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Diversity of echinoderms of class echinoidea and holothuroidea in waingapu old pier, east sumba regency

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ABSTRACT

Echinoderms are in habitats in coastal waters because is a biota that can maintain the sustainability and the balance of the coral reef ecosystem. Human activity in utili zing Echinoderms, namely in *Echinoidea* and *Holothuroidea* can affect life his life. The purpose of this study was to determine the diversity of phyla Echinoderms class Echinoidea and Holothuroidea at the Harbor Waingapu Old Pier and its use as a medium Biology learning. The research method used is purposive sampling and analyzed using the approach quantitative descriptive with the Shannon diversity index formula Wiener. Echinoderm samples were calculated using the technique quadratic transects with a plot size of 2 x 2 meters are placed perpendicularly in the direction of 50 meters using a plot of 30 plot. Environmental factors measured are temperature, salinity, degrees acidity (pH) and levels of oxygen (DO). Measurements are taken at each observation station. The results showed 11 species Echinoderms are divided into 2 classes, namely Diadema setosum, Diadema savignyi, Tripneustes gratilla, Strongylocentrotus droebachiensis, Echinocardium flavescens, Clypeaster subdepressus, and Mespilia globulus from the class Echinoidea. Holothuria atra, Holothuria scraba, Euapta godeffroyi and Chiridota rigida from the class Holothuroidea. The diversity index obtained includes medium category with a value of H = 1.696.

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INTRODUCTION

Indonesia is a country that has many islands and the potential for abundant marine and marine resources. This shows that Indonesia has a very diverse ecosystem diversity such as shallow

exposure, coral reefs, mangroves, many fish species, and also various species of seaweed (BPS, 2012: 35). High water resources make Indonesia has a variety of marine life, such as diversity of fauna. The fauna that is mostly found in coastal environments is the Echinoderms fauna. Echinoderms live in coastal habitats because they are biota that can maintain the sustainability and balance of the coral reef ecosystem. Echinoderms are more commonly found in clear and calm waters and reach the highest diversity on coral reefs and shallow beaches (Herman, 2004: 4; Radjab *et al.*, 2014: 17; Rompis *et al.*, 2013: 27).

Echinodermata comes from the Greek word Echinos means thorns, Derma means skin. Echinoderms are marine animals that inhabit shallow seas, generally found in coral and seagrass areas. These animals have the ability of the body and regeneration of damaged parts. All animals included in this class have bodies with radially symmetrical shapes and most have an endoskeleton of limestone such as protrusions in the form of spines (Jasin, 1984: 125). Echinoderms also have an important role in marine waters, namely as a cleaner for waste and garbage, have high economic value, and several types of which are edible, such as sea cucumbers and sea urchins. Most of the aquatic people use the beach by looking for various species for food. In addition, Echinoderms can also be used as wall decorations (Lalombombuida, *et al.* 2019: 40). The diversity of Echinoderms can be seen from the activities of humans who often use and take Echinoderms as food and medicine. This is of course a problem because this utilization is not balanced with the preservation of marine ecosystems and does not pay attention to the size and age of Echinoderms that are captured for their survival (Iksan, 2017: 101).

Based on the results of observations made by researchers, damage to the ecosystem also occurred in one of the waters at Waingapu Old Pier, East Sumba Regency. The use of Echinoderms from theclass Echinoidea and Holothuroidea by fishermen at Waingapu Old Pier Port, East Sumba Regency, has resulted in an unbalanced ecosystem in the form of pollution of the aquatic environment due to human activities and the use of chemicals intentionally or unintentionally. This causes the type of biota to experience a decline in reproduction which will result in the reduction or loss of echinoderms. The problems above will affect the habitat or surrounding marine ecosystem because Echinoderms are useful as recyclers of nutrients and as environmental cleaners (Ariyanto 2016). Therefore, the condition of the aquatic ecosystem will affect the biota that depends on living in it. In this case, not only Echinoderms will be disturbed but other marine biota will also experience the same thing.

Activities at Waingapu Old Pier will affect the habitats of Echinoidea and Holothuroidea because these places are places for recreation, places to buy and buy culinary foods as well as activities from boats or boats going in and out around the Waingapu Old Pier Port area. These activities can trigger disruption of the marine ecosystem around the port because the port is a place for passengers to hop on and off and load and unload goods. This will have an impact on the ecosystem of the coastal area as a location for flora and fauna at Waingapu Old Pier. The decline in natural resources and biodiversity due to port activities can affect the coastal ecological structure and even have a negative impact on marine biodiversity, one of which is Echinoderms. Human activity is the biggest factor in the decline in reproduction of echinoderms (Echinoidea and Holothuroidea). Based on the above problems, it is necessary to conduct research on the diversity of echinoderms at Waingapu Old Pier.

