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Analysis of Bivalvia Community Structure in The Pangkajene River Estuary, Pangkajene dan Kepulauan Regency

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Abstract

Community structure analysis is one way to describe and assess the environmental quality of an ecosystem. One part of environmental biotic that establish mangrove ecosystems is Bivalves. The mangrove area in the Pangkajene river estuary has become one of the Bivalve habitats, which has been widely used by the community. Research on the Bivalve community structure of the mangrove area in the Pangkajene river estuary was conducted in April - June 2019, which aims to get an overview of Bivalve community structure in the mangrove area of Pangkajene river estuary. The research area was divided into three estuary, each estuary was divided into two sampling areas. Sampling was carried out using a 50 x 50 cm plot method. Community structure analysis includes density, diversity index, uniformity, dominance, and distribution patterns. The results showed that the composition of Bivalve community consist of 19 species included in 12 families. The results showed that the composition of Bivalvia community consist of 19 species included in 12 families with the highest relative density, *Saccostrea sp*. with a density of 15.11 ind/m^2 (Average Relative Density 50.77%). Diversity index values in each sampling area are low and high, ranging from 0.91 to 1.91 and the value of uniformity varies with no species dominating in all sampling areas. Commonly, all species of uniform spread, except *Saccostrea sp*. with clumped distribution patterns.

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Introduction

Mangrove ecosystems are one of the coastal ecosystems that have high ecological and economic potential (Printrakoon & Temkin, 2008). One area in South Sulawesi province that has natural resource potential for coastal areas is Pangkajene dan Kepulauan Regency, in the form of mangrove ecosystems, fish ponds, coral reefs as well as diversity of fish and other marine biota species (Noveria et al., 2008). Mangrove ecosystems are dynamic ecosystems and have an important contribution to the availability of organic detritus for living things that

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live in and around them (Karimah, 2017). One of macro invertebrate who has ecological and economic value in the mangrove ecosystem is Bivalvia, which can live on the bottom of the waters.

Bivalvia is one of the members of the mollusks with a shell, which lives and obtains food by filtering (filter feeders) (Anonymous, Animal Diversity Web (ADW) and can be used as a bioindicator for changes in the quality of the aquatic environment (Odum, 1993). An analysis on a substrate or habitat can give a description of the environmental quality of waters (Athifah et al., 2019) (Wahyuni et al., 2017). Based on the description above, this research was conducted on the structure of bivalve communities in the Pangkajene river estuary, Pangkajene dan Kepulauan Regency, South Sulawesi.

Materials and Methods

Time and Place of Research

This research was done in April - June 2019, in the river estuary area of Pangkajene dan Kepulauan Regency, South Sulawesi. Data analysis was carried out at the Zoology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Makassar.

Tools and Materials

The tools used in this research were Global Positioning System (GPS), plot size of 50x50 cm, meter roll, sample bags, tweezers, trays, writing instruments, cameras, bivalvia identification books. The materials used are samples of Bivalves, formaldehyde, alcohol, and tissue.

Sampling Method

Sampling is done at three estuary, each estuary was divided into two sampling areas. between the coordinates 04 ° 49 '52.8 "LS - S. 04 ° 32" 06.5 "LS and 119 ° 29" 51.0 "East - 119 ° 30" 23.9 "East with using the plot method (Litaay et al., 2014); (Fitriana, 2006); (Suwondo et al., 2012). 50x50 cm plot size. Bivalves contained in the plot were taken and put into sample bags preserved using alcohol and formalin, then labeled plot and station numbers. The sample is then taken to the laboratory for identification.

Data Analysis

The resulting Bivalvia type of identification Data is subsequently obtained at the analysis of density, relative density, diversity index (Shanon-Wiener index), uniformity Index, dominancy Index and dissemination Analysis (Morisita index).

