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Original research article

The Density of Megabentos in Coral Reef Ecosystems in The Waters of Pongok Island, South Bangka District

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ABSTRACT

Biota plays a role in reef coral is megabenthos . Megabenthos is a large benthic biota more of 1cm and has Power adaptation to condition environment . Benthic biota usually found at the bottom waters like ecosystem reef coral and fields seagrass . Waters Island Pongok own diversity biological abundant sea _ so that made source search society in general working as a fisherman with method netting, fishing and doing arrest with another way . Apart from that, some fisherman Still use tool catch those who don't friendly environment like use bomb and shoot For catching fish. Megabenthos data collection use method Benthos Belt Transect and reef data collection coral use method Underwater Photo Transect . Research results in Water Island Pongok 12 species were found of the 6 families found in the waters Island Pongok . Density value megabenthos found _ range between 0.007-1.257 (ind /m²) which is dominated by species Diadem setosum with average value _ amounted to 0.688 (ind /m²), whereas density Lowest is in the species Drupella cornus , Linckia multifora and Trochus niloticus with the average value density 0.002 (ind /m²). Percentage cover reef coral live on the Island Pongok range between 28.67%-63.87% in Medium to Good category . Analysis results Principal Component Analysis (PCA) was obtained results density highest that is Correlated diadema _ with temperature with mark the correlation is 1,000 and temperature namely 0.825, next clams correlated with pH and value the correlation is 0.465 and pH 0.982. From these two biota categorized as correlated perfect with physical and chemical parameters waters. Connection density megabenthos with form growth reef coral density megabenthos highest at the location study is species Diadem sp . which is correlated tall with Dead Coral Algae (DCA) with mark the correlation is 0.998. Density megabenthos Lowest is Correlated Drupella _ tall with Dead Coral Algae (DCA) with mark the correlation is 0.998, and Linckia multifora correlated tall with Coral Foliose (CF) with mark the correlation is 0.925.

Introduction

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According to South Bangka BPS data in 2019, the island Pongok is One from eight island small area located in South Bangka Regency, Bangka Belitung Islands. The fisheries sector _ is one of sector main in the economy of Subdistrict Island Pongok, because is the contributor biggest to economy of Subdistrict Island Pongok. The potential for coastal resources is very large, making the people earn a living as fishermen because Pongok Island has marine biodiversity, one of which is the coral reef ecosystem.

Coral reefs are underwater ecosystems produced by Cnidarians in symbiosis with Zooxanthella which then form sediment structures in the form of calcium carbonate or a type of limestone (Arisandi et al., 2018) . Based on the condition of coral cover, it also influences the biota that live in coral reef ecosystems, one of the biota that plays a role in coral reefs is megabenthos.

Megabenthos is a large benthic biota more of 1cm and has Power adaptation to condition environment. Benthic biota the normally found at the bottom waters like ecosystem reef coral and also fields seagrass. Megabenthos includes creeping and attached biota like corals, echinoderms, molluscs and crustaceans. (Arbi and Sihaloho, 2017).

Waters Island Pongok has a diverse biological abundant sea, so that made source search for society in general working as a fisherman with method netting , fishing and doing arrest in another way. Apart from tools catch the part fishermen also still do use tool to catch those who don't friendly environment like using bombs and shooting to catch fish. Using fish bombs for fishing has a impact significant negative like the damage Coral reef ecosystem as a place of living biota (Latuconsina, 2010). As well as changes as small as anything on land can affect it existing waters surrounding. Therefore, it is necessary done study about density of megabenthos in the ecosystem of reef coral in the waters of Island Pongok, South Bangka Regency, to know the condition of megabenthos and reef coral. The research result is expected to be based on effort management and conservation of reef coral in the future.

Materials and Methods

Research Sites

The study was held in October 2023 on the Island Pongok, District Island Pongok, South Bangka Regency, Indonesia (Figure 1).

