Diversity of Bivalves on the Sowan Coast As a Tourism Object in Tuban Regency

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Abstract

Sowan beach is a beach located north of Java Island in Tuban Regency. Local people take advantage of this beach as a tourist attraction and activities of daily life. Community activity on Sowan beach is currently getting higher so that it affects the quality of the waters and the abundance of biota such as Bivalves (shellfish). Based on this, it is necessary to research to know the diversity of Bivalves on Sowan Beach as a tourist attraction. This type of research is a quantitative descriptive study. The method used in this research is purposive sampling. The research location has 2 stations, namely Karang Beach and White Sand Beach. The results of this study were in the form of data on the types of Bivalves found in the research location as many as 184 consisting of 4 species, namely *Perna viridis*, *Meretrix meretrix*, *Polymesoda erosa*, and *Anadara granosa*. Based on the results of data analysis, the abundance value of Bivalvia species at station I is 8, and station II is 10.4. The diversity index of Bivalvia species at the station I is 0.61 and station II is 1.28. The dominance index value of Bivalvian species at station 1 is 0.5585 and station II is 0.2687. Based on the abundance value, the diversity index and dominance of Bivalvia in Sowan beach are low. This means that the environmental conditions on the Sowan beach are not good enough to support the breeding of Bivalves.

Keywords: Sowan Beach, Bivalvia, Diversity index, Tourist attraction, Community Activities.

1. Introduction

Sowan beach is a beach located north of Java Island in Tuban Regency, East Java. The beach is known as "Wana Wisata Pantai Sowan". Based on the results of interviews with Perum Perhutani, the Sowan beach tourist area has an area of about 17 hectares with the characteristic of having white sand and coral beaches so it is suitable for use as a tourist attraction. Apart from being used for tourist attractions, it is also used for other activities such as fishing and shellfish. Community activity will affect the condition of this beach, especially the quality of the waters (Barnett, Jackson-Smith, and Haeffner 2018). Water quality can be characterized by the abundance of biota such as Bivalves which must meet physical and chemical standards in the environment (Abdel-Satar, Ali, and Goher 2017; Custodio et al. 2018; Saad Abdelkarim 2020). Bivalve abundance is related to environmental changes such as levels of contaminants, toxicity, ecological pressure, and community activities (Karthikeyan et al. 2021; Kolarova and Napiórkowski 2021). Besides, environmental conditions such as temperature, salinity, and pH of water greatly affect the distribution of Bivalves (Islami, Muhammad 2013; Perrett et al. 2021) at Sowan beach.

Bivalves are marine biota that is widely used by the community in Sowan Village as a source of food. The Bivalvia class is a soft-shelled animal from the Phylum Mollusca that lives in the sea and estuaries (Ambarwati, Faizah, and Trimulyono 2016). Bivalvia or Pelecypoda comes from the words *bi* (two) and *valve* (pole). So, the meaning of Bivalvia is a soft-bodied animal and has two graft halves. While Pelecypoda comes from two words, namely the word *pelekhis* (small ax) and *poda* (foot). So, the meaning of Pelecypoda is an animal that has flat legs like a small ax consisting of various types of shells and mussels (Fitrianti 2014; Khalil 2016).

Bivalves are one of the macrozoobenthos of the most important group of organisms (Bódis et al. 2014; Pratiwi, Fachrul, and Hendrawan 2020). This is because the group of organisms has a function as an indicator of the quality of water which makes the community has a high diversity (Belal 2019; Mariné Oliveira et al. 2016; Reyna et al. 2019). Besides, Bivalvia is a filter feeder that is useful for increasing water clarity (McLeod et al. 2019; Quinn 2014). Therefore, Bivalves have a very important role ecologically to maintain stability and a natural source of food for organisms in the water. Economically, Bivalvia can be sold or consumed as a side dish (Aru et al. 2018; Smaal et al. 2018). Bivalves can live in freshwater, estuary, and marine waters and have the characteristics of living by immersing themselves and attaching to the substrate (Canesi and Pruzzo 2016; Thorp and Rogers 2015; Zia Ulmaula, Syahrul Purnawan 2016). The abundance of Bivalves is influenced by environmental conditions, availability of food, and competition (López-Rocha et al. 2020). However, the abundance of Bivalves can decrease due to human activity in overexploiting shellfish which results in changes in shellfish populations (Brown et al. 2020; Silva-Cavalcanti et al. 2017). Damage to the marine ecosystem can result in a decrease in the population of organisms that inhabit these habitats, especially Bivalves (Samir, Nurgayah, and Ketjulan 2016).

