

The Abundance and Distribution Patterns of Echinoderms in the Intertidal Zone of Nglolang Beach, Gunungkidul, Yogyakarta

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ABSTRACT

Echinoderms are marine animal invertebrates that can be found from the intertidal zone to the deep sea. Nglolang Beach is dominated by rocky coral basins substrate with the presence of macroalgae which refers to the abundance of marine organisms such as Echinoderms. This research reports a study of the abundance and distribution patterns of echinoderms species in the intertidal zone of Nglolang Beach, Gunungkidul, Yogyakarta. This observation started on 27 September 2020 at 12.00-1.00 p.m. Data were collected using the plot quadrat method. In this study, an area of 1,197 m² was obtained so data collection was used for 12 plots or replications. Data analysis with measuring Margalef index (D), Relative Abundance (RA), and Variant value (V) then the data were analyzed using a distribution pattern. The results based on the research are from 9 species that have discovered the highest relative abundance of Echinoderms species in the intertidal zone of Nglolang Beach is *O. erinaceus* with 54,44%. The distributions pattern of *E. mathaei*, *T. ventricosus*, *T. gratilla*, *S. variolaris*, *O. scolopendrina*, and *O. erinaceus* were clumped.

Keywords: abundance, distribution pattern, echinoderms, Nglolang Beach

1. INTRODUCTION

Indonesia is an archipelagic and maritime country with most of its surface area being the ocean. The marine ecosystem is the richest ecosystem with many resources that can be found in it. The marine ecosystem consists of several zones, one of which is the intertidal zone. The intertidal zone is an ecosystem that is built between the terrestrial and the marine zone. The intertidal zone is important to study because the conditions affected by the two ecosystems are different (terrestrial and marine zone). Intertidal zone is defined as the area with the highest and lowest tides in sea water of beach [1].

One of the abundant marine life in the intertidal zone is the Echinoderms. Echinoderms are a phylum where all members can only live in marine ecosystems (marine exclusive). Factors that influence the abundance of Echinoderms are temperature, environmental conditions, food availability, and

biotic interactions. In ecosystems that contain corals and macroalgae, some echinoderms will live prominently and dominantly. For example, echinoderms are coralline eaters, so echinoderms are abundant and active participation will decrease the number of corallines [2].

Echinoderms are a marine animal that have spines embedded in their surface bodies. Echinoderms are characterized by a radially pentamerous symmetrical body, triploblastic, a spine made of calcareous, a skeletal endoskeleton, and can move with the ambulacral feet (Water Vascular System). Echinoderms are invertebrate animals consisting of 5 classes, namely: Crinoidea consists of feather stars and sea lilies, Ophiuroidea consists of Brittle stars, Holothuroidea consists of sea cucumbers, Echinoidea consists of sea urchins, and Asteroidea consists of sea stars. Crinoids can only be found in the deep sea. Crinoids have their mouths facing upwards to aid in getting nourishment [3]. Ophiuroidea (brittle stars)

live in the intertidal zone to the deep sea. Brittle stars have flexible arms for movement. These five arms are very fragile and can break easily. Brittle stars can live in sandy, seagrass and coral areas [4].

Holothuroidea has about 1500 species. Holothuroidea has a cylindrical body that elongated from anterior to posterior with soft and fleshy structure and covered with a tough and leathery structure. Holothuroidea has tentacles around the mouth that help to get some food. Echinoidea is about 950 species of sea urchin and sand dollars. Echinoidea have rounded shapes that are covered by spines that protect their bodies. Echinoidea eating from macroalgae or organisms that cling to substrate with five part nipping jaws in the center of the oral surface. Asteroidea has about 1500 species around the world. The asteroidea body consists of a central disk that is surrounded by 5-20 arms. Asteroidea has pedicellariae at the base of their spine [5].

Nglolang Beach located in the western area of Gunung Kidul, Yogyakarta, which is developed as a tourism area. The intertidal zone of Nglolang Beach substrate that dominated by rocky coral basins and covered by macroalgae. [6] mention that in Krakal and Drini Beach in Gunung Kidul, which has the same substrate type as Nglolang Beach, obtained the highest abundance of Echinoderms in the the Ophiuroidea and Echinoidea class. This study aims to find out the abundance and distribution pattern of Echinoderms species that contained in the intertidal zone of Nglolang Beach, Gunung Kidul, Yogyakarta. Knowing the abundance and distribution of Echinoderms species is important to enhance knowledge about abundance and distribution of Echinoderms and to determine the effect of interaction between Echinoderms and other organism or their environment that can affect the abundance and distribution of Echinoderms [7].

2. MATERIALS AND METHODS

2.1. Data Collection

Data was collected from the intertidal zone at Nglolang Beach, Gunungkidul, Yogyakarta. Coordinates of the sampling points used are 110°33'38" E and 8°8'6" S. Data taken on September 27, 2020 at 12.00-1.00 p.m. This research was conducted at low tide in order to facilitate data collection in sunny weather without clouds. The substrate at Nglolang Beach is in the form of dead coral and partly covered with algae. The dominant algae brown algae (*Turbinaria* sp.). The study site was rugged, with many basins or lacunae.

