

Gastropod Community Structure in Mangrove Pancer Cengkong Ecosystem, Trenggalek Regency, East Java

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Abstract:- The condition of mangrove vegetation habitat determines the community structure of organisms associated with it, including gastropods. Mangrove Pancer Cengkong is located in Trenggalek Regency, which is a conservation and ecotourism area. The purpose of this study is the identification of gastropods morphologically and the abundance of gastropod species. The research was conducted in August 2024, using the survey method, at 6 research points using transects, the size transect is 10 x 10 m. Mangrove species found as many as 9 species, with mangrove density ranging from 0.038 - 0.078 ind/m². Gastropods found as many as 10 genus, consisting of Cerithidea genus, Littoraria, Faunus, Terebra, Clypeomorus, Crassispira, Nerita, Terebralia, Neritina, and Cassidula. The abundance of gastropod species ranged from 34.4 - 92.4 ind/m², with the highest abundance in the Cerithidea genus and the lowest in the Nerita and Neritina genus. The diversity index ranged from 0.84 to 1.30 (low-medium), the uniformity index ranged from 0.36 to 0.57 (low-medium), and the dominance index ranged from 0.37 to 0.60 (some points had genus dominance). Water temperature (27.2 - 28.8°C), pH (7.2 - 7.8), DO (4.48 - 5.31 mg/L), and salinity (24 - 29 ppt), water quality parameters are considered good for gastropod life. The structure of the gastropod community in the MPC ecosystem is classified as slightly unstable, because there are still several points that have low diversity and uniformity values, and there are points that have a dominance value close to the value of 1, which means there are several genus that dominate. Continuous monitoring and management of mangrove ecosystems are needed so that the gastropod community remains in a balanced condition and there is a need for efforts to utilize Cerithidea gastropods.

Keyword:- Gastropods, Habitat, Mangrove, Community Structure, Trenggalek

I. INTRODUCTION

Mangrove ecosystems in Indonesia are evenly distributed, and have many ecosystem services. Trenggalek Regency has a mangrove ecosystem area, namely Mangrove Pancer Cengkong (MPC), which is included in the conservation and ecotourism area. It was recorded that mangrove damage in this area reached 50% in 2003 [2]. Factors that are thought to affect this damage is the

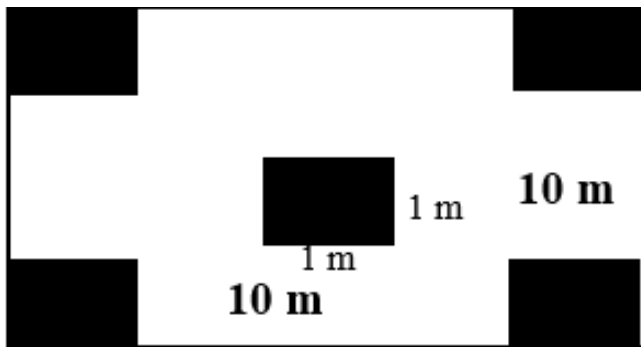
conversion of mangrove land into aquaculture ponds and plantation land by the community. Damage to mangrove ecosystems, has an impact on the disconnection of mangrove ecosystems with other ecosystems [1]. This causes a decrease in the ability of mangroves, in supporting the lives of biota that inhabit it, one of which is gastropods [3]. Gastropods in mangrove ecosystems, act as environmental bioindicators, so their existence is very important for the ecosystem [4]. Pressure caused by human activities can change habitat conditions and disrupt the survival of gastropods [5]. A decrease in gastropod density may indicate compromised ecosystem health [6]. Therefore, research on the identification and density of gastropods in mangrove ecosystems is very important to determine the environmental conditions in the Mangrove Pancer Cengkong area. The results of this study are expected to be a reference in the management and protection of mangrove ecosystem resources and the biota that inhabit it.

