THE INFLUENCE OF ENVIRONMENTAL FACTORS TO MOLLUSCS DISTRIBUTION PATTERNS IN NATURAL AND REHABILITATED MANGROVE ECOSYSTEM

PENGARUH FAKTOR LINGKUNGAN TERHADAP POLA PENYEBARAN MOLUSKA PADA EKOSISTEM MANGROVE ALAMI DAN HASIL REHABILITASI

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ABSTRAK

Ekosistem mangrove merupakan habitat Moluska (Gastropoda dan Bivalvia). Ekosistem ini selalu dipengaruhi oleh faktor lingkungan. Penelitian ini bertujuan untuk mengetahui pengaruh faktor lingkungan terhadap pola distribusi pada ekosistem mangrove alami di Pulau Pannikiang, Kabupaten Barru dan ekosistem mangrove hasil rehabilitasi di Desa Tongke-tongke, Kabupaten Sinjai. Penelitian ini menggunakan metode kuantitatif. Faktor lingkungan yang diukur adalah suhu dan salinita air, serta kandungan karbon dan nitrogen sedimen. Sampel Moluska (Gastropoda dan Bivalvia) dan sedimen diambil secara acak. Pengamatan komunitas Moluska meliputi komposisi jenis Moluska (Gastropoda dan Bivalvia) dan pola penyebaran. Data dianalisis dengan menggunakan regresi linear berganda. Hasil penelitian menunjukkan pola distribusi Moluska (Gastropoda dan Bivalvia) pada kedua lokasi tidak berbeda nyata dan suhu, salinitas, karbon, dan nitrogen sedimen juga tidak mempengaruhi pola distribusi Moluska di kedua lokasi penelitian.

Kata kunci *: faktor lingkungan, moluska, pola penyebaran, mangrove*

ABSTRACT

Mangrove ecosystem is a habitat of Molluscs (Gastropoda and Bivalvia). This ecosystem is always influenced by environmental factors. This study aims to determine the influence of environmental factors on the distribution patterns Molluscs of natural mangrove ecosystems in Pannikiang Island, Barru Regency and rehabilitation mangrove ecosystem in Tongke-tongke village, Sinjai regency. This research uses the quantitative method. Environmental factors measured were temperature and salinity of the water, as well as carbon and nitrogen content of sediment. Samples of Molluscs (Gastropoda and Bivalves) and sediments were taken randomly. The observations of the Molluscan community include the composition of Mollusc species (Gastropoda and Bivalvia) and dispersal patterns. Data were analyzed by using multiple linear regression. The results showed that the distribution pattern of Molluscs (Gastropoda and Bivalvia) at both sites was not significantly different and the temperature, salinity, carbon, and nitrogen sediments also did not affect the Mollusk distribution pattern in both sites.

Keywords: Environmental Factors, Molluscs, Distribution Patterns, Mangroves

INTRODUCTION

Mangrove forests have a number of ecosystem services and functions (Nagelkerken et al., 2008; Lee, 2008; Rahman, Yanuarita, & Nurdin, 2014). Mangrove forests play a key role in nutrient cycles in coastal and global carbon ecosystems and have been shown to play a role as a source of nutrients (Kristensen, Bouillon, Dittmar, & Marchand, 2008). Carbon cycle cycling and other processes in mangrove forests assist in providing ecosystem services such as fish, shrimp, and crab breeding areas (Sheridan et al., 2003; Nagelkerken et al., 2008). The many advantages that can be obtained from mangroves that encourage people to exploit the ecosystem.

The location of the rehabilitated mangrove ecosystem is located in Tongke-tongke village, Sinjai district. This location is the result of rehabilitation carried out independently by the community and through the reforestation program on natural mangrove forest area that has been damaged due to converted into farm and settlement area in the area (Ernawati, Niartiningsih, Nessa, & Andy Omar, 2013). Pannikiang Island, Barru Regency is one example of the natural mangrove ecosystem in South Sulawesi. The mangrove cover area in Pannikiang Island reaches 89.01 hectares or reaches 87.45% of the land on the island. The types of mangroves and macrofauna that live on Pannikiang Island are very diverse (Amran, Yasir, Hamzah, Selamat, & Niartiningsih, 2012).

There are many factors that affect the mangrove ecosystem such as salinity (salinity), flow, pH (acidity), exposure to waves, substrates, and so on. There are several studies that have found linkages of environmental factors to macrozoobenthos (Samsi, Andy Omar, & Niartiningsih, 2016). Gastropods and Bivalves are important for research because they are settled in a place (Samsi, Litaay, & Soekendarsi, 2012). Based on the above description and still lack of information about the influence of environmental factors on the distribution pattern and specific species of Molluscs, it is

necessary to do this research. This study aims to determine the influence of environmental factors on the pattern of distribution of mollusks in natural mangrove ecosystems in Pannikiang Island, Barru Regency and rehabilitation mangrove ecosystem in Tongke-tongke village, Sinjai regency.

