

ECHINODERM COMMUNITY STRUCTURE IN TAMBA BEACH, NORTH MINAHASA REGENCY, NORTH SULAWESI PROVINCE

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Received: May 12, 2023

Accepted: July 20, 2023

Abstract

Tamba Beach has several ecosystems, namely seagrass beds, sandy and rocky. Ecologically, seagrass beds are home to marine life, including Echinodermata. Echinoderms play an important role as an integral part of the food chain, eating organic waste. The purpose of this study was to analyze the community structure of Echinoderms at Station I (Seagrass Zone), Station II (Sandy Zone) and Station III (Coral Zone). Two methods are used in this study. The first is a qualitative description method by directly observing and quantitatively calculating the diversity index, uniformity index, dominance and abundance index formulas. The echinoderms found consisted of 4 classes, namely Holothuidea, Ophiuroidea, Echinoidea and class Asteroidea. The echinoderms found at the study site used a diversity index classified as stable. The dominance index is low because there are no dominant individuals, and the uniformity index is low. From the results obtained from the abundance in Tamba Beach, the highest value was in the *Diadema setosum* species with 113 individuals. *Diadema setosum* has the highest quantity at the three existing stations. This species can adapt to environmental changes.

Keywords: Diversity Index, Uniformity, Dominance and Abundance

INTRODUCTION

Echinoderms are one of the richest biodiversity in Indonesian waters. These marine organisms can be seston eaters or detritus eaters, so their role in the ecosystem is to decompose organic matter that is not used by other species but is available to Echinodermata (Dahuri, 2003). Echinodermata comes from the Greek words Echinus, meaning thorn, and dermis, meaning skin. Echinodermata are shallow-water animals that usually live in coral reefs and sea grass. These

animals can regrow and regrow lost, damaged or damaged body parts. (Jasin, 1984).

Echinoderms have good potential for community development. However, if this potential is exploited excessively, it will threaten the survival of echinoderms. As a first step to minimize Echinodermata exploitation, you need to understand the structure of the Echinodermata community. Understanding the Echinodermata community structure is important because it provides an overview of information from the current Echinodermata community structure. So far, there have been many studies, especially on Echinodermata in various habitats where they live, and only a little has been done, so this research is fundamental.

The survival of Echinoderms is influenced by physical and chemical factors in the water, such as temperature, salinity, pH and dissolved oxygen. All Echinodermata live in the oceans from coastal waters to depths of 6,000 meters. Echinoderms are one of the most important animals in marine ecosystems because they are part of the food chain and eat organic waste and other small animals. (Duri, 2003). Echinoderms, whether herbivores, carnivores, omnivores or scavengers, play an important role in the food web of coral reef ecosystems (Clark & Rowe, 1971; Birkeland, 1989; Best, 1994). In addition, Echinoderms are a food source for organisms living in coral reef ecosystems. Sea urchins and sea urchins are a food source for various reef fish (Shirley, 1982; Birkeland, 1989). The existence of echinoderms in the North Minahasa waters of North Sulawesi needs to be better documented, and limited information about echinoderms on the coast at Tamba Beach requires further research to obtain information on the diversity of echinoderm species. The diversity index and abundance index, therefore, this study aimed to determine the diversity of echinoderms at Tamba Beach, Maen Minahasa Utara Village, North Sulawesi.

Tamba Beach is located in Maen Village, East Likupang District, North Minahasa, North Sulawesi Province. This beach is a tourist area close to the Paradise Hotel. Tamba Beach has seagrass and coral ecosystems, which create ideal conditions for the natural habitat of Echinodermata. The diversity and abundance of Echinodermata in the North Minahasa coastal area has yet to be widely observed. In addition, high human activity in coastal areas can threaten the survival of these marine organisms. The purpose of this study was to examine the community structure of Echinodermata on the coast of Tamba, North Minahasa, North Sulawesi.

