International Journal of Social Sciences and Humanities Invention 10(02): 7713-7724, 2023
DOI: 10.18535/ijsshi/v10i02.03
ISSN: 2349-2031
https://valleyinternational.net/index.php/theijsshi

Diversity of Sea Stars (Asteroidea) in Baluran National Park Bilik Beach Intertidal Zone As a Source of Learning Biology

Novia Ayu Lestari, Suratno, Concerned Jekti

Biology Education Study Program Faculty of Teacher Training and Education
University of Jember, Jalan Kalimantan No. 37 Tegalboto Campus, Krajan Timur,Sumbersari, Sumbersari District, Jember Regency, East Java 68121

Abstract
Starfish (Asteroidea) is one of the biota that make up Bilik Beach, Baluran National Park. The aim of theresearch was to determine the diversity of starfish species (Asteroidea) in the intertidal zone of Bilik Beach, Baluran National Park, Situbondo Regency, East Java. The research method used is survey method. Data collection was carried out by site surveys, determining research locations, sampling, observing, and identifying species. Sampling was carried out when the seawater reached its maximum ebb. The research location uses 3stations with location points that represent the area of Bilik Beach. Sampling used transect plotting technique with a total of 3 transects at each station. Based on the research results, 2 types of starfish (Asteroidea) were found, namely *Linckia laevigata* and *Archaster typicus*. The results of the calculation of the diversity index of starfish (Asteroidea) found on Bilik Beach are 0.44 which is relatively low. The findings of sea stars are used as a learning resource in the form of popular scientific books.

1. Introduction

1.1 Background of the study

Indonesia is believed to have very high marine resources which are spread overmore than 99,093 km of coastline, 70% of which is marine area (BIG 2013; Farhan and Lim 2011). Given that several species of Echinodermata are important animals indetermining the structure of marinehabitats and can represent a large part of ecosystem biomass, it is important to know new information about the biology of the species and their geographic distribution. Echinoderms play a very important role in a marine ecosystem, one of which is the starfish (Rodrigues, 2016:1).

The territorial waters have various coastal resources, one of which isEchinodermata. Baluran National Park isone of the national parks in East Java, in which there is Bilik Beach. Bilik Beach has abiotic factors that affect the diversity and abundance of germplasm such as marine invertebrates (Setiawan *et al*., 2019: 193). This is reinforced by Mutaqin *et al* (2020: 183) stating that in theintertidal zone Bilik Beach has a high diversity of marine biota due to supportfrom environmental factors, such as seagrass communities, tidal conditions,macro benthic marine algae populations, plankton , to the number of sheltersavailable for marine life.

The existence of starfish (Asteroidea)itself is an animal associated with coralreefs, cleaning beaches from organic material so that it is one of the bio- indicators of a clean sea. In general, Echinoderms achieve the highest diversityin the ocean, on coral reefs and shallow beaches. This is because the larvae of echinoderms, especially starfish and sea urchins, are pelagic and usually swim longdistances so that they can expand their distribution (Jalaluddin and Ardeslan, 2017:82).

Sea stars (Asteroidea) are biota fromthe phylum Echinodermata which are quitecommercial, namely as biota kept in aquariums. This animal also has a veryhigh economic value so it is used as decoration and souvenirs (Lalombombuida*et al*., 2019: 40). Utilization and processing of starfish (Asteroidea) body parts can produce glycoside compounds which are useful as antibiotic ingredients (Mbana *et al*., 2020). As a result of the utilization carried out by humans by trading these animals and not payingattention to the number of animals caught, it is bad for the growth of marine organisms, resulting in a decrease in population.

Research on the diversity of starfish species (Asteroidea) has previously been carried out by Yuanditra (2015) and Vendi(2016) at Bama Beach, Baluran National Park. The results of Yuanditra's research (2015) show that there are three types of starfish species on Bama Beach, namely *Archaster typicus*, *Linckia laevigata* and