METHODS OF STUDY

Time and Place

Research location at rehabilitation mangrove area in Tongke-tongke village, East Sinjai district, Sinjai regency is 5 ° 8'54.55"S and 120 ° 16'15.95"E while natural mangrove located in Pannikiang Island, Barru regency is 4 ° 21'5.11 " and 119 ° 36'1.31"E from May to July 2014.

Materials and Methods

The study population is the community of mangrove vegetation and the community of Gastropoda and Bivalvia associated with mangrove. In addition, salinity, pH, temperature, organic carbon content, nitrogen and sediment texture are also research objects. Samples of mangrove vegetation, Gastropoda, Bivalvia, and sediments were taken randomly (random).

The sampling of Gastropoda and Bivalvia is done at low tide. All samples (epifauna and infauna) contained in the observation plot (1 m x 1 m) were collected, either on the surface of the substrate or attached to the root, stem, or mangrove leaves. Sediment samples that have been taken, filtered through a sieve that has a mesh size of 2 mm. Salinity is measured using a hand-refractometer. Temperature is measured using a thermometer. The organic C content of sediment was analyzed using Walkley and Black method while the sediment nitrogen content was analyzed using the Kjeldahl method.

Data Analysis

To find out the distribution pattern of Gastropoda and Bivalvia used dispersion index was calculated using formula (Elliot, 1977):

$$Id = \frac{S^2}{\bar{x}}$$

Description: Id = Pivot index, S2 = variance, x = average value of individual.

If Id = 1.0 then the random distribution, if Id = 0 then the distribution is uniform, and if Id = n (all

individuals are in one plot or cell) then the distribution is very clustered.

To know the correlation between the density of Gastropoda and Bivalvia and environmental factors, multiple linear regression analysis (Steel & Torrie, 1993), using the following formula:

$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4$

Description: Y = Distribution patterns of Gastropoda or Bivalves, X1 = salinity, X2 = temperature, X3 = organic carbon, X4 = nitrogenous materials, a = constants

RESULTS AND DISCUSSION

The composition of Molluscs and Environmental factor

Gastropods found in natural mangrove ecosystems in Pannikiang Island have 23 species from 12 families while Bivalves are found to have 7 species from 6 families. Gastropods found in rehabilitated mangrove ecosystems in Tongke-tongke village have 18 species from 10 families while Bivalves are found to have 8 species from 7 families. The number of Gastropoda and Bivalvia species in the natural mangrove ecosystem (Pannikiang Island) and rehabilitated mangrove ecosystem (Tongke-tongke village) is not so different (Samsi, 2017).

Some studies are also similar results. Sirante (2011) found 12 species of Gastropoda from 7 families in Tongke-tongke Village. Ernawati et al. (2013) found 22 types of Gastropods from 11 families and 13 species of Bivalves from 7 families.The findings of this study have the number of types Gastropoda and Bivalvia not much different.

Gunarto (2004) has conducted a study and found 9 species of Gastropoda and 7 species of Bivalves in the mangrove ecosystem. Printrakoon & Wells (2008) also found 31 species of Gastropoda and 16 Bivalvia species. Chen, Ye, & Lu (2007) found 8 species of Gastropoda in rehabilitated mangrove ecosystems in Jiulongjiang, China. These results indicate that the number of Gastropoda species is higher than the number of Bivalves species in the mangrove ecosystem. Gastropods are found to be more abundant than Bivalves because Bivalves are sedentary and cannot move actively, so

this class has a more limited tolerance than Gastropods (Samsi et al., 2012).

The result of environmental parameter measurement in Pannikiang Island is water temperature between 27˚C to 29˚C, water salinity between 25,5 ‰ to 32 ‰, sediment carbon content between 3,94% until 14,34%, and sediment nitrogen content between 0,22% to 0.47%. The result of environmental parameter measurement in Tongke-tongke village is water temperature between 27˚C to 29,75˚C, water salinity between 12 ‰ to 27 ‰, sediment carbon content between 2,11% to 10,79%, and nitrogen content sediment between 0.09% to 0.15%.

Gastropoda and Bivalvia dispersion index

The range of Gastropoda dispersion index values in Pannikiang Island ranged from 0.009 - 0.014 whereas in Tongke-tongke village ranged from 0.011 - 0.038. The spreading pattern of Gastropoda on Pannikiang Island and Tongke-tongke Village in all research stations is random as it approaches zero. The range of Bivalvia dispersion index values on Pannikiang Island ranges from 0.017 to 2,000 whereas Tongke-tongke village ranges from 0.003 - 0.609. The distribution pattern of Bivalves on Pannikiang Island is random and clustered whereas in Tongke-tongke village in all research stations classified as random as close to zero.