The increasing number of residents and tourists on Sowan Beach will cause pressure on biological natural resources, one example is the diversity of Bivalves. Bivalves are important as one of the biological resources that are often used by the community in Sowan Village for consumption. The high level of human activity around this aquatic

environment can affect water quality which results in the diversity of Bivalves in these waters (Budi, Suryono, and Ario 2013). Good seawater quality can be known the level of seawater transparency, if the water transparency level is low in normal weather it can indicate that a large number of suspended marine organisms (Hamuna et al. 2018; Katili, Koroy, and Lukman 2020).

So far, Sowan beach has been widely used by the community, in terms of water quality, exploitation of shells, and tourist objects, but the diversity is not yet known. Unfortunately, there are no studies related to the abundance and diversity of Bivalves. Even though this information on the diversity of Bivalves is very important to know the quality of these waters, especially when it has been used as a tourist attraction. So far, there is no information data regarding the types of diversity of Bivalves. Besides, community activities that exploit fish and Bivalves, environmental conditions, and water quality on Sowan Beach also affect the abundance of Bivalves. Based on these factors, it is necessary to research to know the diversity of Bivalves on Sowan Beach as a tourist attraction in Tuban Regency.

2. Research Method

2.1 Types and Research Methods

This research is a quantitative descriptive study that describes the diversity of Bivalves in Sowan Beach as a tourist attraction. This research was conducted at Sowan Beach, Bancar District, Tuban Regency on December 25, 2020, at 09.00 WIB. The method used in this research is purposive sampling conducted at two stations, the station I at Karang Beach and station II at White Sand Beach, the sampling location is shown in Fig 1.

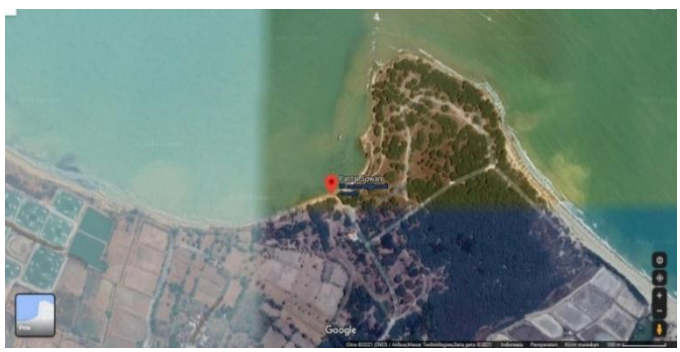

Fig 1. Map of Research Location
(Source: Google maps documentation for the map of Sowan Beach)

2.2 Research Steps

The research steps in this preparatory stage began with the field observation stage which was carried out to determine the initial state of the field conditions. This followed by determining the location of the research based on the results of the survey that has

been carried out, namely at Sowan Beach. The research location has 2 stations, namely at the station I which is on Karang Beach and sandy. Meanwhile, station II is located on the sandy White Sand Beach. The next stage is to prepare the tools used in this study in the form of writing instruments, plastic, litmus paper, salinometer, thermometer, and camera. Then proceed to the sampling stage of Bivalvia which was carried out at 2 stations, station I on Karang Beach and station II at White Sand Beach with cruising techniques. The transect is drawn perpendicularly from the shore towards the tidal zone for a length of 10 meters. The distance for each transect is 5 meters to the left and 5 meters to the right of the transect line. The distance between station transects is 20 meters

2.3 Data Collection and Analysis Techniques

Data collection in this study was carried out using an observational technique using the purposive sampling method. This observation was carried out at Sowan Beach, Tuban Regency. The data collected includes the location of the research station, the type of substrate that dominates, the date of the study, the quality of the waters, and the calculation of the number of Bivalves on Sowan Beach. Bivalve samples were taken for the identification process first cleaned of mud or dirt stuck to the shells, then put in a clear plastic bag that has been labeled according to the research location.

