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Asteroidea in the Timbul Bone Labunta Sand Waters, Buton Tengah, Southeast Sulawesi

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ABSTRACT: *This* study aims to determine the community structure of starfish (Asteroidea) at three observation stations, namely sandy substrate, sandy substrate dominated by seagrass, and sandy substrate dominated by coral reefs in Pasir Timbul Bone Labunta waters. Sampling was carried out in April-May 2023. The indicators in this study are the species abundance index, diversity index, uniformity index, and dominance index. This type of research is a type of quantitative descriptive research. Determination of stations using purposive sampling technique, namely sampling based on substrate conditions and the presence of starfish (Asteroidea). The results of data analysis are presented in the form of figures and tables. The results showed that there were 4 species of starfish in the Asteroidea class, namely Protoreaster nodosus, Linckia laevigata, Archaster typicus, and Culcita novaeguineae. The diversity index at all observation stations showed a moderate category. The uniformity index at all observation stations shows a high category. The dominance index of Protoreaster nodosus, Linckia laevigata, Archaster typicus, and Culcita novaeguineae at all stations showed a moderate category.

KEYWORDS: Dominance, Asteroidea, Diversity, Uniformity, Community Structure

I. INTRODUCTION

Pasir Timbul Bone Labunta is one of the waters in Tanailandu, Mawasangka District, Buton Regency Tengah, which has an area of ± 100 meters long and ± 20 meters wide. Pasir Timbul Bone Labunta is often used as a tourist spot and a place to find livelihoods for residents. These waters are rich in marine biota, one of which is from the Echinodermata phylum, such as starfish (Asteroidea), sea urchins (Echinoidea), and sea cucumbers (Holothuroidea). The ecosystems in these waters include coral reef ecosystems and seagrass ecosystems.

Starfish are a species of the Asteroidea class and are grouped in the phylum Echinodermata, which consists of approximately 6000 species and live in seawater [1]. In general, Asteroidea are animals with thorn skin. All animals in this class have radial symmetry in body shape, and most have an endoskeleton made of limestone with protrusions in spines [2]. This animal can autotomy and regenerate lost, broken, or damaged body parts [3]. The starfish class Asteroidea is a group of animals with the second highest diversity after the brittle star group (Ophiuroidea) [4]. Ecologically, sea stars have benefits as cleaners of detritus litter in the intertidal zone [5]. The existence of starfish is an animal associated with coral reefs [6], cleaning beaches from organic material so that it is one of the bioindicators of a clean sea [7]. The habitat of sea stars stretches from the intertidal zone to the abyssal zone [8].

Apart from coral reefs, starfish are also often found in seagrass beds and sandy areas. Seagrass meadows support biota that are quite diverse and interconnected with each other, whereas the food web formed between seagrass meadows and other marine biota is very complex [9]. Seagrass beds contain many associated organisms that use seagrass to find food [10], spawn or use it as a nursery area, and so on [11]. The existence of organisms in seagrass meadows is very important because of the reciprocal relationships that influence their habitat [12]. At the same time, sea stars are often found in areas with muddy sand substrates because they feed on leftover sediment and aquatic detritus [13].

II. RESEARCH METHODS

This research was carried out in April-May 2023 in the waters of Pasir Timbul Bone Labunta, Buton Tengah Regency, Southeast Sulawesi. The tools used in this research were a boat, GPS, stationery, water quality meter, pH meter, roll meter, flow kite, Sacci disk, thermometer, and stakes. The materials used in this research were raffia rope, tissue, label paper, plastic bags, and petrol.

This research begins with a field survey which aims to see the water area's condition and so on. After that, determine the station's position using purposive sampling, which is determined based on the research objectives. Transect installation uses the quadrant method and is carried out at 3 observation stations. Station I is on a sandy substrate, Station II is on a sandy substrate dominated by seagrass beds, and Station III is on a sandy substrate dominated by coral reefs. At each station, 2 transect lines were made. An observation plot is placed on each transect. Transect lines are installed 20 m horizontally from the shoreline. The distance between transects 1 and 2 is 10 meters with a length of 50 meters each. On each transect line, 4 observation plots measuring 5 x 5 meters were made, with a distance of 10 meters between the plots.