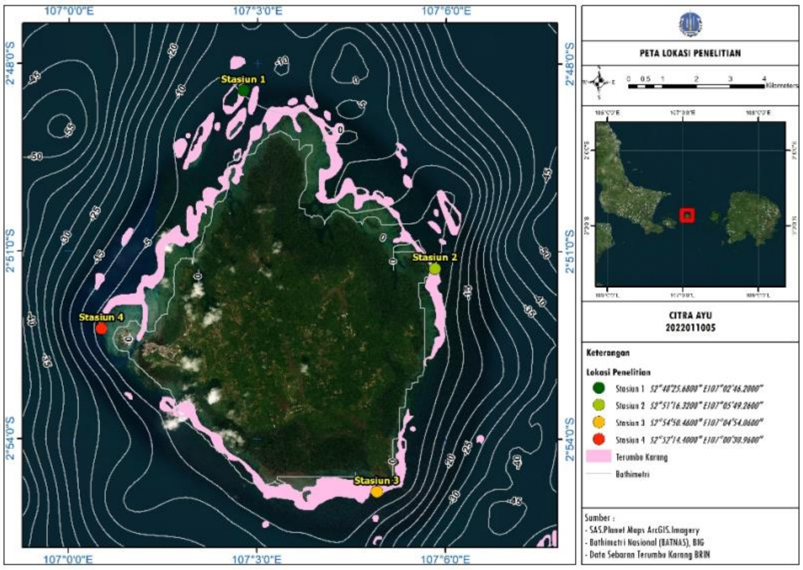

Figure 1. Research Location

Tools and Materials

Tools and materials used are Stationery, TSS bottle, Frame (44 × 58 cm), GPS, Refractometer, Underwater camera, SCUBA set, pH Meter, Secchi disk, Thermometer, book identification megabytes, roll meter, kite current, and stopwatch.

Data Collection Method

Physical and chemical parameters of water are measured both *in situ* and *ex situ*. Samples of total suspended solids (TSS) were collected using sampling bottles and tested at the UPTD Laboratory of the Environment and Forestry Service of Bangka Belitung Islands Province.

Megabenthos data collection uses the BBT (*Bentos belt transect*) method which is a modification from the method *Belt Transect* combined with the *Reef Check Benthos method*. This method done with method draw a transect tape line scale (roll meter) parallel to the coastline with a ribbon length 70 meters. Then recording group or type target megabenthos per individual at start from point 0 to 70 meters with wide observation 1 meter to left and 1 meter to right of the transect line, so the size of the monitoring area to 140 m^2 (2 m × 70 m) (Arbi and Sihaloho, 2017).

Reef data collection coral uses the method of *Underwater Photo Transect* (UPT) which means Underwater Photo Transect. Where deep-use method, is done by stretching of transect lines throughout 50 meters parallel with the coastline with put square *frame* every meter (Daud *et al.*, 2021). Laying *frames* started from meters to one, for odd meters *frames* were placed next to the left line, and for even meters, *frames* were placed next to the right line.

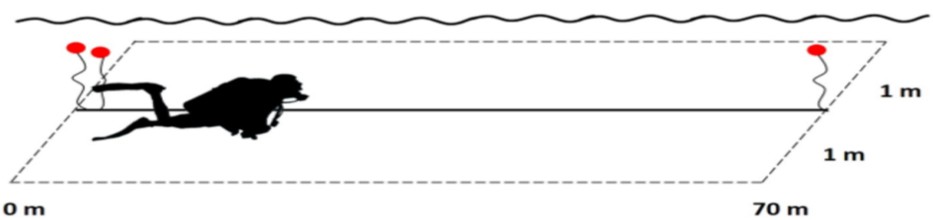

Figure 2. The scheme for collecting megabenthos data (Arbi and Sihaloho, 2017)

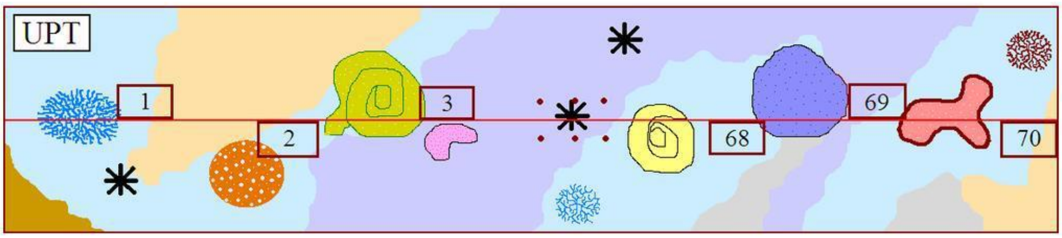

Figure 3. Coral data collection scheme (Giyanto, 2014)

