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Diversity of molluscs in the mangrove forest area of Cengkrong Beach-Trenggalek

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Abstract. Research on the study of the diversity of molluscs in the mangrove forest area of Cengkrong Beach – Trenggalek has an important role in knowing the decline in the ecological function of mangrove forests due too exploitation. Exploitation that occurs is illegal logging of mangrove trees. The purpose of this study was to analyze environmental conditions through physic-chemical parameters, analyze the relationship between environmental conditions and the diversity of molluscs in the mangrove forest Cengkrong Beach- Trenggalek. Sampling was carried out at three stations with 27 plots. Sampling using purposive sampling technique with the belt transect method then measures environmental conditions. Data analysis using regression test. The results showed that the conditions of pH, temperature, salinity were normal. The diversity of molluscs found was 13 species consisting of 11 species from the Gastropoda class and 2 species from the Bivalvia class. Furthermore, there is a significant relationship between environmental conditions and the diversity of molluscs.

Keywords: Diversity, mangrove forest, molluscs

INTRODUCTION

The role of mangroves to maintain the balance of coastal ecosystems has been widely explored by researchers [1–3]. The unique characteristics possessed by mangrove ecosystems have a large impact on the surrounding ecological functions. Tolerance of high salinity conditions causes mangroves to become suitable places for the function of phytoremediation, conservation [4,5], and reproduction of several marine biota [6–8]. Some other researchers also report that mangrove ecosystems have high productivity due to the abundant amount of detritus [3,9,10]. However, some people do not yet know the important role of mangrove ecosystems, so they tend to do destructive and counterproductive actions [11,12].

Damage and decline in mangrove function is reported to occur in almost all coastal areas in Indonesia starting from the Sumatran coast [13,14], Sulawesi [12], Bali [15], and Java [6,16,17]. Much of the damage has been caused by the high exploitation of mangrove areas, including illegal logging [12]. According to a report from the Marine and Fisheries Service (2016); [18] exploitation in the Cengkrong Beach - Trenggalek coastal area resulted in 5 hectares of mangrove forest experiencing heavy damage, while the other 32 hectares suffered minor damage. This damage has a direct impact on the decline in the ecological function of the mangrove area and causes higher sea levels [19,20], and declining the number of species and biota populations [21].

One group of animals that are widely used as indicators of changes in the balance of the mangrove ecosystem is molluscs [20,22]. This group of soft-bodied animals plays an important role as a key organism in food webs and as a decomposer [23]. Mollucs function as predators, detritus eaters, and carcass eaters in the waters. In other words, the presence of molluscs guarantees a balance of energy flow in the ecosystem [20].

In addition to these special functions, the unique molluscs distribution characteristics are one of the reasons why many researchers use these animals as bio-indicators. Species diversity and distribution of molluscs are

closely related to the characteristics of their habitat, so that these differences can give a characteristic in displaying diversity in each region [24]. Some groups of molluscs that have been reported to be used as bio-indicators and agent for improving environmental quality is bivalve class [25] and gastropod class [26,27].

Mangrove area of Cengkrong Beach – Trenggalek has different characteristics from other regions. Substrates in this region have three different types, including clay, mud, and sandy substrates. The characteristics of these different substrates are indicated to have an impact on the diversity of molluscs in each type of substrate in particular and diversity throughout the Cengkrong beach area in general. This study aims to identify the diversity of molluscs in the Cengkrong coastal mangrove area after rehabilitation. Information from the results of this study is used as a basis for efforts to conserve mangrove areas to maintain ecosystem biodiversity.

MATERIALS AND METHODS

This descriptive study was conducted in April 2019 along the coastal mangrove area of Cengkrong – Trenggalek (FIGURE 1). Trenggalek is a regency located in East Java Province (FIGURE 2). The sampling technique used in this study was purposive sampling with the belt transect method. The research location is divided into 3 stations with an area of 50 x 10 m^2 per station. Determination of station location based on different substrate characteristics. Station 1, station 2, and station 3 has a clay, muddy sandy substrate, respectively. Each station consist of 9 plots with an area of 1 x 1 m^2. Each Gastropod and Bivalves class sample species was identified in the laboratory.