Observations of starfish (Asteroidea) and environmental parameter data collection were carried out at low tide to facilitate the data collection. Each sea star (Asteroidea) contained in the plot was grouped based on the same morphological characteristics, and then the number of each type was counted. Data collection on aquatic environmental parameters was carried out in situ to determine the condition of the waters, which are the habitat of starfish (Asteroidea). Environmental measurements include temperature, brightness, current speed, turbidity/turbidity, conductivity, TDS, pH, DO, and salinity. Data analysis uses the formula Species Abundance Index, Diversity Index (H'), Uniformity Index (E), and Dominance Index.

III. RESULTS AND DISCUSSION

The total number of individual starfish of the Asteroidea class in the waters of Pasir Timbul Bone Labunta found at Station I was 167 individuals consisting of 4 species, namely Protoreaster nodosus totaling 84 individuals, Linckia laevigata totaling 63 individuals, Archaster typicus totaling 11 individuals and Culcita novaeguineae totaling 9 individuals. At Station II, 234 individuals were found consisting of 4 species, namely Protoreaster nodosus, totaling 88 individuals; Linckia laevigata, totaling 87 individuals; Archaster typicus, totaling 36 individuals; and Culcita novaeguineae totaling 23 individuals. The number of individuals and types of starfish (Asteroidea) found in the waters of Pasir Timbul Bone Labunta can be seen in Figure 1.

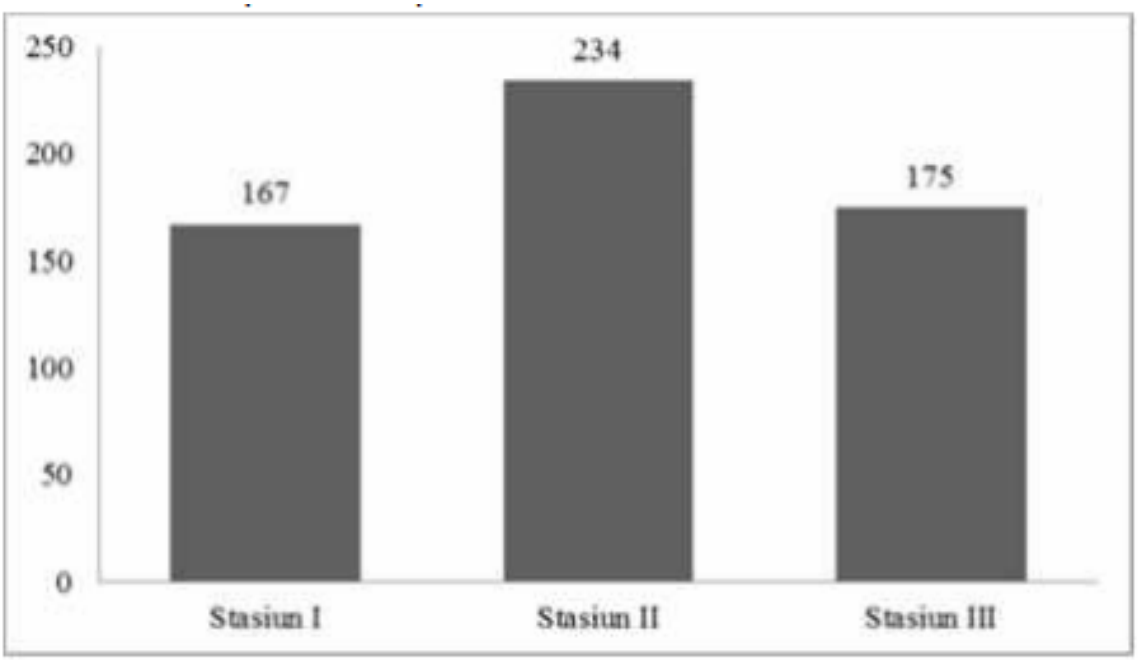

Figure 1. Number of Individual Sea Stars (Asteroidea) at Each Station

At Station III, 175 individuals comprised 4 species, including 46 Protoreaster nodosus, 82 Linckia laevigata, 32 Archaster typicus, and 15 Culcita novaeguineae. The number of individuals and types of starfish (Asteroidea) found in the waters of Pasir Timbul Bone Labunta can be seen in Table 1.