This research has a difference with other research, namely the type of research used quantitatively by using a descriptive approach. In addition, the location of this research is Waingapu Old Pier, East Sumba Regency. The method used in this study is a quadratic transect method with a size of 2x2 square meters with a distance between plots of 5 meters, a transect rope length of 50 meters and consists of 10 plots in each station and the station consists of 3. The

sampling technique is purposive sampling while the sampling technique is purposive sampling. Data analysis in this study is an ecological index data analysis technique, namely diversity index, dominance index and uniformity index. The ecological indicators used are density, relative density, frequency and relative frequency.

RESEARCH METHODS

Research Design

The method for this study used thesampling method transect quadratic. Transect sampling can be carried out parallel, vertically or diagonally to the water line. The study was divided into three stations, namely with transects that were stretched for 50 meters at each collection station. Each Station is divided into 10 squared plots. The size of each quadratic plot is 2x2 meters. The distance between each squared plot is 10 meters at each station. The distance between stations is 50 meters. Observations were made at low tide. Each Echinoderm (animal Echinoidea and Holothuroidea) contained in the square was recorded for the number of species and the number of individuals, and samples were obtained.

Population and Samples

The population in this study were all Phylum Echinoderms ofclasses Echinoidea and Holothuroidea found in the tidal waters along the Old Waingapu Port. The samples studied were all Echinoderms of theclass phyla Echinoidea and Holothuroidea contained in the plot using the design Belt Transect Quadrat in the Waingapu Old Port area.

Instruments

The tools used in this study were bamboo, bucket, thermometer, refractometer, pH meter, Dissolved Oxygen (DO), sample box, observation book, camera, roll meter, raffia rope, gloves, and rulers. The materials used are 70% alcohol, distilled water, formaldehyde, tissue, label paper. In this study, bamboo is used to make a frame/plot with a size of I x I meter, a bucket serves to carry tools and materials used during field research, a thermometer to measure water temperature, a refractometer to measure seawater salt content, a pH meter is used to measure acidity of the water content, Dissolved Oxygen (DO) is used to measure the oxygen content in the water, the sample box is used to store the samples taken during the study, the observation book is to write the number of samples obtained during the study, the camera is used to take pictures during the study, roll meter is used to measure the distance between the station and the frame frame, raffia rope is used as a transect rope, gloves to protect hands when sampling because the samples taken have sharp and poisonous spines, a ruler is used to measure samples of sea cucumbers and sea urchins. Materials such as Alcohol, Aquades and Formalin were used to preserve samples taken from the research site. Tissues are used to clean the tools used during research, while label paper serves to label so that errors do not occur when identifying species.

Procedures

The research procedure includes the preparatory (pre-research) stage and the research implementation stage. In the preparation stage, including field observations with the aim of determining the location for sampling, preparing a research permit, determining the time and place for research, preparing tools and materials to be used. In the preparation stage, the researcher made transect lines for three lines / stations with a length of 50 meters each, then made a square with an area of 2 x 2 meters, then made a box / plot of 30 pieces divided into three stations. Next, prepare a measuring instrument for ecological parameters and prepare work safety equipment in the field.

At the research implementation stage, echinoderm samples were taken using the quadratic method which was carried out with 3 repetitions for 3 days, sampling was carried out at low tide. Next, take measurements of physico-chemical parameters, namely measurement of water temperature, water pH, salinity, and Dissolved Oxygen (DO). The samples that have been observed are then identified and classified in the Integrated Laboratory of Wira Wacana Christian University, Sumba.

Data Analysis

The data analysis technique was carried out in a descriptive quantitative manner which was explained in the form of tables and figures. Then calculated using the formula density index, frequency index, diversity index, uniformity index, and dominance index. The formula is as follows.

1. Specific Density

The number of individuals per unit area is called the density of species. Species density at each station is calculated using the formula (Odum 1971, in Nurafni *et al.,* 2019: 76).

$$Di = \frac{ni}{A}$$

Descriptions:
Di : Density of Species
ni : Total number of individuals of species
A : Area to be sampled

2. Relative Density

The relative density according to (Odum 1993, in Insafitri 2010: 57) is the percentage of the number of individuals of a species to the total number of individuals found in a certain area in a community and is formulated as follows:

$$KR = \frac{ni}{N} \times 100\%$$

Descriptions:
KR: Relative abundance
Ni : Number of individuals of species i -
N : Number of all individuals