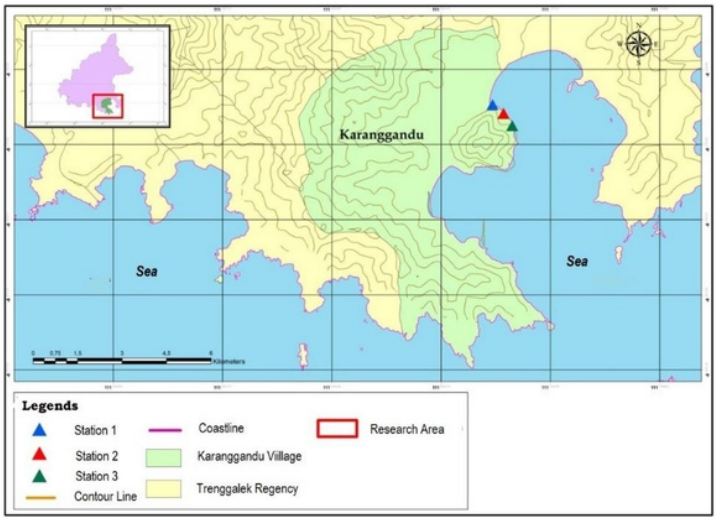

FIGURE 1. South coast of Trenggalek Regency. Insert: Research sites at Cengkrong Beach

FIGURE 2 Location of Trenggalek Regency in East Java Province [28]

Supporting research data taken includes measurements of environmental conditions through physicochemical parameters including temperature, pH, salinity, and type of substrate. Data analysis in this study consisted of: (a) calculation of Shannon-Winner diversity index, (b) Evenness index, (c) and Important Value Index (IVI).

$$H' = -\sum_{i-0}^{i} pi\ In\ pi \qquad \text{(a)}$$

Description: H' (Shannon-wiener diversity index), Ni (number of individual species i), N = total importance value/total number of all individuals), Pi (chance for each type (ni/N)), S (number of species). Diversity index criteria according to [29] consist of: high (H' > 3), moderate (1 < H' < 3), and low (H' < 1).

$$E = \frac{H\prime}{H\ maks} = \frac{H\prime}{\ln S} \qquad \text{(b)}$$

Description: E (evenness index), S (total number of species), H' (Shannon-Wiener index), H' max = ln S (maximum diversity index). Evenness index scores close to 0 indicate that organisms in the community are uneven, conversely, if the evenness index close to 1, the organisms in the community are evenly distributed [30].

$$IVI = Rdi + Rfi \qquad \text{(c)}$$

Description: IVI (important value index), Rdi (relative density of species i), Rfi (frequency of species i)

The data analysis technique used consisted of the normality assumption test and regression analysis. Kolmogorov-Smirnov normality assumption test is used to find out that the data obtained are normally distributed before being analyzed for regression. Regression analysis is used to find out how much the relationship is involved between variables.

RESULT

Measurement of environmental parameters aims to determine the environmental conditions occupied by molluscs. In addition, these measurements are used to determine the possible relationship to the Mollusk species. Based on Table 1 temperature measurements in the mangrove forest area of Cengkrong Beach-Trenggalek Regency, the results of the three stations have relatively small temperature differences. Station 1 has an average temperature of 30 0C, the average temperature of station 2 is 30 °C and station 3 has an average temperature of 31 oC. The average temperature is obtained from temperature measurements from repetitions 1, 2, and 3 stations. Based on Table 1, it can be seen that the average pH in the the mangrove forest area of Cengkrong Beach-Trenggalek Regency at stations 1 to 3 has a pH which does not differ much. At station 1 it has a pH of 6.7; station 2 ranges from 6.8; and the pH value of station 3 is 6.7. The acidity of the three stations is neutral. The results of measurements of water salinity in the mangrove forest area of Cengkrong Beach-Trenggalek Regency are presented in Table 1 known that Station 1, Station 2, and Station 3 have the same level of salinity. Station 1 has an average salinity of 30 ppm, station 2 is around 30 ppm, and at station 3 it is 30 ppm. Based on Table 4.1 shows the type of substrate found in the mangrove forest area of Cengkrong Beach-Trenggalek Regency. The type of substrate found at station 1 is clay, station 2 is muddy substrate, and station 3 is sandy mud. Determination of substrate type through Δ USDA.

TABLE 1. Hasil pengukuran factor lingkungan di setiap stasiun

Parameter	Station 1			Station 2			Station 3			Average		
	1	2	3	1	2	3	1	2	3	1	2	3
Temperature	29	30	30	30	31	30	31	31	30	30	30	31
pH	7	6,7	6,7	6,6	6,5	6,7	6,7	6,6	6,8	6,7	6,8	6,7
Salinity (ppm)	29	30	30	31	30	29	30	31	29	30	30	30
Substrate type (Δ USDA)		clay			muddy			sandy muddy			-	

Molluscs found consisted of 13 species representing 2 classes (Gastropods and Bivalves) as described in TABLE 2. There are 11 species of Gastropods, including *Rhinoclavis articulata, Cerithidea quadrata, Calliostoma olssoni, Nerita planospira, Littorina scabra, Faunus ater, Theodoxus coronatus, Cymatium*

tranquebaricum, Neritina pulligera, Natica inexpectans, and Polinices catena. The bivalve class contains 2 species, namely *Nucula sulcata* and *Lutraria lutraria*.