Data Analysis

Density megabenthos

Density species is something method to find out the number of individuals per unit area of a certain area and is characteristic something depicting community _ about diversity something species present _ in community the density megabenthos can calculated use formula under this (Hakiki , 2022):

$$Density\ of\ X\ species = \frac{Number\ of\ individuals\ X}{Belt\ transect\ width}$$

Percentage Coral Reef Cover

Percentage cover generated from method measure *intercept* colony coral through which the transect line passes . Number of *Intercept* Lengths colony coral along the divided transect line with Transect length ×100% then give results percentage the cover . Condition cover reef coral based on percentage cover coral life according to Minister of Environment Decree No.4 of 2001 concerning Damage Quality Standards Coral Reefs are:

Bad = 0% - 24.9%
Medium = 25% - 49.9%
Good = 50% - 74.9%
Very well = 75% - 100%

Reef data coral that has obtained with method method *Underwater Photo Transect* (UPT) identified Then processed use CPCE application .

Connection Density Megabenthos with Environmental and Form Factors Growth Coral reefs

Connection abundance megabenthos with factor environment and form growth reef coral identified use analysis *Principal Component Analysis* (PCA). PCA analysis is a statistical technique For change some of the original variables used each other correlated One with the others become One more new groups of variables small or simple and mutual free , so analysis This works For present information on the inner data matrix form graph (Noya *et at* ., 2017).

Result and Discussion

Results

Abundance of Megabenthos

There are 10 types of megabenthos found at the observation site. The highest megabenthos density is Diadema setosum with an average density value of 0.452 individuals/m². The megabenthos density in the waters of Gelasa Island can be seen in the following Table 1.

Table 1. Density of megabenthos species (ind/m²) in the Waters of Gelasa Island

No.	Megabentos	Density (ind/m²)				Averange
		Station 1	Station 2	Station 3	Station 4	
1	*Diadema setosum*	0,136	0,764	0,186	0,721	0,452
2	*Diadema antilarium*	0,050	0,057	0,029	0,386	0,130
3	*Echinothrix calamaris*	0	0	0,114	0,264	0,095
4	*Drupella rugosa*	0,021	0	0,043	0,029	0,023
5	*Drupella cornus*	0,086	0	0,043	0,021	0,038
6	*Tectus pyramis*	0	0	0,007	0	0,002
7	*Trochus conus*	0	0	0,014	0	0,004
8	*Tridacna squamosa*	0	0,014	0	0	0,004
9	*Tridacna crocea*	0	0,036	0,014	0,086	0,034
10	*Acanthaster planci*	0	0,007	0	0,007	0,004

Coral Reef Cover Percentage

The coral reef ecosystem coverage in the waters of Gelasa Island, after analysis using the CPCE (Coral Point Count With Excel Extensions) software, revealed that there are 2 stations categorized as 'good,' namely stations 1 and 3, with values ranging from 64.40% to 71.00%. Meanwhile, stations 2 and 4 fall under the 'fair' category, with values ranging from 26.60% to 41.33%. The data for live coral reef cover results are presented in the following Table 2.

Table 2. Percentage of Live Coral Reefs

No	Category	Location			
		Station 1	Station 2	Station 3	Station 4
1	Coral (HC)	64,40	41,33	71,00	26,60
2	Recent Dead Coral (DC)	0,00	0,00	0,07	0,00
3	Dead Coral with Algae (DCA)	27,20	47,13	21,20	37,40
4	Soft Coral (SC)	0,80	0,47	0,60	1,20
5	Sponge (SP)	0,00	0,00	0,00	0,20
6	Fleshy Seaweed (FS)	0,07	0,07	0,00	0,13
7	Other Biota (OT)	2,73	3,27	2,73	5,93
8	Rubble (R)	4,60	5,80	4,40	16,60
9	Sand (S)	0,20	1,93	0,00	11,93

Water Quality Parameters

The water quality data comprises physical and chemical parameters collected during coral and megabenthos data collection, including temperature, pH, salinity, clarity, water depth, current velocity, and TSS. The processed results are presented in the following Table 3.