Table 1. Abundance of Starfish (Asteroidea) at each Station

Species	Station I		Station II		Station III	
	ni	Di	ni	Di	ni	Di
Protoreaster nodosus	84	3,36	88	3,52	42	1,68
Linckia laevigata	63	2,52	87	3,48	82	3,28
Archaster typicus	11	0,44	36	1,44	32	1,28
Culcita novaeguineae	9	0,36	23	0,92	15	0,60
Total	**167**	**6,68**	**234**	**9,36**	**171**	**6,84**

Protoreaster nodosus is a sea star species with the highest abundance in sandy substrate areas (Station I) and sandy substrates dominated by seagrass (Station II) with values of 3.36 Ind/m2 and 3.52 Ind/m2. Meanwhile, the lowest abundance at stations I and II was Culcita novaeguineae, with values of 0.36 Ind/m2 and 0.92 Ind/m2. Protoreaster nodosus is often found in seagrass beds because its main food is seagrass, detritus, and seaweed. This species can adapt and is suitable for environmental conditions with a sandy substrate type dominated by seagrass beds. It also likes areas with high seagrass density because it can increase habitat complexity and provide shelter from predation [14]. Apart from that, the physical and chemical conditions (temperature, salinity, pH, and DO) in the Pasir Timbul Bone Labunta waters are still in the optimum category for the survival of starfish [15]. The abundance of Asteroidea species in waters can be caused by several factors, such as differences in the number of species and individuals [16]. Apart from that, the composition of the substrate also determines the abundance and diversity of starfish species [17]. Species that have the highest species abundance can adapt to environmental changes [18].

The sea star species that has the highest abundance in sandy substrates dominated by coral reefs (Station III) is Linckia laevigata, with a value of 3.28 Ind/m2, and the lowest is Culcita novaeguineae with a value of 0.60 Ind/m2. Linckia laevigata is a blue sea star whose association is not harmful to coral reefs. Linckia laevigata uses coral reefs to get enough food from other organisms that live around coral reefs, such as algae, sponges, sea urchins, and deposits of organic material trapped in coral reefs. The sea stars Archaster typicus, and Culcita novaeguineae have low abundance values at the three stations and are found in groups in small numbers, occupying shallow water areas with sandy substrates and seagrass beds [19]. The environment influences the existence and abundance of species in a location, both biotic and abiotic factors, which are interconnected, as well as interactions between the various species that form the system [20]. The distribution of sea stars depends on the substrate or living place, the amount and type of food available in the water area where the biota resides, and other influencing environmental factors [21]. The results obtained for the diversity index (H') and uniformity index (E) can be seen in Figure 2.

