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COMMUNITY STRUCTURE OF GASTROPODS AT THE SEAGRASS SPECIES ASSOCIATION AT TUNDA ISLAND IN SERANG BANTEN REGENCY

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Abstract

Gastropods is one of the association biota in seagrass vegetation as an important component in the food chain in seagrass ecosystems. Research on the community structure of Gastropoda in the association of seagrass species in the waters of Tunda Island was carried out in May 2018. The purpose of this research was to identify the Gastropod community structure and evaluate the relationship between community structures of Gastropods with seagrass species and associations of seagrass species. The implementation of this research used experimental methods in the field, Randomized Block Design, with 6 treatments at 4 stations. The treatments tested were differences in seagrass species, and associations of seagrass species, from 3 seagrass species namely Enhalus acoroides, Halophila ovalis, and Cymodocea rotundata. Each quadrant plot measures 1m x 1m. The results of the research show that seagrass conditions at the research site in the waters of Tunda Island, namely seagrass cover 20% - 33.33% and seagrass density 9.17-60.33. Gastropods were found as many as 77 individuals, from 22 species which included 12 families. The Gastropoda diversity index is in the moderate category (0.63-1.74) while the uniformity index is in the high category (0.8-1.47). The value of water-physico-chemical parameters, still within the range of seawater quality standards for marine biota, means that they still support seagrass and gastropod life. The composition of seagrass species one species and species associations affected the Gastropod community structure in seagrass beds in the eastern region of Tunda Island.

Keywords: association, community structure, gastropods, seagrass, Tunda Island,

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BACKGROUND

Tunda Island is a small island located in Serang Regency. The location of Tunda Island is at the end of Banten Bay and geographically located at the coordinates of 5 ° 48'43 "LS and 160 ° 16'47" BT. Tunda Island has sandy beaches in the west and north, in the south there are natural coral reef ecosystems and seagrass beds that are scattered on the coast of Tunda Island. Tunda Island has several potentials that can be developed, including capture fisheries, grouper and lobster shrimp cultivation, coastal tourism and fishing tourism (Firdaus 2013). This potential can be utilized optimally if the management is done holistically by paying attention to the bio-ecological functions of each ecosystem.

The ecosystem that was studied in this study was seagrass beds on Tunda Island. Seagrass beds are rich in biodiversity and a potential contributor to nutrition for aquatic ecosystems. Seagrass beds are a place to live and breed various marine biota, including green turtles, dugongs, fish, echinoderms and various invertebrate biota, as well as various other biota associated with seagrass plants and make the nursery as a nursery, as a place for spawning (spawning ground), and as a feeding ground. The condition of seagrass beds on Tunda Island is a good category with seagrass cover reaching 66% (Firdaus 2013). Seagrass vegetation spread in the waters of Tunda Island, namely *Cymodocea rotundata, C. serullata, Enhalus acroides, Halophila ovalis and Thalasia hemprichi* (Azizah 2016).

Various species of invertebrate biota live and are concentrated in seagrass beds, especially mollusks, one of which is the Gastropod family. The Gastropoda community is an important component in the food chain in seagrass beds. Gastropoda is a basic animal that detritus feeders and litter from seagrass leaves that fall, and circulates suspended substances in water (Tomascik et al. 1997). According to Klump et al (1992) in Syari (2005) as much as 20–60%, epiphytic biomass in Philippine seagrass beds is utilized by epifauna dominated by Gastropods.

The interactions that occur in seagrass beds can be interactions between individuals of the same species, can also be interactions between individuals of different species. Research on the association of seagrass species on Tunda Island found positive associations in couples or two types of seagrass, namely a) *Enhalus acoroides* with *Halophila spinulosa*, b) *Enhalus acoroides* with *Cymodocea rotundata*, c) *Halophila spinulosa* with *Cymodocea rotundata* (Firdaus 2013). Gastropod biota are also common in seagrass beds on Tunda Island. Interaction between the Gastropoda biota community and seagrass plants on Tunda Island, interesting to study further. Information about the interaction of association biota is very necessary in controlling a community in an ecosystem. Communities can be assessed based on the classification of structural characteristics (community structure). Community structure can be studied through composition, size and species diversity (Odum 1994). One characteristic of the community is that there is a clear association between the same species and between different species. Based on this, it is necessary to do a study of the community of Gastropods that are associated with seagrass plants. In this research, the community structure of Gastropoda in the association of seagrass species formed in the waters of Tunda Island between three types or species of seagrasses, namely *Enhalus acoroides, Halophila ovalis and Cymodocea rotundata*. Identify the community structure of Gastropods on each seagrass species and association of seagrass species in the waters of Tunda Island and evaluate the relationship between seagrass species differences and associations of seagrass species with Gastropod community structures.

