The coral reef health index in Teluk Sebong, Bintan Island

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Abstract. Teluk Sebong is one of the areas around Bintan Island, Indonesia, that has potential coral reef resources. Bintan borders directly with neighbouring countries and with a major shipping lane (ALKI I) traversing the Indonesian Archipelago. This makes the coral reef ecosystems in this region particularly vulnerable to disruption from changes in the aquatic environment. There is a need for primary data on the coral reef ecosystem condition as a basis for understanding changes in this ecosystem. One commonly used method is the Coral Reef Health Index (CRHI), which can describe the current status in terms of live coral cover, the level of resilience (potential for recovery) during times of stress, the condition of economically important reef fish biomass, and ecologically related functions. The CRHI can be used in monitoring coral reef status and can provide a basis for the management of coral reef ecosystems. This study examined five sampling sites located in Teluk Sebong, Bintan Island. The in-situ data collection included the condition of coral reefs using the Underwater Photo Transect (UPT) method and reef fish condition using the Underwater Visual Census (UVC) method. The coral data collected were analyzed using the CPCe (Coral Point Calculate with Excel extension) software version 4.0 to determine the percentage benthic cover. The coral reef fish data were analyzed to provide target fish density and biomass values (carnivores and herbivores). The live coral cover in Teluk Sebong ranged from 30.87 - 45.40%. Out of the five research sites, Berakit, Pengudang, and Lagoi Bay had coral cover in the high category while coral cover at Banyan Tree and Rawa Island was in the medium category. Reef fish biomass in Teluk Sebong ranged from 9.26 - 108.07 kg/ha, and at all research sites fish biomass was in a low category. The coral reef ecosystem resilience in Teluk Sebong was high at the Berakit and Banyan tree sites; in contrast, Pengudang, Lagoi Bay, and Rawa Island were in the low resilience category. The coral reef index (CRHI) value was highest in Berakit (CRHI = 6), followed by Banyan Tree (CRHI = 5), Pengudang (CRHI = 4), Lagoi Bay (CRHI = 4), and Rawa Island (CRHI = 2).

1. Introduction

Bintan is one of the districts in the Riau Islands Province, which consists of coastal areas and small islands. Since the Bintan Regency directly adjacent to neighbouring countries. Consequently, the Bintan Regency has strategic values with various comparative and competitive advantages and has the potential to become the primary driver of national and regional development. The Teluk Sebong is one of the

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locations directly adjacent to neighbouring Malaysia and Singapore in the Bintan that has the potential for superior marine resources. Several Teluk Sebong areas are famous as a marine tourism destination due to the location has white sandy and beautiful panoramic landscape, including Berakit Beach, Pengudang Beach, and Lagoi Tourism Area. Besides having a beautiful panoramic beach, The Teluk Sebong has coral reef ecosystem resources. Coral reef ecosystems are essential ecosystems in the marine ecosystem that play a significant role in the survival of marine life such as fish and another biota [1–3]. Several research results in the Teluk Sebong had found a diverse endanger marine species are associated with coral reef ecosystems, including giant clamp and sea horses [4]. Coral reefs also have a high aesthetic value for the development of marine tourism. However, in addition to their essential functions and roles, coral reefs are an ecosystem that is vulnerable to damage [5,6] from changes in the aquatic environment [7].

The Teluk Sebong area, which is directly adjacent to neighbouring countries and the Indonesian Archipelago Sea Channel (ALKI) I. Consequently, the coral reef ecosystem in this area also very vulnerable to disturbances from changes in the aquatic environment, both physically and chemically. The Baseline data regarding the condition of coral reef ecosystems is needed as a basis for knowing changes in these ecosystems and the Coral Reef Health Index (CRHI) is suitable analysis for determining the health of coral reef ecosystem. The CRHI has been developed by several institutions and researchers [8–10]. Kaufman et al. (2011) include three parameters to determine the Coral Health Index (CHI), including benthic condition (i.e. live coral cover and *crustose coralline algae*); Fish (i.e. total biomass), and microbes (*vibrio* bacteria concentration) [8]. The World Bank (2006) developed a tool to measure ecosystem health by integrating social and community dimensions. Díaz-Pérez et al. [10] converted from a Coral Health Index (CHI) into a two-dimensional Coral Health Index (2D-CHI). The 2D-CHI index consists only of the benthic and fish parameters used.