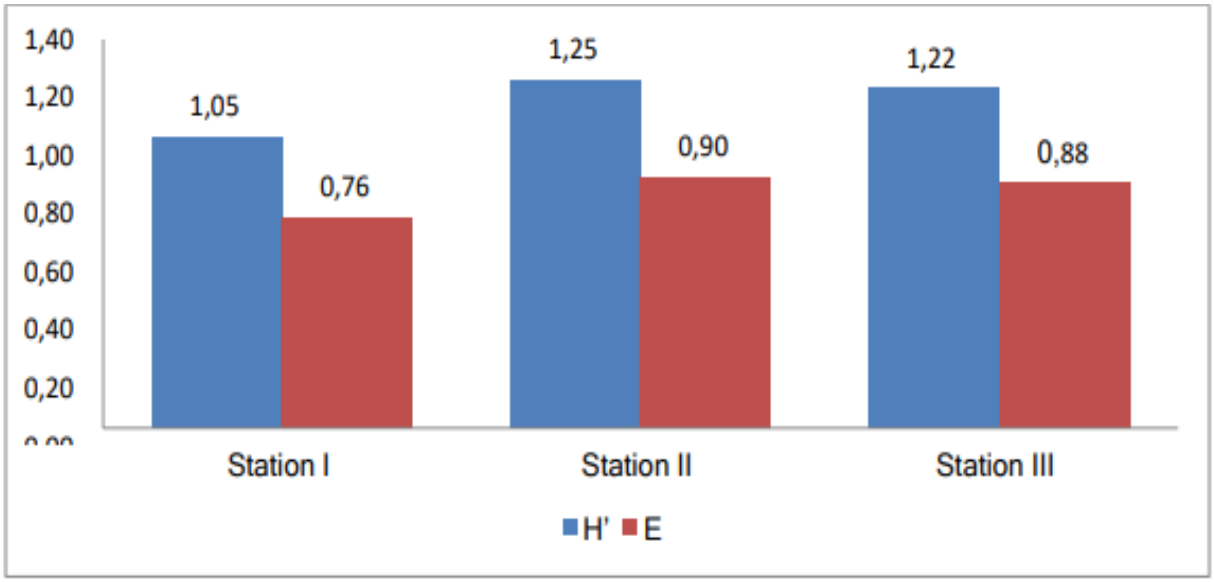

Figure 2. Comparison of the Diversity Index (H') and Uniformity Index (E) for each station

Based on the research results, it is known that the three stations have a medium category diversity index. Moderate diversity indicates a moderate distribution of the number of individuals of each type and moderate ecosystem stability. The diversity index (H') consists of several criteria, namely, if (H') is more than 3.0, it indicates very high diversity. If the (H') value is 1.0-1.5, it indicates moderate diversity. A community is said to have high species diversity if the community is composed of many species

with the same or almost the same abundance of species; if the community is composed of few species and if only a few species dominate, then the species diversity is low [22].

The state of the ecosystem also influences the level of diversity. If the diversity of an ecosystem is relatively high, then the ecosystem's condition tends to be stable. Ecosystems disturbed by diversity tend to be moderate, while ecosystems polluted by species diversity tend to be low. Apart from that, the low diversity index is influenced by surrounding environmental factors, namely the activities of residents [23]. Apart from these factors, the imbalance of a community at the research location causes low diversity, namely the pH, which is not suitable for the habitat of starfish (Asteroidea). The normal pH for starfish life is in the pH range of 7-7.5. 1.25 1.22 1.05 0.90 0.88 0.76 0.45 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05 0 Station I Station II Station III Meanwhile, the pH at the research location ranges from 8.1 to 8.4, which is alkaline. The uniformity index value at Station I is 0.76, Station II is 0.90, and Station III is 0.88. This shows that the uniformity index value is stable because the uniformity at the three stations is close to 0. Suppose the uniformity index value is around $0.75 < E < 1.00$. If the value is close to 0, the uniformity is stable because there is a dominating species. If it is close to 1, the uniformity is stable, indicating no dominant species.

The uniformity index will reach the maximum if the abundance of individuals per type is spread evenly. The uniformity index value ranges from 0-1. The greater the value, the more uniform the number of individuals obtained. Meanwhile, the smaller the uniformity value, the smaller the species uniformity in the community. This means that if the distribution of the number of individuals for each species or genera is not the same, there will be a tendency for a community to show uniformity of the same species or not much difference. The dominance of certain species is very small, and there is no dominance. This category shows that the uniformity of starfish (Asteroidea) at the three stations shows the dominance of the species at each station. The dominance index (C) analysis results were carried out according to Simpson as a reference. The dominance index value of starfish (Asteroidea) in the waters of Pasir Timbul Bone Labunta can be seen in Figure 2.