RESEARCH METHOD

Research was carried out in seagrass ecosystems in the eastern part of the waters of Tunda Island, Serang Regency. Data on seagrass and gastropods, measurements of water quality, and sampling of gastropods and substrates were carried out in May 2018.

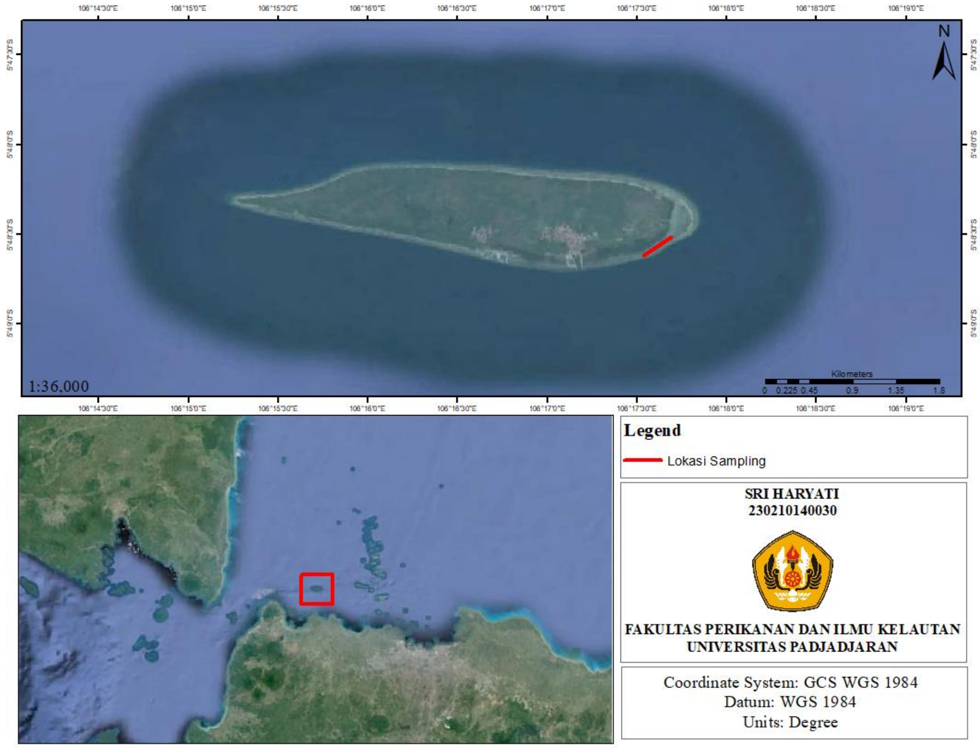

Figure 1. Research Location

Identification of the type of gastropod was carried out at the Research Center for Natural Resources and Environment, Padjadjaran University, on Jalan Sekeloa Bandung. Substrate sample analysis was carried out at the Marine Science and Technology Laboratory of the Faculty of Fisheries and Marine Sciences, Padjajaran University, Unpad Campus, Jatinangor. Data processing and data analysis is carried out in May-July 2018.

Tools and Materials

The tools and materials used during the sampling of seagrasses are 1 x 1 meter quadrants, GPS, handcounters and seagrass identification books. Gastropod data collection using shovels, filters and ziplock. Retrieval of environmental parameter data using Float Tracking, secchi disk, thermometer, refractometer, pH meter and DO meter. Sediment collection and analysis using shovels, coolboxes and sieve shakers.