Table 3. Physical and Chemical Water Data

No	Parameters	Station 1	Station 2	Station 3	Station 4
1	Temperature (℃)	29	30	31	30
2	Salinity (‰)	28	26	30	30
3	Current Velocity (m/s)	0,0453	0,0182	0,0584	0,0267
4	Clarity (%)	100	100	100	100
5	Depth (meters)	6	5	6	6
6	Potensial of Hydrogen (pH)	9	8	8	8
7	Total Suspended Solid (TSS) (mg/liter)	19,4667	17,8667	26,7333	43,8

The Relationship Between Megabenthos Abundance and Water Physics and Chemistry Parameters

The analysis results indicate the presence of correlation information on axes F1 = 46.67% and F2 = 34.87%. The results of Principal Component Analysis (PCA) for megabenthos abundance with water physics and chemistry parameters can be seen in the following Figure 4.

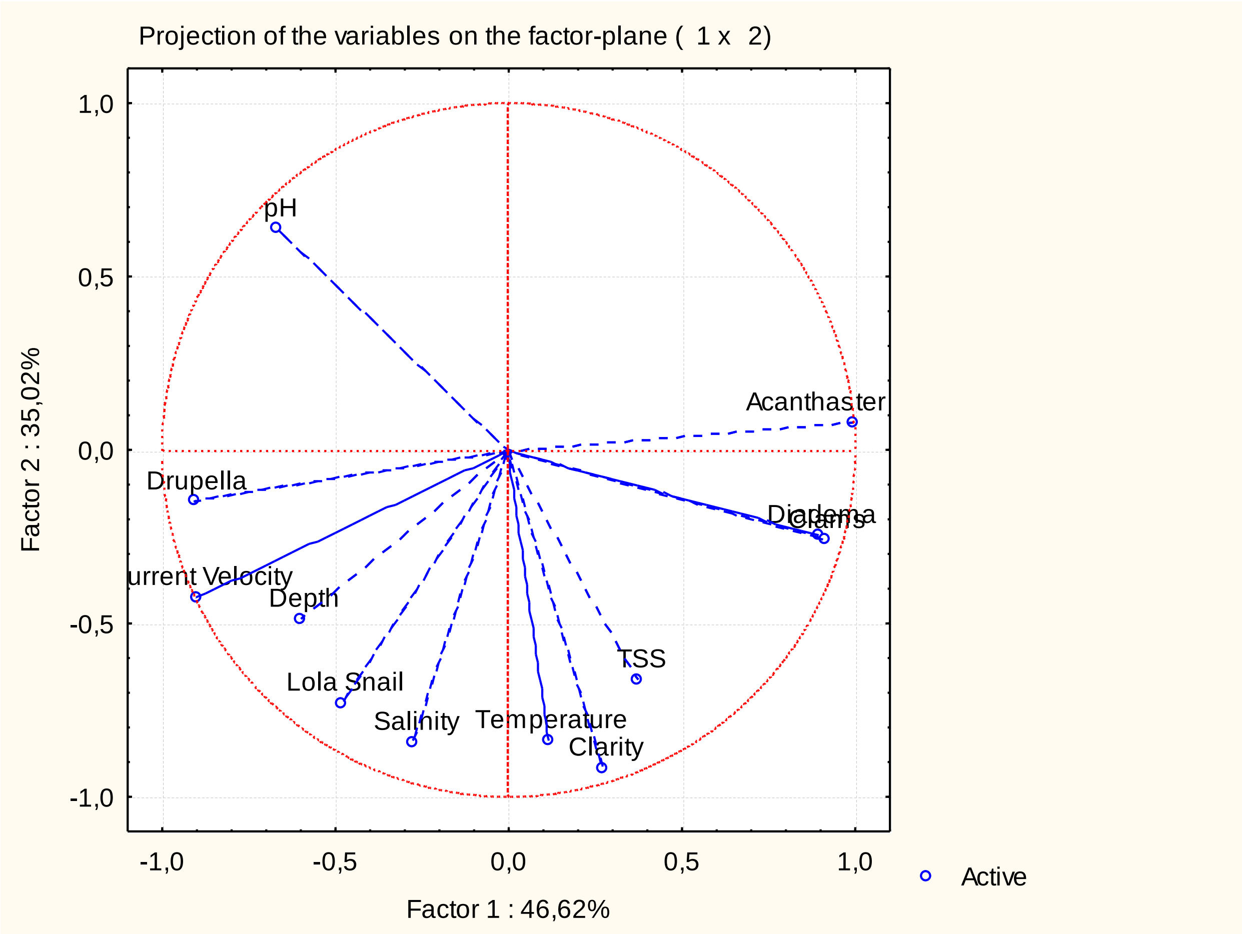

Figure 4. PCA Graph of Megabenthos' Relationship to Water Parameters

The Relationship Between Megabenthos and Coral Reefs

The analysis results indicate the presence of correlation information on axes F1 = 50.15% and F2 = 28.07%. The results of Principal Component Analysis (PCA) for megabenthos abundance with coral reef life forms can be seen in the following Figure 5.