Asteropsis carinifera. Vendi (2016), found
3 types of starfish (Asteroidea) in his research namely *Linckia laevigata*, *Archaster typicus* and Echinaster callosus. According to Vendi (2016), starfish(Asteroidea) can be found starting fromsandy, mud, seagrass to coral substrate conditions.
This study aims to complement or add information regarding insights regarding the abundance of starfish (Asteroidea)found in Bilik Beach, Baluran National Park, Situbondo, East Java, as well as looking for the diversity index of starfish (Asteroidea) that have been found on BilikBeach to determine the level of diversity. the starfish on this beach are in the high, medium or low category. The findings of starfish (Asteroidea) will be used as learning resources in the form of popular scientific books.
Learning is a process of interaction between students and educators as well as learning resources in the learning environment (Suratno *et al*., 2018: 45). Learning resources are something that can contain messages to be presented through the use of tools or by himself, or something that can be used as conveying messages stored in the learning materialsto be provided (Daryanto, 2016). Learning resources have a fairly important role in the teaching and learning process to improve understanding and student learning outcomes (Maisyaroh & Dewi, 2022: 43).
Learning outcomes are abilities acquired by students or children after going through and carrying out learning activities, thus it is necessary to know the factors related to learning outcomes to improve the quality of education. Student learning outcomes are assessed based on two domains, namely the cognitive domainand the affective domain (Khoiriyah *et al*., 2015: 55).
Popular scientific books are books that are written in a way that is easy for the general public to understand and understand (Jendral Soedirman University,2016). Popular scientific books as learningresources can be used to attract students' interest because of their simple form, contain information, are easy to understand, and provide a variety of views so they are not boring (Irwandi *et al*., 2019: 48).

2. Research Methods

2.1 Place and Time of Research

The research was conducted at Bilik Beach, Baluran National Park, Situbondo Regency, in the intertidal zone. The research was conducted at the maximum low tide that is when the full moon. Morphological identification was carriedout at the beach resort of Bilik BaluranNational Park. The research was carried out in February 2022 - May 2022. Data collection for Asteroidea Class samples was carried out when the sea water reached its maximum ebb.

2.2 Tools and Materials

The tools used in this study were field study stationery (chest board, pencil, writing paper and ruler), thermometersticks to measure water temperature, pH meter to measure the degree of acidity of water, thick gloves for sampling, plasticbags, tape measure, refractometer, plastic jar as Asteroidea container, raffia, Echinodermata identity book and DSLRcamera (1200 D) for documentation of the Asteroidea found.
The materials used in this study were label paper, tissue paper, sterile distilled water.

2.3 Sampling Method

Asteroidea data collection uses thedirect observation method, with researchdata collection techniques directly to the research object. The location used in the study was Baluran National Park's Bilik Beach using three location points within
50 meters of the coastline. The methodused in this study was the method of plotting transects with a size of 1x1m2 systematically along the transect. Thedistance between transects is 10 m with each transect being plotted. This method was carried out at three research stationlocations in Bilik Beach, Baluran National Park.

Figure 1. Sampling station locations

Coordinate point:
Station I: 7º45'03"S 114º22"21"E ‘
Station II: 7º45'05"S 114º22"23"E
Station III: 7º45'10"S 114º22"25"E

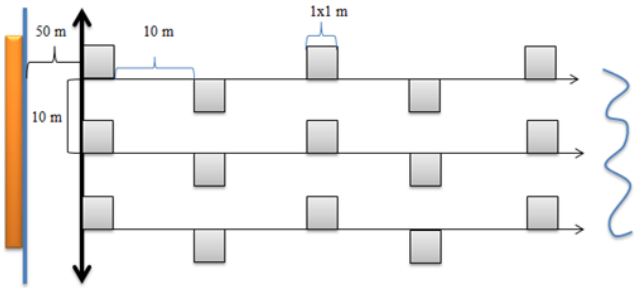

Figure 2. Positioning of the maintransect axes and plotting

Information:

: Mainland
: Plots
: Coastlin
: Main axis
:Line
: Sea

N

2.4 Starfish Identification

The process of identifying starfish includes describing the morphological characteristics of the starfish found. The morphological structures include dorsal and ventral body structures, tube feet type, paxilla, presence or absence of pedicellaria, size of arm length and body color. Morphological observations referred to the reference book (Echinodermataidentification book) "*Biology and Ecology of Pharmaceutical Marine Life: Echinoderms*" and then compared with information from the websites itis.gov and GBIF to obtain the most recent taxonomic data.