RESEARCH METHODS

This research was conducted at Tamba Beach, Maen Village, East Likupang District, North Minahasa Regency, North Sulawesi Province. Two methods are used in this study: the first qualitative descriptive method for direct observation and the qualitative descriptive method for

direct observation and for quantitative methods for calculating and processing quantitative data and using the formula diversity index, uniformity index, and dominance index.

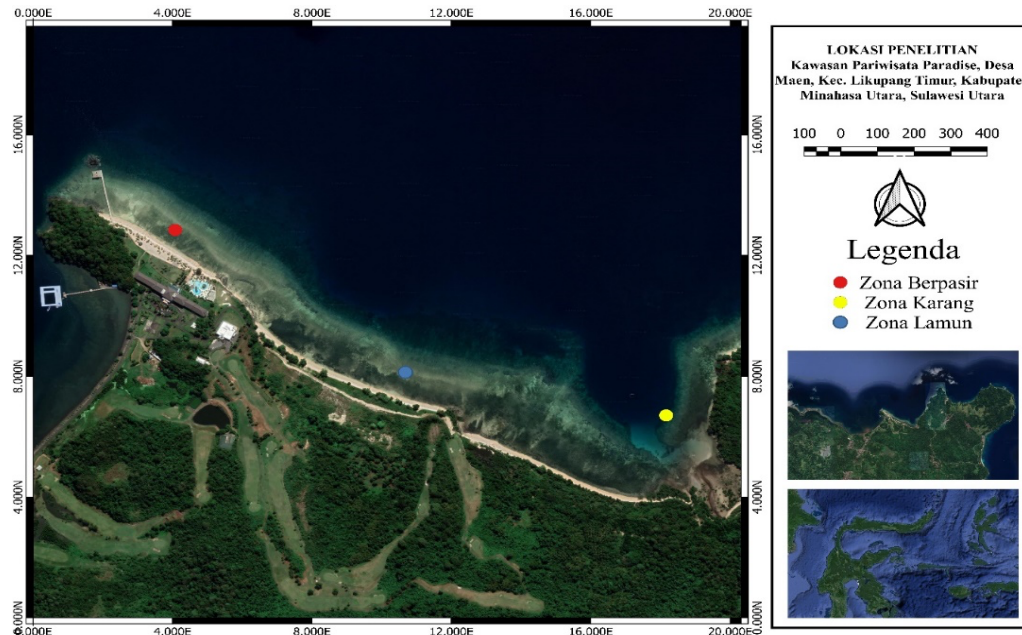


Figure 1. Location

Tools and materials

The tools used in this study were plastic straps, roll meters, GPS (Global Positioning System), thermometers, pH meters, Dissolved Oxygen meters, cellphone cameras, jars, buckets, shovels, tongs, knives, echinoderm phylum identification books, rulers, and stationery. The materials are all types of Echinodermata at Tamba Beach Maen Village, East Likupang District, North Minahasa Regency, North Sulawesi Province.

Sampling

Echinodermata community structure was observed using the line transect method. The line transect method is made by using a transect that is stretched perpendicular to the shoreline and is 5 m from the beach. The transect lines are made as many as two lines at each predetermined station and the distance between transects is 10 m. For each transect, 3 plots measuring 3x3 m² will be used with a distance of 5 m between each plot. Based on data from the Maen village government, the Tamba beach area of Maen Village covers a length of ± 1400 m, land to the shoreline of ± 25 m. The data obtained was analyzed descriptively which was explained in the form of tables and figures. Then the calculated data are diversity index, uniformity index, and dominance index, while the formula is as follows:

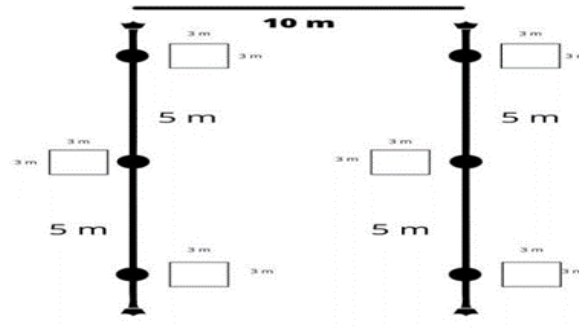


Figure 2. Line transects

Data analysis

The diversity index is calculated using the Shannon Weiner Index formula

$$H' = -\sum P_i \ln P_i ; P_i = n_i/N$$

P_i = Kelimpahan relatif spesies ke - i

n_i = Jumlah individu suatu jenis ke - i

N = Jumlah total semua individu

H' = Indeks Shannon Weiner

Shannon Weiner's classification of diversity indices is as follows:

