Fisheries Journal, 14(4), 1951-1961 (2024)
http://doi.org/10.29303/jp.v14i4.830

BIOECOLOGY OF SEA URCHINS (*Echinoidea*) IN THE COASTAL WATERS OF HUTUMURI STATE, AMBON CITY

Bioekologi Bulu Babi (*Echinoidea*) di Perairan Pantai Negeri Hutumuri Kota Ambon

Fiqih Muharby*, Laura Siahainenia, Yuliana Natan

Master of Marine Science Study Program, Faculty of Fisheries and Marine Sciences, Pattimura University

Mr. Chr. Soplanit Street, Poka, Tlk. Ambon, Ambon City, Maluku 97233

*Corresponding Author: fmuharby98@gmail.com

(Received May 1st 2024; Accepted May 16th 2024)

ABSTRACT

Hutumuri Country has beaches which can be said to be strategic water areas due to their proximity to residential areas. The potential resource of sea urchins makes people use sea urchins as food animals when the seasons change. There are several types of sea urchins that are used as food by local people. Such as being used as a berth for fishing boats, bameti and other coastal activities which can result in disruption of the presence of aquatic organisms, including sea urchins (*Echinoidea*). The results of research at the Hutumuri State Beach location show that the level of gonad maturity in the Tripneustes gratilla species during the east season consists of 2 levels of gonads, and is moniated by (TKG III) with a size range of 51 - 60 mm wide in diameter. Meanwhile, during the transition season I, individuals were obtained with (TKG V) in the range of diameter 56 - 72 mm. The *Echinometra mathaei* species shows a gonad maturity level during the east season of 3 gonad levels, and is dominated by (TKG IV) with a diameter of 26 - 35 mm. Meanwhile, in the transition season I it was monasted by (TKG V) with a size range of 35 - 45 mm wide diameter. In the eastern monsoon, the *Diadema antillarum* species found that gonad maturity occurred at stages (TKG I & II) with a size range of 95 - 105 mm in width. Meanwhile, during the first season, the *Diadema antillarum* species could not be found at the research location, which is thought to be due to the influence of the season.

Keywords: Hutumuri, sea urchins, gonad maturity level

ABSTRAK

Negeri Hutumuri mempunyai kawasan pantai yang strategis dikarenakan kondisinya yang dekat dengan pemukiman. Adanya potensi sumber daya bulu babi membuat masyarakat memanfaatkan bulu babi sebagai hewan konsumsi jika terjadi pergantian musim. Berbagai aktivitas yang dapat dilakukan masyarakat seperti dijadikan tempat berlabuhnya kapal nelayan, bameti dan aktivitas pantai lainnya sehingga dapat mengakibatkan terganggunya kehadiran organisme perairan, termasuk bulu babi (*Echinoidea*). Penelitian ini dilakukan karena belum adanya informasi ilmiah tentang aspek Bioekologi Bulu babi di perairan Pantai Negeri

Hutumuri. Hasil penelitian pada lokasi Pantai Negeri Hutumuri menunjukan tingkat kematangan gonad pada spesies *Tripneustes gratilla* selama musim timur terdiri atas 2 tingkatan gonad, dan didominasi oleh (TKG III) dengan kisaran ukuran diameter lebar 51 - 60 mm. Sedangkan selama musim peralihan I diperoleh individu dengan (TKG V) pada kisar ukuran diameter lebar 56 - 72 mm. Spesies *Echinometra mathaei* menunjukan tingkat kematangan gonad selama musim timur 3 tingkatan gonad, dan dominasi oleh (TKG IV) dengan ukuran diameter lebar 26 - 35 mm. Sedangkan pada musim peralihan I didominasi oleh (TKG V) dengan kisaran ukuran diameter lebar 35 - 45 mm. Spesies *Diadema antillarum* pada musim timur ditemukan kematangan gonad terjadi pada tahap (TKG I & II) dengan kisaran ukuran diameter lebar 95 - 105 mm. Sedangkan musim peralihan I spesies *Diadema antillarum* sudah tidak dapat ditemukan pada lokasi penelitian yang diduga karena adanya pengaruh musim.

Kata Kunci: Hutumuri, bulu babi, tingkat kematangan gonad

INTRODUCTION

Sea urchins are included in the Phylum Echinodermata, which in Greek means spiny skin. The Echinoidea class is a marine animal that is round in shape and has spines on its skin that can be moved. The Echinoidea class is divided into two main subclasses, namely the Echinoidea subclass and the Perischoechinoidea subclass. Echinoidea is a regular sea urchin while the Perischoechinoidea subclass is an irregular sea urchin. (Rahayu *et al.*, 2020).

