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IMPACT SEDIMENTATION TO COMMUNITY STRUCTURE MACROZOOBENTHOS IN SEGARA ANAKAN LAGOON

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ABSTRACT

Change of structure community of Macrozoobenthos due to sedimentation has apparently contributed to a reduction of the quality of the aquatic environment, particularly in Segara Anakan Lagoon. This study aims to determine the extent to which the effects of sedimentation and nutrients in the Segara Anakan Lagoon on macrozoobenthos community structure. The method used in this study surveys. Primary data collected are nutrients, macrozoobenthos, sedimentation rate and secondary data. The results showed that the rate of sedimentation in the dry and rainy season was 0.067 to 2 m/s and 1.61 to 2.00 m/s respectively.

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Balanus sp, *Melanoides* sp, *Corbicula* sp, *Polychaeta* sp., *Thiara* sp. were dominance in the dry season, while *Corbicula* sp, *Melanoides* sp, *Thiara* sp, *Tarebra* sp, *Balanus* sp, *Polychaeta* sp. and *Barbatia* sp. were dominance in the rainy season.

Keywords: sedimentation; community structure Macrozoobenthos; Segara Anakan Lagoon.

1. INTRODUCTION

Segara Anakan Lagoon is located in an area of the waters of the estuary on the South coast of Central Java, located on the border between Ciamis West Java and Cilacap Regency, Central Java. Segara Anakan currently has experienced relatively high sedimentation due to sediment from the river Citanduy, Cibeureum, Cimeneng, Cikonde, all of which converge to Segara Saplings. The presence of deforestation and land use that is not paying attention to the environment in the upstream of the river becomes the cause of high rates of erosion on the river. Erosion on the River-a river that empties into a lagoon Segara Saplings donated materials and wastes as much mud 5 million m3/year, which amounted to 1 million m^3/year sediment in Laguna. From the m^3, 750,000 1 million m^3 of material donated by the Citanduy river flow brought, 250,000 m^3 while the rest comes from material brought in other rivers. So, total sedimentation in the lagoon is unaccounted since 1994 until now already exceed 5 million cubic meters. The material of mud and sewage water flow of the River and will be suspended on the basis of the water which then accumulates into the sediment. The result of these deposits causes the superficiality at the lagoon, the vast waters of narrows as well as the presence of land arising [1].

Macrozoobenthos had sensitivity to the nature of some contaminants, low mobility, easily captured and have a long viability. Therefore the role of the macrozoobenthos in the balance of the aquatic ecosystem can be an indicator of ecological conditions in a certain area. Macrozoobenthos is an organism that has a size of more than 1.0 mm like the mollusk, macrozoobenthos is an organism that has a size of 0.1-1.0 millimeter like Cnidaria and macrozoobenthos is an organism that has a size of fewer than 0.1 millimeters [2]. Macrozoobenthos which has the nature of a Digger, eaters of the deposit tends to overflow on sediment and sediment is software containing organic materials is high as in sediment pore.

The presence of animals on water the benthos, strongly influenced by various environmental factors, either from biotic or abiotic component. Biotic factors are influential manufacturers, which was one source of food for animal's bentos. As for factors of abiotic component is physical-chemical water include: temperature, flow, dissolved oxygen (DO), biology and chemical oxygen demand (BOD and COD) as well as the content of nitrogen (N), water depth and the basic substrate [3-4].

Nutrients are taken from the river empties into a lagoon will Citanduy Segara Anakan. Nutrients used for metabolism of the organism. Nutrients needed by the organism as an energy source including Ammonia, Nitrate, Nitrite, Total Nitrogen, Phosphate, Carbon and Chlorophyll-α. Nutrients of sediments are in three forms namely dissolved in the pore water of sediment, absorbed on the surface of the sediment and are present in the structure of the lattice grain-grain sediments. Then, the nutrient creeps in the lagoon.

Pore space is found in sedimentary layers are filled with water or air. The pore water is water that is present in the porous sediment. The pore water in the pores of sediments coming from outside that is on the surface of the sediments. This pure water contains nutrients that are present in the water column. On the pore water of sediment changes or reshuffles, the nutrients that can be caused by bacteria or microorganisms. Microorganisms residing near the pore water of sediment will utilize the nutrients in sediment pore water, one of them namely macrozoobenthos. In general in the tropics, the concentrations of nutrients in the surface water are lower while the concentration of nutrients in sediment pore water is higher.