Method

The research method used is a quasi-experimental or experimental field method, for seagrass communities and Gastropod biota in Tunda Island waters. Determination of sampling plots using purposive sampling method or selected sampling method, namely the technique of determining the sample based on certain criteria or considerations (Sugiyono 2012).

The experimental design used in this research was Randomized Block Design (RBD). In the research location 4 stations were made, each station had 6 (six) treatment plots, namely three patches of mono treatment of seagrass species; *Enhalus acoroides, Halophila ovalis, Cymodocea rotundata* and 3 (three) association plots of two seagrass species: *E. acoroides & H. Ovalis; H. ovalis & C. rotundata, E. acoroides & C. rotundata.*

Measurement of Physics Parameters - Aquatic Chemistry

Measurement of physical and chemical parameters of water which is a limiting factor for the life of seagrass and gastropods, including: temperature, salinity, pH, brightness, DO and current in-situ.

Seagrass Observation

Seagrass was observed in each plot, which included: Seagrass species, number of stands or densities, and broad seagrass cover for each type of seagrass. The observations are recorded in the loog book and photo documentation is made.

Observation of Biota Gastropoda

Observation of Gastropoda biota in each plot is carried out at the lowest tide. In each plot, it was observed Gastropods attached to: (a) seagrass plants, (b) the surface of the substrate and (c) in the substrate to a depth of 10 cm. Then identification of the type and number of individuals of each type of Gastropod is carried out. Identification of the type of Gastropoda using the reference book identification. The observations are recorded in the loog book and photo documentation is made.

Sediment Extraction

Sediment sampling was carried out to determine the granulometry or the size of the sediment by using a shovel by taking several sample points on the data collection plots that had been determined on Tunda Island.

Data Processing

Seagrass Density

$$k_i = \frac{n_i}{A}$$

Information :

ki = i type density at unit area (ind / m2)

ni = total number of individuals from i

A = Total area of sampling

percentage of seagrass cover

$$p = \frac{total\ area\ closure\ to - i}{total\ sampling\ area}$$

Gastropod Community Structure

Abundance

Abundance is calculated using the following formula (Odum 1993)

$$A = \frac{\text{number of individual species}}{\text{area of observation (m}^2\text{)}}$$

Diversity Index

Diversity index describes the state of the Gastropod biota population mathematically in order to facilitate the analysis of the level of population diversity in a community using the Shannon and Wienner indices (Krebs 1989):

$$H' = -\sum_{I=1}^{S} Pi \log Pi$$

Information:

H '= Shannon-Wiener diversity index
Pi = ni / N (i type proportion)
ni = number of individuals for each type i
N = total number of individuals
S = number of species

Diversity index category:

H '<1: low diversity
1 <H '<3: moderate diversity
H '> 3: high diversity

Uniformity Index

The uniformity index is calculated by the following formula (Krebs 1989).

$$E = \frac{H'}{H\,max}$$

Information:

E = uniformity index
H '= ShannonWiener diversity index
Hmax = log2 S

Uniformity index category:

0 ≤ E <0.4: low uniformity
0.4 ≤ E <0.6: medium uniformity
0.6 ≤ E ≤ 1.0: high uniformity

Sediment analysis

Stages of laboratory analysis with sample drying, then filtering (sieving) weighed sediment left on each sediment size. The data obtained from the sieve shaker results again using the KUMMOD-SEL application to find out the size of the sediment grains.

Data analysis

The data obtained in this research were analyzed descriptively comparatively, namely explaining all the data from observations of seagrasses and seagrass species and the Gastropod community structure from six treatments, four replications. The physical-chemical

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parameters of water are compared with the value of sea water based on the Decree of the Minister of Environment No. 51 of 2004 concerning seawater quality standards for marine biota. An analysis of variance was also carried out for RAK to determine the effect of seagrass species and seagrass species on the Gastropod community structure, followed by the Duncan mean difference test.

RESULTS AND DISCUSSION

Water quality parameters

In this research water quality was measured from several physical and chemical parameters. Physical factors are temperature, current, depth and brightness while chemical factors include DO, pH and salinity. The results of measurements of water quality during research at four stations in the eastern part of Pulau Tunda, in general the quality of water in the research location is in the range that corresponds to the standard of seawater quality for marine biota, which is in the annex of Minister of Environment Decree No. LH. 51 of 2004.