3. Frequency Species and Relative Frequency

The probability of finding an ith species in all plots is called Frequency (Fi) (English et al., 1994, in Parmadi *et al.,* 2016: 85). Frequency formula is as follows:

Frequency Type:

$$Fi = \frac{Ji}{K}$$

Descriptions:
Fi: Relative frequency for the ith species
Ji: Number of plots containing the ith species
K: Number of plots made

Relative Frekuency

$$Fr = \frac{Fi}{\Sigma F} \times 100\ \%$$

Descriptions:

Fr: Relative frequency of ith species
Fi: Frequency for ith species
ΣF: Total number of frequencies for all species

4. Diversity Index

According to Magurran 1988, dalam (Sulistyani *et al.*, 2014: 10).Index of diversity can be seen as follows:

$$H' = -\Sigma \, Pi \ln Pi \; ; Pi = ni/N$$

Descriptions:
Pi = Relative abundance of species - i
ni = Number of individuals of a species - i
N = Total number of all individuals
H' = Shannon Wienner Index

5. Uniformity index

Formula according to Odum, 1993 the formula for uniformity index can be seen as follows :

$$E = \frac{H'}{InS}$$

Descriptions:
E = Index unifprmity
H' = Diversity index
InS = Number of species with E values ranging from 0-1

6. Dominance index

Formula according to Odum, 1993 index of dominance can be seen as follows:

$$D = \frac{\Sigma [ni]^2}{N}$$

Descriptions:
D = Dominance index
ni = Number of individuals of each type
N = Total number of individuals

RESULTS

Based on the observations of Echinoidea and Holothuridea that have been carried out at Waingapu Old Pier, 11 species are found, as follows are presented in table. Table above is the identification result of Echinoidea and Holothuroidea at the research location showing that there are 11 species found, namely *Diadema setosum* as many as 214 individuals, *Diadema savignyi* as many as 35 individuals, *Tripneustes gratilla* as many as 11 individuals, *Strongylocentrotus droebachiensis* as many as 27 individuals, *Echinocardium flavescens* as many as 2 individuals, *Clypeaster subdepressus* as many as 1 individual, *Mespilia globulus* as many as 5 individuals, *Holothuria atra* as many as 29 individuals, *Holothuria scraba* as many as 44 individuals, *Euapta godeffroyi* as many as 12 individuals, *Chiridota rigida* as many as 2 individuals, so the total individuals found at the study site were 382 species.

Table 1. Number of species found at the research location

Class	Order	Family	Genus	Species	Station			Σ
					I	II	III	
Echinoidea	Diadematoida	Diadematidae	*Diadema*	*D. setosum*	81	62	71	214
				D. savignyi	19	8	8	35
	Temnopleuroida	Toxopneustidae	*Tripneustes*	*T. gratilla*	4	1	6	11
	Echinoida	Strongylocentrotidae	*Strongylocentrotus*	*S. droebachiensis*	9	11	7	27
	Spatangoida	Loveniidae	*Echinocardium*	*E. flavescens*	1	1	0	2
	Clypeasteroida	Clypeasteroidae	*Clypeaster*	*C. subdepressus*	0	1	0	1
	Camarodonta	Temnopleuridae	*Mespilia*	*M. globulus*	1	4	0	5
Holothuroidea	Holothuriida	Holothuriidae	*Holothuria*	*Holothuria atra*	12	9	8	29
				H. scraba	15	17	12	44
	Apodida	Cynaptidae	*Euapta*	*E. godeffroyi*	7	2	3	12
		Chiridotidae	*Chiridota*	*C. rigida*	1	0	1	2
Total Number of Individuals								382

Table 2. Ecological Index

No	Species Name	Di	KR	Fi	FR
1.	*Diadema setosum*	1.783	56%	0.212	13%
2.	*Diadema savignyi*	0.291	9%	0120	7%
3.	*Tripneustes gratilla*	0.091	2%	0.064	4%
4.	*Strongylocentrotus droebachiensis*	0.225	7%	0.120	7%
5.	*Echinocardium flavescens*	0.016	0%	0.018	1%
6.	*Clypeaster subdepressus*	0.008	0%	0.009	0%
7.	*Mespilia globulus*	0.041	1%	0.037	2%
8.	*Holothuria atra*	0.241	7%	0.157	9%
9.	*Holothuria scraba*	0.366	11%	0.166	10%
10.	*Euapta godeffroyi*	0.1	3%	0.074	4%
11.	*Chiridota rigida*	0.016	0%	0.018	1%

Information:
Di = Dencity

KR = Relative Density
Fi = Frequency
FR = Relatif Frequenc

Based on table 2 ecological indicators of the density of Echinoidea and Holothuroidea species seen in species that have The number of high densities was thespecies *Diadema setosum* with a density of Di = 1.783 while the species with the lowest density was *Clypeaster subdepressus*, namely Di = 0.008. Relative density also shows that the species *Diadema setosum* is the species with the highest relative density with a percentage of 56%.