A high sedimentation rate brings nutrient elements (nutrients) that will affect the existence of macrozoobenthos in the waters there are carried with the flow and there are also able to survive with the condition of the environment is filled with nutrients. Excessive nutrients within the waters will trigger the onset of blooming algae that will be detrimental to aquatic organisms life coupled with high temperatures that would cause the occurrence of the round in the waters, which flow ride that carries toxic compounds from the base of the waters that could lead to reduced oxygen content.

Based on the foregoing, it should be examined and nutrient sedimentation happens by looking at the impact that macrozoobenthos occurs in marine life particularly in the Segara Anakan

Lagoon.

2. RESULTS AND DISCUSSION

The value of pH on the Citanduy River up to the Segara Anakan Lagoon in the rainy season is on the range 5.5 to 4.7 contains the acid. While in the dry season, the pH ranges from 7.2 to 8.2 which are included in the base. PH value differences due to the high process of decomposition of organic matter in the rainy season led to the formation of organic acids are compounds that will lower the pH. In-situ parameters that do include the physical and chemical parameters of the water are listed in Table 1.

Table 1. Physical-chemical parameters of waters

Parameter	**Station**				**Station**			
	Rainy Season				**Dry Season**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
pH	4.73 ± 0.07	5.37± 0.15	5.34 ± 0.05	5.5 ± 0.15	7.2 ± 0.6	8.19 ± 0.02	7.91 ± 0.11	8 ± 0.3
Depth (cm)	251 ± 2.52	155.3 ± 2.52	127 ± 2.08	222 ± 1	110 ± 2	40 ± 2	52 ± 1	70 ± 2
Flow Velocity (m/s)	8 ± 0.76	3.5 ± 0.1	2.4 ± 0.36	4.5 ± 0.1	1.2 ± 0.1	1.7 ± 0.2	1.4 ± 0.1	1.5 ± 0.3
Brightness (%)	16.2 ± 1.5	13.6 ± 1.53	7 ± 1	10.3 ± 1.53	100 ± 0	100 ± 0	100± 0	20 ± 1
DO (mg/L)	4.5 ± 0.2	7.4 ± 0.06	5.83 ± 0.29	6.9 ± 0.1	4.5 ± 0.2	3.2 ± 0.10	3.8 ± 0.3	3.2 ± 0.15
Salinity ($^0/_{00}$)	0.01 ± .01	0.01 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.01 ±0.1	28 ± 0.5	28± 0.4	28 ± 0.3
Temperature (^{0}C)	25.17 ± 0.04	31.3 ± 0.58	33 ±1	31 ± 1	30 ± 1	27± 1	26 ± 1	28 ± 1

The value of research in what depth in the rainy season ranged from 127 cm to 251 cm. 3 The

station which is the middle of the lagoon is the most superficial with station depth 127 cm because at the station 3 is the endpoint of a process of sedimentation that is a lagoon. During the dry season, the value of depth ranges from 40 cm to 110 cm with the most superficial station on station 2 the estuary with a depth of 40 cm. According to [5], in waters depths of Segara Anakan are quite varied, ranging from the fewer one meter up to more than 20 meters (Muara s. Donan). The most superficial waters obtained on the waters of the lagoon to the East of Karanganyar, followed by aquatic Tritih Kulon. The water of the lagoon to the East of Karanganyar is a calm body of water and receives sediment from the Citanduy River.

The speed of the flow in the rainy season ranges between 2.4 m/s up to 8 m/s, the highest station i.e. the Citanduy River 1 station with the value of the current speed of 8 m/s because the Citanduy River is a river basin in the rainy season speed of flow increase than usual. The lowest flow speed occurs at the station 3 lagoon of 2.4 m/s due to lagoon many covered by land arise that can withstand the current entry. The speed of the flow during the dry season ranges 1.2 m/s up to 1.7 m/s in dry season torrential currents do not occur in both the Citanduy River or in the lagoon since experiencing drought.