Ambon Island is influenced by the West or North season and the East or Southeast season. The change of seasons is always interspersed with the Pancaroba season which is a transition from the two seasons. The West season generally lasts from December to March, where April is the transition period to the East season. While the East season lasts from May to October, where November is the transition period to the West season (Kotarumalos, 2023).

Negeri Hutumuri has a coast that can be said to be a strategic water area because of its condition which is close to settlements. The potential for sea urchin resources makes people use sea urchins as animals for consumption when the seasons change. Various activities that can be carried out by the community such as being used as a place for fishing boats to anchor, bameti and other beach activities can disrupt the presence of aquatic organisms, including sea urchins (Echinoidea). This research was conducted because there is no scientific information about the Bioecological aspects of Sea Urchins in the coastal waters of Negeri Hutumuri.

METHODS

Time and Location of Research

This research was conducted in Negeri Hutumuri, Ambon City. It took place during August - November 2023. The following map of the research location is presented in (Figure 1).

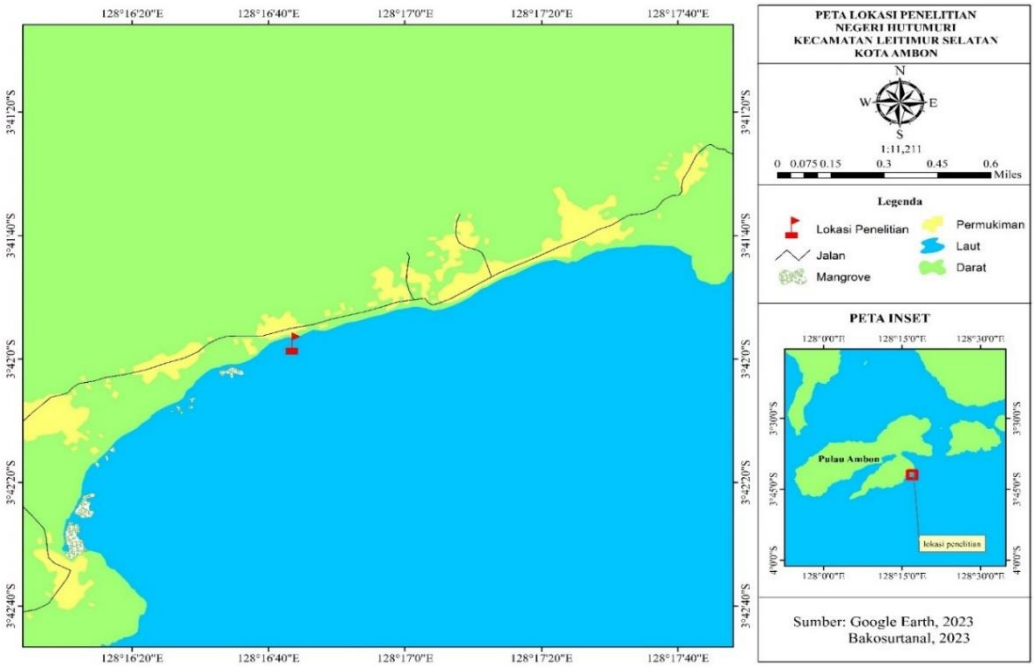
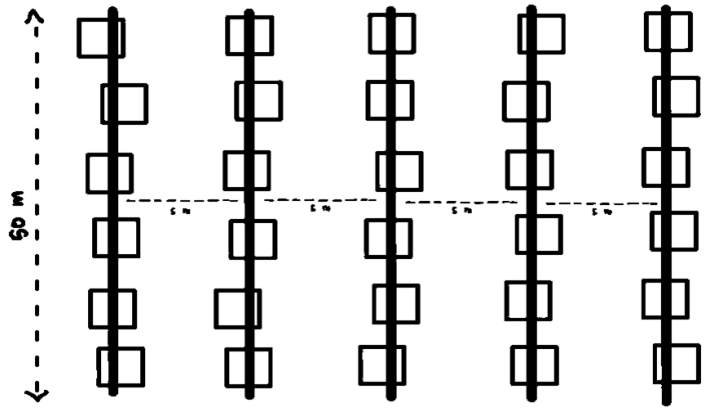


Figure 1. Research Location

Observation Plot Determination

Sea urchin sampling was carried out on an area of 1000 Meter2. Using the line transect method, perpendicular parallel to the coastline along 50 meters towards the sea, the distance between transects is 5 meters on each transect, using a quadrant measuring 5x5 meters. In addition, data collection on each transect uses a free collection technique (Gaffar *et al.*, 2014), free collection in the research area, This sampling technique aims to further optimize the collection of sea urchins in their natural habitat so that the samples obtained can cover the entire sampling area. Sampling is carried out at the lowest ebb.