II. METHOD

The research was conducted at Mangrove Pancer Cengkong (MPC), Karanggandu Village, Watulimo District, Trenggalek Regency, East Java Province. The research was conducted in August 2024, method is a survey method with purposive sampling. The research location is in the form of transects totaling 6 points, where the transect size is 10 x 10 m, with 5 plots measuring 1 x 1 m. The description of each sampling point is as follows:

- Point 1, at coordinates -8.302897° N and 111.74674° E, natural mangrove area
- Point 2, at coordinates -8.296539° N and 111.70637° E, rehabilitated mangrove area.
- Point 3, at coordinates -8.296847° N and 111.706453° E, near the entrance to the ecotourism area.
- Point 4, at coordinates -8.284983° N and 111.71693° E, river estuary area.
- Point 5, at coordinates -8.303292° N and 111.70499° E.
- Point 6, at coordinates -8.302771° LS and 111.706331° E, inland mangrove zone.

➤ *Illustrates the Establishment of Sampling Transects:*



➤ *Description:*

-  = Research Transect
-  = Gastropod Collection Plot

Referring to the mangrove species guidebook. If there is any doubt during the identification process, plant parts such as leaves, flowers and fruits can be collected for further analysis.

Gastropod sampling was carried out by digging the soil to a depth of ± 10 . Next, a screening process was carried out using a multilevel sieve with sizes 4.75 mm, 2.00 mm, 1.00 mm, 100 μ m. Samples were put into a container, then given 50% alcohol as a preservative. Counting and identification of gastropod species were carried out at the Hydrobiology Laboratory, Faculty of Fisheries and Marine Science, Universitas Brawijaya. Sample identification used the book Tropical Seashells (1998) and Morris (1963).

Water quality measurements include temperature and dissolved oxygen using a DO Meter, pH using a pH meter, and salinity using a Refractometer. Determination of substrate type is done with Sieve Analysis.

➤ *Data Analysis*

Data on mangrove vegetation structure, water quality and gastropod species composition were tabulated in tables and graphs and then analyzed descriptively.

• *Mangrove Density*

Mangrove density calculation formula [7], as follows:

$$D_i = \frac{N_i}{A} \quad \dots (1)$$

$$RD_i = \frac{N_i}{\sum n} \times 100\% \quad \dots (2)$$

✓ *Description:*

- D_i = Density
- N_i = Number of individuals of species i
- A = Total area of sampling area
- Rd_i = Relative density (%)
- N_i = Number of individuals of the i th species (ind)
- $\sum n$ = Total number of individuals (ind)

• *Gastropod Diversity Index*

The following is the formula for determining Index [8]:

$$H' = - \sum p_i \ln p_i \quad \dots (3)$$

✓ *Description:*

- H' = Species Diversity Index
- P_i = Probability for each species (n_i/N)

✓ *Classification of Species Diversity:*

- Nilai $H' > 3$ = high diversity
- Nilai $H' 1 \leq H' \leq 3$ = medium species diversity
- Nilai $H' < 1$ = low diversity

• *Gastropod Species Abundance Index:*

✓ *Abundance value calculation formula:*

$$K = \frac{\text{Number of individuals of the species}}{\text{Sample plot area (m}^2\text{)}} \quad \dots (4)$$

$$KR = \frac{\text{Number of individuals of the species}}{\text{number of individuals of all species}} \quad \dots (5)$$

• *Gastropod Diversity Index (E)*

The uniformity index (E) was calculated using the Shannon Evenness Index formula :

$$E = \frac{H'}{\ln S} \quad \dots (6)$$

✓ *Description:*

- E = Uniformity index
- H' = Diversity index
- S = Number of organism species

➤ *Classification of the Species Uniformity Index:*

- $E > 0,6$ = High species uniformity
- $0,6 \geq E \geq 0,4$ = Medium species uniformity
- $E < 0,4$ = Low species uniformity

➤ *Dominance Index*

The calculation of the dominance index (D) is calculated using the Simpson Dominance Index formula as follows:

$$D = \sum \left(\frac{n_i}{n} \right)^2 \quad \dots (7)$$

✓ *Description:*

- D = Dominance index
- n_i = Number of individuals of each species
- n = Total number of individuals

➤ *Classification of Community Conditions:*

- $0 < C \leq 0,5$ = No dominance
- $0,5 < C < 1$ = There is dominance

• *Gastropod Distribution Pattern*

Gastropod Distribution patterns were calculated using the Morisita Index [9]:

$$ID = n \left(\frac{\sum x^2 - \sum xi}{(\sum xi)^2 - \sum xi} \right) \quad \dots (8)$$