$H' < 1$: Indeks keanekaragaman rendah

$1 \leq H' \leq 3$: Indeks keanekaragaman sedang

$H' > 3$: Indeks keanekaragaman tinggi

The uniformity index is calculated by the Evenness-index formula

$$E = (H')/\ln S$$

E = Uniformity index

H' = Diversity index

$\ln S$ = Number of species with E values ranging from 0-1

The dominance index is calculated by the Dominance of Simpson formula

$$D = \sum \frac{[n_i]^2}{N}$$

D = Indeks dominansi

n_i = Jumlah individu setiap jenis

N = Jumlah total individu

The abundance index is calculated by Abundance index analysis (Odum 1996)

$$"K" = n_i/A$$

K = Abundance (ind/m²)

n_i = Number of individuals of the i -th species

A = Area of observation plot (m²)

RESULTS AND DISCUSSION

Based on the identification results shown in Table 1, the echinoderms found in two research locations on the coast of Tamba, Maen Village, North Minahasa Regency, North Sulawesi Province, include four classes, nine orders, eight families, nine genera and ten species. Based on observations from all Locations I, II and III on various substrates at the study sites. Of the ten species of echinoderms found in the Tamba beach area, nine were found in the habitat (seagrass zone), eight in the habitat (sandy site), and nine in the habitat. (Coral zone). This data shows that Echinodermata dominates seagrass and coral habitats. There are ten species of Echinodermata, including three species of Echinodermata, two species of Holothuridae, three species of Asteroidea, and two species of Echinodermata. In addition, the taxonomy of Echinodermata found at the study site is shown in Table 1.

Table 1. Phylum Echinoderm Classification in Tamba Beach, Maen Village, Minahasa Regency North, North Sulawesi Province

| Kelas | Ordo | Family | Genus | Spesies |
|---------------|---------------|-----------------|-------------|--------------------------------|
| Asteroidea | Valvatida | Ophidiasteridae | Linckia | <i>Linckia laevigata</i> |
| Asteroidea | Valvatida | Oeasteridae | Protoreater | <i>Protoreaster nodosus</i> |
| Asteroidea | Valvatida | Archasteridea | Archaster | <i>Archaster typicus</i> |
| Ophiuroidea | Ophiacanthida | Ophiocomidae | Ophiocoma | <i>Ophiocoma scolopendrina</i> |
| Ophiuroidea | Ophiacanthida | Ophiocomidae | Ophiocoma | <i>Ophiocoma erinaceus</i> |
| Holothuroidea | Holothurida | Holothuriidae | Holothuria | <i>Holothuria atra</i> |
| Holothuroidea | Holothurida | Holothuriidae | Actinopyga | <i>Actinopyga echinites</i> |
| Echinoidea | Camarodonta | Toxopneustidae | Tripneustes | <i>Tripneustes gratilla</i> |
| Echinoidea | Diadematoida | Diadematidae | Diadema | <i>Diadema setosum</i> |
| Echinoidea | Camarodonta | Echinometridae | Echinometra | <i>Echinometra mathaei</i> |