2.2 Sampling Design

In this study, the squared plot method was used by using 1 m x 1 m plot. The technique used in data collection is plot quadrat method. Determination of the quadrat of the plot based on 1% of the coast area. The sampling design was determined prior to sampling. In this study, an area of 1.197 m² was obtained so that 12 plots or replications were used in data collection.



Figure 1. Design sampling using plot quadrat method at Nglolang Beach.

2.3 Data Analysis

The abundance of Echinoderms species can be determined by using:

Margalef Index

$$(D) = \frac{S-1}{\log N} \quad (1)$$

Shannon-Wiener Index

$$(H') = -\sum Pi \ln Pi \quad (2)$$

Annotational:

S = The number of all species

N = The number of the individual that observed

ni = The number from one individual

Pi = ni/N

The Shannon-Wiener diversity Index could be classified into:

H < 1 : low,

1 ≤ H ≤ 3 : moderate,

H > 3 : high.

Relative abundance is to determine the number of individuals toward the total number of the individual. It can be calculated by this formula:

Relative Abundance

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

(3)

Annotational:

- RA = Relative Abundance
- ni = The number from the individual
- N = The number of the individual that observed

To calculate the distribution pattern of the species of Echinoderms, can be known by measuring the mean values and the variant value (standard error) with this following formula:

$$V = \sqrt{\frac{2}{n-1}}$$

(4)

To calculate the mean value by using this formula:

$$m = \frac{n}{N}$$

(5)

Annotational:

- V = Variant
- n = Number of the individual
- m = Mean
- N = The number of the individual that observed

Distribution pattern of organisms that life in nature is divided into three parts that are random,

uniform, and clumped whose give results if:

- v = m; distribution pattern *random*
- v > m; distribution pattern *clumped*
- v < m; distribution pattern *uniform*

3. RESULT AND DISCUSSION

Based on sampling and data analysis Echinoderms species from the intertidal zone of Nglolang Beach, Gunungkidul, Yogyakarta, the result obtained from this study is there are 9 species of echinoderms that found.

Based on the research that has been done, obtained in the form of 90 individuals which are included in 9 species from 2 classes of the Echinoderms phylum, namely echinoidea classes which consist of *D. setosum*, *E. mathaei*, *T. ventricosus*, *T. gratilla*, *S. variolaris* and Ophiuroidea classes which consist of *O. erinaceus*, *O. scolopendrina*, *O. annulosa*, *M. longipeda*. Monograph of Shallow-Water Indo-West Pacific Echinoderms book used to identification species of Echinoderms that found.

The richness value in this study showed the number 4.09. The richness value used was based on the Margalef Index. The highest relative abundance of echinoderms was *O. erinaceus* with 54,44%. The diversity index value (H') in this study showed the number 1.4 diversity index used based on the Shannon-Wiener Index. The index value obtained showed that the species diversity of Echinoderms in

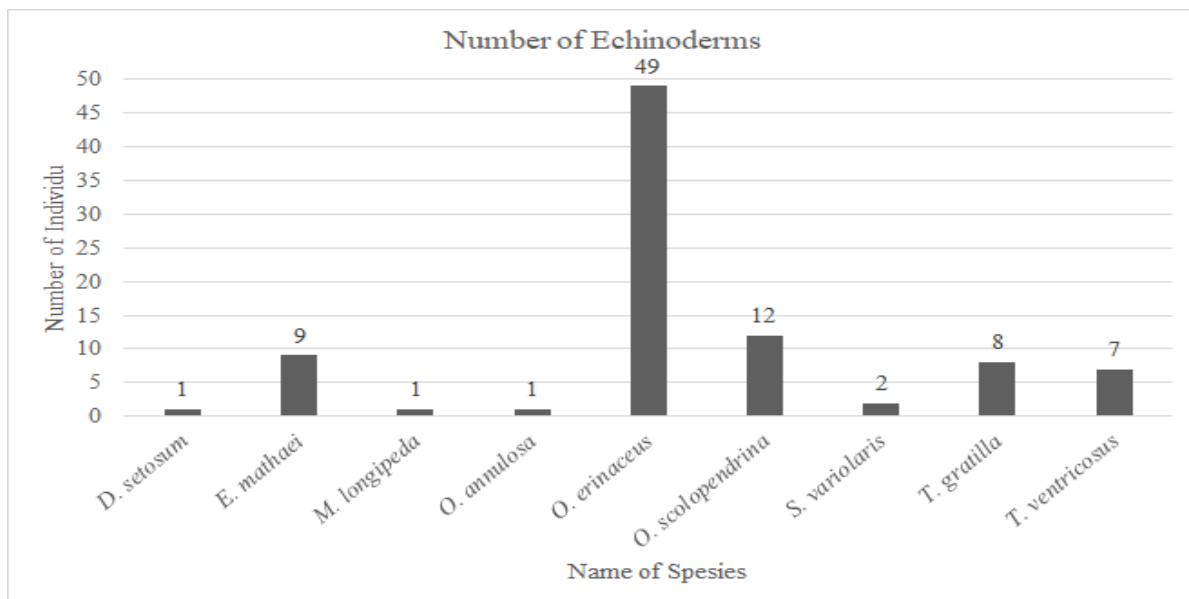


Figure 2. Number of Echinoderms species from the Intertidal Zone of Nglolang Beach