Table 1. Results of Measurement of Water Quality Parameters at Each Station

Parameters	Station				Quality Standards	
	I	II	III	IV	* Marine biota	* Seagrass
Temperature (^{o}C)	31	30	31	31	28 – 30	28 – 30
Salinity ($^{o}/_{oo}$)	31,3	31,2	28,7	30	≤ 34	33 – 34
pH	9,2	7,32	7,8	8,08	7 - 8,5	
DO (mg/L)	4,2	4,6	4,8	4,8	≥5	>5
brightness (%)	100	100	100	100		
current (cm/dtk)	0,03	0,09	0,04	0,12		

The temperature of seawater measured at four stations at the research location ranged from 30^{o}C-31^{o}C. If the temperature is above 45^{0}C, then seagrass growth will be disrupted and will experience stress so that it can experience death (Bercwik 1983). Gastropods can carry out metabolic processes optimally at a temperature range of 25^{0}C-35^{0}C (Suwondo et al. 2006). Seawater salinity at four stations in the range 28.7^{0}/ $_{00}$ - 31.3^{0} /^{00}. According to Dahuri (2001), seagrass vegetation mostly has a wide range of tolerance to salinity which is between 10 - 40^{0}/^{00}, Generally gastropod animals can live in waters with salinity 31 $^{0}/_{00}$-37 $^{0}/_{00}$ (Hitallesy 2015). The results of measurement of the pH of the fluid at four stations, obtained a pH value ranging from 7.32 - 9.2. Seagrasses can live in the optimal pH range between 7.5 - 8.5 (Nybakken 1992). The pH that supports the life of Gastropoda ranges from 5.7 to 8.4 (Pennak 1978).

The measurement of dissolved oxygen (DO) at four stations in the range of 4.2 to 4.8 mg / L, seagrass can still grow because it is above 4 mg / l, because oxygen levels less than 4 mg / L have an adverse effect on seagrass growth (Effendi 2003). The depth of the water at the research location in the eastern part of Tunda Island ranges from 1 meter, so that the water brightness observed at each station is 100%. The current velocity obtained at four

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stations in the research location ranges from 0.025 to 0.12 m / s, including in small or quiet current movements, so that it can be categorized as current velocity in the eastern region of Pulau Tunda which is slow.

Substrate Type

Substrate is a medium for plants to obtain nutrients. The results of granulometric analysis on the substrate or sediment taken from the observation, it can be seen the type of substrate at the research site including little gravel sand - gravel sand.

Table 2. Substrate type in the eastern region of Tunda Island

No.	Station	Substrate Type
1.	I	gravel sand
2.	II	gravel sand
3.	III	gravel sand
4.	IV	little sand gravel

Kiswara (1997), reported that seagrass vegetation can be found in various characteristics of substrate in Indonesia, namely seagrasses that live on mud substrates, sandy mud, sand, lumpy sand, coral debris and rocks. Substrates in the bottom of the waters will determine the abundance and type composition of benthos animals (Welch 1952). The basic substrate type in sediment is a very important component for the life of benthos organisms (Odum 1971).

Seagrass Vegetation

Seagrass vegetation in the eastern part of Tunda Island consists of three species of seagrass *Halophila ovalis, Enhalus acoroides and Cymodocea rotundata* which form mixed vegetation. Based on the observations of the density of seagrass stands for the three species at each station, the highest density was possessed by *H. ovalis* of 47.83 ind / m² - 60.33 ind / m², followed by *Cymodocea rotundata*, and *Enhalus acoroides* had the lowest density.

