

Diversity and Density of Fauna Ekinodermata in Liang and Suli Waters, Ambon Island, Maluku

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Abstract: Liang and Suli waters are located on Ambon Island, Maluku. The waters are quite rich with fishery resources such as fish, sea cucumbers, sea urchins, crabs, shrimp and algae. Research on species diversity and density of echinoderms in the waters of Liang and Suli, Ambon Island, Central Maluku, Maluku needs to be conducted given the lack of data and information about the biota. The purpose of this study was to determine the diversity and density of echinoderms in the waters of Liang and Suli, Ambon Island, Maluku. This research was conducted in January-September 2016, sampling was carried out by the transect method and free collection at 2 locations that contained echinoderms. The results showed that there were 19 species of echinoderms found, from 8 families, 6 orders and 4 classes. Whereas the density of echinoderms (ind/m²) based on class groups in Liang and Suli waters, Ambon Island, Central Maluku, Maluku was highest in the Echinoidea class of 0.006 ind/m² which was dominated by sand habitats overgrown with seagrass in Suli waters and the lowest in the Holothuroidea class of 0.002 ind/m² dominated by sand habitats overgrown with algae in Liang waters.

Key words: diversity, density, fauna ecinoderms, Liang and Suli waters, Maluku

1. Introduction

Echinoderms can be found in almost all coastal waters, from tidal areas to deep waters with a depth of between 0.5 to 40 meters. Echinoderms prefer clear, relatively calm waters. In general, each species has a specific habitat, such as Holothuria scabra which is often found in sandy or muddy sand areas where seagrass is growing. Seagrass beds, sand and coral reef ecosystems provide habitat for various types of marine life. Echinoderms occupy various zones in seagrass beds, alge growth zones, reef zones and coral reef slopes. The presence and role of echinoderms in sand, seagrass and coral reef ecosystems has been reported by Clark and Rowe (1971) [1]. The physico-chemical factors of the sea, including salinity, pH, currents, temperature, and brightness, which always change, greatly affect the life of organisms in tidal areas.

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Another important factor that affects the distribution of echinoderms is the average topography of an island beside the feed and feeding methods. Furthermore, it is said that the density of marine animals depends on temperature, salinity, currents, substrate conditions and habitat which greatly determine the distribution of echinoderms.

The waters of Liang and Suli are located on Ambon Island, Maluku. These waters are quite rich with fishery resources such as fish, sea cucumber, crab, shrimp and alge. These waters still have a fairly extensive seagrass ecosystem, when compared to the alge ecosystem and the coral ecosystem. The waters of Liang and Suli beaches are dominated by sand, fine sand with lots of seagrass and alge growing which can support the life of echinoderms. Information regarding the existence of echinoderms is quite important to know because the number of biota species included in this group has a high economic value in the national and international markets. For this reason, activities such as an inventory of echinoderm resources that exist in a water and calculating the potential are the first steps that need to be done. The local distribution and development of echinoderms are highly dependent on substrate factors, the amount and type of food available in the water areas where these biotas are located [2].

In the waters of Liang and Suli, Ambon Island, Maluku, there is an ideal substrate for echinoderms development because it is supported by relatively sloping beaches and has a habitat consisting of sand overgrown with seagrass and coral areas with relatively clear water conditions. Considering that research and information on echinoderms is still rare and relatively few are carried out in Indonesian waters, this research was conducted to determine the existence and potential of these echinoderms. The purpose of this study was to determine the diversity and density of echinoderms in the waters of Liang and Suli, Ambon Island, Maluku.

2. Research Methods

2.1 Time and Location

This research was conducted in January-September 2016 in the waters of Liang and Suli, Ambon Island, Maluku in sandy areas, seagrass beds, areas overgrown with macroalges and coral reef flats at 2 observation locations (Fig. 1, Table 1).

2.2 Tools and Materials

In this research activity, equipment for research purposes in the field and laboratory are used, including roller meters, nylon ropes, shovels, sediment sieves, frames (squares), snorkel masks, fins, underwater cameras, underwater recording boards, plastic bags, rubber. bracelets, permanent markers, pencils, data books and 10% formalin (Table 2).



Fig. 1 Map of the research location.