✓ *Description:*

- ID = Morisity Dispersion Index
- n = Total number of quadrants
- $\sum xi$ = Total number of gastropod species
- $\sum xi^2$ = Number of i-th gastropod species

Furthermore, the calculation of chi square (x^2) with n-1 free degrees, for the significance of Morisita Index calculation, namely:

Uniformity Index:

$$Mu = \frac{x^2 0.975 - n + \sum xi}{(\sum xi) - 1} \quad \dots (9)$$

- Mu = Moricity Index for uniform distribution pattern
- Mc = Moricity Index for clustered distribution pattern
- $X^2 0.975$ = The chi square value for n-1 free degrees
- $X^2 0.025$ = The chi square value for n-1 free degrees
- Xi = Number of individuals in the plot
- n = total number of sampling plots

✓ *Determination of Gastropod Dispersal Patterns:*

- $Id > 1$ = clustered
- $Id < 1$ = same nature
- $Id = 1$ = random

III. RESULT AND DISCUSSION

A. *Mangrove Vegetation Structure*

Mangrove species found totaled 199 individuals, including *Avicennia alba*, *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Sonneratia alba*, *Sonneratia caseolaris*, *Aegiceras floridum*, *Ceriops tagal*, and *Avicennia marina*. The highest amount of vegetation was found at Point 4 with a total of 47 individuals, while the lowest was at Point 6 with 23 individuals. *Rhizophora apiculata* species were found most at Point 3, and *Aegiceras floridum* was found least at Point 2. The large number of *Rhizophora apiculata* species found, can be influenced by mangrove rehabilitation activities carried out in dominated by this species, so the number is more than other species.

B. *Mangrove Density*

The highest mangrove species density was found at Point 4 at 0.078 ind/m², followed by Point 1 at 0.063 ind/m², and the lowest at Point 6 at 0.038 ind/m² (Table 1). The highest species density by *Rhizophora apiculata* species and the lowest by *Bruguiera gymnorrhiza* species. Mangrove species at point 4 (near the estuary) and point 1, are classified

as major mangroves and natural mangroves, so the mangrove species are more heterogeneous.

Table 1: Mangrove Species Density

Point	Mangrove Density
1	0.063
2	0.060
3	0.050
4	0.078
5	0.042
6	0.038

Variations in mangrove density can be influenced by environmental conditions at the study site. In the mangrove rehabilitation zone, mangrove species tend to be more homogeneous. This condition is similar to Point 3, where mangrove stands are dominated by seedlings and saplings, with the species *Rhizophora apiculata*. The *Rhizophora* genus thrives in areas influenced by tides. The pattern of adaptation to the environment is very good, so that the seeds are easily spread, grow, and develop in the region [10].

C. *Gastropod Community Index*

Gastropod observations in Mangrove Pancer Cengkong (MPC), there are 10 genus identified, namely the genus *Cerithidea*, *Littoraria*, *Faunus*, *Tarebia*, *Clypeomorus*, *Crassispira*, *Nerita*, *Terebralia*, *Neritina* and *Cassidula*. Gastropods were highest at Point 1, with a total of 462 individuals and lowest at Point 3, with a total of 172 individuals. The *Cerithidea* genus was found the highest with a total of 1314 individuals, while the lowest was the *Terebralia* genus with 2 individuals. The difference in the number of individuals found can be influenced by environmental conditions, adaptation patterns, food sources, and individual distribution patterns [11]. Differences in density and composition of gastropod species cause the formation of gastropod zonation. The differences that occur can be caused by differences in sampling distance and environmental factors.

D. *Gastropod Abundance Index*

The results of the gastropod abundance index in the MPC, ranged from 34.4 - 92.4 ind/m². The highest abundance value was found in the *Cerithidea* genus at Point 1 at 67.6 ind/m² and the lowest was the *Nerita* genus at Point 3, *Terebralia* genus at Point 2, *Neritina* genus at Points 3 and 4, with an abundance of 0.2 ind/m² (Fig 1). The highest abundance was found in the *Cerithidea* genus, where this genus was spread across all observation points. The high abundance of the *Cerithidea* genus, because this genus belongs to the *Potamididae* family, which is a native family of mangrove forest dwellers.