Bivalvia species data that have been found, can be collected, identified, and analyzed. Bivalves found at each observation station counted the number of species and individuals of each species based on abundance, diversity index, and dominance index of Bivalves to get an overview of the diversity of Bivalves at each research location station on Sowan Beach.

2.4 Species Abundance

Species abundance is the number of individuals of a species that occupy a certain area or territory (Matthews and Whittaker 2015). Species are said to be abundant when found in very large numbers compared to other individual species. To determine the abundance of Bivalves in Sowan Beach, Bancar District, Tuban Regency, use the species abundance formula from Shannon-Wienner (Odum 1996). Species abundance can be calculated by:

$$D = \left(\frac{Ni}{A}\right) \quad (1)$$

Information :
Ni = The number of individuals of one kind.
A = Sampling area (M^2).
D = Species abundance.

2.5 Diversity Analysis

Diversity is the total number of species found in a particular area (Muralikrishna and Manickam 2017). To determine the diversity of species of Bivalves in Sowan Beach, Bancar District, Tuban Regency, use the species diversity index formula from

Shannon-Wienner (Odum 1996). The diversity index shows the relationship between the number of species and the number of individuals that make up a community.

$$H' = -\sum_{i=1}^{S} \left(\frac{Ni}{N}\right) \ln \left(\frac{Ni}{N}\right) \qquad (2)$$

Information :
H' = Shannon-Wienner diversity index.
Ni = Shannon-Wienner diversity index.
N = Total number.

Based on the diversity index value by Shannon-Wienner, it can be defined as follows :Value H' > 3: The value of the species diversity index is high.

a. Value H' $1 \leq H' \geq 3$: The value of the species diversity index is moderate.
b. Value H' < 1: The value of the species diversity index is low.

2.6 Dominance Index Analysis

To find out the dominance index of Bivalvia in Sowan Beach, Bancar District, Tuban Regency, use the species dominance index formula from Simpson (Krebs 1989).

$$D = \sum (Pi)^2 \qquad (3)$$

Information :
D = Dominance index.
Pi = The proportion of the number-i to the total (Ni / N)

The range of Bivalvian dominance index values is between 0-1, which is categorized based on the dominance index criteria value of Simpson (C), which is as follows:

$0.00 < C \leq 0.50$ = Low category.
0.50 $C \leq 1.00$ = High category.

2 Result and Discussion

3.1 Result

Bivalvia Identification Results

Based on the results of the identification of Bivalves found on Sowan Beach, there were 184 individuals from 4 species. The complete types of Bivalves found on Sowan Beach are presented in Fig 2 and Table 1.

Fig 2. Types of Bivalves in Sowan Beach. Figure 2.a is a green clam (*Perna viridis*), 2.b is a tofu clam (*Meretrix meretrix*), 2.c is a shellfish (*Polymesoda erosa*), and 2.d is a blood clam (*Anadara granosa*) (Source: Personal Documentation)

Table 1. Results of the Identification of Bivalves

No.	Species	Station		Number of Species / Individuals
		I	II	
1.	*Perna viridis*	0	10	10
2.	*Meretrix meretrix*	0	28	28
3.	*Polymesoda erosa*	25	35	60
4.	*Anadara granosa*	55	31	86
Total number		80	104	184

Information : 0 = Not found

The Abundance of Bivalvian Species (Table 2)

The average abundance of Bivalves at the two stations varies. This is because the high and low abundance of Bivalves are influenced by environmental factors around them (Ramadhaniaty et al. 2021).

Table 2. Bivalve Species Abundance Identification Results

No.	Species	Station		Number of Species Abundance
		I	II	
1.	*Perna viridis*	0	1	0.1
2.	*Meretrix meretrix*	0	2,8	0.28
3.	*Polymesoda erosa*	2,5	3,5	0.60
4.	*Anadara granosa*	5,5	3,1	0.86
Total number		8	10,4	1,84

Information : 0 = Not Found

Bivalvian Species Diversity Index (Table 3)

Diversity index describes the balance of the ecosystem, the higher the diversity index value, the water quality is very good for use as Bivalvia growth (Ulfah et al. 2019).