Species density is the total number of each species in one observation area that can be calculated with the equation (Kalidass, 2014):

$$Di : \frac{ni}{A}$$

Information :

In : Specific Density (Ind / m2)

Ni : Total number of Individual species

A : Total area of sampling plot (m^2)

The relative density value is the percentage value of the density of a species to the total density of all species, which is calculated using the formula (Heip et al., 1998):

$$RDi : \frac{ni}{N} x100\%$$

Information :

Rdi : Relative Density (%)
Ni : Total number of species (i)
N : The total number of individuals of all species

A Diversity index is used to see the relationship of species abundance with the number of individuals of each species in a community, which is calculated based on the Shannon-Wiener diversity index (Hutcheson, 1970); (Kassim et al., 2018)

$$H' = -\sum_{i=1}^{s} \left(\frac{ni}{N}\right) \ln \left(\frac{ni}{N}\right)$$

Information :

H ' : Diversity index (shanon-Wiener)
ni : Total number of species (i)
N : The total number of individuals of all species
S : Number of species found
∑ : number from species 1 to species S

The criteria for the Shanon-Wiener diversity index value is as follows (Soeparmo, 1992)

H '<1.0 : low diversity of genera or species
1.0 <H 'ک 1.5 : diversity of genera or species
1.6 ک H 'ک 2.0 : high diversity of genera or species
H '> 2 : diversity of genera or species is very high

Uniformity index is used to decide the balance of species distribution in a community. Uniformity values are calculated using the evenness index formula (Heip et al., 1998); (Okpiliya, 2012):

$$J' = \frac{H'}{\log S}$$

Information

J ' : Uniformity index
H ' : Diversity index
S : Number of species

Uniformity index values range from 0-1, with the criteria for evaluating the condition of a community as follows:

0 <J ک 0.5 : Depressed community
0.5 <J ک 0.75 : Unstable Community

0.75 <E ≤ : Stable Community

Dominance index is used to find out species who dominate in a community. Analysis of dominance index value refers to the Simpson Index formula (Kerkhoff, 2010); (Insafitri, 2010).

$$D = \sum Pi^2$$

Information

D : Dominance Index (Simpson)

Pi : ni / N

The Simpson dominance index value ranges from 0-1, with the criteria for dominance index value as follows (Odum, 1993):

0 <C ≤ 0.5 : No species dominate (stable community)

0.5 <C ≤ 1 : There is a species that dominates (unstable community)

Type Dispersion Index

Determination of personal distribution patterns of each type in a community refers to the Morisita Index with the following formula (Amaral et al., 2015); (Hayes & Castillo, 2017):

I_ (δ) = q ((x ^ 2- x) / ((x) ^ 2 - x))

Information:

I_δ : Index morisita

q : The total number of plots

x : Number of species in each plot

The criteria for determining species distribution patterns are as follows (Silveria et al., 1976):

I_ (δ) <1 : Uniform distribution pattern

I_ (δ) = 1 : Random distribution pattern

I_ (δ)> 1 : Group distribution patterns

Results and Discussion

The results of the research on the Pangkajene River estuary acquired 12 families Bivalvia, consisting of 19 types of Bivalvia community. Results of bivalve density analysis at the Pangkajene River estuary, Pangkajene dan Kepulauan regency are presented in table 1.

Table 1. Species density (ind/m^2) and relative density (%) of Bivalves at the research sampling area, at Pangkajene River Estuary, Pangkajene dan Kepulauan Regency.