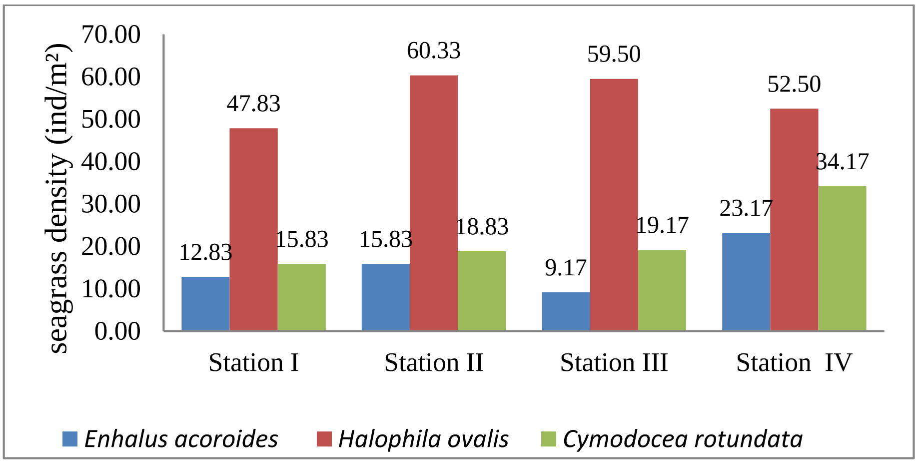

Figure 2. Density of Seagrass Each Station

seagrass density in each treatment obtained the highest seagrass density average in plot B of 152.25 ind /m^2 and the lowest in plot A was 37.75 ind /m^2

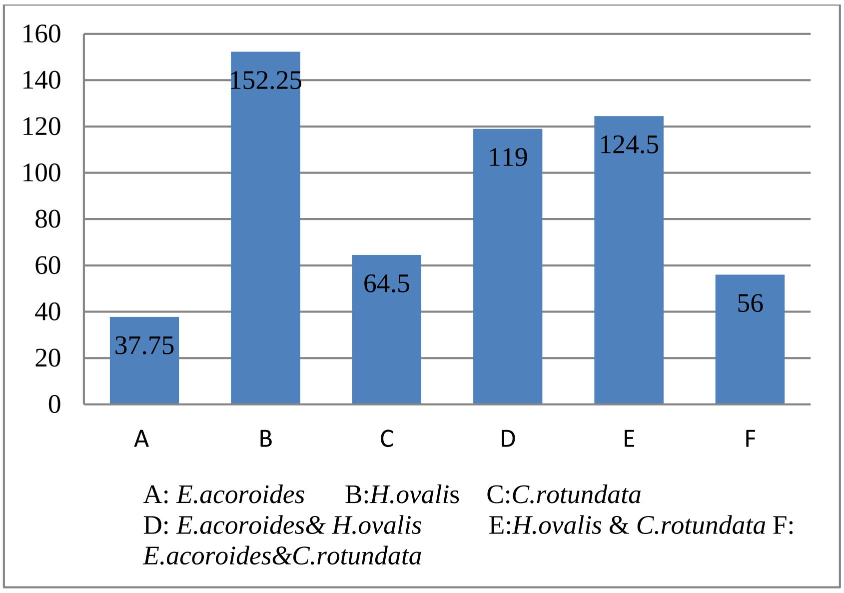

Figure 3. The density of seagrasses every treatment

High seagrass densities were also found in plot D and plot E, namely the treatment plot of seagrass species associations, an association of *E. acoroides* & *H. ovalis* and *H. ovalis & C. rotundata* associations. This D and E plot has similarities to plot B, which is the presence of species H. ovalis. Species *C. rotundata* is also one of the dominant species in intertidal disease.

Table 3. Cover of seagrass in the eastern region of Tunda Island

No.	Seagrass Species	Seagrass Cover (%)			
		I	II	III	IV
1.	*Enhalus acoroides*	33,33	30,83	29,17	30,00
2.	*Halophila ovalis*	20,83	20,83	20,00	24,17
3.	*Cymodocea rotundata*	27,50	29,17	28,33	30,00

The highest cover (33.33%) is owned by species *E. acoroides*, although the density is lowest. This is due to the morphology of *E. acoroides* seagrass leaves which are long and wide. The lowest seagrass cover is owned by species H. ovalis, this type of seagrass has a much smaller individual seagrass size, so it will have a smaller percentage closing value (Short and Coles 2003).