Description:
Quadrant: 5x5 Meters
Distance between transects: 5 Meters
Distance of transect lines: 50 Meters

Figure 2. Sampling at the Research Location

Environmental Parameter Measurement

The environmental parameters measured in this study were temperature and salinity.

Data Analysis

1. Species Composition

Identification is done by observing the characteristics of sea urchins, then matching or comparing the color, body shape and weight according to the criteria according to Radjab (2001). Observation of sea urchin morphology includes body shape, color and morphometrics such as body weight and length of spines.

2. Size Frequency

The size frequency in the first stage in compiling a frequency distribution is by sorting the data. The data obtained can be sorted from the smallest data to the largest data. Next, determine the number of classes. The class itself is a group of data values or variables from random data. According to Umar (2011) to determine the number of classes in the frequency distribution, you can use the formula:

$$k = 1+3,3 \log n$$

Information:
k = number of classes
n = amount of data

Measurement of the diameter of sea urchins is done by measuring the height, measuring the width using a vernier caliper and measuring the weight of the sea urchin using a digital scale. The height measurement is from the abural side to the bottom of the oral side while the width measurement is from the side, namely the ambitus.

3. Gonad Maturity Level

The gonad maturity level (GMT) is the stage of gonad development before and after the organism spawns. The sea urchin species found were then taken to observe their morphological structure in the form of gonad color and gonad size. The results of observations of gonad color and size were then compared with the guidelines according to Cassie, (2007) Sea urchin GMT Table.

4. Gonad Maturity Index

Determination of the gonad maturity index is the comparison between gonad weight and body weight expressed as a percentage.

$$\mathbf{GMI} = \frac{\boldsymbol{GW}}{\boldsymbol{BW}} \boldsymbol{x}\ \mathbf{100\%}$$

Information:
GMI = Gonad Maturity Index (%)
GW = Gonad weight (g)
BW = Body weight (g)

RESULT

Location Description

The waters in Negeri Hutumuri are quite clear around the coast where water breaks or talits are built, have a rocky sand substrate and bameti activities are often found. The coastal waters of Negeri Hutumuri have coastal ecosystems, namely seagrass and coral reefs. The characteristics of Negeri Hutumuri's coast are dominated by sand substrates mixed with dead coral fragments. It has a substrate, namely gravel, very rough beaches, medium sand, fine sand, and mud (Rabiyanti *et al.*, 2023).

Species Composition

Table 1. Types of Sea Urchins Found

Class	Ordo	Family	Genus	Species	Σ Individu
Echinoidea	*Echinaceae*	*Toxopneustidae*	*Tripneustes*	*T. gratilla*	12
	Echinoida	*Echinometridae*	*Echinometra*	*E. mathaei*	12
	Diadematoida	*Diadematidae*	*Diadema*	*D.antillarum*	3

Source: Research Results, 2023

Species Size

Table 2. Height, Width, and Weight/Month of Observation

Echinometra mathaei									
Month	**Height (mm)**			**Width (mm)**			**Weight (gr)**		
	S1	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
August	**45**	**40**	**39**	**43**	**46**	**50**	**14**	**18**	**29**
September	**40**	**45**	**42**	**44**	**52**	**47**	**15**	**30**	**27**
October	**41**	**50**	**38**	**39**	**45**	**58**	**32**	**31**	**31**
November	**47**	**42**	**45**	**42**	**40**	**55**	**15**	**30**	**27**

Tripneustes gratilla									
Month	**Height (mm)**			**Width (mm)**			**Weight (gr)**		
	S1	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
August	**72**	**73**	**76**	**46**	**52**	**55**	**160**	**155**	**170**
September	**58**	**61**	**42**	**79**	**81**	**47**	**165**	**158**	**154**
October	**88**	**79**	**76**	**57**	**50**	**49**	**157**	**170**	**174**
November	**68**	**81**	**60**	**45**	**56**	**72**	**167**	**175**	**174**

Diadema antillarum									
Month	**Height (mm)**			**Width (mm)**			**Weight (gr)**		
	S1	**S2**	**S3**	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
August	**90**	**73**	**96**	**41**	**80**	**67**	**101**	**97**	**98**

