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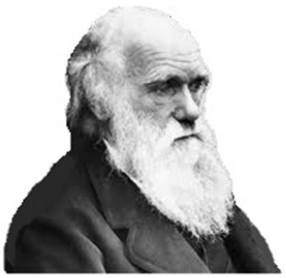

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Influence of Rainfall Intensity Towards Macrozoobenthos Community Structure in Ciletuh Bay Regency of Sukabumi District, West Java, Indonesia

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ABSTRACT

The purpose of the study, undertaken between May 2018 and April 2019, is to determine the effect of rain water intensity on the value of macrozoobenthos structures in Ciletuh Bay. The data used in this research and directly taken from the research site are seawater quality parameters, analysis of sample granulometry and identification of the sample macrzoobenthos, while all data processing was conducted in the laboratory. The method used in this study was purposive sampling. The result of this research in the sand type sediment texture brought a count of 96 macrozoobenthos individuals. In contrast, the count was only 7 in silt type sediments. The study concluded that the effect of varied rainfall intensity impacts the water quality parameters that caused the different types of sediment in Ciletuh Bay.

***Keywords*:** Ciletuh Bay, Macrozoobenthos, Nutrient, Months, Water quality parameters, Sukabumi

1. INTRODUCTION

Ciletuh Bay is an open water bay directly connected with the Indian Ocean. Its aquatic condition is influenced by the wave energy that affects the dynamics of the coastline. In addition to being affected to this, there are several other factors that affect the chemical and physics conditions of the waters in Ciletuh Bay. These include human activity, the weather and the fast moving river water emptying into seawaters of Ciletuh Bay.

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These factors can have an impact on sediment distribution that can impinge upon macrozoobenthos spread in the region. The uptake of biological characteristic values, especially the structure of the macrozoobenthos community (abundance and spread) can help to evaluate the quality of the bay's waters.

Based on the above description and the lack of marine research on the influence of rainfall intensity upon the structure of the macrozoobenthos community in Ciletuh Bay, researchers attached to Sukabumi District, West Java, have undertaken research to determine the difference in the distribution of the macrozoobenthos community structure in sediments during different rainfall intensities in Ciletuh Bay, Sukabumi Regency, West Java, Indonesia.

2. METHODS

2. 1. Research Area

The research area is located at Ciletuh Bay in Sukabumi district of West Java (geographical location – **Figure 1**, location coordinates - **Table 1**).

Figure 1. Research Study Area

Table 1. Coordinates of Research Station

Station	Latitude	Longtitude
1	–7.186861°	106.431861°
2	–7.189389°	106.443500°
3	–7.182806°	106.448667°
4	–7.182845°	106.457651°
5	–7.171157°	106.464503°

2. 2. Data and Method

The data used in this study are water quality (temperature, water transparency, salinity, DO, pH and current velocity), sample sediment, and macrozoobenthos samples taken directly at the research station. Data retrieval was conducted by purposive sampling and was taken on 27 May 2018 to represent May data and on 24 April 2019 to represent April data. The samples of water quality are measured using the tools of each parameter and repeated three times with the results averaged.

The sample sediments were processed to enable comparison with data drawn from granulometric analysis and identification of the macrozoobenthos community structure (identity, abundance, uniformity, diversity and dominance). Macrozoobenthos identification was conducted in the University Ecological Laboratory of Padjajaran, while the processing of sedimentary samples was by way of utilizing Sieve shaker tools and was carried out at the Hydro-Oceanography Laboratory and Laboratory Marine Conservation Faculty of Fisheries and Marine Sciences.

3. RESULTS AND DISCUSSION

3. 1. Research Location Condition

The graph shows that in May 2018 and April 2019, rainfall varied in intensity (**Figure 2**).

From the chart above, on the 27th of May 2018, the intensity of rainfall was 0 mm/day, hence, no rainfall occurred, while the data retrieval in April 2019 on the 24th day of rainfall, indicates that the intensity reached 120.5 mm/day. Since the rainfall rate exceeds 34.8 mm/day, it falls into the category of very high. The difference in rainfall levels at different times will affect physical and chemical water conditions and their biology. The high value of rainfall can influence macrozoobenthos species type and diversity because the level of resistance of each species to changing water conditions differs. The results of water quality data retrieval in Ciletuh Bay during the May and April can be seen in **Table 2**.