Echinoderms Diversity Index

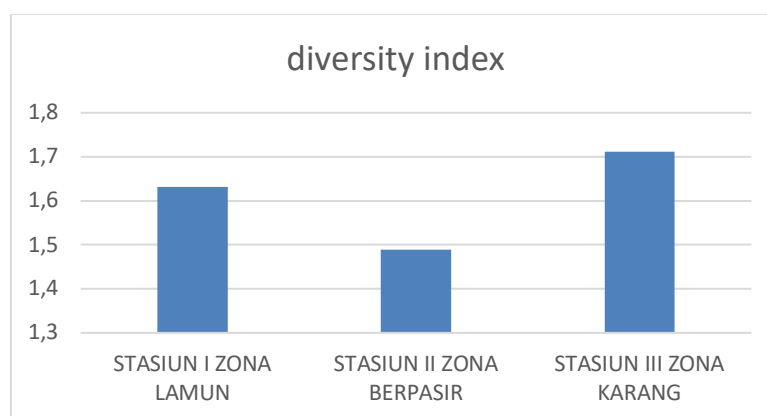


Figure 3. Echinoderm phylum diversity index on Tamba beach, Maen Village, North Minahasa Regency

The results of the Echinodermata phylum diversity index at the research location in Tambba Beach for station I was 1.631. Station II for II 1.488 and at station III 1.711. Furthermore, from the results above, if it is based on the measured value, the diversity index is moderate, which means that productivity is very

low as an indication of heavy pressure and an unstable ecosystem. The calculated data on the diversity index at the three study locations can be seen in Figure 1 above.

If the H value < 1 , the diversity in the waters will be included in the low category and low community stability (Brower, 1997). It is said that if many species are found in a community, on the contrary, if several species are found, it has high diversity (Sugiarto, 2007). If the number of each species is distributed evenly, the diversity will be very high, which means that the number of individuals is relatively the same. Based on the value of the diversity index (Odum, 1994) and then stations I and III, this station is included in the category of medium diversity, with reasonably balanced productivity and moderate ecological pressure. This can be seen in these two locations' need for more settlements and community activities. Station II is included in the low diversity category, which includes low diversity and very low productivity, because according to Odum's (1994) standard, the pressure is severe, and the ecosystem is unstable. This can be interpreted as the location has experienced ecological pressure. The ecological pressure referred to can only come from the activities of the settlement community around the location (Katili, 2011).

Echinoderms Uniformity Index

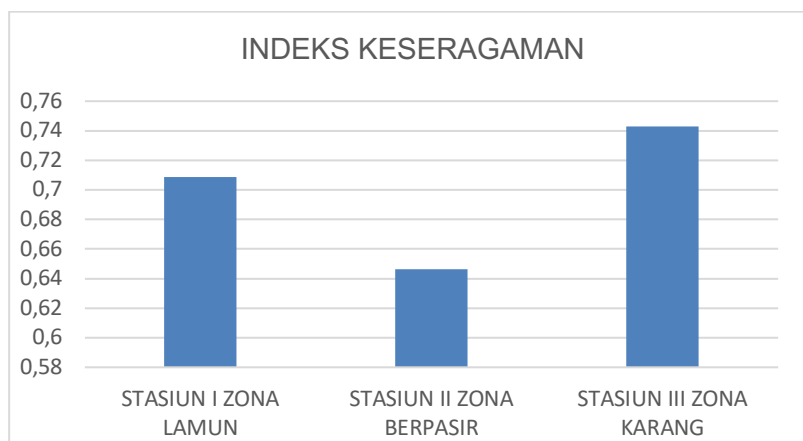


Figure 4. Echinoderm Phylum Uniformity Index on Tamba beach, Maen Village, North Minahasa Regency

Echinoderms uniformity index can be seen from the analysis that the highest uniformity index is found at station III, the uniformity index value is 0.743, and then the uniformity index value at station I is 0.708 and the minimum uniformity is found at station II is 0.646. The uniformity index value of this species describes the balance of the Echinodermata community. The more equitable the distribution of individuals within the species, the more the balance of the ecosystem will improve. This value indicates a high level of uniformity in the distribution of Echinodermata species evenly, and no one dominates.

Echinodermata Dominance Index: It can be seen that the dominance index value of the Echinodermata Phylum at the research location on the Tamba coast for station I was 0.231, station II was 0.328, and station III was 0.264. Data from the calculation of the Dominance index at the research location can be seen in Figure 4.