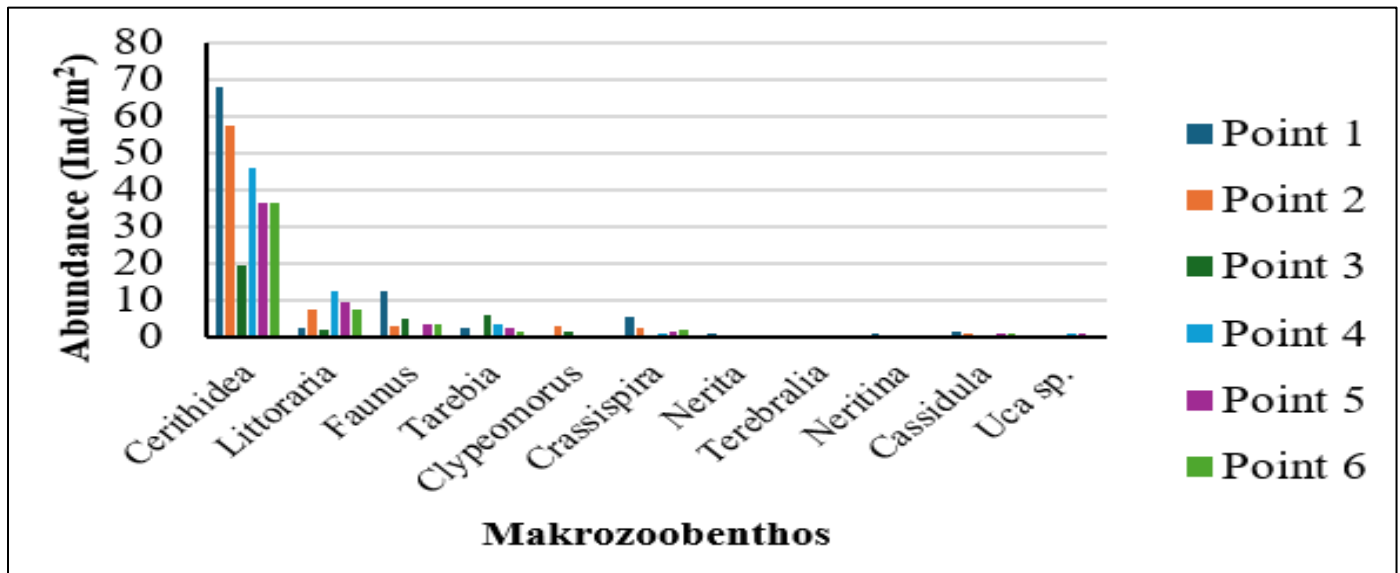


Fig 1: Gastropod Abundance Index

The high abundance of gastropods at Point 1 is positively correlated with the high mangrove density at Point 1. This is because high mangrove density will affect the availability of food sources [12]. The low abundance of the genus *Nerita* and *Neritina*, may be influenced by the factor that this genus is a visitor gastropod group in mangrove ecosystems [13].

E. Gastropod Diversity Index

The results of the diversity index (H') of gastropods, ranged from 0.84 - 1.30. The highest diversity index value was at Point 3 with a value of 1.30 (medium category). The lowest diversity index value was at Point 4 and 5 with a value of 0.84 (Fig 2).