Dissolved oxygen (DO) in the rainy season ranged between 4.5 mg/L up to 7.4 mg/L with the highest station in station 2 (estuary). Dissolved oxygen during the dry season range between 3.2 mg/L up to 4.5 mg/L dissolved oxygen content with the highest located at station 1 Citanduy River of 4.5 mg/l. Oxygen required by water organisms to produce energy that is essential for digestion and assimilation of food, the maintenance of osmotic balance and other events. Supply of dissolved oxygen in the waters is influential for the organism. The dissolved oxygen content of less than 2 mg/L then it will be a problem on either growth or survival of large, his influence on the levels of salinity in the waters and in the content of dissolved oxygen reached less than 2 mg/L then the Gastropod cannot live [6].

The value of salinity on the location of this research in the rainy season has the same salinity values for all stations namely 0.01 $^{0}/_{00}$, which indicates the waters in the area. Although Segara Anakan Lagoon is influenced waters from land and sea, in the rainy season, the Segara Anakan Lagoon only affected the condition of the land. While in the dry season, the salinity values to station 2, 3 and 4 have the same value namely 28 $^{0}/_{00}$ and station 1 has a value of 0.01 $^{0}/_{00}$.

The temperature in the area of research in the rainy season ranged from 25.17^{0}C-33^{0}C. The lowest temperature found in station 1 of 25.17^{0}C and the highest is in station 3 with 33^{0}C. While in the dry season, the temperature value at stations 1, 2, 3 and 4 respectively 30^{0}C, 27^{0}C, 26^{0}C and 28^{0}C. The temperature at station 1 has the value is very high compared to other stations 30^{0}C. This is due to the time of sampling conducted during the daylight hours at around 12. Temperature rising waters due to the influence of sunlight that makes the temperature of the waters rise. While the 3 other stations carried out at 10.15, 14.35 and at 15.

2.1. An Abundance of Makrozoobenthos

Macrozoobenthos is an organism that lives at the bottom of the waters is an indicator of environmental change. The abundance of the macrozoobenthos contained in the location of the research can be seen in Fig. 1.

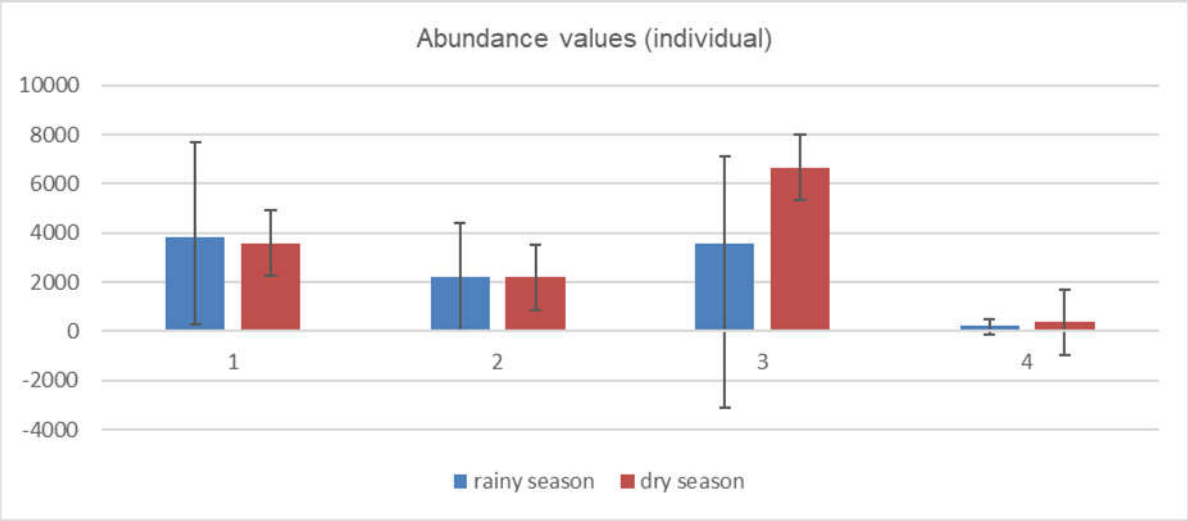

Fig.1. Makrozoobenthos abundance in Segara Anakan Lagoon

Based on Fig. 1, during the dry season, the highest abundances occur at station 3 (middle lagoon) and the value of the individual while 6650 abundance in the rainy season occurs abundance at station 1 due to the value of the abundance of 3850 individuals. Based on physical-chemical factors waters on 3 stations, concentration, pH, the temperature of 26^{o}C 7.91, salinity 28 $^0/_{00}$, DO 3.8 and have higher brightness value. In addition, station 3 has a greater concentration of nutrients compared to other stations. The value content of the concentration of ammonia, nitrate, total nitrogen, phosphate, total oxidation in the carbon concentration value is greater than other stations.