The highest cover is owned by plot F, which is the treatment plot of the association of species of *E. acoroides and C. rotundata*, at 70%. This highest cover is due to the morphology of *E. acoroides* seagrass leaves which are long and wide. While the lowest seagrass cover is owned by plot B with the species *Halophila ovalis* around 43.75%. Unhealthy seagrass conditions can also be affected by the type of substrate or sediment in the east, namely gravel sand. Sandy sediments contain less organic material than muddy sediments, because the muddy bottom of the water tends to accumulate organic material carried by the flow of water, where fine texture and particle size facilitate the absorption of organic material (Ardi 2002) Nutrient deficiencies can affect seagrass growth.

Table 4. Cover of seagrass per treatment

No.	Treatment	Station cover (%)				average
		I	II	III	IV	
1.	A	65	70	60	65	65,00
2.	B	40	45	40	50	43,75
3.	C	65	60	60	70	63,75
4.	D	55	50	50	50	51,25
5.	E	45	50	50	50	48,75
6.	F	80	65	65	70	70,00

Composition and Abundance of Gastropods

Gastropod species obtained at the research site, the most were from Strombidae families of 14 individuals consisting of 4 species (*Canarium mutabile, Canarium urceus Canarium labiatum and Margistrombus marginatus*). Then the Cypraeidae family of 12 individuals from one species, *Cypraea annulus* and the Columbellidae family, as many as 10 individuals from two species of *Euplica varian* and *Pardalinops testudinaria*.

The Strombidae and Cypraeidae families dominate their existence in seagrass ecosystems and sand substrates (Litaay 1994). Cypraeidae is a gastropod that lives in tidal areas and is found in tidal areas between sand and rocks and many grow attached to seagrass and algae (Oemarjati and wardana 1990). Gastropod abundance can be influenced by physical and chemical factors in the eastern region of tunda Island. Gastropods generally live on the ground surface and tend to move downward at low tide and rise again during high tide (Odum 1996).

The most common gastropod species found in research sites, are sequentially (a) *Cypracea annulus, (b) Euplica variance, (c) Engina zonalis.* The *Cypracea annulus* is most commonly found in seagrass species *Enhalus acoroides*, this is because the *Cypracea annulus* can live attached to seagrass leaves. The existence of gastropod species in seagrass *Enhalus acoroides* shows good conditions for living Gastropods, other Gastropod species are found on the surface of the substrate and inside the substrate. *Euplica varian* can be found in shallow intertidal habitats in the tropics (Sowerby 1832). *Engina zonalis* is found mostly in intertidal regions and coral reefs, usually this species is found in substrate rocks or gravel (Lamarck 1822).

Based on observations, not all seagrass species are found in the Gastropod biota. There are three plots that are not found gastropods in the plot. The three plots constitute one replica plot of the treatment plot that does not have *E. acoroides* seagrass species, while Gastropoda is found in each plot that has E. acoroides seagrass species namely plot A (E. acoroides), plot D (*E. acoroides & H. ovalis*), and plot F (*E. acoroides & C. rotundata*). In addition, the highest abundance of gastropods was also found in plots of E. acoroides. This can indicate that gastropods prefer *E. acoroides*, or *Enhalus acoroides*, as a habitat for living associations for Gastropod biota.

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Table 5. Diversity index and uniformity of each station

No.	Treatment	Station	Gastropods	
			H'	E
1.	**A (*Enhalus acoroides)***	**I**	**1.32**	**0.96**
		II	**1.52**	**0.94**
		III	**1.52**	**0.94**
		IV	**0.63**	**0.92**
2.	B (*Halophila ovalis)*	I	1.6	0.99
		II	-	-
		III	0.68	0.98
		IV	1.02	0.92
3.	C (*Cymodocea rotundata)*	I	1.02	1.47
		II	1.02	1.47
		III	1.02	1.47
		IV	-	-
4.	**D (*E. acoroides*& *H. ovalis)***	**I**	**1.08**	**0.98**
		II	**1.36**	**0.98**
		III	**1.74**	**0.97**
		IV	**0.68**	**0.98**
5.	E*(H. ovalis*& *C. rotundata)*	I	0.63	0.90
		II	0.68	0.98
		III	1.08	0.98
		IV	-	-
6.	**F(*E. acoroides* & *C. rotundata)***	**I**	**1.6**	**0.99**
		II	**1.02**	**0.92**
		III	**1.12**	**0.80**
		IV	**0.64**	**0.92**

Overall abundance, diversity index and uniformity of gastropods across stations in each treatment of seagrass species and associations of seagrass species. The diversity of gastropod biota found in each station in each treatment of seagrass species and seagrass associations, including the medium diversity category. Diversity index can be influenced by environmental factors and the type of substrate found in the eastern region of Tunda Island waters. Diversity is influenced by aquatic environmental factors, substrate and seagrass ecosystems so that it is good enough for Gastropod life.