The species frequency in table 2 shows that the *Diadema setosum* species has the highest frequency, namely Fi = 0.212, while the species with the lowest frequency is thespecies, Clypeaster subdepressus namely Fi = 0.009, while the relative frequency of *Diadema setosum* also shows a high number with a percentage of 13%.

Table 3 Climatic factor

Climatic factors	Station			$\dot{x}$
	U1	U2	U3	
Water temperatures				
Day 1	28.7	28.6	28.7	28.6
Day 2	30.5	30.4	29.1	30
Day 3	29.6	29.7	29.9	29.7
pH water				
Day 1	6.7	6.5	6.5	6.5
Day 2	6.0	6.4	6.3	6.2
Day 3	6.2	6.0	5.9	6.0
Salinity				
Day 1	27	26	28	27
Day 2	29	30	29	29.3
Day 3	26	25	26	25.6
Dissolved Oxygen (DO) meter				
Day 1	5.3	5.3	5.4	5.3
Day 2	54	5.3	5.5	5.4
Day 3	5.1	5.4	5.2	5.2

DISCUSSION

Density and Relative Density

In theclass Echinoidea , the species *Diadema setosum* has the highest density at the research location with the number of Di = 1.783 individuals / $m^{2.}$ and a relative density of 56%. This species is abundant in coral and seagrass areas because these species live in groups and stick to rocks and gaps to protect themselves and adapt to their environment from changes in temperature and strong wave currents so as not to be carried away by sea waves. Similar to seagrass beds, this species is in this habitat because it is a substrate that will provide nutrition for sea urchins because Echinoidea (sea urchin) food is algae and detritus that live there (Budiman *et al.*, 2014: 99).

The lowest density was found in thespecies *Clypeaster subdepressus* with a total density of Di = 0.008 and a relative density of 0%. This is because the number of individuals found is only 1 individual during sampling and only in one plot at station 2. The existence of this species is

influenced by very strong ocean currents so that this species is in a habitat that is not where it lives. Another factor that causes this species to be found only in 1 plot is its ability to survive even though the presence of this species is not in its own habitat.

In the class Holothuroidea the highest density was found in thespecies, *Holothuria scraba* namely Di = 0.366 and a relative density of 11%, while the species with the lowest density was *Chiridota rigida* with a percentage of Di = 0.016 and a relative density of 0%. The species density and relative density of theclass Holothuroidea compared to Echinoidea are still low due to the continuous collection of species by the community so that it will affect their reproduction (Rumahlatu *et al,* 2008: 82).

Frequency and Relative Frequency

The habitats of coral, seagrass and sand areas have the highest frequency in theclass, Echinoidea namelyspecies *Diadema setosum* with a value of Fi = 0.212 and a relative frequency of 13%. The lowest frequency was in thespecies *Clypeaster subdepressus* with a value of Fi = 0.009 and a relative frequency of 0%. Thespecies *Clypeaster subdepressus* can occupy the bottom of the coral substrate and coexist with seaweed so that it will affect its color and presence, in line with Emlet's statement, (1985: 184) that thespecies is *Clypeaster subdepressus* also said to be planktotroph because it is in a substrate consisting of many species that are mutually exclusive competing, as planktotrophs this species cannot develop properly when it is still in a larval state because this species is very rarely found.

In theclass Holothuroidea the highest frequency was in thespecies, *Holothuria scraba* namely Fi = 0.166 and a relative frequency of 10%. Species *Holothuria scraba* is the species most widely consumed by the public in general, these species are found in sand substrate to form a long body such as cucumber, although these species are often taken by the community, the presence of this species is still quite a lot because *Holothuria scraba* is the species most capable adapt to the environment so that its presence can still be maintained (Chaiyamoon, 2019: 2). The lowest frequency in thespecies *Chiridota rigida* is Fi = 0.018 and the relative frequency is 1%. Compared to theclass Echinoidea, the species *Holothuria scraba* and Chiridota rigida are in the low category. The decrease in the percentage of this species is influenced by the amount of presence in the habitat. This is due to the continuous collection of species by the community so that the reproductive power of these species has decreased.