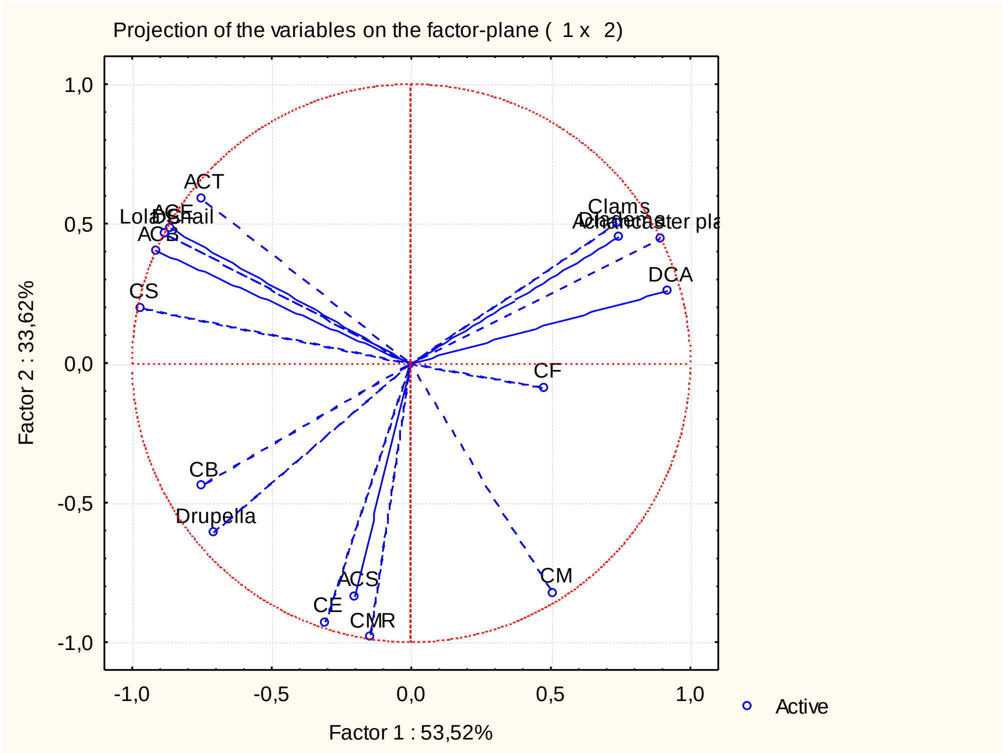

Figure 5. PCA Graph of Megabenthos' Relationship with Coral Reefs

Discussion

Megabenthos Abundance

The megabenthos found in the waters of Gelasa Island consists of 10 species: Diadema setosum, Diadema antillarium, Echinothrix calamaris, Drupella cornus, Drupella rugosa, Tectus pyramis, Trochus conus, Tridacna squamosa, Tridacna corcea, and Acanthaster planci. Diadema sp. was found at all observation stations. There are 3 types of Diadema, namely Diadema setosum, Diadema antillarium, and Echinothrix calamaris. The highest density value of Diadema setosum was found at station 2, which is 0.764 ind/m². The highest density value of Diadema antillarium was found at station 4, with 0.385 individuals/m². Echinothrix calamaris was only found at stations 3 and 4, with the highest density value being 0.264 individuals/m². The presence of Diadema sp. was found at all observation stations because Diadema sp. can thrive in various coral reef ecosystem conditions.