The gastropod uniformity index at the research location ranged from 0.87 to 1. Based on the uniformity index according to Krebs (1989), Gastropods found at the research sites have high uniformity values. According to Odum (1993) the index uniformity value will be close to 1 if the distribution of individuals between species is evenly distributed and will approach 0 if the distribution of species is uneven or there are individuals who dominate. This means that the gastropods found in the research location have a uniform distribution on each station, there is no dominance of the species.

Table 6. Index of each treatment

No.	Seagrass Treatment	H'	E	abundance	notation
1	*A : E.acoroides*	2.09	0.95	5	c
2	*B : H. ovalis*	2.3	1	2,5	abc
3	*C : C. rotundata*	1.79	1	1,5	a
4	*D : E.acoroides & H.ovalis*	2.3	0.96	3,75	abc
5	*E: H.ovalis& C.rotundata*	1.91	0.98	2	ab
6	*F : E.acoroides & C.rotundata*	2.03	0.87	4,5	bc

The highest Gastropod abundance is found in plot A of 5 ind / m2 and the lowest abundance in plot C is 1.5 ind / m2. Differences in gastropod abundance can be influenced by aquatic environmental factors at each station, including salinity, pH and current. The abundance of a species in a species is determined by the level of availability of resources and the conditions of chemical and physical factors that must be in the range of being tolerated (Soetjipto 1993). The highest gastropod abundance is found in E. acoroides, so this seagrass species can be used as a gastropod as its place of life because it has a wide morphology of seagrass leaves and has a high seagrass cover.

The results of analysis of variance, randomized block design: the effect of the treatment of seagrass compositions, one seagrass speceies and associations of seagrasses (two seagrass species), showed that the composition of seagrass species significantly different the abundance of individual Gastropods in each treatment plot (at the level 5%). Then continued with Duncan's mean difference test, it was found that the treatment in this research showed that plot A with species E. acoroides which gave a better / higher influence on the abundance of Gastropods in the waters of Pulau Tunda, on plots that had the composition of E.acoroides such as D plots (E.acoroides & H.ovalis) and plot F (E.acoroides & C. rotundata) show gastropod abundance which is better than plot treatments C and E. This indicates an association between speciesE seagrass composition. acoroides with an abundance of gastropods.

Plot treatments of C (C. rotundata) and E (H.ovalis & C. rotundata) differed from the treatment of other seagrass types against the abundance of Gastropods. Gastropod abundance in plot C is 1.5 ind / m2 and plot E 2 ind / m2, this shows that the plot has the lowest gastropod abundance compared to other plots. In plots C and E the morphology of seagrass leaves is not too large, for seagrass species H. ovalis has round and small leaves, while Cymodocea rotundata has a fairly long leaf shape and rounded leaf edges but compared to E. acoroides this type of seagrass the longest and the broadest, so that in plots C and E have seagrass cover smaller than other plots.

CONCLUSION

Gastropod community structure in seagrass treatment in the eastern region of Tunda Island waters includes: (i) Gastropods as many as 77 individuals from 22 species including 12 families, (ii) abundance: 1.5-5 (ind / m2), (iii) low-medium diversity index (0.63 -1.74) and high uniformity index (0.8-1.47) or even distribution. The difference in composition of seagrass species and the association of seagrass species shows the structure of different Gastropod communities, in seagrass vegetation in the eastern region of Tunda Island waters.

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Seagrass vegetation that has species Enhalus acoroides (monospecies and associations) tends to have more gastropods, due to the long and wide leaf shape of E. acoroides, providing wider space for epiphytic biota as Gastropod feed.

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