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No.	Research location	activities	Position	
1	Liang	Transect + Free collection	S 03°50'337″	
	2		E 128°33'130"	
2	Suli	Suli	Transect + Free collection	S 03°54'321″
			E 128°30'431″	

Tool/Material	Function
Roller meter	Transect measuring aid
Nylon rope	Transect aid
Shovel	Sampling aid
Sediment sieve	Sample selector
Frame (squared) 1×1 m	Detection tool for sampling
Mask	Swimming aids
Snorkel	Swimming aids
Fin	Swimming aids
Underwater camera	Sample documentation tool
Plastic bag	Material filling sample
Rubber band	Plastic bag binding material
Permanent marker	Marks the sample
Pencil	Records data
Data book	Records data
Formalin 10%	Preserves the sample

Table 2Tools and materials used during sample collectionand analysis.

2.3 Sampling Method and Data Analysis

This study used the quadratic transect method. The transect line is drawn perpendicular to the coast to the sea along 100 meters at low tide or before the lowest tide, starting from zero and a 1×1 m frame is placed at every 10 m distance along the transect line which is considered to represent locations where echinoderms are present [3]. Echinoderms along the transect line were visually observed in the species composition and the number of individuals from each species was counted and the type of substrate was observed.

To obtain echinoderms immersing themselves in sand and obtain optimum data, the search for echinoderms is carried out by digging or shoveling the substrate in the frame for sieving and filtering. For locations where biota is sparse, a free collection is carried out by swimming "snorkeling" along the coastal waters. The samples obtained were immediately identified in the field, while the samples that had not been identified were put into plastic bags and preserved with alcohol for identification in the laboratory. Identification is carried out according to the literature developed by Clark & Rowe (1971) [1]. Analysis of data on several parameters according to the literature developed is:

- a) Attendance Frequency (Fi)
- b) Relative Frequency of Presence (RFi).
- c) Population Density (In).
- d) Relative Density (RDi).
- e) Diversity Index (H').
- f) Dominance Index (D).
- g) Evenness Index (E).
- h) Species Distribution Pattern Index (Id).

3. Results and Discussion

The results of research that have been conducted in the waters of Liang and Suli, Ambon Island, Maluku. Overall, it was obtained: 2367 individuals consisting of 19 species, 10 families, 6 orders, 4 classes belonging to the phylum of the echinoderms, as can be seen in Tables 3, 4, and 5, with the following details: 19 types of Liang waters, 10 families, 6 orders and 4 classes with a total of 873 individuals, and 18 species of Suli waters, 10 families, 6 orders and 4 classes with a total of 1494 individuals. The total individual echinoderms from free collections in the waters of Liang and Suli, Ambon Island, Maluku can be seen in Table 3.

3.1 Relative Frequency of Attendance (%)

The results of the research obtained at each research station showed that, at station 1 (Liang) the highest relative attendance frequency was in the Ophiuroidea class by 35.00% and the lowest relative attendance frequency in the Echinoidea class by 13.00% (Table 4) and graphically it can be seen in Fig. 2.

In Liang waters, the presence frequency is relatively high in the Ophiuroidea class of 35.00% and the lowest is in the Echinoidea class at 13.00%. In Suli waters, it was found that the presence frequency was relatively high in the Echinoidea class of 33.00% and the lowest was the Holothuroidea class at 20.00%. The frequency of presence plays an important role in determining the level of presence of each species in each quadrant in a transect. Seeing the values above, it can be seen that in the waters of Liang and Suli, Ambon Island, Maluku, it indicates that the eco-nomic resources are still better when compared to areas that have been observed in the waters of Weda Bay, North Maluku where the highest frequency of presence is obtained, namely from the Asteroidea class only 31.32% [4].

Class		F ace 1	G•	Research Location		Total
Class	Order	Family	Species	Liang	Suli	Individuals
	Vavlatida	Arhasteridae	Archaster typicus	23	48	71
Asteroidea		Ophidiasteridae	Linckia laevigata	37	52	89
		Oreasteridae	Protoreaster nodosus	21	45	66
			Culcita novaeguineae	4	2	6
	Diadematoida	Diadematidae	Diadema setosum	92	218	310
Echinoidea			Diadema savignyi	12	14	26
		Toxopneustidae	Tripneustes gratilla	237	213	292
	Camarodonta	Echinometridae	Echinothrix calamaris	26	32	58
			Echinothrix diadema	28	18	46
			Echinometra mathaei	13	7	20
	Aspidochirotida	Holothuriidae	Holothuria atra	4	520	757
Holothuroidea			Holothuria leucospilota	37	-	4
			Holothuria edulis	6	79	116
			Bohadschia argus	2	3	9
		Synaptidae	Synapta maculata	79	1	3
	Apodida	Ophiocomidae	Ophiocoma brevipes	45	88	123
Ophiuroidea			Ophiocoma erinaceus	67	59	126
-			Ophiomastix annulosa	88	74	162
	Ophiurida	Ophiotrichidae	Macrophiothrix longipeda	52	31	83
	Total			873	1494	2367

Table 4The frequency of presence of echinoderms based on class groups at stations research on the waters of Liang and Suli,Ambon Island, Maluku.