Two types of Drupella were found at the observation stations: Drupella cornus and Drupella rugosa. The highest density value of Drupella cornus was found at station 1 with a value of 0.085 ind/m². The highest density value of Drupella rugosa was found at station 3 with a value of 0.042 ind/m². The high density values of Drupella at these stations can be attributed to the favorable condition of the coral reefs, providing an abundant food source for Drupella.

The keong lola was only found at station 3. There are 2 types of keong lola found at the observation site: Tectus pyramis and Trochus conus. Keong lola is difficult to find because they are active at night, and during the day, they hide behind the corals. This behavior is consistent with their nocturnal lifestyle (Arbi and Sihaloho, 2017).

There are 2 types of giant clams (kima) at the observation site: Tridacna squamosa and Tridacna crocea. Tridacna squamosa was only found at station 2 with a density of 0.014 ind/m². The highest density value of Tridacna crocea was at station 4, with a value of 0.085 ind/m². Giant clams were almost found in all research stations because they are relatively easy to find in clear waters. Clear waters allow maximum sunlight penetration, facilitating photosynthesis for zooxanthellae living in the mantle tissues of giant clams (Rivanda et al., 2020).

Acanthaster planci was only found at stations 2 and 4, with a density of 0.0071 ind/m². This type of starfish preys on coral polyps, especially branching or table-shaped corals, such as Acropora species. Acanthaster planci lives in coral reef areas, following the distribution pattern of its coral prey (Arbi and Sihaloho, 2017).

Coral Reef Ecosystem Condition

The research results indicate that at station 1, there is a live coral cover percentage of 64.40%, station 2 has a live coral cover percentage of 41.33%, station 3 shows a live coral cover percentage of 71%, and station 4 has a live coral cover percentage of 26.60%. According to the Minister of Environment Decree No. 4 of 2001 regarding the Standard for Coral Reef Damage, the coral reef condition in Gelasa Island's waters can be classified as being in moderate to good health, as evidenced by the percentage of live coral cover. This is also attributed to the penetration of light into the water column, allowing Zooxanthellae to undergo photosynthesis, along with favorable physical and chemical water factors (Fajri, 2014).

Physical and Chemical Water Parameters

The water temperature obtained from data collection ranged from 29°C to 31°C, which is considered normal and suitable for organisms living in coral reefs. The salinity values ranged from 26 to 30‰. The salinity values at the research location are still within the supporting category for marine life. According to Hartoni (2012), salinity in coral reef ecosystem waters typically falls within the range of 27 - 40‰.

The current velocity ranged from 0.0182 to 0.0584 m/second, which falls into the calm category. Calm to moderate current speeds typically range from 0.1 to 1 m/s. Calm currents are advantageous for benthic organisms as they promote the renewal of organic and inorganic materials without accumulation. Water clarity data indicated 100% clarity, with water depths at each station ranging from 5 to 6 meters during data collection. Water clarity is one of the important factors in an aquatic environment.

The values of Total Suspended Solids (TSS) ranged from 17.8667 to 43.8 mg/liter. The water's pH levels at the research stations ranged from 8 to 9, indicating a basic nature, which is typical of seawater. High pH values in a water body indicate good water quality in that location (Susana, 2019).

The Relationship Between Megabenthos Abundance and Water Physical and Chemical Parameters

The abundance of Drupella correlates with pH, current velocity, depth, and salinity because these parameters have a significant impact on the presence of Drupella in the waters of Gelasa Island. pH can influence the presence of Drupella in a water body (Istiqomah et al., 2019). pH plays a role in the survival and reproduction of gastropods. Low pH levels can lead to a decrease in the dissolved oxygen content in a water body, causing an increase in gastropod respiratory activity and a decrease in their feeding.

Slow current velocity can support the growth of gastropods that prefer slower currents because they can grow and move undisturbed. Depth affects the organisms that live in the water. Deeper waters have lower dissolved oxygen levels due to lower light penetration, which hinders the process of photosynthesis (Siswansyah and Kuntjoro, 2023). Salinity is also a critical parameter in marine life, as changes in salinity can affect the density of organisms in the water.