2.5 Diversity Index Calculation

The calculation of the diversity index ofstarfish is carried out using the Shannon- Wiener index (Magurran, 2004), with the formula:

$H' = -\sum$ $pi\ ln\ p$iand$pi = \frac{ni}{N}$

Notes:
H': Shannon-Wiener Diversity Index;
pi : Comparison of the number ofindividuals of a species with thewhole species;
ni : Number of individuals for theobserved species;

N : Total number of individuals.Criteria for diversity results (H'):
H'< 1 : Low diversity;
H' < 3 : Medium diversity;H' > 3 : High diversity.

3. Results And Discussion

3.1 Results

Based on the process of identifyingsamples of sea stars found in Bilik Beach found 2 species consisting of 2 families(Table 1).

Table 1. Results of identification of starfish species found in Bilik Beach

No.	Family	Species
1.	Archasteridae	*us* (Müller & Troschel,1840)
2.	Ophidiasteridae	*Linckia laevigata* (Linnaeus, 1758)

The description of each species of starfish (Asteroidea) found is as follows.

***Archaster typicus*(Müller & Troschel, 1840)**

Archaster typicus(Müller & Troschel, 1840) is gray- brown with freckles, has five arms and a flattened body. The sleeves are pointed and have a transverse brown stripe pattern. *Archaster typicus* on the aboral side there is a madreporite which functions as a water circulation system and there is anus. The morphology of the oral part of the starfish consists of a mouth, cylindrical tube feet and openings of the ambulaclar system. This species has a body covered with spines on the inferolateral side. *Archaster typicus* has thorns that are white and are blunt and flat. This species has a habitat ina sandy substrate

***Linckia laevigata*(Linnaeus, 1758)**

The species *Linckia laevigata* (Linnaeus, 1758) was found to be solitary, has five cylindrical arms and blunt ends, has an overall length of 20-21 cm and a strong body structure. The oral part of this species has an ambulaclar and mouth, while the aboral part has a madreporite adjacent to the anus. This species has a smooth surface, there are tube feet (tube feet) without suckers which are white in color, there are small granules that cover the discs. *Linckia laevigata* has a deep blue color. This type of starfish is commonly found around coral reefs.

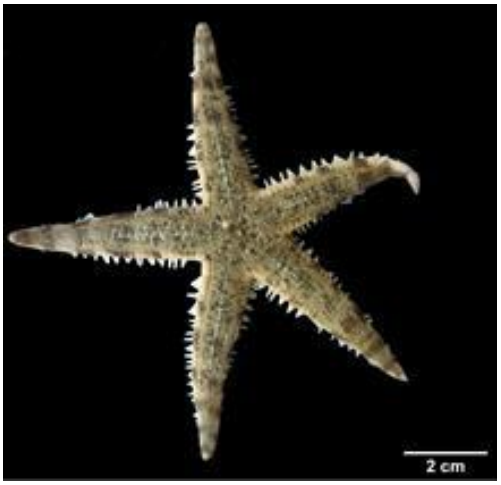

Figure 3. *Archaster typicus* (Müller & Troschel, 1840)

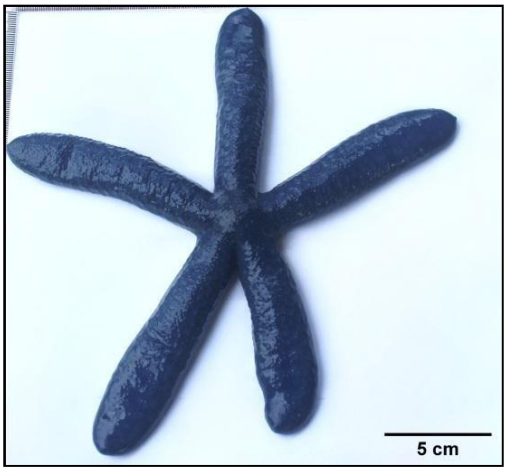

Figure 4. *Linckia laevigata* (Linnaeus, 1758)

The results of the identification of the starfish samples obtained showed that there were 2 species found at Baluran National Park Bilik Beach. The distribution of starfish is presentedin Table 2.