According to Giyanto report in 2017 [11], the health of coral reefs in Indonesia is primarily determined by two main components, specifically the benthic component and the reef fish component. The benthic component is strongly influenced by the current condition of live coral cover and the level of resistance, including the ability to adapt and be able to withstand any disturbance/pressure, the level of resilience in the potential for recovery to their original state when the coral is disturbed/stressed. Healthy coral reefs, apart from having a high live coral cover with high resilience and recovery potential, also have economic reef fish biomass (target fish). Regarding the level of resistance or the potential for recovery after the damaged due to disturbance/stress, a pure, healthy coral condition will recovery back to its original condition and show there are no signs of severe damage or disturbance, including the absence of a lot of unconsolidated debris and *fleshy seaweed* [11]. A healthy coral but has a low recovery potential from disturbance will not be better condition than a healthy coral but has a high recovery potential from disturbance. Likewise, corals that are unhealthy (moderate) but have a low recovery potential from disturbance will have a lower condition than corals that are in poor condition but have high recovery potential from disturbance [11].

However, until now, the primary data regarding the condition of the coral reef ecosystem in Teluk Sebong still limited. CRHI value can be suitable for implemented and describe the condition of the current live coral cover value, the level of stress resistance and, the condition of the economical reef fish biomass and the related ecological functions in Teluk Sebong coral reef ecosystem. The CRHI value also can be used as input for Bintan local governments in the context of sustainable coral reef ecosystem management.

2. Materials and Methods

2.1. Research Location

The study was conducted between April 2019 to November 2019 at Teluk Sebong in the northern Bintan Island, Indonesia. The characteristics of the Teluk Sebong coastal area are sandy and muddy sediment composition. The coastal sedimentary is characterized by white to blackish-grey sandy sediment composition result from cleavage of igneous or metasedimentary rocks and shards of white material.

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The coastline structure is straight and curved, and several location areas are bays structure and form of sand and mud coastal sediment. The muddy sediments consist of black clay, and several plant compositions remain. This type of coastal relief is classified as slope topography and forms the plains morphology. Several rivers are actively shrinking in their coastal estuaries area. Besides that, several seasonal rivers form their channels exist in several areas on the ETA coastal area of the Lagoi Bintan. The tides on the northern coast of Bintan Island are tidal propagation from the South China Sea, which is identical to tides in other coastal areas with tidal patterns that tend to be semi-diurnal tides occurring Ebbs and flows twice a day. Generally, the waves in the waters of Teluk Sebong are caused by winds blowing above sea level. The resulting waveform depends on the factors that generate the wave itself, such as wind speed and wind period, also the distance the obstacle passes. Sebong Bay waters are part of shallow waters with a depth distribution of 0 - 28 meters below sea level. The deepest water area is north of Batu Tunggal Island, while the lowest depth is around the coast, ranging from 0 - 10 meters.

The determination of the research site location was using a purposive sampling method based on the existence of coral reef ecosystems in Teluk Sebong. The number of study sites was selected for the cover area in Teluk Sebong and including the exclusive marine tourism and non-exclusive marine tourism location. Three sites located at the exclusive Bintan tourism Area (Lagoi Bay, Banyan Tree and Rawa Island) and another two research sites located at outside exclusive Bintan tourism Area (Berakit and Pengudang) can be seen on Figure 1 and Table 1, as follow.