The temperature of water in the May shows that it ranges between 28 – 30 ºC, while in April it is between 26 to 30 ºC. The difference between the water temperature of both months is due to the time differences in each sampling of seawater temperature, as sunlight intensity

can affect water temperature. In April, the water temperature becomes cooler because the intensity of sunlight that enters it is reduced due to cloud cover. Still, the natural temperature of the water itself ranges from 0 ºC to 33 ºC, so it can be concluded that the value of the change of water temperature data has no effect on species population change.

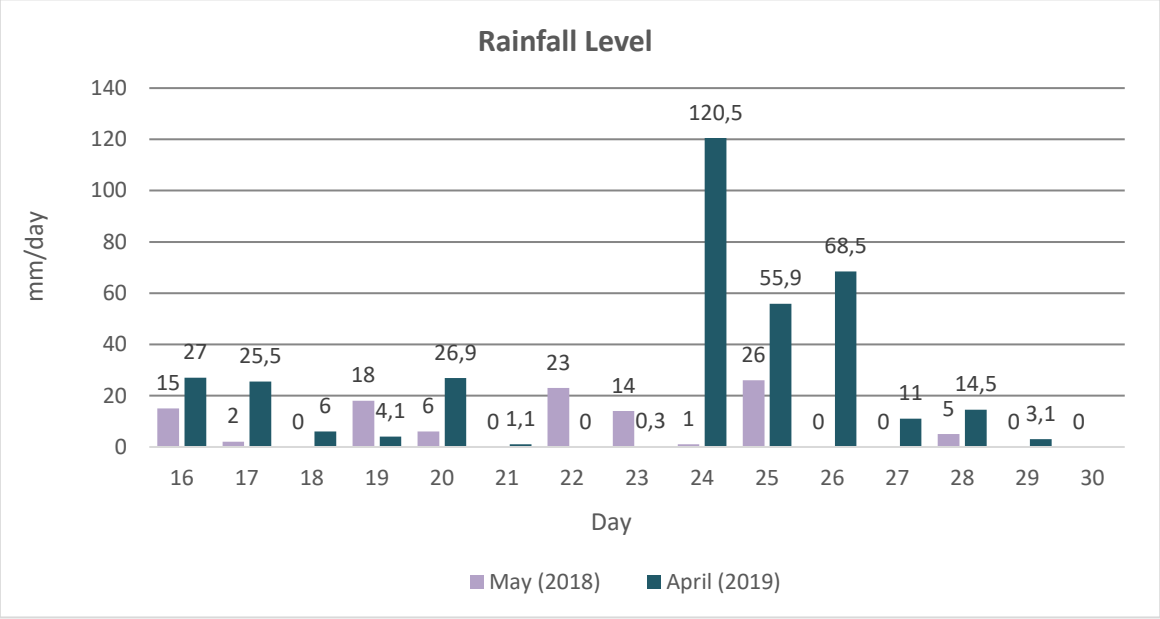

Figure 2. Rainfall Level in May 2018 and April 2019

Table 2. Result of Water Quality Parameters

Station	Water Quality Parameters						
	Months	Sea Temperature (°C)	Water Transparency (%)	Salinity (°/oo)	DO (mg/L)	pH	Current (m/s)
1	May	28	41	15	9.5	7.34	4.7
	April	26	21.43	19	8.5	8.1	4.3
2	May	29	50	26	8.7	7.13	2.3
	April	30	27.78	16	8.3	8	5
3	May	29	15	33	8.3	7.1	0.5
	April	28	17.5	14	5.6	8	4

4	May	29	35	31	7.7	7.13	11.7
	April	27	13.3	20	5.6	8	3.81
5	May	30	25	34	8.7	7.07	8.3
	April	30,5	7	18.33	8.15	8.1	2.48

The value of the water transparency in May ranged from 20.83 - 87.5%, while in April, the water brightness level value differs by 7% - reaching 27.78%. The water value of transparency in May indicate that the water is of good quality according to the quality of the sea of KEPMEN LH No. 51 2004, where the value of good water transparency for sea water is > 3 m or above 10%. The lower value of seawater transparency in April is due to due rainfall intensity and particle run-off into the rivers that carry it into the bay. It, however, can still be classified as 'good'.

In May, the salinity value is between 25 – 34$^{o}/_{oo}$, while in April the salinity value ranges from 14 - 20$^{o}/_{oo}$. The difference in salinity values is due to dilution with freshwater due to rainfall either directly or because of river discharge.

The DO levels in May ranged from 7.7 – 9.5 mg/L, whereas in April, the DO levels were between 5.6 – 8.5 mg/L. The level of DO in the waters of Ciletuh Bay is acceptable as it holds values above DO baseline quality in seawater (> 5 mg/L).