The spreading pattern of Gastropoda on Pannikiang Island and Tongke-tongke Village in all research stations is random as it approaches zero. This random distribution pattern exists because of the uniformity in the environment. Gastropoda spread randomly allegedly because the food is plentiful and spread evenly. The distribution pattern of Bivalves on Pannikiang Island is random and clustered whereas in Tongke-tongke village in all research stations classified as random as close to zero. The pattern of random distribution in this group of Bivalves exists because of the uniformity in the environment. Bivalves are randomly dispersed allegedly because the food is plentiful and spread evenly on Pannikiang Island and Tongke-tongke Village. Bivalves have a dispersive pattern of clumping due to a limiting factor. One of the limiting factors is food. Bivalves are thought to be clustered because the food is uneven and clumped at a point.

Yona (2002) found out that the spread pattern of Gastropoda is spread in clumped and uniform with the value of Id $\geq$ 1 in Prapat Benoa mangrove area, Bali. Ariani (2004) obtained a pattern of distribution of Gastropoda in the mangrove ecosystem in Margasatawa asylum in Rambut Island, Jakarta, which is grouped and only type of *Terebralia sulcata* which has pattern of random distribution. When compared with the results obtained, it shows very different results with Pannikiang Island. This is due to many factors including anthropogenic disturbance in Margasatawa asylum in Rambut Island, Jakarta. Anthropogenic disturbance in Pannikiang Island is still considered to be very small and this is evidenced by the spreading pattern of Gastropoda in Pannikiang Island, which is classified as random.

Linkage of Spreading Pattern of Gastropoda and Bivalves with Environmental Factors

1. Gastropoda and Bivalvia in Natural Mangrove Ecosystem

Regression results obtained significant values above 0.05 ie α (0.484), which means carbon and nitrogen have no significant effect on the spreading pattern of Gastropoda in Pannikiang Island. The spreading pattern of Gastropoda on Pannikiang Island was allegedly influenced by environmental factors not observed in this study. Particle and food sizes are thought to have an effect on the spreading pattern of Gastropoda.

Bivalvia groups also get the same results. The significance value above 0.05 is α (0.207) which means carbon and nitrogen have no significant effect on the pattern of Bivalves distribution in Pannikiang Island. The pattern of spread of Bivalves on Pannikiang Island is thought to be influenced by environmental factors not observed in this study.

Akhrianti, Bengen, & Setyobudiandi (2014) obtained the results of research that is C-organic content, particle size, current, TSS, temperature, and salinity are the main factors limiting the distribution and density of Bivalves. Different results if compiled. The results showed that sediment carbon and nitrogen did not affect the Bivalvia distribution pattern.

Bivalves have a filter feeder method so it is suspected that Bivalves are more affected by TSS and particle size.

2. Gastropoda and Bivalvia in Mangrove Rehabilitation Ecosystem

If significant values for X1 = Temperature, X2 = Salinity, X3 = Carbon, and X4 = Nitrogen at research station are obtained significant value greater than α (0,05), meaning that all variables do not give significant effect pattern of spreading of Gastropoda on rehabilitated mangrove ecosystem in Tongke-tongke village. The pattern of spreading of Gastropoda on rehabilitated mangrove ecosystem in Tongke-tongke Village was allegedly influenced by environmental factors not observed in this study.

The same results were also found in the Bivalves group, the significant values for the variables X1 = Temperature, X2 = Salinity, X3 = Carbon, and X4 = Nitrogen at the research station were found to be significantly greater than α (0.05) gives a significant (real) effect to the pattern of Bivalves distribution on the rehabilitated mangrove ecosystem in Tongke-tongke Village. The pattern of spread of Bivalves on rehabilitated mangrove ecosystems in Tongke-tongke Village is suspected to be influenced by environmental factors not observed in this study.

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Several factors that may affect the distribution of Gastropoda and Bivalvia are mangrove density, turbidity, flow velocity, phosphate, nitrate, dissolved oxygen, and others. Chen & Ye (2011) also found a weak response between benthic and sedimentary nutrients, suggesting further research to find the factors affecting the distribution of macrobenthic fauna in rehabilitated mangroves in China. Sitorus (2008) also found a weak response about the influence of chemical physics factors on diversity and distribution of Bivalves in Labu Coastal Water.

Silaen, Hendrarto, & Supardjo (2013) suggests the distribution pattern of Gastropoda is suspected as it is influenced by mangrove vegetation that can provide a place to live as its habitat and other environmental factors. The higher the mangrove vegetation, the higher the species abundance and the individual abundance. Miralka (2006) obtained the result that the analysis of species preferences on habitat and major component analysis showed the variability of Molluscs (Gastropoda and Bivalves) caused by substrate texture.

CONCLUSION

Temperature, salinity, carbon, and sediment nitrogen do not affect the spread of mollusks (Gastropoda and Bivalves) to natural mangrove ecosystems on Pannikiang Island and to rehabilitated mangrove ecosystems in Tongke-tongke Village.

Spreading patterns of Gastropoda and Bivalvia were thought to be influenced by other factors not observed in this study. Several factors that may affect the distribution of Gastropoda and Bivalves include mangrove density, turbidity, current velocity, phosphate, nitrate, and dissolved oxygen.

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