Source: Research result, 2023

Information: S : Sample
Mm : Milimeter
gr : Gram

Sea Urchins Size Frequency

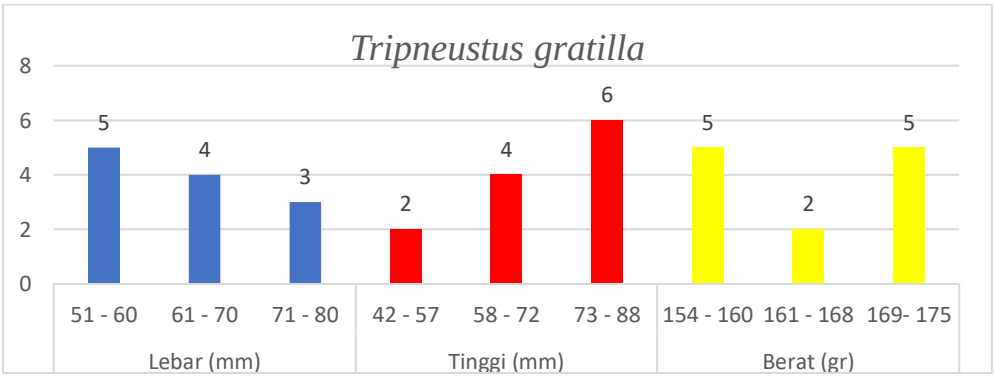


Figure 3. Size Frequency of *Tripneustes gratilla*

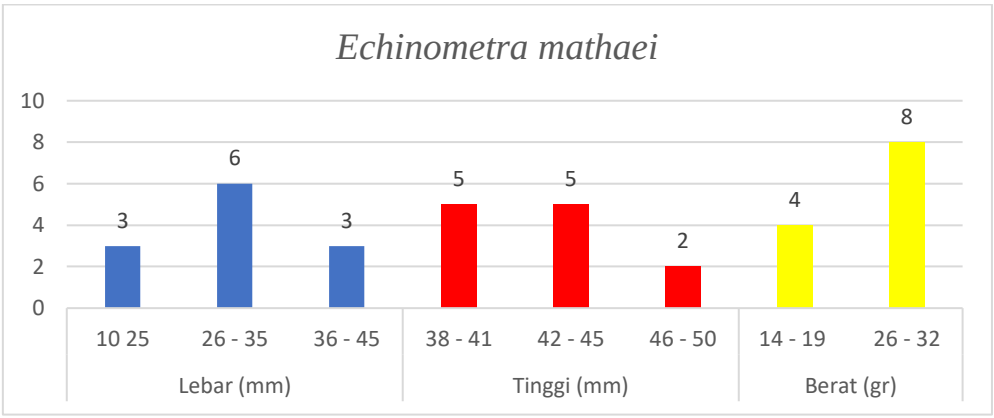


Figure 4. Size Frequency of *Echinometra mathaei*

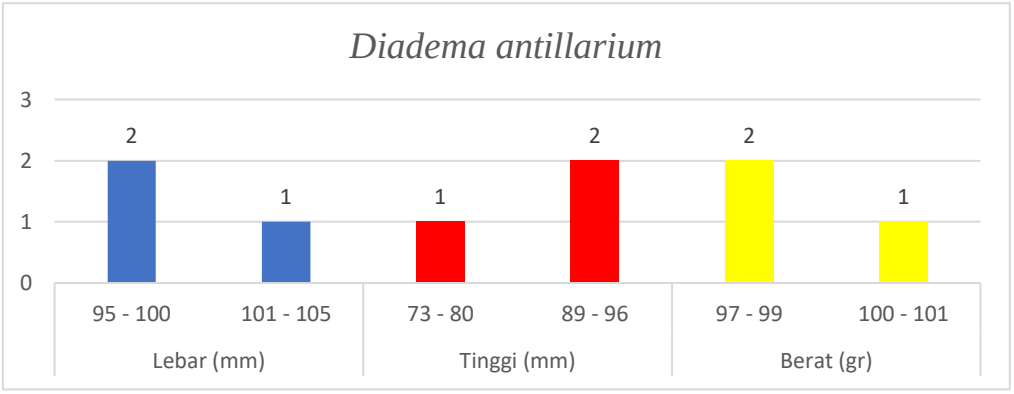


Figure 5. Size Frequency of *Diadema antillarum*

Gonad Maturity Level

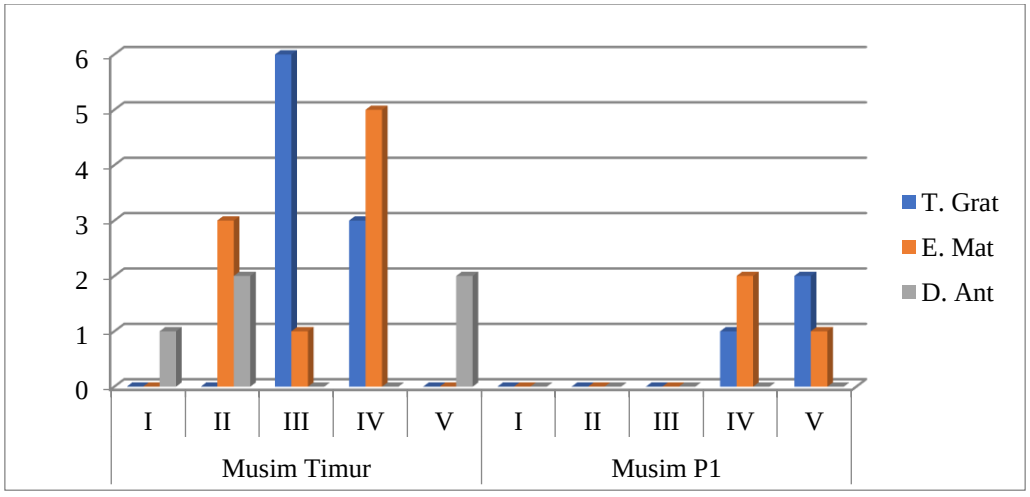


Figure 6. Gonad Maturity Level of Sea Urchins Based on Season

Gonad Maturity Index

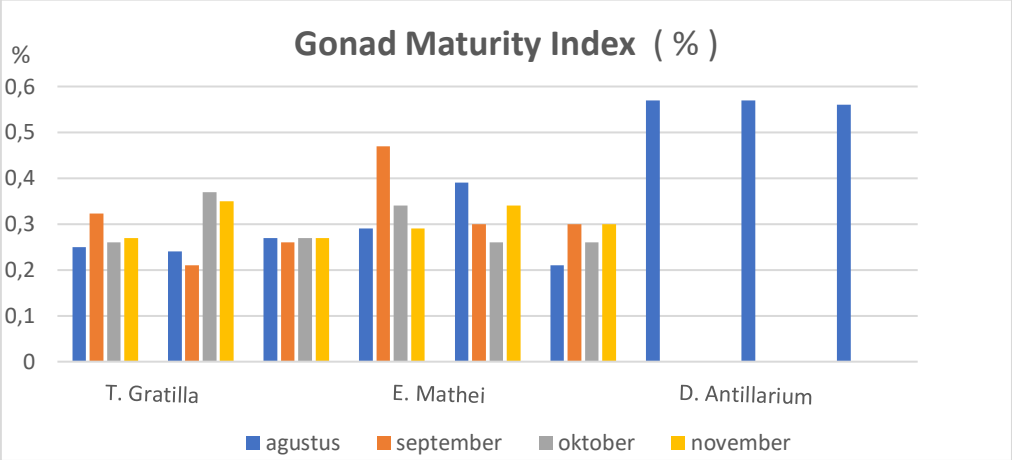


Figure 7. Gonad Maturity Index