Value of seawater pH in May ranges from 7.07 to 7.34, whereas during April, pH values are fairly stable and range between 8 and 8.1. According to the guidelines of the quality of the sea of KEPMEN LH No. 51 2004, acceptable pH values for sea water are above 5, so pH values are good and have little or no effect on the differences in macrozoobenthos diversity and population.

Average rate of current velocity in May amounted to 5.5 m/s and during April – 3.918 m/s. The current conditions in Ciletuh Bay in both months are classified as very fast (> 1 m/s). This is due to the tidal phenomenon wherein the main drivers of water mass in closed waters such as the bay are tidal.

3. 2. Sediment Type Classifications

An analysis results of sediment samples at each station was made utilizing the software package KUMMOD SEL to assess and to classify the largest sediment sizes obtained during sampling (**Table 3**).

Table 3. Sediment Clasification

Station	Months	Sediment Type
1	May	Gravel Sand
	April	Mud Pebbles

2	May	Sand
	April	Gravel-Sand-Mud mixtures
3	May	Little Gravel Sand
	April	Silt
4	May	Little Gravel Sand
	April	Silt
5	May	Little Gravel Sand
	April	Silt

The type of sediment sampled in May shows that the texture of sediment in Ciletuh Bay is dominated by sand. In contrast, in April, the sedimentary fraction in Ciletuh Bay is dominated by silt. The different types of sediment in each month are caused by the size of the particles carried by current, as well as by run-off.

The spread of sedimentary fraction in April is influenced by slower seawater current movement (Table 3).

Furthermore, the types of gravel-sand sediment fraction present in May contain more macrozoobenthos compared to that held in muddy-silt sedimentary fractions, this results from the silt sediment type being not fit for macrozoobenthos to live in.

3. 3. Macrozoobenthos Community Structure

Observations of macrozoobenthos populations are seen in **Table 4**.

Table 4. Macrozoobenthos

Station	Months	Species					∑
		1	2	3	4	5	
1	May	0	2	0	0	0	2
	April	3	0	2	1	1	7
2	May	18	0	0	0	0	18
	April	0	0	0	0	0	0
3	May	25	0	0	0	0	25
	April	0	0	0	0	0	0

Station	Months	Species					∑
		1	2	3	4	5	
4	May	45	0	0	0	0	45
	April	0	0	0	0	0	0
5	May	6	0	0	0	0	6
	April	0	0	0	0	0	0

Notes:
1: *Donax* sp.
2: *Nassarius* sp.
3: *Engina Zonalis*
4: Larva *Trichoptera*
5: *Conus* sp.

The two species evident in May include *Donax* sp. (**Figure 3**). The mussels have an elliptical shape and a wide line in the shell. A filter feeder, it feeds on phytoplankton and detritus suspended in seawaters. Its vertical spread is related to the ability to dig into the substrate, while, horizontally, its movement is over the surface of substrates in the intertidal area. It lives in sandy type substrates.

Figure 3. *Donax* sp.
(left) Observation Results; (right) Literature Figure (Linnaeus 1758)
(from marinespecies.org)

- *Donax* sp. Classification (Linnaeus 1758):

Kingdom: Animalia
Phylum: Mollusca

Class: Bivalvia
Order: Cardiida
Family: Donacidae
Genus: *Donax*

Another species found in the May period is *Nassarius* sp. (**Figure 4**). This is a specimen that has a cone-shaped graft that is twisted. This type of gastropod is found on the substrate of fractional corals or dead corals and can live in the area of intertidal sands and mud flats.

Figure 4. *Nassarius* sp.
(left) Observation Results; (right) Literature Figure (Linnaeus, 1758)
(from marinespecies.org)

- *Nassarius* sp. Classification (Linnaeus 1758):

Kingdom: Animalia
Phylum: Mollusca
Class: Gastropoda
Order: Neogastropoda
Family: Nassariidae
Genus: *Nassarius*

The April sampling resulted in obtaining 4 species of 4 different families of Macrozoobenthos biota that only exist in Station 1, while in the station 2 – 5, there was no indication of macrozoobenthos biota living in or above the substrate. One of the species found is *Engina zonalis* which is a common tropical gastropod in sand-type substrates (**Figure 5**). Gastropod spawning occurred in the month of Febuary, so the gastropods that emerged in March – April were small in size.