No	Species	Absolute Density (Ind / m^2) (D)							Average Relative Density (%) (Rd)						
		North Estuary		Middle Estuary		South Estuary		Average	North Estuary		Middle Estuary		South Estuary		Average
		I	II	III	IV	V	VI		I	II	III	IV	V	VI	
1	*Anadara antiquata*	0.67	0	0.67	3.33	0	0	0.78	3.57	0	4	5.15	0	0	2.12
2	*Batissa violaceae*	0	0	0	0.67	0	0.67	0.22	0	0	0	1.03	0	2.7	0.62
3	*Corculum cardissa*	0	0	0	1.33	0.67	0	0.33	0	0	0	2.06	2.13	0	0.7
4	*Chlamys squamosa*	0.67	0.67	1.33	0	0	3.33	1	3.57	9.09	8	0	0	13.5	5.7
5	*Fragum unedo*	0	0	0	0.67	0	0	0.11	0	0	0	1.03	0	0	0.17
6	*Gaffarium tumidium*	3.33	0.67	1.33	2.67	0.67	0.67	1.56	17.9	9.09	8	4.12	2.13	2.7	7.32
7	*Harvella pricularia*	0	0	0	0	0.67	0	0.11	0	0	0	0	2.13	0	0.36
8	*Hiatula chinensis*	0	0	0	12	0.67	0	2.11	0	0	0	18.6	2.13	0	3.45
9	*Mactra maculata*	4.67	0	1.33	2.67	0.67	0.67	1.67	25	0	8	4.12	2.13	2.7	6.99
10	*Marcia upima*	0.67	1.33	0.67	0	0	0	0.45	3.57	18.2	4	0	0	0	4.29
11	*Meretrix meretrix*	0.67	1.33	3.33	1.33	0	0	1.11	3.57	18.2	20	2.06	0	0	7.3
12	*Pitar manillae*	0	0.67	0	1.33	0	0	0.33	0	9.09	0	2.06	0	0	1.86
13	*Pteria penguin*	0	0	0	0	0.67	0	0.11	0	0	0	0	2.13	0	0.36
14	*Saccostrea sp.*	5.33	2.67	6	34	25.3	17.3	15.1	28.6	36.4	36	52.6	80.9	70.3	50.8
15	*Scapharca sp.*	0.67	0	0	0.67	0.67	0	0.34	3.57	0	0	1.03	2.13	0	1.12
16	*Semele crenulata*	0.67	0	0	2.67	0	0	0.56	3.57	0	0	4.12	0	0	1.28
17	*Tellina timorensis*	1.33	0	2	0	0.67	1.33	0.89	7.14	0	12	0	2.13	5.41	4.45
18	*Vepricardium* sp.	0	0	0	1.33	0	0	0.22	0	0	0	2.06	0	0	0.34
19	*Trachycardium subragosum*	0	0	0	0	0.67	0.67	0.22	0	0	0	0	2.13	2.7	0.81
	Total	18.7	7.33	16.7	64.7	31.3	24.7	27.2	100	100	100	100	100	100	100

Some species such as *Gaffarium Tumidum*, *Anadara antiquate*, *Fragum unedo*, *Tellina sp*., Have been commonly found in mangrove areas (Riniatsih & Widianingsih, 2007); (Fauziani, 2017); (Islami et al., 2018). Some of these Bivalves have quite high economic values, which can increase people's income. Several types of Bivalves have been developed both for consumption, raw materials for jewelry and for raw materials for medicines (Islami et al., 2018).

The highest density of Bivalves in sampling area IV (64.7 ind/m^2) and lowest in sampling area II (7.33 ind/m^2). The highest relative density of species is *Saccostrea sp*. in the sampling area V (80.9%) and the lowest in the sampling area I (28.57%). Whereas the density of Bivalves in the middle estuary sampling area (16.7 - 64.7 ind/m^2) and lowest in the northern estuary sampling area (7.33 - 18.7 ind/m^2).

Diversity index values (H ') obtained at all sampling area ranged from 0.91 - 1.91, and for sampling areas I and IV based on diversity index criteria included high diversity criteria, while those in the V-VI sampling area included low to moderate diversity levels. The diversity value of a community describes the level of variation of species that live in an ecosystem. Ecosystems tend to be balanced if the diversity index value is high, and vice versa the ecosystem is indicated to be depressed if the diversity index value is low (Clark, 1974).