Habitat Characteristics

Table 3. Physical Parameters of the Research Location

Parameter	Measurement results				Average
	Ags	Sep	Oct	Nov	
Temperature (ºC)	29	28	27	29	28
Salinity (ppt)	31	31	30	31	31
Substrat	Coral, sandy, coral				

Source: Research Data, 2023

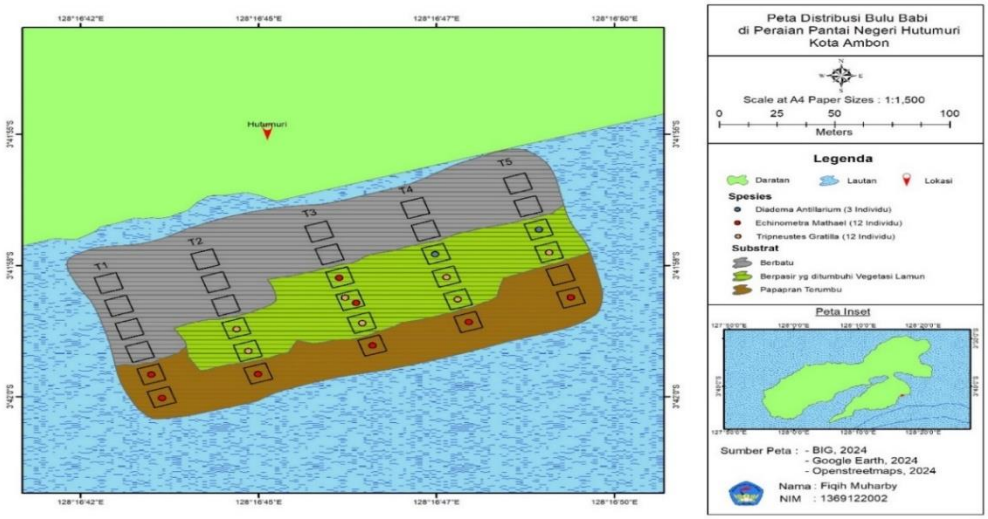


Figure 8. Map of Sea Urchin Distribution in the Coastal Waters of Hutumuri Country

DISCUSSION

Species Composition

Based on the results of the study, it was found that there were 3 species of sea urchins classified into 1 Class, 3 Orders, 3 Families, 3 Genuses, 3 Species, and 27 Individuals (Table 1).