The analysis results show that station II has the highest dominance index, 0.328, station III has 0.264, and station I has the lowest dominance index, 0.231. The greater the dominance index value, the greater the dominance of a species in the population. Leksono (2007) states that dominance arises due to competition between one individual and another, while the highest dominance occurs because the substrate is sand and stone. The low dominance value for Tapak at station I (Seagrass Zone) is caused by the uneven distribution of species. In contrast, the high dominance value at station II was caused by the dominant species *Diadema setosum*.

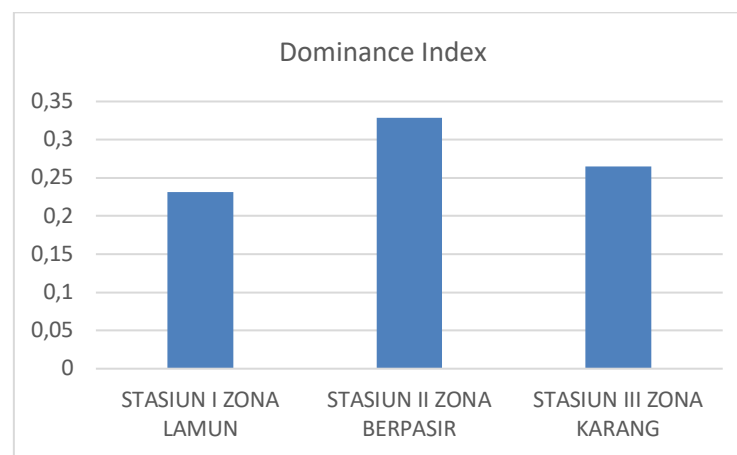


Figure 5. Dominance Index of Echinodermata Phylum on Tamba Beach, Maen Village, North Minahasa Regency

Echinodermata Abundance Index

Calculation of the abundance of the Echinodermata phylum in Tamba Beach, Maen Village, showed that for each species present, Ophiuroidea and Echinoidea species were most abundant at station I with an abundance value of *Ophiocoma scolopendrina* 69 individuals and *Ophiocoma erinaceus* 64 individuals, followed by *Diadema setosum*, namely with a value of 61 individuals.

Table 2. Results of the Echinodermata phylum Abundance index on the Tamba beach, Maen Village, North Minahasa Regency

| Species | Ni | A(M2) | Kepadatan Mutlak |
|--------------------------------|-----|-------|------------------|
| <i>Linckia laevigata</i> | 13 | 100 | 0.13 |
| <i>Protoreaster nodosus</i> | 18 | 100 | 0.18 |
| <i>Archaster typicus</i> | 16 | 100 | 0.16 |
| <i>Ophiocoma scolopendrina</i> | 83 | 100 | 0.83 |
| <i>Ophiocoma erinaceus</i> | 75 | 100 | 0.75 |
| <i>Diadema setosum</i> | 113 | 100 | 1.13 |
| <i>Tripneutes gratilla</i> | 8 | 100 | 0.08 |
| <i>Echinometra mathaei</i> | 8 | 100 | 0.08 |
| <i>Holothuria atra</i> | 88 | 100 | 0.88 |
| <i>Actinopyga echinites</i> | 3 | 100 | 0.03 |
| | 425 | | 4.25 |

Several factors, such as differences in the number of species and the number of individuals, can cause the abundance of Echinodermata species in a body of water. From the results obtained from the abundance on Tamba Beach, the highest value was for the *Diadema setosum* species of 113 individuals. *Diadema setosum* has the highest abundance at the three existing stations. This species can adapt to environmental changes.

DISCUSSION

Based on the research results above, all three locations are in Tamba Beach, Man Village, North Minaha Regency. Among the results of the diversity index of the three research stations, station III (Coral Zone) has the highest species diversity value of 1711, which is a typical species, and station II (Sanky Zone) has the lowest value. The value is 1,488, classified as a low species. Citation (Krebs, 1989) is presented in (Nova, 2016) Station I (Seagrass Zone) Species Value Criteria. Shannon-Wiener, if the species diversity value obtained is < 1 , then the diversity value is low. Moderate diversity if $1 \leq$ and >3 indicates high diversity. The high value of species diversity at station III (Coral Zone) is due to the more numerous and evenly distributed individual species compared to stations 1 (Seagrass Zone) and Station II (Sandy Zone). The value of species diversity obtained at Station II was lower because only seven species were found.