Table 2. Distribution of starfish on Bilik Beach

No.	Species name	Station			Number of Individuals	H'
		T1	T2	T3		
1.	*Archaster typicus*	43	34	33	110	0.44
2.	*Linckia laevigata*	10	11	0	21	
	Total				131	
	Number of types				2	

Note:

T=th station

Based on the calculated data, it is known that the value of the diversity index(H') of starfish on the beach obtained 0.44,which is classified as low. Data from the calculation of the diversity index of starfish at each station can be seen in Table 3.

Table 3. Starfish diversity index at station 1

No.	Species name		Station 1		H'
		L 1	L2	L3	
1. 2.	*Archaster typicus* *Linckia laevigata*	1 9 4	16 0	8 6	0. 17 0. 31
	Total				0. 48

Note:
L = Transect to-
Based on the calculation results in table 3 above, it can be seen that the value of the diversity index (H') of starfish at station 1 Bilik Beach Baluran National Park is low, while the results of calculatingthe diversity index of starfish at station 2of Bilik Beach can be seen in Table 4

Table 4. Starfish diversity index at station 2 Bilik Beach

No.	Species name	Station 2			H'
		L1	L 2	L3	
1. 2.	*Archaster typicus* *Linckia laevigata*	1 1 5	9 2	1 4 4	0.21 0.34
	Total				0. 55

Note:
L = Transect to-

Based on the calculation results in Table 4 above, it can be seen that the valueof the diversity index of starfish at station 2. Bilik Beach was obtained 0.55 which is classified as in the medium category. While the results of calculating the diversity index of starfish at station 3 can be seen in Table 5.

Table 5. Starfish diversity index at station 3 Bilik Beach

No.	Species name		Station 2		H'
		L 1	L 2	L3	
1.	*Archaster typicus*	12	1 3	8	0
	Total				0

Note:
L = Transect to-
Based on the calculation results in Table 5, the value of the diversity indexfor sea stars is H' of 0, which means the diversity value is low. Each sampling location has different abiotic conditions. The abiotic conditions of each location canbe seen in Table 6.

Table 6. Abiotic conditions of the sampling locations

Parameter	Stations (Average number)		
	T1	T2	T3
Temperature (ºC)	27.5	27,8	28,8
Salinity (ppt)	30,3	30,8	30,6
Water pH (Potential hydrogen)	8.01	8,22	8.36
DO (Dissolved oxygen	4,9	4.93	4.88
Light intensity (lux)	14146.6	16,990	17,770
substrate	Rocks, coral, sand	Sandstone coral	Sandstone

Note:
T: The station

Test the Validity of Popular Scientific Books

Validity data is used with the aimof testing the validity of research products that have been developed (Retnowati *et al*., 2015: 34). Popular scientific books thathave been compiled are then submitted to the validator to be tested for product validation. Product validation is carried out by material experts, media experts and the user community. The validation test bymaterial experts and media experts was carried out by the Biology Education Lecturer at FKIP University of Jember. Test validation by users who are the community. The validation test results obtained from the two lecturers and thecommunity can be seen in Table 7 below.

Table 7. Popular Scientific Book Validation Test Results

Validators	**Total score**	**Score**	**Category**
Material expert	59	82,86	Worthy
Media expert	105	84	Worthy
User	79	75,2	Worthy
Average		80.6	Worthy

1.1 Discussion

Based on the results of the calculation of the diversity index of starfish (Asteroidea) is 0.44. This figure is included in the low category (H'<1). The diversity index of starfish (Asteroidea) at station I of the cubicle beach was 0.48,station II was 0.55 and station III was 0. Each research station location had different characters, so the diversity of starfish found at each location was alsovaries.

The high or low value of diversity is caused by various factors, including thenumber of individuals found, the

abundance of a species found, thehomogeneity of the substrate and theconditions of two important coastal ecosystems (paddocks, sea grasses and coral reefs) as habitats for aquatic fauna (Ernawati *et al*. ., 2019:50). The smallerthe species uniformity index value in the community, it means that the total distribution of the number of individualsof each species is not the same, namely there is a tendency that the community is dominated by certain species (Suwartimah *et al*., 2017: 59).

The first factor affecting the diversity value of starfish (Asteroidea) is the number and types of starfish (Asteroidea) found in the intertidal zone of the coast of Bilik Baluran National Park. According to Nurafni (2019), a community is said tohave high species diversity if there are many species with relatively even or nearly the same number of individuals of each species. There are two types of starfish (Asteroidea) found on Bilik Beach,namely *Linckia laevigata* and *Archaster typicus*. The number of individuals found on Bilik Beach is quite large, this is because *Archaster typicus* lives in groups and is easily adaptable and *Linckia laevigata* has the ability to regenerate.