No	Class	Research	Average	
INO.		Liang (%)	Suli (%)	(%)
1	Asteroidea	27.00	22.00	24.50
2	Echinoidea	13.00	33.00	23.00
3	Holothuroidea	25.00	20.00	22.50
4	Ophiuroidea	35.00	25.00	30.00
	Total	100	100	100



Fig. 2 The frequency of presence of echinoderms at each research station in the waters of Liang and Suli, Ambon Island, Maluku.

No	Class	Research Station		A	
INO	INO	Class	Liang	Suli	Average
1	Asteroidea	0.004 (33.33%)	0.004 (23.53%)	0.004 (28.57%)	
2	Echinoidea	0.003 (25.00%)	0.006 (35.29%)	0.004 (28.57%)	
3	Holothuroidea	0.002 (16.67%)	0.004 (23.53%)	0.003 (21.43%)	
4	Ophiuroidea	0.003 (25.00%)	0.003 (17.65%)	0.003 (21.43%)	
	Total	100%	100%	100%	

 Table 5 Individual density (ind/m²) and percentage (%) at each research station in Liang and Suli waters, Ambon Island, Maluku.

3.2 Population Density (ind/m²) and Relative Density (%)

Ecinoderm density (ind/m²) based on class groups in Liang and Suli waters, Ambon Island, Central Maluku, Maluku. The highest density was found in Liang waters in the Ophiuroidea class of 0.005 ind/m² and the lowest in Suli waters in the Echinoidea class of 0.001 ind/m². Overall the average density (ind/m²) based on class groups at each research station in Liang and Suli waters, Maluku can be seen in Table 5.

From the results of data analysis, the density of echinoderms (ind/ m^2) at the two research stations showed that the highest density in Suli waters was Echinoidea class of 0.006 ind/m² (35.29%) and the lowest was found in Liang waters in the Holothuroidea class of 0.002. ind/m² (16.67%). Overall density (ind/m²) based on class groups at the two research stations and the average density (%) in the waters of Liang and Suli, Ambon Island, Central Maluku, Maluku, respectively are as follows: in Suli waters of the class Echinoidea 0.006 ind/m^2 (35.29%), then followed by Liang waters of the Asteroidea class: 0.004 ind/m² (33.33%), Liang waters, respectively from the Echinoidea and Ophiuroidea classes, 0.003 ind/m² (25.00%), Liang waters of the Holothuroidea class 0.002 ind/m² (16.67%) as can be seen in Table 5.

The density of echinoderms varies according to class and life habits, some are grouped and some are solitary. The density according to the species can be caused by the ability of each species to occupy the habitat, which in this case is related to reproduction. The small or low density values of Holothuroidea may be caused by a lack of competitiveness in occupying the habitat. Meanwhile, the magnitude of the density value of Ophiuroidea species is probably due to its adaptability and large ability to occupy habitats.

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3.3 Diversity, Dominance, Evenness, and Distribution Patterns

The results of the analysis of several ecological indexes of echinoderms in the waters of Liang and Suli, Ambon Island, Maluku. Diversity index values, dominance, evenness and distribution of echinoderms in the waters of Liang and Suli, Maluku can be seen in Table 6 and Fig. 3.

3.3.1 Diversity

The diversity index of echinoderm species in the tidal areas in the waters of Liang and Suli, Ambon Island, Central Maluku, Maluku as a whole is 1.5414, thus showing that, in general, the diversity of each research station is moderate. The dominance index of echinoderms in the tidal area as a whole is 0.4538, thus indicating that, for each research station there is no dominance of certain species. The equinoderm evenness index in the tidal area as a whole is 0.8686,

thus indicating that the evenness of species at each research station is evenly distributed. The index of the distribution pattern of the species of echinoderms in the tidal area as a whole is 0.2301, thus indicating that the distribution pattern of the types of each research station is diverse.

