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Community structure of sea cucumber on coral reefs in Togean Islands national park central Sulawesi, Indonesia

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Abstract
The study was conducted in Togean Islands National Park which is located in Central Sulawesi Province from August to October 2016. Data were collected using linear transect quadrant with 1 x 1 m^2 square size. Observations found 6 types of sea cucumbers. With the highest density of *Synapta maculata* (0.064 ind.m-2), while the lowest sea cucumber density is *Sticopus variegabus* (0.021 ind.m-2). Diversity index values range from 0.56 - 1.04 which can be categorized as low. For uniformity values ranging from 0.31 to 0.75 are categorized under moderate conditions. Domain values range 0.38 - 0.63 low. Based on the above index, it can be concluded that sea cucumbers on coral reefs in Togean Islands National Park of Central Sulawesi have steady state conditions.

Keywords: sea cucumber, community structure, density, diversity, Togean Islands

1. Introduction
Sea cucumbers are a rich diversity of marine biodiversity in Indonesia's marine waters. Sea cucumbers are one of the animals of Echinodermata phylum that has ecologically and economically, ecologically significant role of sea cucumber role as feeder deposit, so it can process the substrate it occupies and as food provider in the form of eggs, larvae and juvenile sea cucumber, for marine biota predator in the vicinity [1]. While economically sea cucumber economic role of food which have very high nutrient content. In dry conditions, sea cucumbers contain 82% protein, 1.7% fat, 8.9% moisture content, ash content 8.6%, and 4.8% carbohydrate [2].
Coral reef ecosystems are very important for marine life. Coral reefs serve as a refuge for teenage marine species and sources of nutrients that help maintain many complex food chains [3]. One group of marine animals that inhabit the coral reef is the Echinodermata. Echinoidea (sea urchins), Crinoidea (sea lilies) and Holothuroidea (sea cucumber), which consists of about 6,500 species [4].
Sea cucumbers are an important source for food and medicine industries in Malaysia [5, 6, 7]. The coral reefs of the Togean islands have a variety of substrates such as muddy sand, gravel and rocky sand. The place of sea cucumbers in this area consists mainly of *Thalassia hempricii* and *Enhalus acoroides* various coral cover that support the Echinoderms presence.
Information on the structure of sea cucumbers in reef habitats has not been reported. The purpose of this research is to know the structure of sea cucumber community in coral reefs in Togean islands, by discussing some ecological aspects such as species richness, frequency of occurrence, density, dominance, and diversity.

2. Materials and Methods
2.1 Study area and analysis
The study area was conducted on coral reefs in the Togean Islands National Park area located in Central Sulawesi Province (Figure 1). Echinoderms samples were collected during low tide using a linear square transect proposed by Yusron and Susetiono (2005) [14]. With squared size being 1 x 1 m^2.

Fig 1: Map showing the study area (sampling site I to VIII).

The species identification is based by Clark and Rowe (1971) [9] and Lane and Vandenspiegel (2003) [10]. The data were processed with PAST (Palaentological Statistic) software. Comparison of the diversity of sea cucumbers in different coral cover areas was analyzed using the t-student test proposed [13]. The transect belt method is a frequently used method of observation to calculate the abundance of macrobentic species. The transect belt observation method uses a rool meter tool to limit and represent the observation area. Area of observation from transect line that is each 1 meter from left and right, so that the area of observation is 140 m2. For the method of calculating coral cover using Under Water Photo Transect (UPT).

3. Results

The type of sea cucumber contained in the Togean Islands National Park of various kinds. The results of observation on Togean Islands waters found 6 species of sea cucumbers. Sea cucumbers are found i.e. *Pearsonothuria graffei*, *Holothuria nobilis*, *Holothuria arta*, *Holothuria scraba*, *Sticopus variegatus* and *Synapta maculate*. Number of individuals by species i.e. *Pearsonothuria graffei* 6 individuals, *Holothuria nobilis* 5 individuals *Holothuria arta*, *Holothuria scraba* 5 individuals, Black sea cucumber 7 individuals, *Sticopus variegatus* 3 individuals, and *Synapta maculata* 9 individuals. The number and presence of sea cucumbers found in each observation sampling site (Table 1).