The second factor is the spread of individuals. Diversity is not only seen from the large number of species, but also seen from the distribution of individualsfrom each species (Simatupang *et al*., 2017: 101). Diversity has a high value because the number of species and each individual is found evenly. However, the diversity value is low if the number of each individual obtained is not evenly distributed (Nurafni, 2019). The results showed that the diversity value of *Linckia laevigata* was higher than *Archaster typicus* because *Linckia laevigata* species have an even distribution.

Research on the diversity of starfish species (Asteroidea) has previously been carried out by Yuanditra (2015) and Vendi(2016) at Bama Beach. When compared to the Bama Beach area of Baluran National Park, the condition of starfish fauna (Asteroidea) found on Bama Beach has greater diversity. The results of Yuanditra's research (2015) show thatthere are three types of starfish species on Bama Beach, namely *Archaster typicus, Linckia laevigata* and Asteropsis carinifera. Vendi (2016), found 3 types of starfish (Asteroidea) in his researchnamely *Linckia laevigata*, *Archaster typicus* and Echinaster callosus.

Humans are also thought to play a role in the low diversity of starfish, becausemany are taken both live and dead for aquarium decorations and souvenirs (Hartati *et al*., 2018: 46). Baluran National Park Bilik Beach is used as a tourist spot during the dry season. In addition, this beach is the main route for sea transportation from settlements to the highway during the rainy season andfishing activities, thus affecting the existence of biota communities in these waters.

The fourth factor that affects the diversity index is the abiotic environmental conditions which include temperature, salinity, sunlight intensityand degree of acidity (pH). Watertemperature affects the metabolic activity of starfish. The temperature is still within the tolerance limit for starfish life, which ranges from 25°C to 30°C (Aziz, 1998). Another abiotic factor that affects the diversity of starfish is pH. Beaches with a pH of 7 – 7.5 are included in the normal range for starfish life.

The salinity (salt content) of water inthe environment affects the water balance in organisms' bodies, so changes in salinityalso affect the mechanisms of diffusion and osmosis (Siwi *et al*., 217:122). According to Aziz (1998), starfish have a salinity tolerance limit of 30 – 34º/◦◦. Starfish larvae are more sensitive to the effect of decreasing or increasing salinity, in contrast to adult starfish.

Substrate affects the diversity ofstarfish, this is because the availability of food is more in sandy substrates such as detritus litter deposits. According to Aziz (1997) several types of starfish like muddysand bottoms, this is related to starfish as sediment or detritus eaters. There are onlya few seagrass beds in Bilik Beach, which is a factor causing low diversity. According to Supono and Arbi (2010), starfish also like seagrass substrates, this isbecause their main food is seagrass, detritus and seaweed.

Based on data obtained from research atBilik Beach, station I has a temperaturerange of 27.2–27.8 ºC so that an averageof 27.5 ºC is obtained. Station II is 27.6-28ºC so that an average of 27.8 ºC is obtained. Station III obtained 28.4-29 ºCso that an average of 28.4 ºC was obtained.The temperature at the three stations is stillwithin the tolerance limit for starfish life. Sea water temperature greatly affects the spawning of starfish (Asteroidea). The optimal temperature to support the life of starfish is 25-30ºC (Aziz, 1998).

The salinity found at each station varies, at station I it is 30-30.5 ppt and an average of 30.3 ppt is obtained. Salinity found at station II is 30.6-31 ppt so that an average of 30.8 ppt is obtained, at station III it is obtained 30.5-31 ppt with an average of 30.6 ppt. Based on the abiotic data at the three stations, it supports thelife of starfish (Asteroidea). According to Aziz (2007) states that starfish(Asteroidea) are animals that are

classifiedas stenohalin, so they are very sensitive to changes in salinity. The ideal salinity range for starfish life is 29-33 ppt. A low salinity range (23-26 ppt) will cause changes in color pigments so that starfish will become inactive, refuse to eat and result in death (Rominmohartono, 2007).