Table 3. Bivalve Species Diversity Index Results

No.	Species	Station		Total Species Diversity Index
		I	II	
1.	*Perna viridis*	0	0,22	0,22
2.	*Meretrix meretrix*	0	0,35	0,35
3.	*Polymesoda erosa*	0,36	0,36	0,72
4.	*Anadara granosa*	0,25	0,35	0,6
Total number		0,61	1,28	1,89

Information : 0 = Not Found

Dominance Index Analysis (Table 4)

The dominance index value describes the presence or absence of Bivalvian species that dominate the area or place (Ulfah et al. 2019)..

Table 4. Bivalve Dominance Index Analysis Results

No.	Species	Station		Total Species Dominance Index
		I	II	
1.	*Perna viridis*	0	0,0081	0,0081
2.	*Meretrix meretrix*	0	0,0676	0,0676
3.	*Polymesoda erosa*	0,0961	0,1089	0,205
4.	*Anadara granosa*	0,4624	0,0841	0,5465
Total number		0,5585	0,2687	0,8272

Information :0 = Not found

Water Environment Parameters (Table 5)

Measurement of physical and chemical parameters in the waters of Sowan Beach includes water temperature, water pH, salinity, and water transparency to determine the effect of physical and chemical factors in seawater (Saifullah et al. 2014)

Tabel 5. Chemical Physics Parameters in Sowan Beach Waters

Parameters	Station I	Stastion II	Sea Water Quality Standards for Marine Biota
Temperature	28℃	28℃	28℃ - 32℃
Salinity	27 ‰	26 ‰	33‰ - 34‰
pH	7	7	7 - 8,5
Brightness	Cloudy	Cloudy	Bright

2.2 Discussion

Based on the identification data of Bivalves at Sowan Beach, there were 184 species of Bivalvia found consisting of 4 species, namely *Perna viridis* from the Mytilidae family, *Meretrix meretrix* from the Veneridae family, *Polymesoda erosa* from the Cyrenidae family, and *Anadara granosa* from the Arcidae family. *Anadara granosa* or blood clam is a type of shellfish that has a brownish-red pigment in its flesh because

there is hemoglobin in the blood (Mitha et al. 2019). *Anadara granosa* is infauna, that is, it lives by immersing itself under the surface of the mud, has two thick white shells, and is elliptical (Hendra, Efriyeldi, and Galib 2020). These shells can live at relatively low oxygen levels (Mitha et al. 2019). *Anadara granosa* is a type of shellfish that has high economic value as a source of protein and minerals (Komala and Zahara 2021). Meanwhile *Perna viridis* is one of the shells that live in the litoral area, has a pair of oval triangular shells with growth lines on the outer shell that are clear, bluish-green (Cappenberg 2008). *Perna viridis* is a clam that is used for monitoring the marine environment because green clams live as a filter feeder that filters particles in the waters where they (Rahim, Yaqin, and Rukminasari 2020; Yap and Al-Barwani 2012). *Perna viridis* lives in estuary waters, is muddy, and has a salinity that is not too high. However, the survival of *Perna viridis* can be hampered due to environmental pollution (J.M.Vakily 1989).

Tofu shells or *Meretrix meretrix* have various colors with flat triangular shells, smooth and shiny (Indraswari, Litaay, and Soekendarsi 2014). The pattern on the outer surface of the shell with concentric parallel lines as growth lines, and likes fine sandy areas that can make digging easier when it loses water (Gifari A 2011; Indraswari, Litaay, and Soekendarsi 2014). *Meretrix meretrix* is a plankton-eating animal that lives in intertidal to subtidal areas with salinity ranging from 10-30 ppm, temperature 26℃ - 31℃, pH = 7 (A. Zhang et al. 2018; S. Zhang, Wang, and Xu 2012). The presence of *Meretrix meretrix* in their habitat is decreasing due to overexploitation, while there has been no cultivation effo (Boominathan et al. 2014). *Polymesoda erosa* is a type of shellfish that lives by immersing itself in the bottom of the water (Rizal 2016). This shell has a white, rounded triangle-like shell shape and a dorsal hinge has a hinge on both sides (Kadarsah and Susilawati 2019).