In addition, the water of the lagoon is a rather quiet water so as to allow the deposition of mud

followed by accumulation of inorganic material to the bottom of the water. The sediment in aquatic had indirectly affected by the abundance of macrozoobenthos. It is also related to chlorophyll a during the dry season is higher compared with the rainy season..

2.2. The Value of Diversity

The value of diversity is used to find out the level of diversity of macrozoobenthos in waters with concentrations of nutrients in the water. The following graphs the value of diversity at research stations.

Fig. 2 can be seen that during the dry season the highest macrozoobenthos diversity values occur at station 4 with value diversity 1.86 individuals. While in the rainy season, the highest there on station 1 with a value of diversity 1.31 individuals. In the rainy season, the value of diversity at station 4 the opposite of dry season because with value is 0. This happens because, in the rainy season, there is only 1 type of macrozoobenthos that exists at this station. Understanding the diversity of types is not only synonymous with the number type, but rather the nature of the community that is determined by the type and the number of individual life equity each type.

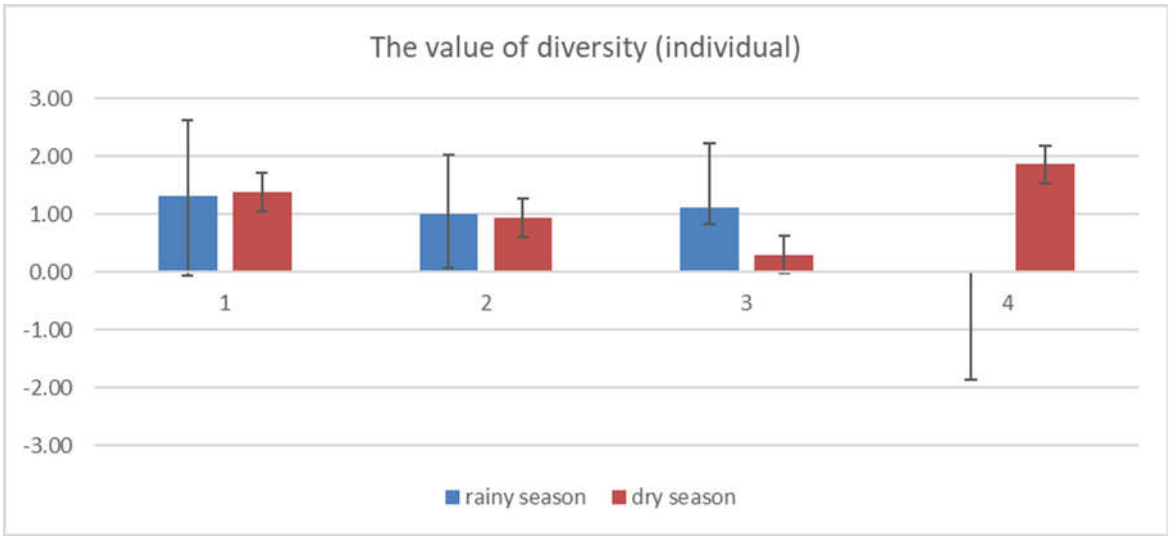

Fig.2. The value of diversity Makrozoobenthos

Based on the value of diversity index, in the dry season 4 have diversity 1.86 station which marks the light pollution has occurred. At this station, there is the influence of the sea waters that indirectly affect the condition of the water. In the rainy season, the highest diversity index value is present on the Citanduy River station 1 with the value of the index is being polluted by category 1.31, on these waters many polluters who entered starting from the Citanduy

River.