The pH conditions found at each stationwere slightly different, at station I a pH of 7.84-8.28 was obtained so that an average of 8.01 was obtained. Station II obtained a susceptible pH of 7.94-8.40, resulting in anaverage pH of 8.22. Station III obtained a pH of 8.12-8.50 so that an average of 8.36 was obtained. According to Katili (2011), pH is a limiting factor for organisms that live in a waters. Water with a pH that istoo high or low can affect the survival of organisms. According to Effendi (2003) states that marine biota likes a pH range of 7-8.5. This statement is reinforced by Odum (1971), the safe limit for aquatic liferanges from 6.5-8.0.

The DO conditions found at each station varied, at station I the range was 4.89-5.6 mg/l so that an average of 4.9mg/l was obtained. Station II obtained DO susceptible 4.60-5.12 mg/l resulting in an average of 4.9 mg/l, and at station III obtained DO 4.6-5.12 mg/l resulting in an average of 4. 93. According toSimanjuntak (2007) oxygen levels in waters are strongly influenced by an increase in organic matter entering the waters, and other factors such as temperature rise, salinity, respiration, the presence of layers above the surface of the water, compounds that are easily oxidized,and pressure. atmosphere.

In general, dissolved oxygen found in the intertidal zone of Bilik Beach is still in accordance with the quality standards for marine life. Rivai (1983) said that in general an oxygen content of 5 mg/l with water temperatures ranging from 20-30 ºC is relatively good. According to Sutamihardja (1987) states that the oxygenlevel in lightly polluted marine waters is 5 mg/l.

Light has a major influence on marine animals, namely as a source of energy for the photosynthetic process of plants which are a source of food and a provider of oxygen. Light is also an important factor in relation to the movement of marine animal populations (Romimohtarto and Juana, 2009). The data from the measurement of light intensity obtained at each station was slightly different, atstation I it was obtained 12,630-12,590 luxand an average of 14,146.6 lux wasobtained. The light intensity at station II ranged from 16,890-17,150 lux andobtained an average of 16,990 lux, and at station III it was found to be in the range of 16,370-17,540 lux and obtained an average of 16,770 lux.

Some types of starfish (Asteroidea) likemuddy sand bottoms, this is related to theireating habits as sediment or detritus. The location of the research conducted at Bilik Beach has a substrate of sand, rocks and coral rubble. *Linckia laevigata* species are found on rock and coral substrates, while *Archaster typicus* species are found on sand substrates.

*Linckia laevigata*found on Bilik Beach with an average temperature range of 27.5-
27.8 ºC, an average salinity range of 30.3-
30.8 ppt, an average pH range of 8.01-8.22, an average DO range average 4.88- 4.93, average light intensity 14146.6- 16990 lux, the type of substrate is rocks and coral. *Linckia laevigata* is also known as an algae-eating starfish. This type ofstarfish can live in a substrate of sand, rocks and other solid objects which are algae attachment sites.

Like other echinoderms, starfish are also known as true sea dwellers, with a tolerance limit of salinity between 30 pptto 34 ppt (Zamani, 2015: 7-8). *Archaster typicus* is found on Bilik Beach with an average temperature range of 27.5-28.8 ºC,an average salinity range of 30.3-30.8 ppt, an average pH range of 8.01-8.36, DO range average 4.88-4.93, light intensity 14146.6-17770 lux, sand substrate type. The type of starfish *Archaster typicus* livesin groups on a sand substrate. This is in accordance with Alfatmadina (2019) that *Archaster typicus* is found on sandy substrates in shallow waters

Utilization of research results as a source of learning biology

Learning is organized not only to make students have cognitive skills, but also to have skills to apply in their lives (A'yun *et al*., 2018:1). The results of an inventory of sea stars (Asteroidea) found in Baluran National Park Bilik Beach are made into a learning resource in the form of popular scientific books. A popular scientific book entitled "Diversity of Starfish (Asteroidea) in Bilik Beach Baluran National Park" has gone through the validation stage of mediaexperts, material experts and users.

Popular scientific books consist of a cover, title page, preface, table of contents,introduction, material, bibliography, index,glossary and about the author. Based on the results of the feasibility validation test of popular scientific books, an average value of 80.6 is obtained which is in the feasible category. Based on these

results, apopular scientific book about the diversity of starfish (Asteroidea) in Baluran National Park Bilik Beach can be used as reading material by adding and considering the contents of the book.