Uniformity index values close to 1.00 indicate that the number of species in one station are same, or there are no species who dominated, and if the value of J '<0.5 or close to 0, indicates that the uniformity of species is not balanced, or there are species who

dominated (Hartati & Awwaluddin, 2007). The index value of the uniformity of the Bivalve community in the Pangkajene river estuary area varies from 0.39 to 0.92. Based on the uniformity index criteria, the sampling areas I, II, and III show a stable Bivalve community (0.83 - 0.92). In the sampling areas IV and VI the Bivalve community was unstable (0.55 and 0.65), where in the sampling area V the Bivalvia community was in a depressed state (0.39). The variation in the diversity index value is thought to be due to the condition of mangroves that have experienced disturbances (pressures) due to land conversion activities being the location of community aquaculture ponds.

The result of the analysis of the index of diversity and the uniformity of Bivalves community in the estuary area of Pangkajene River, Pangkep Regency is presented in table 2.

Table 2. Diversity index (H') and Uniformity index (J') of Bivalve communities in the Pangkajene river estuary

	Sampling Area	Diversity Index (H')	Uniformity Index (J')
North Estuary	I	1.91	0.83
	II	1.64	0.92
Middle Estuary	III	1.81	0.87
	IV	1.66	0.65
South Estuary	V	0.91	0.39
	VI	1.07	0.55

The highest dominance index value was found in *Saccostrea sp.* in the sampling area III with a dominance index value of 0.135 and the lowest type of *Anadara antiquate, Scapharca sp., Semele crenulata, Marcia upima, Meretrix meretrix, Chlamys squamosal* with a dominance index value of 0.001. The overall dominance index value in the Pangkajene river estuary area ranges from 0.001-0.135, which based on the Simpson dominance index criteria (Odum, 1993) shows that there are no Bivalves that dominates in all sampling areas. A low dominance index value indicates that all Bivalves found in the sampling area have good adaptability to live in the area. According to Kharisma et al., (2012) that the depth and content of organic matter also affect the presence of Bivalves in certain waters or habitats. Furthermore, according to Islami (2013), environmental factors such as salinity and temperature have an influence on the distribution and physiological functions of Bivalves.

The results of the calculation of the mean distribution index (Id) obtained 18 species of Bivalves with the index value of the spread pattern Id <1 (Table 3), based on index morisita criteria, the distribution pattern is uniform. This shows that the Bivalve community can live in all research sampling areas or not be limited by environmental factors. *Saccostrea sp* has a distribution index value of 1.58 (Id>1) which indicates that this species has a clumped distribution pattern so that it can only live on certain substrate.

Table 3. Dominance index (D) of species and distribution patterns of Bivalve communities in the Pangkajene river estuary

No	Species	Dominance Index						Distribution Pattern
		Sampling area						
		I	II	III	IV	V	VI	
1	*Anadara antiquata*	0.001		0.017	0.023			0.17
2	*Batissa violaceae*				0.002		0.010	0.11
3	*Corculum cardissa*				0.006	0.007		0.09

No	Species	Dominance Index						Distribution Pattern
		Sampling area						
		I	II	III	IV	V	VI	
4	*Chlamys squamosa*	0.001	0.048	0.041			0.073	0.26
5	*Fragum unedo*				0.002			0.06
6	*Gaffarium tumidium*	0.032	0.048	0.041	0.017	0.007	0.010	0.19
7	*Harvella pricularia*					0.007		0.13
8	*Hiatula chinensis*				0.098	0.007		0.14
9	*Mactra maculata*	0.063		0.041	0.017	0.007	0.010	0.14
10	*Marcia upima*	0.001	0.096	0.017				0.28
11	*Meretrix meretrix*	0.001	0.096	0.104	0.006			0.16
12	*Pitar manillae*		0.048		0.006			0.30
13	*Pteria penguin*					0.007		0.13
14	*Saccostrea sp.*	0.082	0.135	0.135	0.114	0.030	0.061	1.58
15	*Scapharca sp.*	0.001			0.002	0.007		0.13
16	*Semele crenulata*	0.001			0.017			0.13
17	*Tellina timorensis*	0.005		0.065		0.007	0.025	0.16
18	*Trachycardium subragosum*					0.007	0.010	0.14
19	*Vepricardium sp.*				0.006			0.06
	Total	0.189	0.470	0.459	0.319	0.090	0.198	