According to Shannon-winner, diversity index of fewer than 1 means low macrozoobenthos diversity. As at station 4 in the rainy season which has a diversity index of 0, because only 1 kind of just macrozoobenthos that dominate on the station. Species diversity tends to be low in the ecosystem that is experiencing the pressure of physical or chemical [7]. The process of sedimentation can make the limiting factor on a diversity of macrozoobenthos. High rates of sedimentation resulted in the existence of particular types that can tolerate these conditions.

2.3. The Value of the Dominance

The dominance of macrozoobenthos is the most macrozoobenthos can survive in the conditions of waters with a nutrient that existed at sediment. According to [7], macrozoobenthos may indicate the quality of the waters, the waters have not been in such a polluted, the number of individuals is relatively evenly from all existing species, polluted waters, rather a spreading of the number of individuals is uneven and there are species tend to dominate. For the dominance of the location of the research can be seen in the following Fig. 3.

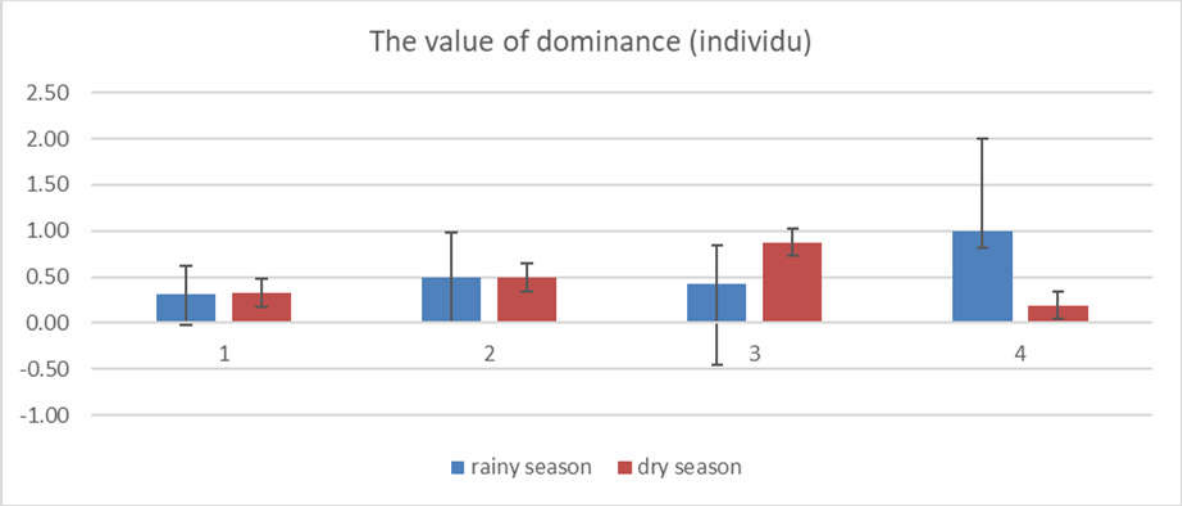

Fig.3. The dominance of Makroozoobenthos

Based on dominance index, during the dry season the stations 1, 2 and 4, there is no kind of macrozoobenthos dominant in the station. But, there station 3 macrozoobenthos which dominate the station. Types of macrozoobenthos are dominant at the station 3 is Gastropod class, where most are deposit feeders (deposit eaters) because it usually more found on a smooth substrate that contains enough organic matter and inorganic [8]. In the rainy season, station 4 has the highest value of the dominance of 1 individual with type species *Balanus*

improvisus with a population of 10 individuals. *Balanus* are members of the Subphylum Crustacea and Cirripeda Classes. This sea animal groups in the form of the adult form a shell that is not at all similar to shrimp, but the form of the shell-shaped flower, consisting of header plate plates of calcium carbonate. This beast in the form of adult lives anchored firmly on the hard rocks, shells from other Intervetrebrata.

Macrozoobenthos types obtained during the dry season, the dominant is the kind of *Balanus sp*, *Melanoides sp*, *Corbicula sp*, *Polychaeta*, *Thiara sp*. While in the rainy season, the dominant type of macrozoobenthos is a species of *Corbicula sp*., *Melanoides sp Thiara sp*, *Tarebra sp*, *Balanus sp*, *Polychaeta* and *Barbatia.*

2.4. The Rate of Sedimentation

The process of sedimentation in waters can lead to superficiality and decreased water quality. The number of particles of the sediment carried by the river flows into the sea will be deposited around the River estuary, so potentially interfere with the Groove cruise and cause flooding when the rainy season arrives. In addition, the high concentration of sediment in a body of water will cause turbidity which not only endangers life but also causes water unproductive because blocking the Sun for photosynthesis [9].