4. Conclusion

The diversity level of starfish (Asteroidea) in Bilik Beach, Baluran National Park, is low with a diversity index of 0.44. Abiotic conditions at Bilik Beach Baluran National Park are ideal for the life of starfish (Asteroidea) with an average water temperature range of 27.5- 28.8 ºC, salinity 30.3-30.6 ppt, pH 8.01-8, 36, DO 4.88-4.93, light intensity 14146.6- 17770 lux and rock substrate, coral, sand. The results of the popular scientific book validation test obtained an average of 80.6 in the feasible category.

References

5. Alfatmadina, N., Ira., LOMY Haya. 2019. Habitat Preferences for Sea Stars(Asteroidea) in Seagrass Beds in Langara Bajo Village, Konawe Islands. Say hello. 4(1): 23-29.
6. A'yun M., Suratno., E. Narulita. 2018. Development of Students' Book Based on Science, Technology, and Society With Integration Life Based Learning inBiotechnology Materia in the XII Grade. Education Radiation. 7(3): 1-6.
7. Aziz, A. 1997. Observations of EchinodermataCommunities in Jakarta Bay. Journal of Oceanography and Limnology inIndonesia. 30(1): 1 – 12.
8. Aziz, A. 1998. Effect of heat stress onEchinodermata fauna. Journal *ocean*. 13(3): 125-132.
9. Bappenas. 2017. Indonesian BiodiversityStrategy and Action Plan (IBSAP) 2015-2020. Ministry of National Development Planning/Bappenas.Jakarta.
10. Daryanto. 2016. Learning and Teaching. Bandung: Yrama Widya.
11. Effendi, Hefni. 2003. Water Quality Review: For Resource Management and *Aquatic Environment*. Publisher:Kanisius. Yogyakarta.
12. Ernawati, NW, IW Arthana., NM Ernawati.2019. Abundance, Diversity, andNatural Growth of Sea Stars (Asteroidea) in the Waters of SemawangBeach and Samuh Beach, Bali. Current Trends in Aquatic Science. II(1): 46-53.
13. Hartati, R., E. Meirawati., S. Redjeki., I. Riniatsih., RT Mahendrajaya. 2018. Types of Starfish and Sea Urchins(Asteroidea, Echinoidea:Echinodermata) in Cilik Island Waters, Karimunjawa Islands. Tropical Marine Journal. 2(1): 41-48.
14. Irwandi., A. Winarti., M. Zaini. 2019. The validity of popular scientific books on sea turtles for high school students in coastal areas. Journal of Bioedukatika. 7(1): 47-58
15. Jalaluddin and Ardeslan. 2017. Identification and Classification of PhylumEchinodermata in the Marine Waters of Sembilan Village, Simeulue Barat District, Simeulue Regency. Journal of Biology Education. 6(1): 81-97.
16. Katili, AS 2011. Echinodermata Community Structure in the Intertidal Zone in Gorontalo. Journal of Research andEducation. 8(1): 51-61.
17. Khoiriyah, BA, Suratno., S. Murdiyah. 2015. The Influence of the Mind Map and Question Student Have IntegrationModel on Critical Thinking Skills and Learning Outcomes of Class VII Science Biology, SMP Negeri 10Jember. Educational Journal. II(2): 51- 57.
18. Kwang, SY, Shau-Hwai, AT and Yasin, Z. 2008. The Diversity and Abundance of the Sea Stars (Echinodermata: Asteroidea) from Coral Reefs of the Central South China Sea. The NagisaWestpac Congress: 25-36.
19. Maisyaroh, S & RF Dewi. 2022. Development of a Catalog of Insect Diversity in Chili Plants in Sindetlami Village as a Learning Resource. Bioeduca: Journalof Biology Education. 4(1): 36-44.
20. Mbana, YR, Y. Daud., NI Bullu. 2020. Diversity of Starfish (Asteroidea) on Lamalaka Beach, Ile Boleng District, East Flores Regency. Journal of BiologyEducation and Science. 3(2): 56-67.
21. Lalombombuida, S, M. Langoy and DY Katili. 2019. Echinodermata Diversity at Paranti Beach, Tabang Village, Rainis District, Talaud Islands Regency, Sulawesi Province. Journal of Fisheries and Tropical Marine. X(2): 40-50.
22. Mutaqin, BW, EP Yuendini., B. Aditya., IN Rachmi., MI Fathurizqi. SI Damayanti., SN A gift., NA Puspitasari.