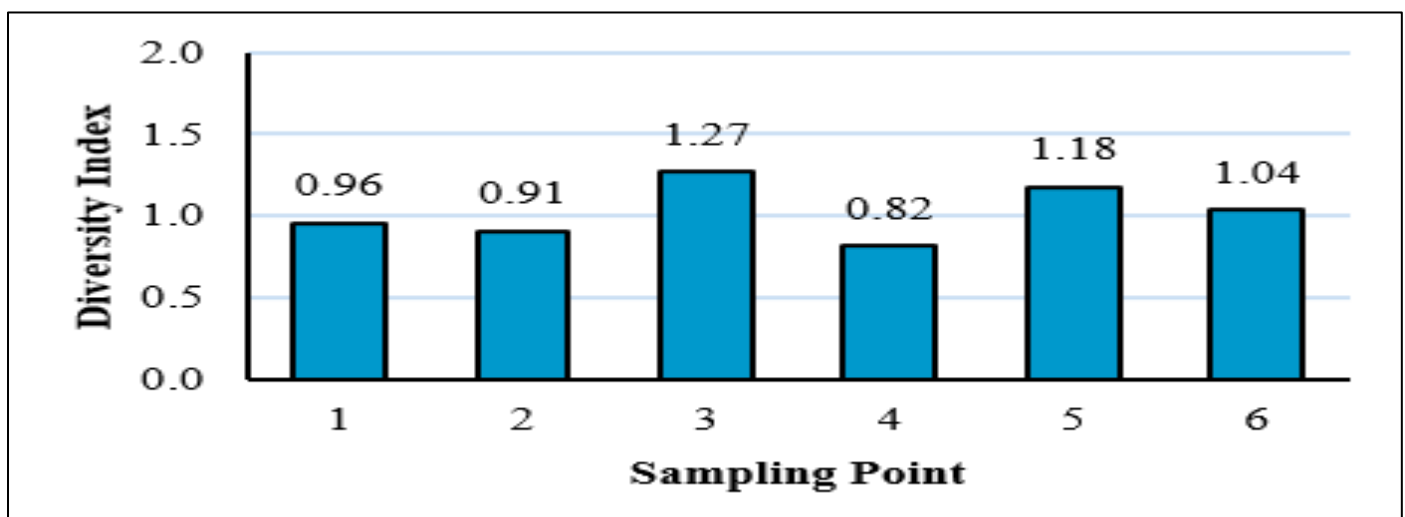


Fig 2: Gastropod Diversity Index

The high diversity index value at Point 3 can be influenced by the number of species and species distribution. Low species similarity and few species population values are some of the factors that can affect the low value of the diversity index in an ecosystem [14]. A community can be said to have high species diversity if it is composed of many species with the same or almost the same abundance. Conversely, if it is composed of a few species and only a few

species dominate, then the community is said to have low species diversity [15].

F. Gastropod Uniformity Index

The value of Diversity Index (E) of gastropods in Mangrove Pancer Cengkong ranges from 0.36 - 0.57. The highest uniformity index value is found at Point 3 with a value of 0.57 (medium category). The lowest uniformity index value is found at Point 4 and 5 with a value of 0.36 (Fig 3).