Echinoidea and Holothuroidea Dominance Index

The dominance index at the research location was classified as moderate, namely 0.594. The dominance index in this study is close to 1, meaning that one species has a high dominance index. The dominant species is *Diadema setosum*, this species has a very wide distribution, ranging from coral areas as natural habitat, seagrass beds and sandy areas. The distribution of species is influenced by several factors, namely the strong wave currents that carry this species to areas that are not their original habitat. According to Muthiga & McClanahan, (2020: 398) the genus *Diadema* in general can live in habitats up to a depth of 70 meters into the sea and is able to adapt to its new environment so that thespecies *Diadema setosum* found can live in areas that can guarantee its life in an area. specific habitat.

Uniformity Level of Echinoidea and Holothuroidea

The uniformity index at the research location is classified as depressed, namely 0.285. A species uniformity is depressed because of the unequal distribution of a species in a community, meaning that there is one species that has the most number in a particular community which will

result in an imbalance of a community (Insafitri, 2010: 57). The same thing was stated by Nahlunnisa *et al.*, (2016: 96) if a species dominates a certain area, the distribution of species in an area is uneven. Inequality is due to the fact that the individuals of each species are not evenly distributed, because in the habitat / study location, only one species that lives is very large.

Diversity Level of Echinoidea and Holothuroidea

Based on the results of research that has been carried out the diversity of Echinoidea and Holothuroidea, which has the most number of individuals is *Diadema setosum* as many as 214 individuals. This species is mostly found in all stations because the original habitat of *Diadema setosum* is in habitats with hard seagrass substrates such as corals and seagrass beds. The diversity index of Echinoidea and Holothuroidea at Waingapu Old Pier is classified as moderate with a value of H '= 1.696, which means that the distribution of species found at the research location is not evenly distributed because it is dominated byspecies *Diadema setosum*.

The number of Echinoidea and Holothuroidea sampled at each observation station varied, some were the highest and some were the lowest. The difference in the number of individuals of the two types illustrates that the type that has a high number of individuals, namely *Diadema setosum* is a type that has high mobility and is able to compete to adapt to the environment and compete with other species, this is in line with the statement of Muthiga & McClanahan, (2007: 207) namelyspecies *Diadema setosum* also do not often live in their own habitat because it is influenced by the movement of water/ waves that bring this species to other substrates.

The temperature range at 3 stations is 28 - 30^0 C. Conditions with such temperatures are still eurythermal, meaning that these conditions are not a limiting factor for Echinoderms to live because they are still in a condition of wide tolerance so that the life of Echinoidea and Holothuroidea in the research location is still maintained, this is in line with the opinion of Aziz (1994: 29) which states that the normal temperature for Echinoderms is 20 - 33^0 C. Dissolved oxygen content at 3 stations is 5 - 5.5 mg / L. This condition is still very normal for invertebrate animal life including Echinoidea and Holothuroidea. According to the Minister of Health Decree No. 51 of 2004, dissolved oxygen (DO) in water has a limit. normal> 5 mg / L. Salinity ranges from 25-30, it is still within normal limits and good enough for the life of Echinoidea and Holothuroidea. The salinity value in the study area is euryhaline, meaning that it is not a limiting factor or is not at a maximum or minimum condition, this is in line with the opinion of Aziz (1994: 29) which states that normal salinity for Echinoderms is 25% - 35%. The pH value ranges from 6 - 6.5, the optimal pH for marine organisms is 6 - 8 which means that it is still the maximum limit for optimal pH so thatorganisms Echinoidea and Holothuroidea can live in that range. If the pH exceeds the threshold or is below the threshold, reproduction and metabolism do not run optimally which results in death (Patty *et al.*, 2015: 48)

If the aquatic environment is problematic, Echinoderm is one of the species that shows signs of stress, this is because Echinoidea can live and survive with a salinity tolerance limit between 30-34% (Maleko *et al.*, 2017: 78). A habitat and aquatic conditions can affect all abiotic components that are in it so that changing environmental conditions can affect the distribution of species.

CONCLUSION

The diversity of Echinoderms at Waingapu Old Pier Port is still within normal tolerance limits for Echinoderms, meaning that the results of research with a moderate diversity level H '= 1.696 are influenced by human activity, namely species collection carried out by the community around the port, without any further preservation. In addition, the measurement of ecological parameters that have been carried out at the research location is not a limiting factor for

Echinoderms to live but because Echinoderms have a very wide tolerance for contamination levels at the study site.

This research has benefits for the people of East Sumba, especially the community around Waingapu Old Pier, namely as a source of information to understand what types of biota are found in the research location, especially Echinoidea and Holothuroidea class Echinoderms to assist in preserving marine life and maximizing the diversity of marine ecosystems. to maintain balance. This research can also provide input for the government or related agencies regarding the preservation and cultivation of marine life at the Old Pier of Waingapu by conducting counseling or socialization about the importance of preserving the aquatic environment.

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