2020. Abundance of Megabenthos as an Indicator of Coral Health in Bilik Waters, Baluran National Park, Indonesia.*Enggano Journal.5(2):181:194.*

23. Nurafni., SH Muhammad., I. Sibua. 2019. Echinodermata Diversity in the Waters of Ngele Ngele Kecil Island, MorotaiIsland Regency.*Journal of Archipelago Marine Science. 2(2): 74-83*

24. Odum, EP (1996). Fundamentals of Aquatic Ecology. Yogyakarta: Gadjah Mada University University Press.

25. Retnowati, A., Suratno., D. Wahyuni. 2015. Development of PQ4R-Based Biology LKS in Improving Metacognition andLearning Outcomes (Sub-topic of the Human Nervous System at MAN 2 Jember Academic Year 2014/2015). UNEJ Educational Journal. II(2): 33-38.

26. Rivai, RS and Pentagunawan, K,. 1983. Fisheries Biology I. CV. Kagayo: Jakarta.

27. Rodrigues, Nuno Vasco. 2016. Northernmost record of Hacelia attenuate (Echinodermata: Asteroidea) in the Atlantic. Marine Biodiversity Recorded.9(9): 1-3.

28. Rominmohartono, Kasijan. & Sri, Juwana. 2007. Marine Biology. Science of Marine Biota. Bridge.

29. Setiawan, R., FA Ula., SF Sijuang. 2019. Inventory of the Brittle Star(Ophiuroidea) Species at Bilik Beach, Baluran National Park, East Java. Marine Journal. 12(2): 192-200.

30. Setyowati, DA, Supriharyono and WT Taufani. 2017. Sea Star Bioecology(Asteroidea) in Menjangan Kecil Island Waters, Karimunjawa Islands. Journal of Macquares. 6(4): 393-400.

31. Simanjuntak, M. 2007. Dissolved Oxygen and Apparent Oxygen Utilization in Klabat Bay Waters, Bangka Island. Jour. Mar. sci. Diponegoro University MarineScience. 12(2): 59-66

32. Simatupang, MYC, Sarong, MA, Ulfah, M.2017. Echinodermata Diversity and Environmental Conditions in theShallow Waters of Pulau Pandang, Batu Bara Regency, North Sumatra Province 2017. Unsyiah Maritime and FisheryStudent Scientific Journal. 2(1): 97-103.

33. Siwi., Sudarmadji., Suratno. 2017. Diversityand Density of Gastropods in the Mangrove Forest of Si Runtoh Beach, Baluran National Park. Journal of Basic Sciences. 18(2): 119-124.

34. Suratno., E. Narulita., S. Luthfia. 2018. Development of Contextual-Based Student Books Filled with Islamic Religious Values in Class XII High School/MA Biotechnology Materials. Educational Journal. V(1): 45-48.

35. Susilo, Vendi Eko. 2016. Local Distribution of Echinodermata in Pantai Bama, Baluran National Park. Bioeducation. XIV(2): 31-38.

36. Sutamiharja, RTM 1987. Quality and Environmental Pollution. Postgraduate Faculty, Bogor Agricultural Institute. 92pages.

37. Suwartimah, K., DS Wati., H. Endrawati., R. Hartati. 2015. Composition of Echinoderms in the Litoral Flat of CoralReefs at Krakal Beach, Gunung Kidul, Yogyakarta. Marina Oceanographic Bulletin. 6(1): 53-60.

38. General Soedirman University. (2016).Incentive guide for writing books, seminars, and scientific publications. Taken fromhttps://docplayer.info/29943300Un iversitas-jenderal-soedirman- panduaninsentif-penulisan- bukuseminar-dan-publikasi-ilmiah.html

39. Zamani, Nevianty P. 2015. Condition of Coral Reefs and Their Association with Starfish (*Linckia laevigata*) in Tunda Island Waters, Seram Regency, Banten Province. Journal of Fisheries and Marine Technology. 6(1): 1-10