Species Size

In the *Tripneustes gratilla* type with the largest diameter in August, namely 76 mm and a width diameter of 55 mm. The comparison in November or transition one has the highest diameter of 81 mm and a width diameter of 56 mm. The *Echinometra mathaei* type at the beginning of the eastern season has the highest diameter of 45 mm and the widest diameter of 43 mm, while in the transition season one, precisely in November, it has the highest diameter of 59 mm and the widest of 55 mm. In contrast to the other two types, *Diadema antillarium* was only found at the beginning of August in the eastern season with the highest diameter of 96 mm and the widest diameter of 67 mm. These results are in line with Aslan's research (2005) which also found that shell diameter closely affects the body weight of sea urchins.

Frequency of Sea Urchin Length Size

From the results of the *Tripneustes gratilla* species study from August to November, a width diameter of 51 - 60 mm was found for 5 individuals (TKG III), a size of 61 - 70 mm for 4 individuals (TKG IV) and 71 - 80 3 individuals (TKG V). It can be concluded that the size of the width diameter can represent the level of gonad maturity if seen directly. The peak of Tripneustes gratilla spawning in August and September in eastern Indonesia with a shell diameter ranging from 75.01 mm - 80.00 mm and a weight of 165.30 g - 185.50 g. (Radjab, 1998).

From the results of the *Echinometra mathaei* species study from August to November, a width diameter of 10 - 25 mm was found for 1 individual (TKG II & III), a size of 26 - 35 mm for 6 individuals (TKG IV) and a size of 35 - 45 mm for 3 individuals (TKG V). The species of *Echinometra mathaei* when viewed directly without measuring at the research location is very difficult to distinguish or compare (TKG). Because this species has almost the same size at each level of its gonads. Similarly, according to Satyawan *et al*. (2013), the diameter size of *Echinometra mathaei* on Mandalika Beach has the largest average size of 31.02 mm. The results of the study showed that the species *Diadema antillarium* was found only in August with a diameter of 95-100 mm 2 individuals (TKG I) and 101-105 mm 1 individual (TKG II). Measurement of this species is considered suboptimal because it was only found at the beginning to the middle of the eastern season, which is precisely in August. It is suspected that this is due to the impact of the influence of the season which causes this species to only be found in certain months.

Gonad Maturity Level

The results of the study at the Negeri Hutumuri Beach location showed that the gonad maturity level of the *Tripneustes gratilla* species during the east season consisted of 2 gonad levels, and was dominated by (TKG III) with a diameter width range of 51 - 60 mm (Figure 4.7). While during the transition season I, individuals were obtained with (TKG V) in the diameter width range of 56 - 72 mm. Similar to the study according to Radjab (1998), the *Tripneustes gratilla* sea urchin when it reaches the early maturity level (TKG) has a shell diameter of 60 mm - 70 mm and a weight of 160 gr - 170 gr. The *Tripneustes gratilla* sea urchin species has gonad maturity that is ready to spawn throughout the year, especially in the Tripneustes genus where TKG IV and V are found every month, although in a small percentage and peaking in August and September with a shell diameter ranging from 70 mm - 80 mm and a weight of 165.30 - 185.50 g.

The *Echinometra mathaei* species shows a level of gonad maturity during the east season of 3 gonad levels, and is dominated by (TKG IV) with a diameter width of 26 - 35 mm. While in the transition season I it is dominated by (TKG V) with a diameter width range of 35 - 45 mm. Results According to Juliawan *et al*., (2017). *Echinometra mathaei* weighs between 20.29-67.54 gr with a diameter of 38-51 mm, a primary spine length of 8-13 mm. (TKG IV & V).

The *Diadema antillarum* species in the eastern season was found to have gonad maturity at the stage (TKG I & II) with a range of diameter and width sizes of 95-105 mm. While in the transition season I, the *Diadema antillarum* species could no longer be found at the research location, which is thought to be due to the influence of the season.