Table 1: Type of Sea Cucumber found at research sites per station

No	Species	Observation Station							
		I	II	III	IV	V	VI	VII	VIII
1	Pearsonothuria graffei	1	-	-	-	3	-	2	-
2	Holothuria nobilis	-	2	-	2	-	1	-	-
3	Holothuria scraba	2	-	-	-	1	2	-	-
4	Holothuria arta	1	2	-	-	-	-	2	2
5	Sticopus variegabus	-	1	-	1	-	1	-	-
6	Synapta maculata	-	-	4	-	-	-	-	5
	Population	4	5	4	3	4	4	4	7

Based on observations found in 6 types of sea cucumbers, the most sumptuous species found is *Synapta maculata*, while the least found in the type of *Sticopus variegabus*.

3.1 Density of Sea Cucumber

The density of sea cucumber obtained from the observation was relatively low, the highest cucumber density was sea cucumber type *Synapta maculata* (0,064 ind / m^2), while the lowest cucumber density was S*ticopus variegabus* (0,021 ind.m-2). The density of sea cucumber species of *Holothuria nobilis* (0.04 ind.m-2), *Holothuria scraba* (0.04 ind.m-2), *Holothuria arta* (0.05 ind.m-2), and *Pearsonothuria graffie* (0.43 ind.m-2). The results of research in Bunaken Island waters of North Sulawesi recorded the highest cucumber density obtained for the type of *Stichopus chloronotus* (1.02 ind.m-2), B. argus (0.97 ind.m-2) and H. atra (0.78 ind.m-2) . The low density was due to the lack of competing ability to occupy habitat, also caused by excessive exploitation. Sea cucumber resources in these Togean waters is relatively low. The richness of the Sea Cucumber species in the Togean Islands waters was low compared with the number of Echinodermata species in waters of Kema.

3.2 Diversity of Sea Cucumber

The highest diversity was in Station 1 and station 6, and the lowest was at station 5. The more species biota present in the waters, the higher the diversity. The results of sea cucumber research in Togean waters show diversity index with a value of 0.56 to 1.04. Based on the findings of each research station are at station 1 (1.04), station 2, station 3, station 4 (0.64), station 5 (0, 56), station 6 (1, 04), station 7 (0.64) and station 8 (0.60).

3.3 Uniformity Index of Sea Cucumber

The uniformity index is used to identify the dominant species in a community and to know the spread of the number of individuals of each species. Uniformity indexs at station 1 (0.75), station 2 (0,58), station 3 (0,36), station 4 (0,58), station 5 (0,41), station 6 (0,75) station 7 (0,58) and station 8 (0,31).

3.4 Dominance Index

The higher the dominance index, the lower the diversity and vice versa. The dominance of *Stichopus chloronotus* at station 1 (0.38), station 2 (0,56), station 3 (0,56), station 4 (0,56), station 5 (0,63), station 6 (0,38) station 7 (0,56) and station 8 (0,59). Density is not determined by the number of squares in which a species is found, but is related to the number of individuals found in the squares.

3.5 Cover of Coral Reefs

The highest coral cover condition on coral reef research in the Togean islands with 99.05% percentage which is the core zone of the Togean Islands National Park plan. While for the lowest coral cover is the percentage of 19% is because of its location close to the transport and residential areas, but also caused because of the former bombing and the use of potassium. The results of coral reef cover assessment in the waters of the Togean islands, overall coral cover ranges from 19 to 99.05% and can be categorized as coral cover between medium to good. Need to do further research to predict the impact of bomb and potassium use on coral cover.

