation area are continuously exploited, and activities from the history of fish farming at BBIP Tablolong, which was still in operation at the time, by often disposing of aquaculture waste to the research site.

The factors mentioned above such as tourist activities that often dispose of garbage and direct exposure to marine debris will result in sedimentation and will also cover the mouth of seagrass leaves so that it affects disrupting the photosynthesis process for seagrass plants as a habitat for macrozoobenthos to grow and survive which then affects the death of seagrass and marine biota such as macrozoobenthos associated in it so that there is a change in the value of its diversity. Due to the history of fish farming (BBIP) in Tablolong, in the past when the aquaculture industry was still in operation, all forms of waste disposal would lead to the sea area which is the habitat of seagrass and its associated macrozoobenthos biota so that exposure to these wastes will certainly cause the death of seagrasses and associated macrozoobenthos biota and the effect will be that there will be fewer macrozoobenthos populations left today and then have an impact on changes in diversity value. Also, algae farming activities, which often involve the exploitation of benthic invertebrate biota that are perceived as pests by farmers, and a history of over-exploitation or exploitation of biota, including benthic invertebrates, from ancient times to the present, with the result that there are less benthic invertebrates left today, which then impacts on diversity value changes. This explanation is supported by the findings of Al Ayubi et al. (2016), Paulus et al. (2020), and Hapsarti et al. (2023) that the smaller population of biota including macrozoobenthos in an aquatic environment as a result of a history of excessive exploitation will certainly have an effect on changes in the value of diversity of these biotas including macrozoobenthos as found in this study [29,3,5].

CONCLUSION

The coastal area of Tablolong Village is the site of many community activities, such as tourism, anchoring of fishing boats, etc. These activities can affect the water quality. The results of this study found as many as 38 species of macrozoobenthos in the seagrass ecosystems in the coastal area of Tablolong Village with population density ranging from 25.47-59.93 ind/m² with a mean of 44.0 ind/m² or low category, and diversity value ranging from 0.317-0.368 with a mean of 0.348 or also low category.

ACKNOWLEDGMENT

The author is grateful to the Aquatic Resource Management Study Programme, Faculty of Animal Husbandry, Maritime Affairs and Fisheries, Nusa Cendana University, for financial support in the conduct of this research. We would also like to thank the following people for their assistance in data collection: Siti Asma Abdul Kadir, Arlan Aludin, Aidin Wahyudin Al-Ayubi, Qonita Khuzaimah Al-Ayubi and Qania Syaffiah Al-Ayubi.

REFERENCES

[1] Dahuri R., Rais, S. P., Ginting, M. J., Sitepu.2004. Pengelolaan Sumberdaya Wilayah Pesisir dan Laut Secara Terpadu. Edisi revisi. PT. Pradnya Paramita, Jakarta.

[2] Romimohtarto, K., Juwana, S. 2007. Biologi Laut. Ilmu Pengetahuan tentang Biota Laut. Edisi Revisi. Djambatan, Jakarta.

[3] Paulus, A. C., Soewarlan, C. L., Al Ayubi, A. 2020. Distribution of Marine Debris in Mangrove Ecotourism Area in Kupang, East Nusa Tenggara, Indonesia. Internasional Journal of AACL Bioflux. 13(5):1090-1102p.

[4] Amtiran, M. J., Risamasu, F. J. L., Yahyah. 2016. Human Activity Effect to Ecology and Economy Role of Seagrass Ecosystem in Kupang Bay, West Timor, Indonesia. Scholars Academic Journal of Biosciences (SAJB). 5(6) : 393-401p.

[5] Hapsarti, S., Paulus, A. C., Al Ayubi, A., Adar, D. 2023. Komposisi Jenis Makrozoobentos pada Ekosistem Mangrove di Wilayah Pesisir Desa Balauring, Kecamatan Omesuri, Kabupaten Lembata. Jurnal Bahari Papadak. 4(2):50-58p.

[6] Al Ayubi, A., Utami, S., Rihi, P., Leutubung, S. Y. 2015. Keanekaragaman Jenis Gastrophoda dan Echinodermata pada Ekosistem Terumbu Karang di Wilayah Pesisir Pantai Ramu' Desa Hoelea II Kecamatan Omesuri Kabupaten Lembata. Prosiding Seminar Nasional Kelautan dan Perikanan Ke II, Fakultas Kelautan dan Perikanan. Universitas Nusa Cendana. Kupang.

[7] Abbott, T. K., Dance, P. S. 2000. Compendium of Seashells. Odyssey Publishing. China.

[8] Sugianti, B., Hidayat, H. E., Arta, P. W., Retnoningsih, S., Anggraeni, Y., Lafi, L. 2014. Daftar Mollusca yang Berpotensi Sebagai Spesies Asing Inpasif di Indonesia. Badan Karantina Ikan, Pengendalian Mutu dan Kemanana Hasil Perikanan, Pusat Karantina Ikan, Kementerian Kelautan dan Perikanan. Jakarta.

[9] Al Ayubi, A., Sulaiman, S. M., Halija, S., Sari, K., Gufran, Saraswati, A. S. 2021. Jenis-Jenis Biota Avertebrata Air Konsumsi di Perairan Pantai Tebul Desa Hoelea dan Perairan pantai Ramu' Desa Hoelea II, Kecamatan Omesuri, Kabupaten Lembata. Jurnal Bahari Papadak. 2(2):187-196p.

[10] Indarmawan, T., Manan, A. 2011. Pemantauan Lingkungan Estuaria Perancak Berdasarkan Sebaran Makrzoobenthos. Jurnal Ilmiah Perikanan dan Kelautan. 3(2):215-220p.