Gonad Maturity Index

Based on the research results, the gonad maturity index is unstable because only 3 species were found from September to November (Figure 7). The body weight of the sea urchins found had various body sizes, the *Tripneustes gratilla* species found in the eastern season in August, September and October had a body weight range of 154 - 170 gr and a gonad weight of 14 - 26 gr. The gonad maturity index in the eastern season, August 0.76%, September 0.79%, October 0.90%. While in the transition season I had a body weight range of 167 - 175 gr and a gonad weight of 57 - 74 gr, the gonad maturity index in November was 0.89%. Similarly, according to Aslan (2005), the IKG value of *Tripneustes gratilla* in the Kendari coastal area peaked in July, August, September and October. The *Echinometra mathaei* species was found in the eastern season in August, September and October with a body weight range of 14 - 32 gr, Gonad weight 4 - 11 gr. The gonad maturity index in the eastern season, August 0.88%, September 1.06%, October 0.86%. While in the transition season I, the body weight range was between 15 - 30 gr, gonad weight 12 - 15 gr, gonad maturity index in November 0.93%.

The *Diadema antillarium* species was found in the eastern season in August, with a body weight range of 98 - 101 gr, Gonad weight 55 - 58 gr, gonad maturity index in the eastern season, precisely in August 1.70%.

The results of IKG observations on the *Tripneustes gratilla* species from August to November have a stable average IKG value because the *Tripneustes gratilla* species experiences a stage of gonad maturity every month. While in the *Echinometra mathaei* species, the overall gonad weight and IKG increased from August to September and the gonad weight decreased again in the following months because the peak spawning period had passed. According to Nasurullah (2018), the IKG value in the Kendari Coast area peaked in July, August, and September. In contrast, the *Diadema antillarum* species cannot be classified into stable or unstable categories. Because only the *Diadema antillarum* species was found at the beginning of the research month and was not found again in the following months.

Habitat Characteristics

Based on the results of water condition measurements, it can be seen that the waters of Negeri Hutumuri Village show an average temperature of 28ºC and a salinity of 31 ppt. Alwi *et al.* (2020), stated that a temperature of 28 - 32ºC is a good condition for sea urchins to live and reproduce. Sea urchins can be found in intertidal areas up to a depth of 10 m and are marine inhabitants with a salinity tolerance limit of between 30-34% (Miala, 2015). Thus, it can be said that the temperature and salinity in the coastal waters of Negeri Hutumuri support the existence of sea urchin habitat.

The characteristics of the sea urchin habitat on the coast of Negeri Hutumuri on transect 1 are characterized by rocky and reef exposure. On this transect, the *Echinometra mathaei* species was found in the last zone of the transect in the offshore section.

On transects 2 to 5, the substrate is characterized by rocky, sandy and reef exposure. Three species of sea urchins were found, namely *Tripneustes gratilla*, *Echinometra mathaei* and *Diadema antillarum*. Also overgrown with seagrass vegetation of the species *Thalassia hemprichii* and algae of the species *Sargassum duplicatum* (brown algae). Transect 2 to Transect 5 found the species *Tripneustes gratilla* and *Diadema antillarium* in the middle zone of the transect with sand and rock substrates. While in the last zone of the transect in the

offshore section, the species *Echinometra mathaei* was found which generally lives on the reef shelf substrate.

CONCLUSION

Based on the results and discussion, it can be concluded from this study:

1. 3 species of sea urchins were found in the waters of Negeri Hutumuri Beach which are classified into 1 Class, 3 Orders, 3 Families, 3 Genuses, 3 Species, and 27 Individuals.
2. The size structure of sea urchins in the waters of Negeri Hutumuri Beach varies temporally. For all types, small and medium sizes were found compared to large sizes.
3. The level of gonad maturity stage 2 to stage 4 dominates in the east season. While the level of gonad maturity stage 5 is only found in transition one. These results make the gonad maturity index found unstable.
4. The environmental parameters of the habitat characteristics of Negeri Hutumuri Beach have 3 different types of substrates. Rocky, sandy and reef exposure substrates and seagrass and algae vegetation were also found.

ACKNOWLEDGMENT

Thank you to Dr. Ir. L. Shiahainenia S.Pi, M.Si as the first supervisor and Prof. Ir,.Y. Natan. M.Si as the second supervisor who have given direction and patiently provided knowledge, science and faithfully guided until this research and writing was completed. Thank you also to my older sister, Intan Rabiyanti S.Pi, M.Si who was happy to help me in conducting this thesis research.

REFERENCES

Alwi, D., Muhammad, S. H., & Tae, I. (2020). Karakteristik Morfologi dan Indeks Ekologi Bulu Babi (*Echinoidea*) di Perairan Desa Wawama Kabupaten Pulau Morotai. *Jurnal Sumberdaya Akuatik Indopasifik*, *4*(1), 23–32.

