

Diversity of Echinoderms in Balekambang Beach, Malang District, East Java

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Abstract

Echinoderms is a component of biodiversity in the coral reefs. Echinoderms play an important role in ecosystem of coral reefs especially in food web, generally as predators and detritivores. This report aims to understand composition and density relative of fauna echinoderms on the Balekambang beach. The Transect line method were used and data retrieval was conducted at three stations. The result showed that echinoderms found in Balekambang beach consists of 7 species that are included in three classes, they were *Phyllachantus imperialis*, *Tripneustes gratilla*, *Diadema setosum*, *Clypeaster reticulatus* (Class Echinoidea), *Archaster typicus* (Class Asteroidea), *Ophiotrix fragilis* and *Macrophiothrix belii* (Class Ophiuroidea). The highest abundance of echinoderms on the station where located in the mangrove area which was dominated by *Archaster typicus*. The diversity of echinoderms on Balekambang beach were moderate category. The observations of chemical and physics parameters of the aquatic environment and the substrate obtained quite optimal for life of Echinoderms.

1. INTRODUCTION

Echinoderms is a non-vertebrate organism that widely distributed in the ocean of Indonesia. Echinoderms can be found in the shallow waters up to abyssal depths of the sea

(Dahuri et al., 2001). Although, they are most likely to be found around coral reefs and seagrass beds in shallow water (Romimohtarto and Juwana, 1999). Echinoderms divided into several classes, they are Asteroidea,

Echinoidea, Holothuroidea, Ophiuroidea and Crinoidea.

Dani (2004), Echinoderm is a non-parasitic organism which live in litoral zone to 6000 m. Echinoderms are covered by a hard calcium-rich plate called endoskeleton beneath their delicate skin. They have a unique circulatory system called ambulacra which distinguish them from other animal. They are a non-hermaphrodite organism and it is a bit difficult to distinguish whether male or female.

Intertidal areas such as the Balekambang beach is a suitable habitat for the majority of echinoderms. Echinoderms is a component of biodiversity in the coral reefs. Coral reefs provide shelter and food for the availability of echinoderms. The role of echinoderms in ecology is very important in food web, generally as predators and detritivor (Birkeland, 1989 in Aziz, 1997).

The Balekambang beach in Malang District, Indonesia is one of coastal area which is utilized for tourist activities. In addition to tourism, the area is also used by local fishermen to fulfill their daily needs. Some local also sell dried coral-reef commercially for ornaments and accessories.

Echinoderm is one of the most important components in the food chain. When damage occurs on the community of echinoderms, the balance of food chain in the coastal ecosystem will also be disturbed.

The purpose of this study is to reveal composition and abundance echinoderms on the Balekambang beach, Srigonco, Bantur, Malang district, East Java.

2. MATERIALS AND METHODS

Materials used in this study were: plastic pipes (paralon), plastic ropes (raffia), plastic bags, plastic bottles, plastic ball, time stopwatch, spade, rubber band, paper label, stationery, pH meter, refractometer, tissue paper, erlenmeyer bottle, glass beaker, pipet drops, pipet volume, glass bottle, bure, wooden plot frame 1x1 meters, digital camera, sand substrates, sea water samples, Aquades,

KMnO₄ 0,01N, H₂SO₄, Natrium oxalate, MnSO₄, NaOH + KI, Na₂S₂O₃, Amilum, echinoderms, alcohol 50% and formalin 5-10%

a) Echinoderms Sampling

Transect line method was used to collect samples. Samples collection was conducted at three stations. Station 1 located in tourist area and human settlement, Station 2 located near estuary, and Station 3 located in mangrove ecosystem. The collection of echinoderms is hand sorted in the reef flat by transect method (Mudjiono, 1993). Transect was placed perpendicularly from the coastline to a recede. Samples were taken using a frame measuring 1 x 1 m plot on each transect. All samples were preserved in 50% alcohol (Class Asteroidea and Holothuroidea) and 5-10% formalin (Class Echinoidea, Ophiuroidea and Crinoidea). The samples were marked by a label, label is written some information such as: collector's name, date of collection and collection station, and then taken to the laboratory for identification.

Some Books were used for samples identification, such "General Zoology" (Storer and Usinger, 1957), "Handbook of the Sea Star, Sea Urchins and Related Echinoderms of New-Caledonia Lagoon" (Laboute and Menou, 1986) and "Monograf Echinodermata Perairan Dangkal Pasifik Indo-Barat" (Clark and Rowe, 1971).