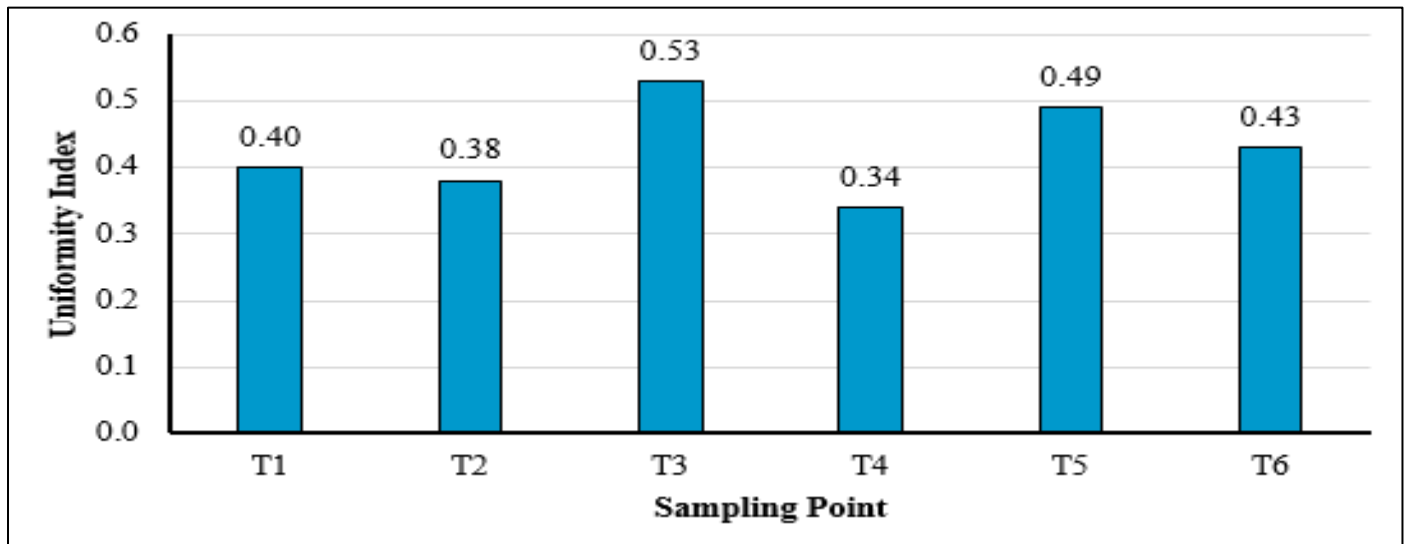


Fig 3: Gastropod Uniformity Index

The low uniformity index of gastropods, in the range of $0.00 < E < 0.50$, reflects that the community is under stress. The highest uniformity index value is found at Point 3 with a value of 0.57. Although it has the highest value of all observation points, the uniformity index at Point 3 is classified as moderate. The lowest uniformity index values were found at Points 4 and 5 with a value of 0.36. A uniformity index that reaches 1.00, indicates that the organisms in the ecosystem have the same number and type of organism [16]. This condition is caused by an environmental imbalance that

makes one species more dominant. High uniformity reflects an ecosystem that supports a variety of species in a balanced manner [17].

G. Gastropod Dominance Index

The Dominance Index (C) value of gastropods in Mangrove Pancer Cengkrong ranged from 0.37 - 0.60 (Fig 4). The highest gastropod dominance index was found at Point 2 at 0.60 (there is species dominance), while the lowest was at Point 3 at 0.37 (no species dominance).