Aslan, L. M. (2005). *Bulubabi, Manfaat dan Pembudidayaannya*. Kendari: Unhalo.

Elfidasari, D., Noriko, N., Effendi, Y., & Puspitasari, R. L. (2017). Kualitas Air Situ Lebak Wangi Bogor Berdasarkan Analisa Fisika, Kimia dan Biologi. *Jurnal Al-Azhar Indonesia Seri Sains dan Teknologi*, *3*(2), 104–112.

Fathurrahman, T., Devianti, R., Rahayu, D. Y. S., & Yunus, R. (2021). Aplikasi "Tetoy" dan Optimalisasi Pemanfaatan Gonad Bulu Babi Dalam Mengatasi Stunting Untuk Mewujudkan Desa Sehat di Bajo Indah Kecamatan Soropia Kabupaten Konawe. *Krida Cendekia*, *1*(4).

Gaffar, S., Zamani, N. P., & Purwati, P. (2014). Microhabitat Preference of Seastar in Hari Island Waters, Southeast Sulawesi. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, *6*(1).

Halmia, A. (2020). *Pola Penyebaran dan Kelimpahan Bulu Babi Diadema setosum di Indonesia*.

Lubis, S. A. (2016). *Spesies Bulu Babi (Echinoidea) di Perairan Pulau Panjang Kabupaten Bangka Tengah Provinsi Bangka Belitung* (Doctoral dissertation, Universitas Pasir Pengaraian).

Miala, I., Pratomo, A., & Irawan, H. (2015). Hubungan Antara Bulu Babi, Makroalgae, dan Karang di Perairan Daerah Pulau Pucung. *Repository Umrah*, *5*.

Nasrullah, R., Sari, W., & Mellisa, S. (2018). Tingkat Kematangan Gonad Bulu Babi (*Tripneustes gratilla*) di Pantai Ahmad Rhangmayang Kecamatan Mesjid Raya Kabupaten Aceh Besar. *Jurnal Ilmiah Mahasiswa Kelautan Perikanan Unsyiah*, *3*(1).

Nisa, R. N. (2018). Diversitas *Echinoidea* (Bulu Babi) Pada Zona Intertidal.

Padang, A., Nurlina, N., Tuasikal, T., & Subiyanto, R. (2019). Kandungan Gizi Bulu Babi (*Echinoidea*). *Agrikan: Jurnal Agribisnis Perikanan*, *12*(2), 220–227.

Purnomo, I. G. P., Darma, I. S., & Putra, I. N. G. (2019). Struktur Komunitas Dan Sebaran Bulu Babi (*Echinoidea*) di Kawasan Padang Lamun Pantai Serangan, Bali. *Journal of Marine Research and Technology*, *2*(2), 29–33.

Priyambodo, M. F. (2023). Struktur Komunitas Echinodermata Pada Ekosistem Lamun di Pulau Mahitam dan Pantai Ketapang, Kabupaten Pesawaran, Lampung.

Radjab, A. W. (2001). Reproduksi dan Siklus Bulu Babi (*Echinoidea*). *Oseana*, *26*(3), 25–36.

Radjab, A. W., Rabiyanti, I., & Muharby, F. (n.d.). Community Structure of Sea Urchin as an Indicator of the Ecological Balance of Coastal Areas. *Journal of Environmental Science and Sustainable Development*, *6*(2), 7.

Radjab, A. W. (1998). Pertumbuhan dan Reproduksi Bulu Babi *Tripneustes gratilla* (L.) di Perairan Tamedan, Pulau Dullah, Maluku Tenggara. *Prosiding Seminar Kelautan LIPI - UNHAS Ke 1, Balitbang Sumberdaya Laut, Puslitbang Oseanologi - LIPI*, 149–156.

Satyawan, N. M., Tutupoho, S., Wardiatno, Y., & Tsuchiya, M. (2013). Feeding Behaviour and Bioerosion: The Ecological Role of the Rock-boring Urchin, *Echinometra mathaei* (*de Blainville*, *1825*), in Okinawa Reef Flat. *Aquatic Science & Management*, *1*(1), 10–16.

Sitanala, M. R. (2023). Pengelolaan Ekowisata Berbasis Masyarakat di Negeri Hutumuri Kota Ambon. *Maanu: Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 40–45.

Suryanti, S., Fatimah, P. N. P. N., & Rudiyanti, S. (2020). Morfologi, Anatomi Dan Indeks Ekologi Bulu Babi di Pantai Sepanjang, Kabupaten Gunungkidul, Yogyakarta. *Buletin Oseanografi Marina*, *9*(2), 93–103.