Water physical and chemical parameters were measured such as tidal range, temperature, current flow, substrates, pH, salinity, dissolved oxygen (DO) and total organic matter (TOM).

b) Data Analysis

The Data was analyzed by using a formula to calculate the abundance of echinoderms found on each station or point of the sample collection. Biological diversity (H') and dominance index (D) were calculated according to the following equation (Shannon

and wiener, as well as Sampson index (1949) in Odum 1998).

$$H' = - \sum_{i=1}^S (Ni/N) \ln (Ni/N)$$

$$D = \sum_{i=1}^S [Ni/N]^2$$

Ni is total Specimen of related species

N is total specimen

S is total species.

3. RESULTS

a) Composition of Echinoderms

The result showed that three classes and seven species of echinoderms were found during data collection in Balekambang (Table 1).

Table 1. Composition of echinoderms of Balekambang Beach

No	Class	Species	Station		
			1	2	3
1	Echinoidea	<i>Phyllachantus imperialis</i>	+	+	+
		<i>Tripneustes gratilla</i>	+	+	+
		<i>Diadema setosum</i>	+	+	+
		<i>Clypeaster reticulatus</i>	-	+	+
2	Asteroidea	<i>Archaster typicus</i>	-	+	+
3	Ophiuroidea	<i>Ophiotrix fragilis</i>	-	+	+
		<i>Macrophiothrix belii</i>	+	+	+

Note : (+) = present

(-) = absent

The surveys result showed that there were seven species of echinoderms represent three class found in Balekambang beach, they were *Phyllachantus imperialis*, *Tripneustes gratilla*, *Diadema setosum*, *Ophiotrix fragilis*, *Clypeaster reticulatus*, *Archaster typicus* and *Macrophiothrix belii*.

The lowest composition of echinoderms was found in station 1 which consists of *Phyllachantus imperialis*, *Tripneustes gratilla*, *Diadema setosum* and *Macrophiothrix belii*. The small composition of echinoderms at this station probably caused by human disruption of tourist and fishing activities.

The impact of human activities on seagrass ecosystems such as port development, domestic waste household, construction of organic waste, and pollution of agricultural waste could lead quality degradation to

habitat destruction, increased water turbidity can also impact on damaged gills of aquatic animals, decreased dissolved oxygen content, and can be very harmful for animals associated with the seagrass (Fahrudin, 2002). This will also affect the existence of echinoderms and reduce the diversity in the water.

The highest composition of echinoderm was found in station 2 and 3. Seven species of echinoderm were found, they were *Phyllachantus imperialis*, *Tripneustes gratilla*, *Diadema setosum*, *Ophiotrix fragilis*, *Clypeaster reticulatus*, *Archaster typicus* and *Macrophiothrix belii*. Habitat in station 2 and 3 share similar condition and substrate. This resulting in similar data.

b) Echinoderms Abundance

The abundance value of echinoderms highly influenced by environmental factors. Based on Table 2, the lowest abundance was in station 2 (13 ind/m²) which was dominated by *Archaster typicus*. Whereas the highest abundance was in station 3 which is equal to 19 ind/m² and was dominated by *Archaster typicus*. The results of the average abundance can be stated to represent the abundance of echinoderms in Balekambang beach.

The highest average of echinoderms abundance was 6 ind/m² for *Archaster typicus*, followed by *Tripneustes gratilla* of 4 ind / m² and the lowest average was *Diadema setosum*, *Ophiotrix fragilis*, *Clypeaster reticulates* of 1 ind/m². The results showed that the habitat in Balekambang beach is suitable *Archaster typicus* and *Tripneustes gratilla*. This also supported by substrate analysis of Balekambang Beach which dominantly has sand substrate contained rocks.