TABLE 2. Diversity of molluscs in the mangrove Cengkrong Beach, Trenggalek

No	Class	Species	∑ number in the station (per m2)		
			1	2	3
1	Gastropod	*R. articulata*	29	65	90
2	Gastropod	*C. quadrata*	36	14	17
3	Gastropod	*C. olssoni*	34	15	8
4	Gastropod	*N. planospira*	19	0	9
5	Gastropod	*L. scabra*	23	29	27
6	Gastropod	*F. ater*	40	42	37
7	Gastropod	*T. coronatus*	29	24	29
8	Gastropod	*C. tranquebaricum*	44	30	24
9	Gastropod	*N. pulligera*	16	61	42
10	Gastropod	*N. inexpectans*	13	15	26
11	Gastropod	*P. catena*	38	0	11
12	Bivalves	*N. sulcata*	12	5	28
13	Bivalves	*L. lutraria*	0	28	26
	Total		**333**	**337**	**374**

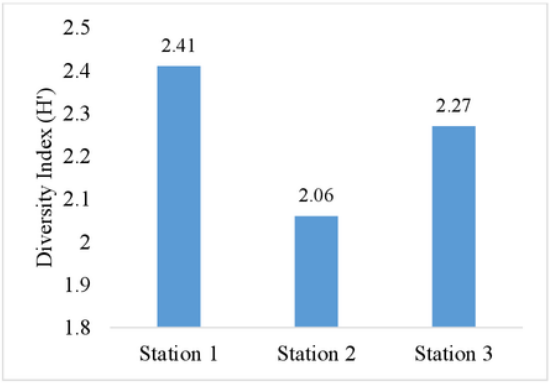

FIGURE 3. Shannon-Wiener diversity index

The Shannon-Wiener diversity index (FIGURE 3) shows that station 1, station 2 and station 3 have diversity of 2.41, 2.06 and 2.27, respectively. Thus, the diversity indexes of the three stations are classified as moderate ($1 < H' < 3$). Diversity is being influenced by adaptive environmental factors such as relatively normal temperatures and good habitat for molluscs.

The molluscs evenness index shows that the three stations are close (FIGURE 4), so it can be assumed that the molluscs evenness, in the Cengkrong Beach - Trenggalek mangrove area, is evenly distributed. These results indicate the stability of the community in a mangrove ecosystem [21].

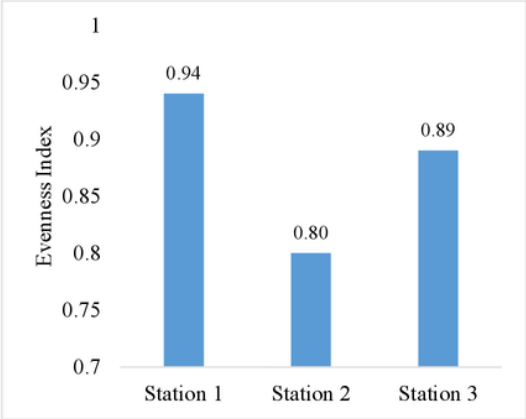

FIGURE 4. Molluscs evenness index

The importance value index at all three stations indicates the same assumptions. FIGURE 5 shows that besides *P. catena, C. tranquebaricum* and *C. quadrata* have the highest importance index. The substrate character in the form of clay becomes an adaptive place for the growth of the four species. The highest importance index at station 2 as described in FIGURE 5 is *N. Pulligera* and *R. Articulata*. Both of the species have muddy habitat preferences, so they are more adaptive and are found in station 2 which has a muddy substrate character.