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No	Class -	Research	Research Station		
		Liang	Suli	Average	
1	Diversity (H)	1.6583	1.4245	1.5414	
2	Dominance (D)	0.4485	0.4592	0.4538	
3	Evenness (E)	0.8522	0.8851	0.8686	
4	Distribution (Id)	0.2188	0.2415	0.2301	



Fig. 3 Ecological index of the echinoderms of each research station in the waters of Liang and Suli, Ambon Island, Maluku.

In general, the diversity index value is 1.5414 as can be seen in Table 6, thus it can be said that the level of diversity of the echinoderms at each research station can be categorized as moderate diversity. A community has a high level of diversity if the Shannon index value is 4.00, while the moderate level of diversity on the Shannon index is between 1.00-3.00 and the level of diversity is low if the Shannon index is 0.00. Furthermore, it is said that if the diversity index value approaches the value 4, it is said to be diverse [5]. The value of moderate diversity found at the research location is closely related to the condition of the location which is somewhat indented like a bay, where most of the area is still submerged in water at low tide, and the ongoing water mass exchange as a result of tidal current activity which is quite dominant at low tide, this location. Thus the biota in these locations can take food and oxygen properly and receive less physical pressure in the form of waves. Chelazzi & Vannini (1980) [6] studied the zoning of biota in the southern coastal waters of Somalia found that species richness increased in the reef flats which were always submerged and had complex bases. Furthermore, it is said that the density of the reef is generally high due to the mass exchange rate of water, high oxygen and low solar thermal pressure [7].

If the Shannon diversity index of a community is less than 3.00, it means that the community is less diverse. It is also explained that the level of diversity is influenced by many factors, including the number and type of environmental quality. The greater the number of species in a balanced proportion, the higher the diversity. The diversity index of echinoderms at each research station is categorized as moderate diversity, this is due to: 1) the number of types and quality of waters, and 2) the capture of echinoderms which is carried out continuously for commercial purposes, regardless of the size of species species and aspects of reproductive circulation.

3.3.2 Domination.

In general, the domination index value for each research station is 0.4538 as can be seen in Table 6. In the table, the one that has the highest dominance value is Suli waters, which is 0.4592 and the lowest is Liang waters, namely 0.4485, this shows that there is no dominance of certain species. The absence of this particular species dominance is probably closely related to the biota's diverse distribution. Furthermore, it is said that domination occurs because of the result of the competition process of evicting individuals from one another or because the habitat characteristics of certain species that live spread to almost all existing zones.

3.3.3 Evenness

In general, the average evenness index value is 0.8686 as can be seen in Table 6. The table shows that the evenness of species at each research station is evenly distributed. The evenness index value of species ranges from 0.85 to 0.88, so if the evenness index value of species is < 0.6, the evenness between species is low and if the evenness index value is > 0.8, the evenness between species is high [8]. Furthermore, it is said that the distribution of biota is called balanced or even if the evenness index ranges from 0.6 to 0.8 [5].

The definition of equitable distribution is that if transects are carried out repeatedly in any location, the chances of obtaining the same results are large. The unequal distribution of biota in an ecosystem is defined as the disruption of the ecosystem. Furthermore, it is said that if the species found in a community have the same or nearly the same number of individuals for each species, then the evenness in that community is high. This echinoderms species inequality is thought to be caused by the distribution of the number of individuals of each species not evenly distributed, or due to physico-chemical factors in the aquatic environment [9].

3.3.4 Distribution Pattern of Species

The index value of the distribution pattern (Id) for each research station is > 1 and the average value of the distribution index is 0.2301 as can be seen in Table 6. Thus, the high value is found in Suli waters which value is 0.2415, the lowest is in Liang waters whose value is 0.2188, while the average distribution value of the two observation areas is 0.2301. The table shows that at each research location in the waters of Liang and Suli, Ambon Island, Maluku are various because the value obtained is less than 1. The index value of the distribution pattern, Id = 1 indicates random distribution, Id < 1 indicates variance spread, and Id > 1 indicates group spread [10].

The variety of distribution values is probably caused by habitat factors such as sand, seagrass and coral reefs in the observation area where the habitat in this area allows all types of echinoderms to adapt to their environment.

4. Conclusion

Based on the research results, it was concluded that echinoderms in transect activities and free collection activities carried out in tidal areas in Liang and Suli waters, Ambon Island, Maluku had a higher diversity value in Liang waters than Suli waters, while high density values were found in Liang and Suli waters. The waters of Suli in the Echinoidea class are dominated by sandy habitats where seagrass is growing.

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