Table 2 . Abundance of echinoderms of Balekambang Beach

Species	S1	S2	S3	K1 (ind/m ²)	K2 (ind/m ²)	K3 (ind/m ²)	K (average)
<i>Phyllachantus imperialis</i>	26	10	9	5	2	2	3
<i>Tripneustes gratilla</i>	29	12	24	6	2	5	4
<i>Diadema setosum</i>	6	1	1	1	1	1	1
<i>Clypeaster reticulates</i>	-	1	3		1	1	1
<i>Archaster typicus</i>	-	19	37		4	7	6
<i>Ophiotrix fragilis</i>	-	5	9		1	2	1
<i>Macrophiothrix belii</i>	9	11	7	2	2	1	2
Total	70	59	90	14	13	19	18

Note :

S1; S2; S3 : Station 1; Station 2; Station 3

K1; K2; K3 : Abundance of station 1; Abundance of station 2; Abundance of station 3

K (average) : Average of abundance

4. DISCUSSION

a) Diversity and Dominance of Echinoderms species

Archaster Typicus population are found in tidal areas (intertidal) with coral and sand substrate, distributed in coral reefs habitat of Indo-West Pacific region by Clark and Rowe in Darsono (1988). The high value of the average abundance *Archaster typicus* is supported by the high value of TOM in Balekambang waters which range between 63-112 ppm. Echinoderms prefer clean and clear water more to support the formation of cell bodies namely lining membranes fertilization which form the larva or embryo of echinoderms at

later stage and will form a new individual in further stage.

Waters turbidity and dirtiness will inhibit larva development and the development of fertilization of echinoderms in waters. The abundance of echinoderms is affected by the ability to survive and to compete in their habitat. Some echinoderms are associated with a harder substrate (a mixture of sand and gravel) such as brittle stars from clan *Ophiotrix*, *Ophioptheron*, *Ophiactis* (Azis, 1997).

Based on Shannon-Wiener index, the range value of 1,207-1,649 belongs to medium diversity, while index of dominance value 0,216-0,333 belongs to low dominance. It

shows that the distribution of echinoderms in Balekambang beach are evenly spread and absence of domination.

b) Environmental condition of Echinoderms

shown in Table 3. The tides range of each location were 1.5 m which are very tolerant for the life of Echinoderms. Water temperature in

Balekambang beach ranges from 27-28° C which are suitable for Echinoderms growth. The types of substrate on the Balekambang beach were vary. Station 1 has rocky and sandy substrate with coral on it along with algae combined in puddles. Station 2 substrate tend to be sandy and there was rarely stone in it which is carried by the stream.

Table 3. Water quality value in sites of study

Physical and chemical character	Station 1	Station 2	Station 3
Tidal Range (m)	1,5	1,5	1,5
Temperature (°C)	28	27	28
Substrate	sand, coral and stone	sand	sand, coral and muddy
Current flow (m/s)	0,06	0,09	0,05
Salinity (‰)	36	33	36
pH	8	8	9
DO (mg/l)	6,50	8,13	10,57
TOM (ppm)	112	63	92

Station 3 was sandy, rocky and a little muddy, with some algae in it. These three locations have suitable parameter and substrate for the life of echinoderms.

The average speed range of the current flow is 0.05 m/s-0.09 m/s which can be classified in the category of very slow. This is in accordance with Welch (1980) in Ayudyawati (2001), who said that the current velocity in water can be divided into five categories: >100 cm/s categorized very fast; 50-100 cm/s: categorized fast; 25-50 cm/s: categorized medium; 10-25 cm/s: categorized slow; and <10 cm/s: categorized for very slow.

Water salinity of each location is ranging from 33-36‰ which classified in normal category. This is consistent with the statement in Effendi (2003) that the salinity of ocean waters is 30%-40 ‰. In general, echinoderms are stenohaline (have narrow tolerance in salinity range), although some members of a class

asteroidea, ophiuroidea, the echinoidea and holoturoidea show wider tolerance. In this case a small group of the Echinodermata fauna can be categorized as euryhaline (Aziz, 1994). Drouin et al., in Aziz (1994) adding that the adaptability of echinoderm group is lower than the molusca group due to their skin membrane relatively thin and very permeable.

Total organic material contained in the waters are ranged from 63-112 ppm. The total organic material of water is derived from vegetation mangrove around the station. The number of organic material is affecting the echinoderms for organic material is a source of food for echinoderm. According to Dahuri (2003), echinoderms are scavenger or detritus eater.

5. CONCLUSION

The diversity of echinoderms on Balekambang beach indicating the absence of

domination. The echinoderms found in Balekambang beach consists of 7 species that are included in three class. The highest abundance of echinoderms found in mangrove area. The diversity of echinoderms on Balekambang beach were moderate category. The observations of chemical and physical parameters of the aquatic environment and the substrate showed optimal for the life of Echinoderms.

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