[11] Ira. 2011. Keterkaitan Padang Lamun Sebagai Pemerangkap dan Penghasil Bahan Organik dengan Struktur Komunitas Makrozoobentos di Perairan Pulau Barrang Lompo. Tesis. Program Studi Ilmu Kelautan, Program Pascasarjana, Institut Pertanian Bogor. Bogor.

[12] Jumadi, M. 2023. Kepadatan dan Kenekaragaman Makrozoobentos Pada Ekosistem Lamun Di Kawasan Wisata Pada Wilayah Pesisir Desa Balauring, Kecamatan Omesuri, Kabupaten Lembata. Laporan Penelitian. Program Studi Manajemen Sumberdaya Perairan. Fakultas Peternakan, Kelautan dan Perikanan. Universitas Nusa Cendana. Kupang.

[13] Irawan, A. 2003. Asosiasi Makrozoobentos Berdasarkan Letak Padang Lamun di Estuaria Bontang Kuala Kota Bontang Kalimantan Timur.

Tesis. Program Studi Ilmu Kelautan Program, Pascasarjana. Institut Pertanian Bogor. Bogor.

[14] Wahab, I., Madduppa, H., Kawaroe, M., Nurafni. 2019. Analisis Kepadatan Makrozoobentos pada Fase Bulan Berbeda di Lamun, Pulau Panggang, Kepulauan Seribu. Jakarta. Jurnal Teknologi Perikanan dan Kelautan. 10(1):93-107p.

[15] Ningsih, W. S., Setyati, A. W., Taufiq, N. 2020. Tingkat Kelimpahan Makrozoobenthos di Padang Lamun Perairan Telaga dan Pulau Bengkoang, Karimunjawa. Journal of Marine Research. 9(3):223-229p.

[16] Astutik, D. M., Watiniasih, L. N., Kartika, D. W. I. 2021. Kerapatan Lamun (Seagrass) dan Kelimpahan Makrozoobenthos di Perairan Pantai Mengiat Nusa Dua, Bali. Jurnal Bumi Lestari. 21(2):1-11p.

[17] Basahona, F., Tahir, I., Akbar, N. 2021. Kepadatan, Keanekaragaman, Dominansi dan Kesamaan Jenis Biota Intertidal di Pulau Ternate dan Pulau Woda. Jurnal Hemyscyllium. 1(2):1-12p.

[18] Riantoby, R. S. E. E., Paulus, A. C., Al Ayubi, A. 2021. Kajian Jenis, Kepadatan dan Keanekaragaman Makrozoobentos di Oesapa Barat Kota Kupang. Jurnal Bahari Papadak. 2(2):12-21p.

[19] Paulus, A. C., Adar, D., Al Ayubi, A. 2022. Sebaran Jenis Mangrove dan Sampah Laut pada Kawasan Wisata di Pesisir Desa Balauring, Kecamatan Omesuri, Kabupaten Lembata. Laporan Penelitian. Lembaga Penelitian dan Pengabdian Kepada Masyarakat, Universitas Nusa Cendana. Kupang.

[20] Marmita, R., Siahaan, R., Koneri, R., Langoy, L. M. 2013. Makrozoobentos Sebagai Indikator Biologis Dalam Menentukan Kualitas Air Sungai Ranoyapo, Minahasa Selatan, Sulawesi Utara. Jurnal Ilmiah Sains. 13(1):58-61p.

[21] Roy, K., Collin, A. G., Becker, B. J., Begovic, E., Engle, J. M. 2003. Anthropogenic Impacts and Historical Decline in Body Size of Rocky Intertidal Gastropods in Southern California. Ecology Letters, 6:205-211p.

[22] Fenberg, Roy. 2008. Ecological and Evolutionary Consequences Of Size Selective Harvesting: How much do we know?. Molecular Ecology. 17:209-220p.

[23] Sato, T. and Goshima, S. 2006. Impacts of Male-Only Fishing and Sperm Limitation in Manipulated Populations of an Unfished Crab, Hapalogaster dentata. Marine Ecology Progress Series, 296:251-262p.

[24] Stern-Pirlot, A., Wolff, M. 2006. Population Dynamics and Fisheries Potential of Anadara tuberculosa (Bivalvia: Arcidae) Along the Pacific Coast of Costa Rica. Rev. Biol. Trop.,54(1):87-99p.

[25] Silva-Cavalcanti, J. S., Costa, M. F. 2011. Fisheries of Anomalocardia Brasiliana in Tropical Estuaries. Pan-Americam Journal of Aquatic Sciences. 6(2):86-99p.

[26] Zulkifli, H., Setiawan, D. 2011. Struktur Komunitas Makrozoobentos di Perairan Sungai Musi Kawasan Pulokerto Sebagai Instrument Biomonitoring. Jurnal Natur Indonesia. 14(1):95-99p.

[27] Rachmawaty, 2011. Indeks Keanekaragaman Makrozoobentos Sebagai Bioindikator Tingkat Pencemaran di Muara Sungai Jeneberang. Jurnal Bionature. 12 (2): 103-109p.

[28] Rahayu, M. D., Yoga, P. G., Effendi, H., Wardiatono, Y. 2015. Penggunaan Makrozoobentos Sebagai Indikator Status Perairan Intertidal Cisadane, Bogor. Jurnal Ilmu Pertanian Indonesia (JIPI). 20 (1):1-8p.

[29] Al Ayubi, A. Gimin, R., Yahyah. 2016. Comparison of Some Aspects of Morphological and Reproductive of Blood Cockle (Anadara granosa L.) in the Intertidal of Kupang Bay, West Timor, Indonesia. Scholar Academic Journal of Bioscience, 4 (11): 1013 – 1021.