The abundance of Turbo Snails has a strong correlation with temperature, salinity, current velocity, and water clarity. Temperature is a supporting factor for Turbo Snail life, with an ideal temperature of 31°C. Temperature influences the abundance and quality of their natural food sources. Salinity affects the distribution of Gastropod organisms. Turbo Snails are active at night and move slowly. During their activities in search of food and shelter, they move slowly, sometimes aided by the movement of ocean currents (Sadili et al., 2015).

Acanthaster planci correlates with Total Suspended Solids (TSS). Total Suspended Solids (TSS) is related to water clarity and sedimentation. The research results show a positive correlation between Total Suspended Solids (TSS) and water clarity. Sunlight penetration into the water is influenced by the sedimentation level.

The abundance of Diadema and Tridacna correlates with water clarity and Total Suspended Solids (TSS). Water clarity and TSS are closely related because high TSS levels in a water body can hinder the penetration of light into the water. Light is a critical factor needed for coral growth. Water clarity values indicate the amount of light entering the water to support productivity in the coral reef ecosystem.

The Relationship Between Megabenthos Abundance and Coral Reefs

Diadema, Tridacna, and Acanthaster Planci have a strong correlation with Dead Coral Algae (DCA). Sea urchins, such as Diadema, feed on algae (Thamrin et al., 2011). Dead coral serves as a substrate for algae growth and is utilized by sea urchins as a foraging ground (Quanita, 2018). Tridacna abundance depends on the condition of the coral reef habitat; if the coral reef is damaged, it can impact the number of Tridacna clams. Acanthaster Planci heavily relies on coral growth or can be found under dead coral rubble, with a preference for microalgae as their food source (Arbi and Sihaloho, 2017).

Drupella has a strong correlation with the growth forms of coral, such as ACB, ACS, CB, CE, CMR, and CS. Kanela et al. (2018) mentioned that Drupella sp. has a habit of feeding on branching coral polyps, especially from genera like Acropora, Pocillopora, and Montipora. Riska et al. (2013) stated that Drupella prefers coral species like Acropora branching, Acropora encrusting, Acropora tabulate, Coral branching, Coral Encrusting, Coral foliose, Coral massive, and Coral submassive for their diet but can consume other coral types if their preferred choices are unavailable.

Keong Lola has a strong correlation with the growth forms of coral, including ACB, ACE, ACT, CB, CS, and DC. Keong Lola typically resides among broken coral, dead coral, and crevices in shallow subtidal and intertidal reef areas (Arbi and Sihaloho, 2017). The highest population density of Keong Lola is found in dead coral areas (Sadili et al., 2015). A suitable habitat for Keong Lola consists of large, hollow, and creviced coral structures. These conditions are related to the nocturnal feeding behavior of Keong Lola, which actively forages for food during the night (Sadili et al., 2015).

Conclusion

A total of 10 megabenthic species were found in Pulau Gelasa, including Diadema setosum, Diadema antilarium, Echinothrix calamaris, Drupella cornus, Drupella rugosa, Tectus pyramis, Trochus conus, Tridacna squamosa, Tridacna corcea, and Acanthaster planci, with the species density dominated by Diadema setosum with an average density value of 0.452 ind/m². Drupella showed correlations with pH, depth, current velocity, and salinity, while Keong Lola exhibited strong correlations with temperature, salinity, current velocity, and brightness. Acanthaster planci had a moderate correlation with Total Suspended Solid (TSS), and Diadema and Kima correlated with brightness and Total Suspended Solid (TSS). Megabenthos related to the life form of coral, namely Diadema, Kima, and Acanthaster planci, showed correlations with Dead Coral Algae (DCA), while Drupella correlated with Acropora branching (ACB), Acropora submassive (ACS), Coral branching (CB), Coral encrusting (CE), Coral mushroom (CMR), Coral Submassive (CS), and Keong Lola correlated with Acropora branching (ACB), Acropora encrusting (ACE), Acropora tabulate (ACT), Coral branching (CB), Coral Submassive (CS), and Dead coral (DC).

References

Adi W. 2019. Ecosystem Mapping At Gelasa Island Central Bangka Regency. *Journal of Tropical Marine Science*. Vol. 1 (2) : 11-14 hlm.