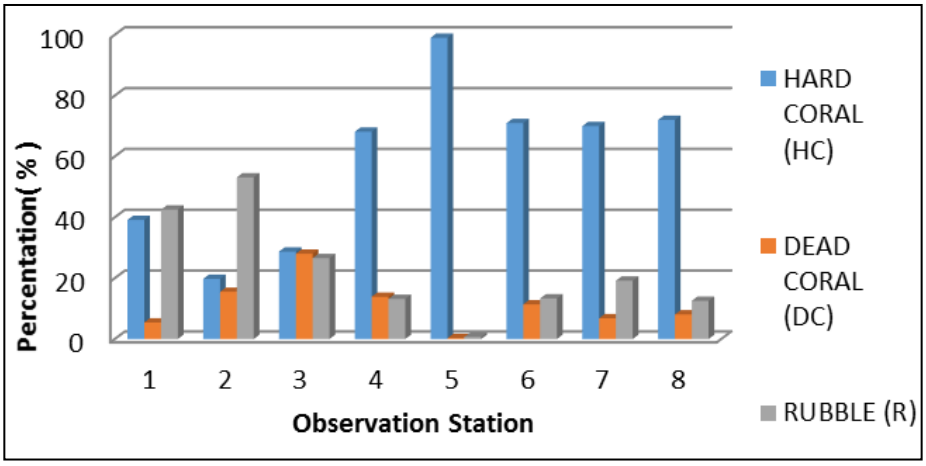

Fig 2: The percentage of coral cover of the Togean Islands

3.6 Water Quality

The parameters of water quality in the observation location are 28-30 ºC, acidity (pH) 8,1 - 8,5, salinity (30-35 ppt), brightness at each station is 100% because the water base can be seen with clear (Table. 2). Overall parameters of the waters are still in accordance with the Quality Standard for Fish and Marine Biota.

Table 2: Waters Quality at the observation area in Togean Islands

Station	Water Quality				
	Temperatur(ºC)	pH	Salinity (ppt)	brightness (m)	Current velocity (m/second)
I	31	8,13	30,7	100%	0.17
II	28,7	8,31	32,2	100%	0.11
III	29,8	8,19	33,5	100%	0.11
IV	28,9	8,20	33,2	100%	0.2
V	30,2	8,2	31,6	100%	0.07
VI	29,5	8,12	32,8	100%	0.17
VII	30,9	8,18	33,5	100%	0.07
VIII	30,5	8,5	33,2	100%	0.18

4. Discussion

The least known type is the type of sea cucumber with high economic price, whereas the most commonly found sea cucumbers are sea cucumbers with low economic value. The results of the study on different habitats with the species composition of the 9 species of Sea Cucumber Holothuroidea in the vegetation area of seagrass beds have more species than in non-vegetation areas. Five species not found in non-vegetation areas are *Stichopus hermanni*, *Opheodesoma spectabilis*, *O. gray*, *Synapta maculata* (Holothuridea) and *Archaster* sp. [15]. The diversity index of Shannon (H ') of the Echinodermata community at Tanjung Tiram is 1.52 [15]. This value is similar to the Shannon index for the Echinodermata community in waters of Kema, North Sulawesi [13] but lower than the Echinoderms diversity index in Kairatu, West Seram [17] and in Tanjung Merah, North Sulawesi [18]. Partially, Shannon index on vegetation area (H '= 2, 27) is higher than non-vegetation area (H' = 1, 16). The highest density of *D. setosum* is also found in several other areas in Indonesia such as in the coastal waters of Kema, North Sulawesi [13] and in the intertidal Kairatu, West Seram [17]. The high density of *D. setosum* is not surprising since these species tend to live in groups and have good adaptability to various habitats and foods. According to Supono and Ardi (2010), *D. setosum* can live on various substrates such as sand, gravel, muddy sand and large rocks [13].

In general, vegetation or coral cover in the Togean Islands is similar to some coral reefs in Indonesia. Coral reefs Bunaken waters on condition of good condition and very productive, with index of diversity 1, there are 29 general and 67 species of coral [19]. Similarly, environmental quality and water are still within the threshold to support life on coral habitats and other habitat associations. Coral Reef condition in Marine Protected Areas of Southeast Sulawesi in Eastern Indonesia shows that live coral increased by 3.14%, dead coral decreased by 4%, other fauna decreased by 10.6%, abiotic

substances (sands and stones) 9% and algae increased by 2.8% [20].

5. Conclusions

Sea cucumbers are found there are 6 types, namely *Pearsonothuria graffei*, *Holothuria nobilis*, *Holothuria scraba*, *Holothuria arta*, *Sticopus variegatus*, and *Synapta maculata*. The density of sea cucumber obtained from the observation is relatively low, the highest cucumber density is sea cucumber type *Synapta maculata* (0,064 ind.m-2), while the lowest cucumber density is *Sticopus variegabus* (0,021 ind.m-2). Diversity index values range from 0.56 - 1.04 which can be categorized as low. For uniformity values ranging from 0.31 - 0.75 are categorized as being. The range of dominance values is 0.38 - 0.63 low. While for coral cover ranged 19% - 99.05%. The parameters of water quality in the observation location are 28-30 ºC, acidity (pH) 8,1 - 8,5, salinity (30-35 ppt), brightness at each station is 100% because the water base can be seen with clear.

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