Anadara granosa is the most dominant species with 86 species of all Bivalves. At Station I, the most abundant Anadara granosa from the Arcidae family is found, with a total of 55. Meanwhile, at station II, *Polymesoda erosa* from the Cyrenidae family was mostly found. The high number of individuals and abundance of *Anadara granosa* and *Polymesoda erosa* species because these species can adapt to their habitat conditions on Sowan Beach which are dominated by sandy and rocky substrates. *Anadara granosa*, including species that generally inhabit soft substrates (Karnisa, Desrina, and Widowati 2019). *Anadara granosa* is one of the Bivalvia class biotas that lives in the sea and is found at the bottom of muddy or sandy waters (Yona et al. 2020). Research results from (Baderan, Hamidun, and Farid n.d.; Yulinda, Saad, and Yusuf 2020) stated that several species from the Bivalvian class such as *Anadara granosa* were found on muddy sand substrates because they contain organic matter. This is consistent with the *Anadara granosa* habitat at station I on Sowan Beach. *Polymesoda erosa* lives on substrates that are capable of storing more oxygen and nutrients (Bay 2013). The bottom substrate at Sowan Beach with sandy characters can support *Anadara granosa* and *Polymesoda erosa.* Both of these species prefer sandy habitats for food and reproductive needs. According to Sutriyah (Sutriyah 2015) in general, Bivalvia's ability to hold circulation is by knowing body size. Meanwhile, in determining the presence of Bivalves, namely by knowing the organic material and texture of the Bivalvia substrate. Observation of the substrate in the research location was carried out visually. Station I has a sandy and rocky substrate. Meanwhile, station II has a sandy substrate. So that the *Polymesoda erosa* and *Anadara granosa* species are more dominant. Environmental

factors such as water temperature, salinity, pH, and Basic Substrate Will Affect The High And Low Abundance Of An Organism Such As Bivalves (Samsi et al. 2018).

Based on the calculation of the abundance of Bivalves found on Sowan Beach, the abundance index value of Bivalvia species is that there are 1.84 individuals from 4 species. Table 2 shows that the abundance value of Bivalvia species at station 1 is 8 with the most abundant, namely *Anadara granosa* species amounting to 5.5, where each type has a different abundance. *Perna viridis* amounted to 0, *Meretrix meretrix* amounted to 0, and *Polymesoda erosa* amounted to 2.5. At station 2 there were 10.4 species with the highest abundance, namely *Polymesoda erosa* with 3.5, while in other species such as *Perna viridis* amounting to 1, *Meretrix meretrix* amounting to 2.8, and *Anadara granosa* amounting to 3.1. This is because it is influenced by the substrate. Be it in or running water, the basic substrate is a very important component for Bivalves. Based on the results of the study, it was shown that the abundance of species obtained was low, so species diversity decreased. A community is stated to have high diversity if the community is composed of many species with the same species abundance (Yeom and Kim 2011). Conversely, if a community has a dominant species with a small number of species, the species diversity is low (Yeom and Kim 2011).

Based on the results of the assessment of the diversity index of Bivalvia species found in Sowan Beach, it is 1.89. Table 3 shows that the calculation results of the Bivalvia species diversity index show that station I has a value of 0.61. Station II has a diversity index of 1.28 which is the highest value. The highest Bivalvian species diversity index at station I was *Polymesoda erosa* with a total of 0.36. While *Perna viridis* amounted to 0, *Meretrix meretrix* amounted to 0, and *Anadara granosa* amounted to 0.25. At station II which has the highest diversity index of Bivalvian species, *Polymesoda erosa* is 0.36. Meanwhile, *Perna viridis* amounted to 0.22, *Meretrix meretrix* amounted to 0.35, *Anadara granosa* amounted to 0.35. So, at a station I the diversity index is low. Meanwhile, the diversity index value at station II was moderate. The low diversity index of Bivalves is caused by limiting factors that are intolerant of the aquatic environment due to human activities so that water quality decreases and results in Bivalvian species (Pawar, Rahman, and Al 2017; Susetya et al. 2018). Diversity index can be used to determine the stability of a community. Besides, several factors influence the high and low value of species diversity, among others, the number of species found, the species found more than the number of other individual species, the condition of the substrate, and the habitat of the species found (Lawrence et al. 2018; Rybicki, Abrego, and Ovaskainen 2020). Meanwhile, according to Odum (1993) and Clark, (1974) in Kisman et al. (Kisman, Ramadhan, and Djirimu 2016), species diversity is not only determined by the number of species found, but also by the nature of the community due to the large variety of species, habitat stability and evenness and abundance of individuals of each species in a community. Therefore, if the conditions of habitat are getting better, the variety of species and the richness of the biota will be greater. Conversely, diversity tends to diminish in oppressed or unstable biotic communities (Sasmita Anggun 2014).