Conclusions

The results obtained 19 species from 12 families that compose the Bivalvia community in the Pangkajene river estuary. The highest relative density of species is *Saccostrea* sp. Diversity index in each sampling area is low until high with the value of uniformity varies and no species dominates in all sampling areas. In general, all species spread uniformly, except *Saccostrea* sp., With clumped distribution patterns.

References

Amaral, M.K., Pellico, N.S., Lingnau, c. & Figueiredo, F.A., 2015. *Evaluation Of The Morisita Index For Determination Of The Spatial Distribution Of Species In A Fragment Of Araucaria Forest.* Applied Ecology And Environtmental Research, XIII(2), pp.361

Anonim, n.d. *Animal Diversity Web (ADW)*. [Online] Available at: https://animaldiversity.org/accounts/Bivalvia/ [Accessed 17 November 2019].

Anonim, n.d. *Worm Register Of Marine Species*. [Online] Available at: http://www.marinespecies.org/ [Accessed 1 Oktober 2019].

Athifah, M.N., Wahyudi, S.I., Edy, R. & Rohyani, I.S., 2019. *Keanekaragaman Mollusca sebagai Bioindikator Kualitas Perairan di Kawasan TPA Kebon Kongok Lombok Barat*. Jurnal Biologi Tropis, XXIX(1), pp.54-60.

Clark, K., 1974. *Coastal Ecosystems; Ecological Considerations For Management Of The Coastal Zone.* Washington D.C: Publications Departement The Conservation Foundation. p.178.

Dharma, B., 1992. *Siput Dan Kerang Indonesia*. 1st ed. Jakarta: PT. Sarana Graha.

Fauziani, D.A., 2017. *Analisis Sumberdaya Dan Pemanfaatan Bivalvia Bernilai Ekonomis Di Perairan Kampung Bugis Kelurahan Tanjung Uban Utara Kabupaten Bintang*. Tanjung Pinang: Fakultas Ilmu Kelautan dan Perikanan Universitas Maritim Raja Ali Haji.

Fitriana, Y.R., 2006. *Keanekaragaman dan Kelimpahan Makrozoobentos di Ekosistem Mangrove Hasil Rehabilitasi Taman Ekosistem Raya Ngurah Rai Bali*. Biodiversitas, ISSN: 1412-033X, VII(1), pp.67-72.

Hartati, S.T. & Awwaluddin, 2007. *Struktur Komunitas Makrobentos Di Perairan Teluk Jakarta*. J. Lit. Perikan. Ind, XIII(2), pp.105-24.

Hayes, J. & Castillo, O., 2017. *A New Approach for Interpreting the Morisita Index of Aggregation through Quadrat Size*. *ISPRS Int. J. Geo-Inf*, VI(296), pp.1-15.

Heip, C.H.R., Herman, P.M.J. & Soetaert, K., 1998. *Indices Of Diversity And Evenness*. Oceanis, XXIV(4), pp.61-87.

Hutcheson, K., 1970. *A Test For Comparing Diversities Based On The Shannon Formula*. J. theor. Biol, XXIX, p.151.

Insafitri, 2010. *Keanekaragaman, Keseragaman, Dan Dominanasi Bivalvia Di Area Buangan Lumpur Lapindo Muara Sungai Porong.* Jurnal Kelautan, III(1), pp.54-59.