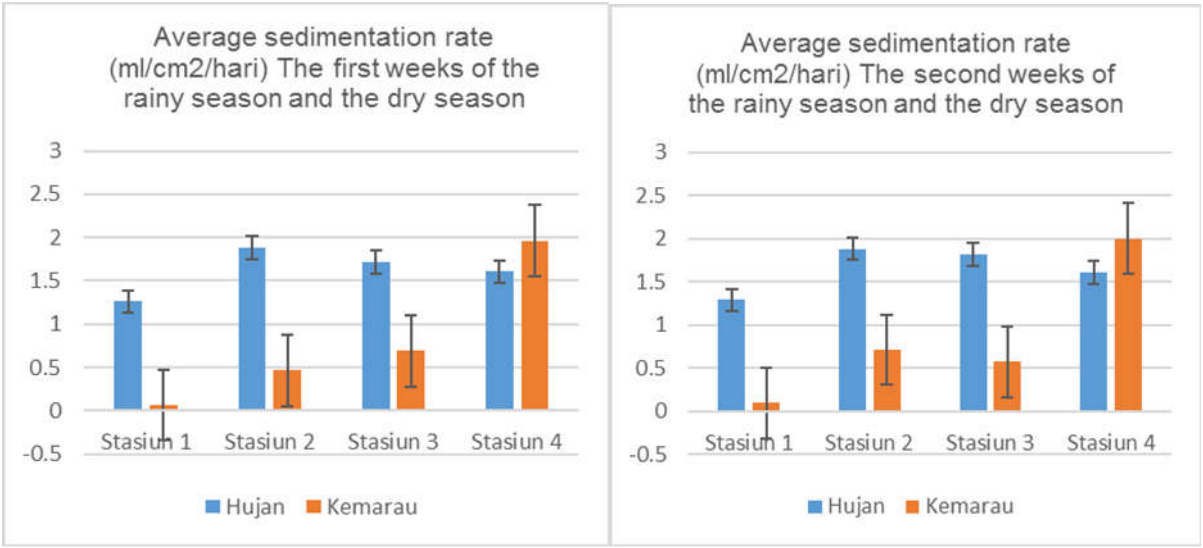

Fig.4. The average rate of sedimentation in the Segara Anakan Lagoon

From the picture above can be seen in the dry season in week 1 and week 2, station 4 which is the border with the sea has accumulated the highest volume rate compared to other stations with the highest volume of accumulated 2.00. This is due to a drought of entries on the

sediments of the lagoon is not so high because the water is calm with small currents. So, the incoming sediment mostly derived from the sea that carried away by the current.

In the rainy season, in week 1 and 2 is the opposite of dry season station 1. The rate of volume accumulated of the highest in week 1 with a value of 2.00 and accumulated volume in week 2 with the value of the volume of accumulated 1.98. In the rainy season flow from upstream Rivers Citanduy very high, this carries sediments.

Mud and waste materials brought in a stream of river water will be suspended on the basis of the water which then accumulates into the sediment. The result of these deposits causes the superficiality at the lagoon, the vast waters of narrows as well as land arises. High sedimentation rates from year to year to cause extents Segara Anakan Lagoon is increasingly shrinking. Although there are differences of data from various different sources, this data shows the same tendency in describing the rate of decrease in the area of Segara Anakan Lagoon.

The high rate of sedimentation in the Segara Anakan Lagoon also resulted in narrows grooves (fissures) in the West of Plawangan that connects the lagoon and the sea of the Indian Ocean up to approximately 60m between Java and Nusakambangan from earlier is a 300m in 2002. Its depth has become increasingly shallow, ranging from minus 0.63m till 4.6m. The gap is so important to drain the river water and sediment into the sea, the circulation of seawater and fresh water in the lagoon as well as being the entrance gate and the discharge of marine life at the time of spawning, rearing and feeding themselves [10].