Adi W, Komarullah U, Dedi, Sanjaya H, Ardyansah R, Gunawan R, Mahatir M, Mustofa K, Ramadhani MR, Sartini, Susanti S, Febryanti E, Khaeruddin, Akbar AH, Arifin SWT. 2020. The Coral Reef Condition of Gelasa Island, Central Bangka Regency . *JOURNAL AKUATIK*. VOL 14(2): 13-19 hlm.

Akbar A.H., Adibrata S., Adi W. 2019. Megabentos Association with Coral Reef Ecosystems in the Waters of Perlang Village Central Bangka, Bangka Belitung. *Journal of Tropical Marine Science*. Vol 13 (2) : 173-177 hlm.

Arbi UY, Sihaloho AF. 2017. Megabenthos Monitoring Guide. Indonesian Institute of Sciences. Jakarta. ISBN 978-602-6504-12-8.

Fajri MA. 2014. Association of Macrozoobenthos with Coral Reefs [Skripsi]. Bangka: Faculty of Agriculture, Fisheries and Biology, Bangka Belitung University.

Giyanto, Manuputty AEW, Abrar M, Siringoringo RM, Suharti SR, Wibowo K, Arbi INEUY, Cappenberg HAW, Tuti HFSY, Anita ZD . 2014. Coral Reef Health Monitoring Guide. Indonesian Institute of Sciences. Jakarta.

Hartoni. 2012. Condition of Coral Reefs in the Waters of Tegal and Sidodadi Islands, Padang Cermin District, Pesawaran Regency, Lampung Province. *Maspari Journal*. Vol 4(1) : 46-57 hlm.

Istiqomah, Supratman O, Syari IA. 2019. The Relationship Between Drupella Snail Density And The Condition Of The Coral Reef Ecosystem In The Waters Of Semujur Island, Province Of Bangka Belitung Island. *Akuatik Journal*. Vol 13(2): 152-161 hlm.

Kanela NWG, Dirgayusa IP, dan Widiastuti. 2018. Predation Preferences of Drupella sp. on Different Types of Coral in Pemuteran Waters, Bali. *Journal Of Marine Research And Technology* Vol 1(1) : 5-10.

Decree of the Minister of Manpower of the Republic of Indonesia No.139 In 2019. Implementation of Indonesian National Work Competency Standards Category of Professional Scientific and Technical Services Main Group of Research and Development of Science in the Field of Coral Reef Condition Assessment.

Mutaqin BW, Yuendini EP, Aditya B, Rachmi IN, Fathurrizqi MI, Damayanti SI, Ahadiah SN, Puspitasari NNA. 2020. Megabenthos Abundance As Coral Health Indicators In Bilik Water, Baluran Naional Park, Indonesia. *Enggano Journal*. Vol. 5(2): 181-194 hlm.

Quanita I. 2018. Echinodermata Density in Coral Reef Ecosystems in the Waters of Ketawai and Gusung Asam Islands, Central Bangka [skripsi]. Bangka: Faculty of Agriculture, Fisheries and Biology, Bangka Belitung University.

Riska, sadarun B, dan Haya Y. 2013. Abundance of Drupella in Corals Reef Area of Belan-Belan Besar Island, Tiworo Strait. Mina Laut Journal. Vol 02 : 69-80.

Rivanda R, Susiana S, Kurniawan D. 2020. Inventory of clams Tridacnidae in Batu Bilis Island, Kelarik Village Bunguran Utara District, Natuna Regency, Riau Islands, Indonesia. *Akuakultur, Pesisir dan Pulau-Pulau Kecil Journal*. Vol. 4(2): 59-63 hlm.

Sadili D, Sarmintohadi, Ramli I, Sari RP, Miasto Y, Rasdiana H, Annisa S, Terry N, Sitorus EN. 2015. National Action Plan Lola Conservation. Director of Conservation and Marine Biodiversity, Ministry of Maritime Affairs and Fisheries.

Susana J. 2019. Acidity Level (pH) and Dissolved Oxygen as Water Quality Indicator at Around Cisadane River Estuary. JTL. Vol. 5(2): 33-39 hlm.

Thamrin, Setiawan, YJ., Siregar,SH. 2011. Analysis of Sea Urchin Diadema Setosum Density on Different Condition of Coral Reef In Mapur Village Riau Archipelago. Vol 5(1): 45-53 p.