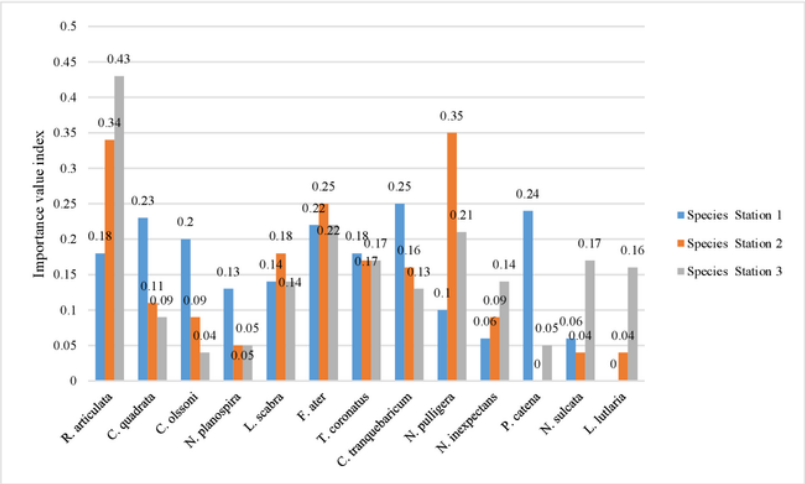

FIGURE 5. Importance value index of molluscs in station 1

DISCUSSION

The pH value at the three stations is relatively stable because it is close to neutral condition (pH 7). The range of stable pH values for mangrove areas ranges from 7 - 8.5 [31]. However, differences in pH values are caused by the content of organic and mineral matter in soil sediments and mineral content of seawater. According to De Jesus [32], a pH value of 5.5 - 6.5 is classified as less productive waters, a pH value of 6.5-7.5 is classified as productive waters, and a pH value of 7.5-8.5 is classified as waters with high productivity. The pH range of the three stations includes productive waters suitable for the habitat of aquatic organisms. Measurement through salinity parameters shows that station 1, station 2, station 3 have the same salinity level of 30 ppm. According to the Ministry of Environmental and Forestry of Indonesia [33], sea water salinity levels for mangrove biota range from 28 to 34 ppm. Patty [34] explain that Indonesian waters have a salinity of 28 - 35 ppm.

The species in the Gastropod class are more commonly found than the Bivalvia class, this is because the Gastropod can move more actively [35]. Macrofauna such as Gastropods found in mangrove forests are usually detritus eaters. Whereas Bivalves class macrofauna is a plankton eater that hovers in waters and algae [24,36]. Based on the abundance of individuals, at station 1 was 333 individuals were found, station 2 was found 337

individuals, and station 3 was found 374 individuals. The abundance of species at each station is influenced by the type of substrate that supports life. Gastropods and Bivalvia class molluscs usually live on mud or sandy muddy substrates that gather and spread.

Evenness index, according to some researchers is closely related to survival, environmental quality, and competitiveness including how the foraging process between species occurs. Thus, based on the calculation of diversity index and evenness index, the mangrove environment area in Cengkrong Beach is a suitable supporting factor for the growth of molluscs.

Diversity does not only depend on the number of species in a community, but depends on the abundance of each species [3,20,29]. In addition, the nature of the community also determines the number of species and the abundance of individuals [30]. Exploitation does not affect the environment severely because the damage does not reach half of the total mangrove forest area.

The genus *Cymatium* is one of the genera which is widely distributed in the Indo-West Pacific region [37] and includes cosmopolitan organisms, so it is relatively easy to find in almost all regions. Meanwhile, according to some studies, *C. quadrata* requires habitats with a clayey and slightly muddy character [38,39]. [39] also stated that the species lived by sticking to mangrove roots and stems to avoid the danger of tides. However, the lowest importance index at station 1 is *N. inexpectans* and *N. sulcata*. Both of them, according to [40] are adaptive gastropods living in habitats with sandy characteristics, so they are less supportive if the species lives in a clay substrate habitat.

. Species species found in Indonesian waters are also reported to be adaptive in the characteristics of brackish waters [41]. The genus Neritidae, according to also thinking about the ability of migration to meet the needs of food sources, biomechanical influences, and to avoid predators [42].

Whereas at station 3 the species that has the highest importance value index is the *R. articulata* species. *R. articulata* is a gastropod that can live on various substrates in mangrove forests ranging from muddy, sandy, and climbing on mangrove leaves [40]. Furthermore, the sandy substrate at station 3 is a supportive habitat for life. The lowest important value index is *C. olssoni* species because this species is found in many areas of coral reefs to shallow sea waters [7,10].

CONCLUSION

Environmental conditions of the research location through physical and chemical parameters show varied results from the three stations. The measurement results are classified under normal conditions for water areas and suitable for aquatic animal habitat including mollusks. The diversity of molluscs found was 13 species consisting of 11 species from the Gastropod class and 2 species from the Bivalvia class. Furthermore, there is a significant relationship between environmental conditions and the diversity of molluscs in Cengkrong Beach – Trenggalek at the East Java.

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