Species diversity is not a synonym for many types, but rather a community trait based on the evenness and abundance of species (Kasmaruddin 2017). Diversity indicates that there are variations between species that exist in an ecosystem. If an ecosystem has a high enough diversity index value, it means that the ecosystem is already in balance. However, if the diversity index value in an ecosystem is low, then

the ecosystem is under pressure by external and internal factors (Daly, Baetens, and De Baets 2018). Based on the calculation of the Bivalvia diversity index value in Table 3, the diversity of Bivalvian species on Sowan Beach is classified as not good enough, because the diversity index value is low-moderate, indicating that the quality of waters and the abundance of biota on Sowan Beach are indicated by several factors, especially activity people on Sowan Beach. According to Odum, (1994) in Kisman (Kisman, Ramadhan, and Djirimu 2016), the diversity index value is low, resulting in low Bivalvian species in terms of survival and reproductive success.

Furthermore, based on the dominance index value (C) of Bivalvia in Sowan Beach, which is 0.8272 (Table 4). By the Simpson Krebs dominance index category index, 1989 in Patty and Rifai (Patty and Rifai 2013), at station I the value is 0.5585, while at station II the value is 0.2687. Then the value is included in the low-medium category. Dominance index values ranged from 0-1. if the value is close to 0, then no species will dominate or the community is in a stable condition. If the index value is close to 1, it means that there is a type that dominates (Pratiwi, Fachrul, and Hendrawan 2020). The ability to survive that is tolerant of the environment causes certain families to dominate. The existence of certain species dominance indicates that all Bivalvian species have differences in terms of adaptation and ability to survive in a certain place (Septiana 2018). This can confirm that the environmental conditions on Sowan Beach, the quality of the environment are not stable enough for the survival of all types of Bivalves in Sowan Beach.

The results of environmental parameter measurements show that the value of water temperature at the two stations is the same namely 28℃, this is by the opinion of Nasir Sudirman (Semeidi Husrin 2019), that the optimum temperature for Bivalvia ranges from 28℃-31°C. This means that the temperature at both stations can still support the life of Bivalves on Sowan Beach. Temperature can affect the activities of organisms such as growth, metabolism, and even cause the death of organisms (Islami, Muhammad 2013). The salinity obtained at the station I is 27 ‰, while station II is 26 ‰. By the opinion of Nasir Sudirman (Semeidi Husrin 2019) that the common salinity for marine life ranges from 33‰-34‰. This means that the salinity values at the two stations are not good enough in the life of Bivalves. Salinity can influence production, distribution, length of life, and migration orientation (Islami, Muhammad 2013). The pH of the water obtained at the two stations is the same, namely 7. By the opinion of Nasir Sudirman (Semeidi Husrin 2019) the pH range of water that supports the life of Bivalves ranges from 7-8,5. This means that the pH value at both stations can support the life of Bivalves on Sowan Beach. Meanwhile, the brightness of the seawater at the two stations on Sowan Beach is classified as cloudy. This means that the waters on Sowan Beach are not suitable for the life of Bivalves. High brightness indicates low suspended particles in the water, while low brightness indicates high suspended particles in the water (Malik 2013).

3 Conclusion

There are 184 types of bivalves found on Sowan Beach, consisting of 4 species, *Perna viridis* from the Mytilidae Famili, *Meretrix meretrix* from the Veneridae Famili, *Polymesoda erosa* from the Cyrenidae Famili, and *Anadara granosa* from the Arcidae Famili. The species mostly found were *Anadara granosa* and *Polymesoda erosa.* Based

on the abundance value, the diversity index and species dominance are low which indicates that the tourist attraction on Sowan Beach has water quality that is not good enough to support the breeding of Bivalves. So, the need to maintain and pay more attention to Sowan Beach so that it becomes a beach that is maintained its sustainability. To explore more detailed information about the diversity of marine biota on Sowan Beach, further research is needed to determine the diversity of biota and water quality in Sowan Beach.

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