- *Engina zonalis* Classification (Lamarck 1822):

Kingdom: Animalia
Phylum: Mollusca
Class: Gastropoda

Order: Neogastropoda
Family : Pisaniidae
Genus: *Engina*

Figure 5. *Engina zonalis*.
(left) Observation Results ;(right) Literature Figure (Lamarck 1822)
(from marinespecies.org)

Another species that was found is that of the larva of caddisflies (caddisfly) (order Trichoptera). This is a type of insect that in its lifecycle occupies two distinct ecosystems, the aquatic ecosystem and the terrestrial ecosystem. The larva phase of this species lives in freshwater with slow flowing currents and it feeds on detritus algae (**Figure 6**). Thus, it can be considered to be wash-in.

Figure 6. *Engina zonalis*.
(left) Observation Results; (right) Literature Figure (Holzenthal 2009)
(from BugGuide.net)

- *Trichoptera* larvae Classification (Holzenthal 2009):

Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Trichoptera
Family: Hydropsychidae
Genus: *Hydropsyche*

The last species found as, albeit, 1 individual is *Conus* sp. (**Figure 7**). This stays active at night and usually hides in sand type substrates during the day. This species is a gastropod known as a toxic invertebrate. The color patterns and the shape of this gastrop can indicate the quality of its habitat, as this highly influence the brightness of the snail's body.

Figure 7. *Conus* sp.
(left) Observation Results; (right) Literature Figure (Hwass 1972)
(from: animaldiversity.org)

- Classification *Conus* sp. (Hwass 1972):

Kingdom: Animalia
Phylum: Mollusca
Class: Gastropoda
Order: Neogastropoda
Family: Conidae
Genus: *Conus*

From the index value of the overall diversity, it is seen that May has a lower value (1.273) than does April (1.277). Herein, the value of diversity index in both months is between $1 \leq H' < 3$, which means that the diversity or spread of each individual is under a state of low community stability - meaning, that water conditions have been polluted.

The overall value of uniformity indicates that April conditions have a higher value 0,9219 compared to that of May with a value 0.7912. Based on uniformity criteria in both months are included in the stable category, with the index value of uniformity being $0 < E \leq 1$. The value

of high uniformity during the April was due to the even distribution of species, so that there was no dominant species in this month (**Table 5**).

Table 5. Abundance Index

Station	Months	Species				
		1	2	3	4	5
1	May	0	25	0	0	0
	April	**37.5**	0	25	12.5	12.5
2	May	225	0	0	0	0
	April	0	0	0	0	0
3	May	312.5	0	0	0	0
	April	0	0	0	0	0
4	**May**	**562.5**	0	0	0	0
	April	0	0	0	0	0
5	May	75	0	0	0	0
	April	0	0	0	0	0

Notes:
1: *Donax* sp.
2: *Nassarius* sp.
3: *Engina Zonalis*
4: Larva *Trichoptera*
5: *Conus* sp.

The highest abundance index value in May was 526.5 ind/cm^2, while in April the comparative figure was lower, being 37.5 ind/cm^2. The high abundance of species *Donax* sp. in May is due to the supporting conditions wherein nutrient needs in the substrate are fulfilled. The low abundance of species during April was caused by the lack of stability in the seawater conditions due to the influence of rainfall (7 individuals only).

The highest dominance index is in May, with *Donex* sp. having a value of 0.9587. The related figure for *Donex* sp. in April is 0.1837. This signifies that the species of *Donax* sp. survives in Ciletuh Bay during April, as well as in May, but it does not thrive.

3. 4. Rainfall Intensity Influences on Macrozoobenthos Distribution

The only major difference between the two months is in rainfall intensity level. The May sampling occurred at a time of no rainfall, while the April sampling was at a time of significant rainfall. In May, as many as 96 individual macrozoobenthos were sampled, while, in April, only 7 individual macrozoobenthos were captured – and this at only one station. We believe that the

intense rainfall brought about instability in the quality conditions of the seawater due to the inclusion of mainland runoff into water and this affecting feeding habits and the transparency of the waters. The value of water quality at Ciletuh Bay on both months were significantly different – especially in seawater current, water transparency and also salinity. The seawater current affected the sedimentary texture type that settle at the bay bottom, and a sediment texture type that not suitable for macrozoobenthos can disturb availability in that area. The abundance of macrozobenthos is related to the sedimentary texture, which means that substrate conditions during different months may impinge upon the availability of macrozoobenthos in such waters.

4. CONCLUSION

The conclusion of this is that rainfall intensity differences affect water quality values that can impact the type of substrate located at the base of the seawater and affect the distribution pattern of macrozoobenthos living in the waters of Ciletuh Bay.

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