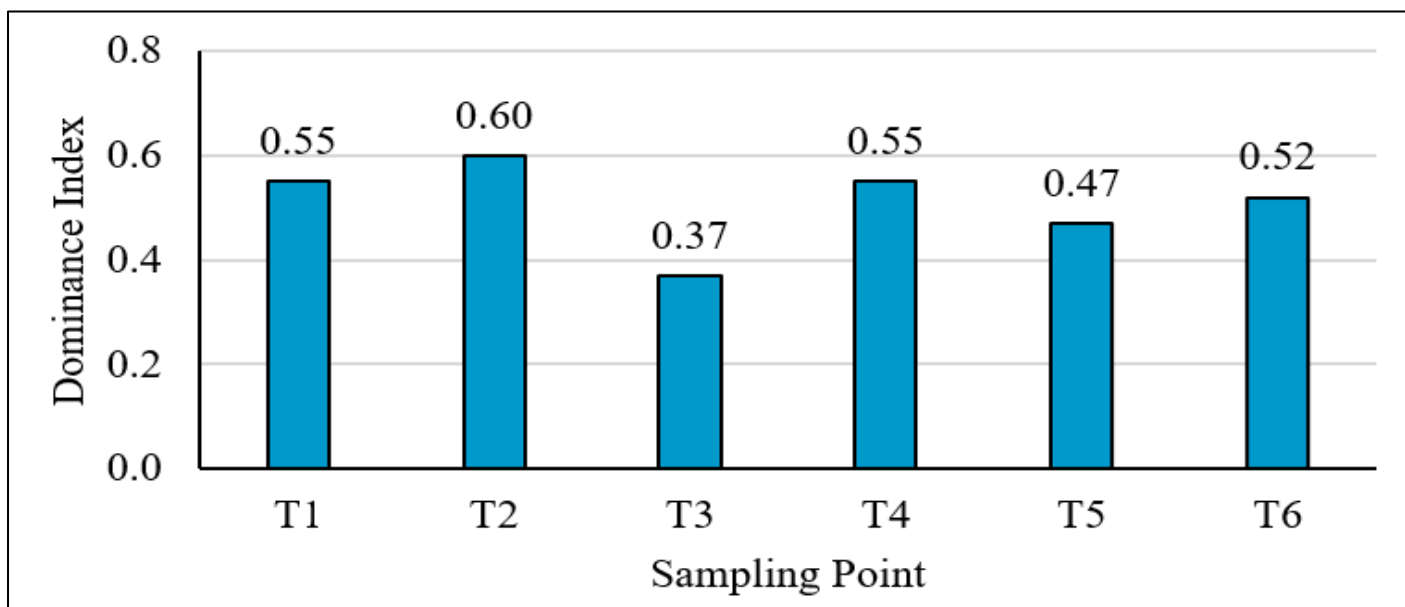


Fig 4: Gastropod Dominance Index

The highest gastropod dominance index was found at Point 2 at 0.60, while the lowest was at Point 3 at 0.37. The dominance index category at point 2 is included in the category of dominant species. The lowest dominance index value is found at point 3, with a value of 0.37. This value indicates that at point 3, the dominance index value is included in the category of no species dominance [18]. Generally, a low dominance index value will always be

followed by a high uniformity index. This correlates with the uniformity index value found at point 3. In accordance with the statement that the high and low dominance index values are interrelated with the uniformity index value. A low dominance index value states that there is no dominating species [19].

H. Gastropod Distribution Patterns

The distribution pattern of gastropods found in the Pancer Cengkong Mangrove ecosystem is random and

group. There is 1 genus with random distribution and 9 genus with group distribution pattern (Table 2).

Table 2: Gastropod Distribution Pattern

No	Genus	Ip	Distribution Pattern
1.	Cerithidea	0	Random
2.	Littoraria	1	Group
3.	Faunus	1	Group
4.	Tarebia	1	Group
5.	Clypeomorus	1	Group
6.	Crassispira	1	Group
7.	Nerita	1	Group
8.	Terebralia	1	Group
9.	Neritina	1	Group
10.	Cassidula	1	Group

The Cerithidea genus with a random distribution pattern, it can be said that this genus has a high adaptability to various environmental conditions. In this study, the genus found clustered, tending to be found only at certain points. The existence of a clustered distribution pattern is a natural thing that occurs in nature, where there is a collection of individuals at a certain point. This can occur because the form of adaptation in each genus is different to environmental changes [20].

I. Substrate Type

Substrate type affects gastropods in mangrove ecosystems [21]. In this study, the substrate type at points 1, 2, and 3, had a sandy clay loam substrate texture, while at points 4, 5, and 6, had a sandy loam substrate texture. The sandy clay loam substrate type, showed the highest abundance of gastropod species and higher mangrove density compared to other points. Substrates dominated by sand tended to have lower gastropod species, except at point 4 which is located in the estuary area.

J. Water Quality

The results of the measurement of water temperature parameters, ranging from 27.2 - 28.8 °C. The highest temperature was found at Point 4, 28.8 °C and the lowest at Point 2 and Point 5, 27.2 °C. Water temperature is influenced by the time of measurement and vegetation cover. The optimum temperature for gastropod life is 28 – 32 °C [22].

The results of measuring the pH parameter at each point, namely point 1 has a pH value of 7.5, point 2 7.3, point 3 7.2, point 4 7.8, point 5 7.6, and point 6 is 7.5. The pH value obtained during the study, in general according to, in accordance with the quality standards for gastropod growth, which is 7 - 8.5.

Dissolved oxygen (DO) values ranged from 4.48 - 5.31 mg/L. The highest DO value was found at Point 4 with a value of 5.31 mg/L and the lowest at point 2 with a value of 4.48 mg/L. Good dissolved oxygen levels for biota growth are around >5 mg/L [23].

Salinity values ranged from 24 - 29 ppt. The highest salinity was found at Point 4, which was 29 ppt, and relatively the same at Points 1, 2, and 3, which were 24 ppt. The high salinity at Point 4 was influenced by the measurement location at the mouth of the river, so the salinity value was higher than other points. The quality standard of salinity for gastropod life ranges from 25-40 ppt [24].

IV. CONCLUSION

The structure of the gastropod community in the Pancer Cengkong Mangrove ecosystem includes 10 genera with species abundance ranging from 0.2 - 67.6 ind/m². Diversity and uniformity indices were at low - medium levels, while the dominance index showed the dominance of the Cerithidea genus at Point 3. Water quality parameters, such as temperature, pH, DO, and salinity, support the life of gastropods in this ecosystem. Continuous monitoring and ecosystem management are needed to maintain the stability of the gastropod community in a sustainable manner.

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