Islami, M.M., 2013. *Pengaruh Suhu Dan Salinitas Terhadap Bivalvia*. Oseana, XXXVIII(2), pp.1-10.

Islami, M.M., Ikhsani, I.Y., Indrabudi, T. & Pelupessy, I.A.H., 2018. *Komposisi Jenis, Keaneka-ragaman, Dan Pemanfaatan Moluska Di Pesisir Pulau Saparua, Maluku Tengah.* Widyariset, IV(2), pp.173-88.

Kalidass, C., 2014. *Distribution And Population Status Of A Critically Endangered Tree Species Symplocos racemosa Roxb. In Eastern Ghats Of Odisha*. International Journal of advanced research, II(11), pp.27-32.

Karimah, 2017. *Peran Ekosistem Ekosistem Mangrove Sebagai Habitat untuk Organisme Laut*. Jurnal Biologi Tropis, XVII(2), pp.51-58.

Kassim, Z., Ahmad, Z. & Ismail, N., 2018. *Diversity Of Bivalves In Mangrove Forest Tok Bali Kelantan Malaysia.* Science Heritage Journal/ Galeri Warisan Sains, II(2), pp.4-9.

Kerkhoff, 2010. *Measuring Biodiversity Of Ecological Communities*. Ecology Lab, (229), pp.1-3.

Kharisma, D., Chrisna, S. & Ria, A.T.N., 2012. *Kajian Ekologis Bivalvia Di Perairan Semarang Bagian Timur Pada Bulan Maret-April 2012*. Journal Of Marine Research, I(2), pp.216-25.

Litaay, M., Darusalam & Priosambodo, D., 2014. *Struktur Komunitas Bivalvia Di Kawasan Mangrove Perairan Bontolebang Kabupaten Kepulauan Selayar Sulawesi Selatan*. Semnas MIPA, pp.1-8.

Noveria, M., Aswatini, Harfina, D. & Malamassan, M.A., 2008. *Kondisi sosial ekonomi masyarakat dilokkasi coremap II Kabupaten pangkajene dan kepulauan*. Jakarta: CREMAP-LIPI.

Odum, E.P., 1993. *Dasar-Dasar Ekologi*. 3rd ed. Yogyakarta: Gadjah Mada University Press.

Okpiliya, F.I., 2012. *Ecological Diversity Indices: Any Hope for One Again?* Journal Of Environment And Earth Science, II(10), pp.45-52.

Printrakoon, C. & Temkin, I., 2008. *Comparative Ecology Of Two Parapatric Populations Of Isognomon (Bivalvia: Isognomonidae) Of Kungkrabaen Bay, Thailand*. The Raffles Bulletin Of Zoology, (18), pp.75-94.

Riniatsih, I. & Widianingsih, 2007. *Kelimpahan dan Pola Sebaran Kerang-kerangan (Bivalve) di Ekosistem Padang Lamun, Perairan Jepara*. Ilmu Kelautan, XII(1), pp.53-58.

Silveria, N.S., Nakano, O., Barbin, D. & Villa, N.N., 1976. *Manual De Ecologia Dos Inseto*. Brasil: Cares Piracicaba. p.419.

Soeparmo, 1992. *Metode dan Teknisk Analisis Komponen Biotik Ekosistem Darat*. Surabaya: Universitas Airlangga.

Suwondo, Ferbrita, E. & Siregar, N., 2012. *Kepadatan Dan Distribusi Bivalvia Pada Mangrove Di Pantai Cermin Kabupaten Serdang Bedagai Provinsi Sumatra Utara*. Jurnal biogenesis, IX(1), pp.45-50.

Wahyuni, I., Sari, I.J. & Ekanara, B., 2017. *Biodiversitas Mollusca (Gastropoda Dan Bivalvia) Sebagai Bioindikator Kualitas Perairan Di Kawasan Pesisir Pulau Tunda, Banten*. Biodidaktika, XII(2), pp.45-56.