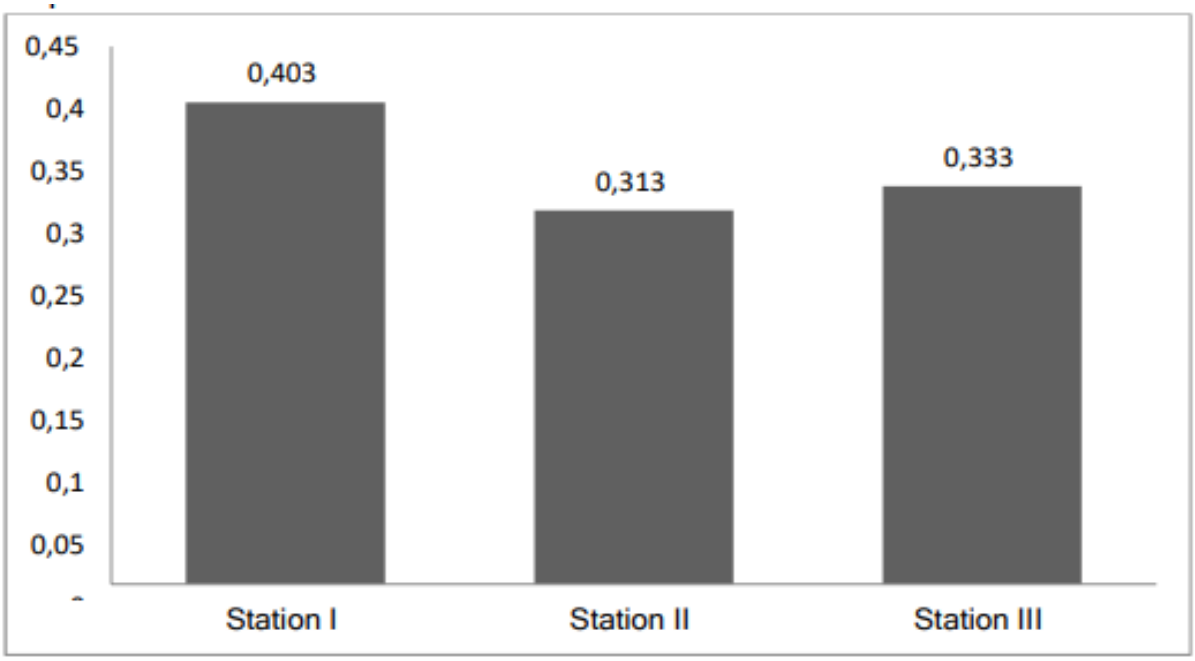

Figure 3. Results of Dominance Index Analysis for Sea Stars (Asteroidea) for Each Species

The dominance index value at Station I and Station II, the dominant species is Protoreaster nodosus with values of 0.253 and 0.141 in the low category, followed by Linckia laevigata, which has a dominance index value of 0.142 and 0.138 in the low category. At Station III, Linckia laevigata species dominates with a dominance index value of 0.230 in the low category, followed by Protoreaster nodosus with a value of 0.060 in the low category. Archaster typicus and Culcita novaeguineae are species that 0.403, 0.313, and 0.333 have low dominance index values at the three observation stations where the values for each species are 0.004, 0.024, 0.035, and 0.003, 0.010, 0.008.

The total value of the dominance index for all stations ranges from 0.313 to 1.403. The dominance index value is Station I and the lowest is Station II. The dominance index value is determined using a calculation method using the Simpson dominance index formula with the provision that if the dominance index is $0 < C \leq 0.5$, there is no dominant species. If the dominance value is close to 1, it means that there is a dominant species in the community. Conversely, if it is close to 0, it means that there are no extremely dominant species in the community structure. The waters of Pasir Timbul Bone Labunta show that the community structure is generally stable, and there is no ecological pressure on starfish (Asteroidea).