While according to [11], velocity sedimentation laterally at the Segara Anakan is 64.73 ha (0.6473 km^2) per year. While, vertically rate is 0.105 cm/year. The rate of sedimentation which quickly enough the narrow waters of the Segara Anakan Lagoon and this process will naturally continue.

3. METHODOLOGY

3.1. Study Area

The material used for this research includes primary data such as sediment sampling at some point of different stations and secondary data which support the research. Research conducted

in the waters of the lagoon Segara Saplings District Cilacap in Central Java Province. The research was conducted from August to June 2016.

4 sampling point station in this research which include:

a. Station 1: Located at the Citanduy River Watershed which will flow toward the Estuary Segara Anakan Lagoon. Coordinate -7.669, 108.788 S. 07°'40' 8,4", E 108° 47' 16,8"
b. Station 2: Located at the mouth of the Segara Anakan Lagoon. Coordinate -7.676, 108.805 S. 07°'40' 33,6", E 108° 48' 18,0"
c. Station 3: Located in the middle of the Segara Anakan Lagoon. Coordinate -7.676, 108.8203 S. 07°'40' 33,6", E 108° 49' 13,08"
d. Station 4: Located in the area that is affected by sea waters. Coordinate -7.694, 108.790 S. 07°'41' 38,4", E 108° 47' 24,0"