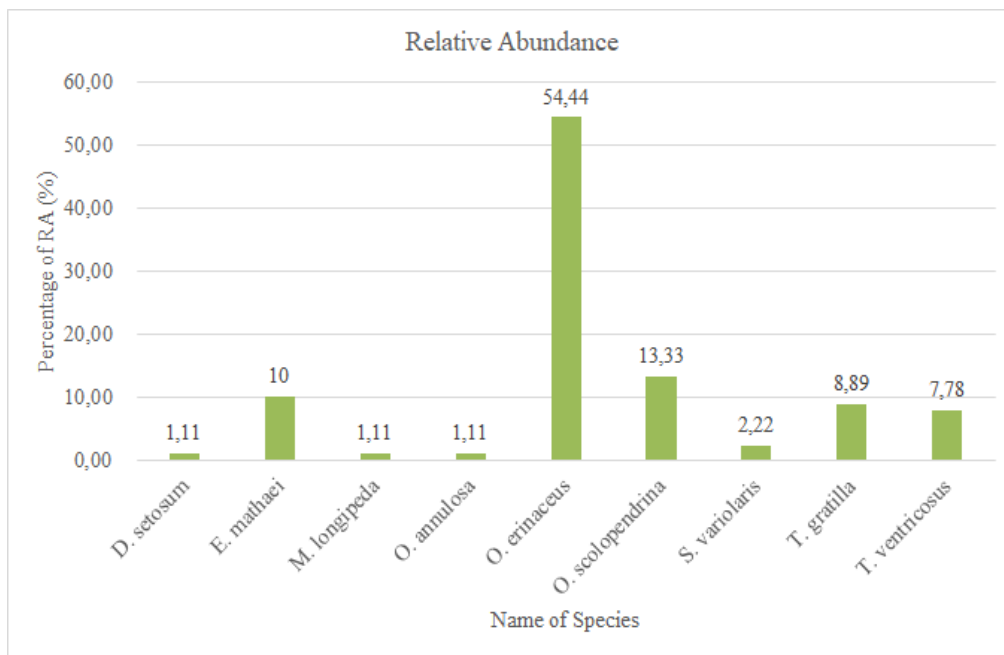


Figure 3. Relative Abundance of Echinoderms species from the Intertidal Zone of Nglolang Beach

Table 1. Distribution Pattern of Echinoderm in Nglolang Beach

No	Name of Species	V	M	Distribution Pattern
1	<i>Echinometra mathaei</i>	2	0,1	clumped
2	<i>Tripneustes ventricosus</i>	1,73	0,07	clumped
3	<i>Tripneustes gratilla</i>	1,87	0,08	clumped
4	<i>Stomopneustes variolaris</i>	0,70	0,02	clumped
5	<i>Ophiocoma scolopendrina</i>	2,34	0,13	clumped
6	<i>Ophiocoma erinaceus</i>	4,89	0,54	clumped

Nglolang Beach was moderate [8]. The moderate diversity of Echinoderms in Nglolang Beach indicated that the productivity level in Nglolang Beach was moderate, so the ecosystem of Nglolang Beach is quite stable which can be caused by the presence of sufficient food source factors, suitable substrate conditions and others. The distribution pattern of distance between individuals within the boundary of a population area intended to escape from the competitive pressures of natural resources. The distribution pattern is influenced by environmental and social factors. There are 3 kinds of distribution patterns, namely clumped, uniform, and random [9]. The result of the analysis distribution pattern of Echinoderms in the zone, showed that species namely *E. mathaei*, *T. ventricosus*, *T. gratilla*, *S. variolaris*, *O. scolopendrina*, and *O. erinaceus* are

included in the clumped distribution pattern. The most common distribution pattern found in nature is clumped. A population will be more likely to form clumped of various sizes to carry out interaction between the individual. The distribution pattern clumped type, also influenced by local habitat factors where organisms will respond by forming a clumped. This is intended as a form of strategy or survival for the individual when one day there is a change in food source, climate, habitat, and reproduction type [10]. Whereas the distribution pattern of species namely *D. setosum*, *O. annulosa*, and *M. longipeda* could not be analyzed because at sampling only 1 individual was found and when it was tried to be analyzed, it was obtained value of 0 in the variant so that it could not be determined.



Figure 4. Dominant species: *Ophiocoma erinaceus*

4. CONCLUSION

Based on this study, there are 9 species that have discovered the highest relative abundance of Echinoderms species in the intertidal zone of Nglolang Beach, Gunungkidul, Yogyakarta is *O. erinaceus* with 54,44%. The diversity index of Echinoderms in Nglolang Beach is moderate. The distribution pattern of *E. mathaei*, *T. ventricosus*, *T. gratilla*, *S. variolaris*, *O. scolopendrina*, and *O. erinaceus* is clumped.

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