The high or low levels of diversity, uniformity, and dominance at each observation station are caused by physical, chemical, and biological parameters such as temperature, salinity, pH, DO, and the behavior of an organism that can adapt to these environmental conditions [24]. Changing habitat conditions can affect the abundance of species that live in that habitat [25]. The results of measuring water quality parameters at the research location can be seen in Table 2.

Table 2. Water Quality Parameters at the Research Location

Quality Parameters	**Station**			
Waters	**Units**	**I**	**II**	**III**
Temperature	°C	27.9	28,2	28,0
Brightness	%	100	100	100
Current speed	m/s	0.41	0.09	0.12
Turbidity	NTU	0.13	0.31	0,13
Conductivity	Umhos	47.6	48.1	40,0
TDS (Total Dissolved Solid)	mg/l	23.8	24.1	23.8
Ph	mg/l	8.2	8.4	8.1
Dissolved Oxygen (DO)	Ppt	7.4	7.3	7.3
Salinity	Meter	32.1	32.2	29.2

The water temperature at all observation stations ranges between 27-28.2°C. This temperature shows that the waters at the research location support the life of starfish. Starfish can grow and develop at temperatures of 25-30°C. Brightness is closely related to light penetration. The brightness at the research location reaches 100%, where light penetration at each observation station reaches the bottom of the water. This happens both when seawater experiences high tides and low tides. Current speed is a factor that greatly influences seagrass growth, but it can also influence macrozoobenthos activity. Currents are important in determining the condition of water [26]. The current speed at the research location is 0.12-0.93 m/s, which shows that the current at the research location is relatively slow, so it is very supportive for the survival of benthic organisms such as starfish [27].

Turbidity describes the lack of clarity in waters due to colloidal and suspended materials such as mud, organic and inorganic materials, and aquatic microorganisms. The results of turbidity measurements at the research location ranged from 0.13-0.31 NTU. Based on the World Health Organization (WHO) provisions, the maximum limit for water turbidity is <5 NTU. Thus, turbidity at the research location shows that it has met the maximum provisions of WHO. Conductivity is a numerical description of water's ability to inhibit the flow of electricity. The conductivity values at the 3 research stations ranged from 40.0-48.1 µmhos, meaning that the conductivity values at the 3 research location stations still met the standards for habitation by marine biota, especially sea stars. The results of measuring the TDS (Total Dissolved Solid) parameters at Stations I to III show an average value of 23.8-24.1. TDS (Total Dissolved Solid) or dissolved solids are solids that have a smaller size than suspended solids.

The pH measurements at the research location showed an average value of 8.1-8.4. The normal pH for sea star life is between pH 7-7.5. Water conditions that are very acidic or very alkaline will endanger the survival of organisms because they will cause metabolic and respiration disorders. The results of DO measurements at 3 observation stations ranged from 7.3 to 7.4 ppm. Dissolved oxygen in water comes from air diffusion and the results of photosynthesis by chlorophyll-bearing organisms that live in waters and are needed by organisms to oxidize nutrients that enter their bodies. DO levels of 2-7 ppm are still normal and support the life of marine biota.

The results of salinity measurements at 3 research stations ranged from 29.2%-32.2%. Salinity is the concentration of all salt solutions obtained in seawater, where the water's salinity affects the water's osmotic pressure. The higher the salinity, the greater the osmotic pressure. The salinity range in marine waters is between 30% -35%. This shows that the salinity levels in the waters of Pasir Timbul Bone Labunta are still very suitable for starfish organisms to live in this area, except at station III, which has salinity levels below 30%.

IV. CONCLUSIONS

The conclusions of this research are as follows: (1). There were 572 types of starfish found at the research location. At Station I, there were 167 individuals; at Station II, there were 234 individuals; and at Station III, there were 175 individuals consisting of 4 species, including Protoreaster nodosus, Linckia laevigata, Archaster typicus, Culcita novaeguineae (2). The diversity index at

Stations I, II, and III shows moderate H' index values. The uniformity index values at Stations I, II, and III show high category E index values. The dominance index values at stations I, II, and III show the index values in the medium dominance category.

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