Based on calculating the uniformity index values of the three stations, the lowest station II value is 0.646, and the highest station III uniformity index value is 0.743. At station I, the value is 0.708. The uniformity index values obtained at the three locations are classified as moderate or stable. According to (Odum, 1993) (Saputra, 2017), high homogeneity means that the abundance of each species is relatively balanced. Of the dominant index values obtained at the three research stations, the highest Dominant Index was obtained at Station II, which was 0.328. a high index value at station II because one species dominates the sea cucumber species, followed by station III at 0.264. The low dominance index value of 0.231 obtained at station I is due to the few species that dominate at this station.

CONCLUSION

The results showed a community structure of echinoderms at Tamba Beach, Maen Village, North Minahasa Regency, North Sulawesi Province. The diversity index value was obtained at Tamba Beach, Maen Village, with a value from the three existing stations with a total of 1.851. The three stations indicated a moderate level of diversity, namely the distribution of the average number of individuals. A high uniformity index indicates an even species distribution, and no one dominates. The echinoderm dominance index at Tamba Beach, Maen Village, with values from the three stations, is low, with the number obtained is 0.187. they are indicating no dominant species. The results of the abundance index obtained are 4.25. From the abundance value, it can be shown that the research location in Tamba Beach is relatively low due to the influence of environmental factors.

REFERENCE

- Birkeland, C. (1989). *Pengaruh Echinodermata pada komunitas terumbu karang. Studi Echinodermata*.
- Brower, J.E., Zar, J.H. (1997). *Field and Laboratory Method for General Ecology*. Iowa : Brown.
- Clark, A.M., & E. Rowei. (1971). *Manograph of Shollow-water Indo West Pacific Echinodems*. Trustees of the British Museum (Natural History). London. 238
- Dahuri, R. (2003). *Keanekaragaman Hayati Laut: Aset pembangunan berkelanjutan Indonesia*. Jakarta: Gramedia Pustaka Utama.
- Hutauruk L. E. (2009). *Studi Keanekaragaman Echinodermata di Kawasan Perairan Pulau Rubiah Nanggroe Aceh*. Skripsi. Universitas Sumatra Utara.
- Jasin, M. (1984). *Sistematika Hewan (Invertebrata dan Vertebrata)*. Sinar Wijaya. Surabaya.
- Katili, A.S. (2011). *Struktur Komunitas Echinodermata pada Zona Intertidal di Gorontalo*. Jurnal Penelitian dan Pendidikan, 8(1): 51-61
- Leksono, A.S. (2007). *Ekologi : Pendekatan Deskriptif dan Kuantitatif*. Malang. Bayumedia Publishing
- Nova. A. H. (2016). *Keanekaragaman Jenis Ophiuroidea di Zona Intertidal Tanjung Bilik Taman Nasional Baluran*. Skripsi. Universitas Jember.
- Odum, E.P. (1994). *Dasar - Dasar Ekologi. Terjemahan Samingan, T. Dan Srigando, B.* Yogyakarta: Gajah Mada Press.
- Odum. (1993). *Dasar-dasar ekologi. Diterjemahkan oleh Samingan. Edisi ketiga*. Gajah mada University. Yokyakarta.
- Saputra B H. (2017). *Hubungan Kandungan Bahan Organik Sedimen dengan Kelimpahan Asteroidea di Pulau Menjangan Kecil Karimunjawa Jepara*. Proposal Penelitian. Universitas Diponegoro Semarang.
- Shirley, T.C. (1982). *The importance of echinoderm in the diet of fishes of a sublittoral rock reef In: Chapman, J. (Eds.). South Texas Fauna. Caesar Kleberg Wild Life Researches Institute*.
- Sugiarto, H. (2007). *Warta seanografi*. Jakarta: Pusat Penelitian