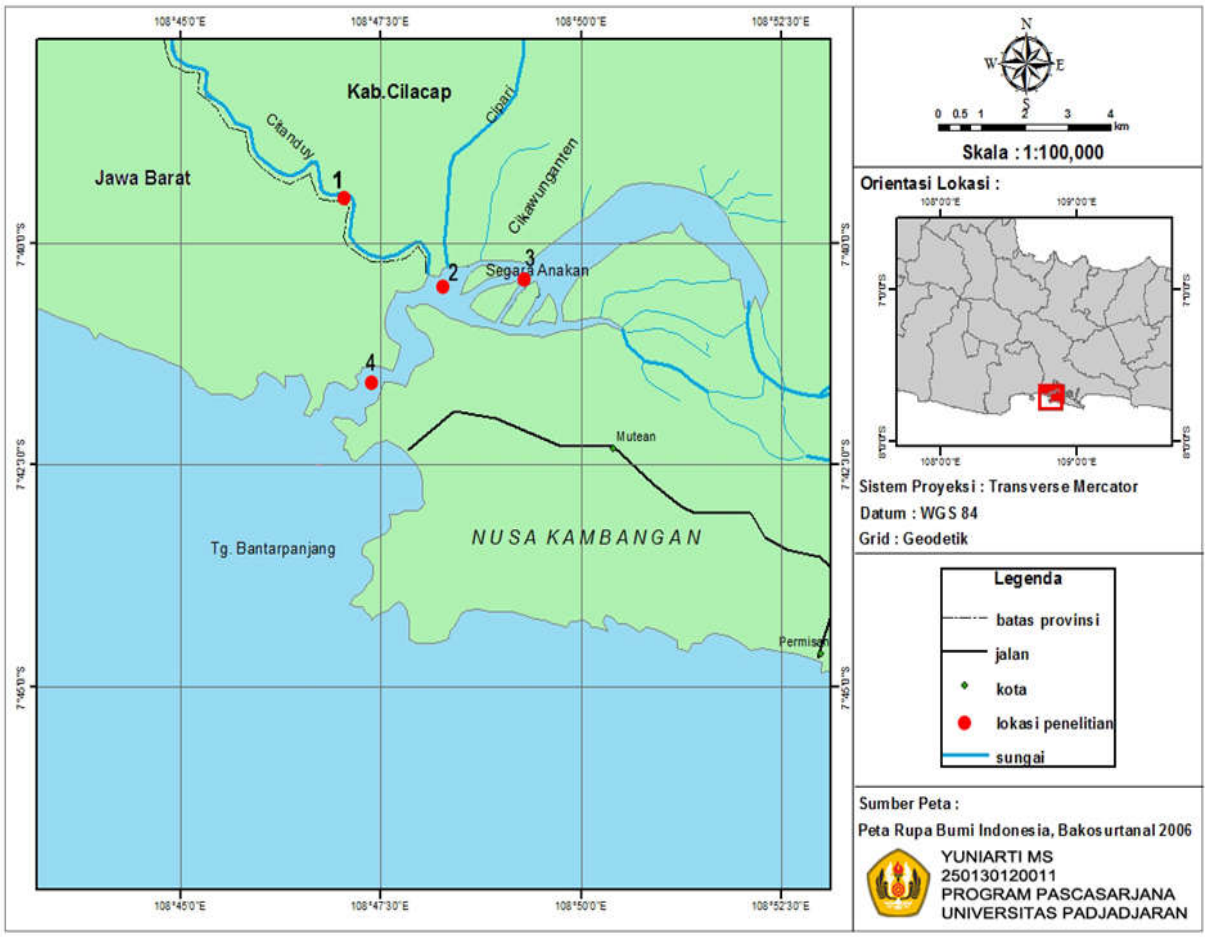

Fig. 5. Location of research

The method used in this research is a descriptive-analytic method. After that, proceed with the processing and analysis of data in the lab and community structure macrozoobenthos.

3.2. Data Analysis

The density and composition of different types of density macrozoobenthos are defined as the sum of the individual macrozoobenthos per unit area (m^2) [12]. Macrozoobenthos density formulation is as follows:

$$K = \frac{10.000 \times Ni}{A}$$

where K = density (ind/m^2), Ni = number of individuals (individuals), A = Wide swath of sampling (cm^2) (a value of 10,000 is a conversion from cm^2 to m^2). The type composition shows a comparison between the percentages of the phylum of organism macrozoobenthos. The composition of the type taxa-taxa also noticed that often appears every station [12].

Index of Diversity at each observation station was the result of the average of the 10 replicates. Diversity index is determined by using the formula the index of Shannon-Wiener diversity [13] as follows:

$$H = -\sum pi \ln pi$$

where pi = number of individuals a type of comparison with the overall type. Uniformity index macrozoobenthos index on each station is calculated by using the index of uniformity [13] as follows:

$$E = \frac{H'}{Hmax}$$

with $Hmax = \log_2 S$

where S = number of taxa, E = value uniformity and H'= value of diversity.

After obtained the value of absorbance of the ammonia, nitrite, nitrate, phosphate, N-total and total oxidation of carbon, then continued by calculating the concentration. Determine the value of the concentrations is done using the Beer-Lambert law to count the number of light scatter them in:

$$T = \frac{It}{Io} \text{ atau } \%T = \frac{It}{Io} X$$

And absorbance is expressed by the formula:

$$A = -\log T$$

$$T = -\log \frac{It}{I0}$$

where I0 is the intensity of the light to come on and It is light intensity I1 or after passing through the sample.

where A = Absorbance a = absorbtivitas Set (if the concentration of the substance measured in $^{0}/_{00}$), c = concentration of the substance measured, ε = molar absorbtivitas Setup (if the concentration of the substance measured in $^{0}/_{00}$) and b = Bold solution (thick kuvet reckoned also generally 1 cm)

Sediment accumulation was measured by calculating the volume per unit area per time, calculation as follows.

The rate of accumulation volume = $\frac{V/L}{T}$

$$L = \pi r^2$$

where volume accumulation rate = (ml/cm^2/day), V = volume of sediments (ml), L = cross-sectional area of the sediment trap (cm^2), T = time of fitting sediment trap (day) and r = radius of the fastening system sediments (cm).

4. CONCLUSION

1. High rates of sedimentation resulting in certain types of macrozoobenthos that can survive, like on rainy season *Balanus improvisus* is a species that can survive with climatic conditions with high rainfall.
2. Types of macrozoobenthos obtained during the dry season, the dominant is the kind of *Balanus improvisus, Melanoides sp, Corbicula sp, Polychaeta, Thiara sp.* While in the rainy season the dominant type of makrozoobenthos is a species of *Corbicula sp., Melanoides sp, Thiara sp, sp, Tarebra sp, Balanus sp, Polychaeta* and *Barbatia.*
3. In the rainy season in week 1 and week 2 is the opposite of dry season station 1. The rate of volume accumulated of the highest in week 1 with a value of 2.00 and accumulated volume in week 2 with the value of the volume of accumulated 1.98. In the rainy season flow from upstream Rivers Citanduy very high, this carries sediments.

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