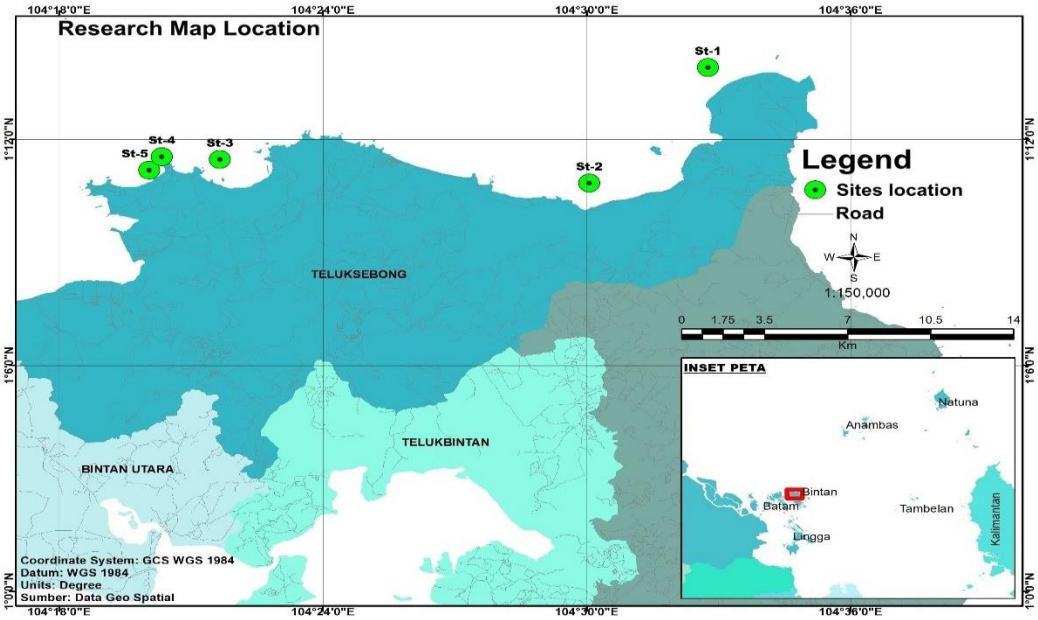

Figure 1. Research map location with three sites located in the Exclusive Tourism Area (ETA) and two sites located in Non-exclusive Tourism Area (Non-ETA).

Table 1. Coordinate of research location.

Sites Location	Sites ID	Longitude	Latitude	Condition
Berakit	St-1	104.5451	1.2309	Non-ETA
Pengudang	St-2	104.5010	1.1807	Non-ETA
Lagoi Bay	St-3	104.3342	1.1864	ETA
Banyan Tree	St-4	104.3390	1.1924	ETA
Rawa Island	St-5	104.3609	1.1913	ETA

Note: ETA (Exclusive Tourism Area)

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2.2. Benthic Survey

The visual observations were made from the coast to the part of the reef where the transect is placed to get a general overview of the research station's condition. Each research station has a measuring tape of 50 meters as the transect line. The transect line was placed parallel to the coastline with 4 m - 7 m of water depth and the land position in the left of the transect. The benthic observation method was used Underwater Photo Transect (UPT), which uses a photo transect with a 44 x 58 cm rectangular frame and taken with underwater camera Canon G15 along the transect line. The photo transect starts from the 1st meter to the 50th meter with a distance between each photo transect was one meter. Each photo transect was taken in sequence by taking odd frame numbers to the left of the transect line (the part closer to the mainland) and followed even frame numbers with taken to the right of the transect line (the part far from the mainland). The coral reef benthic community structure were categories following Giyanto [11,12] with the standard code to input in CPCe based on Kohler [13], including Live Coral/Hard Coral (*Acropora* and *Non-Acropora*), Dead Coral (DC), Dead Coral with Algae (DCA), Soft Coral (SC), Sponge (SP), Fleshy Seaweed (FS), Other Fauna (OT), Rubble (R), Sand (S), Silt (SI) and Rock (RK)

2.3. Reef Fish Assemblages

The coral reef fish assemblages were assessed by Underwater Visual Census (UVC) along 70 meters transect during the diurnal time using SCUBA equipment. The UVC is the standard method for the assessment of reef fishes because it is rapid, non-destructive, and useful for long-term monitoring research. At each site of the research location, a tape meter was laying down with similar sites location with a benthic survey. The reef fishes were recorded in 5 meters wide observation along 70 meters transect line. Thus, the total area of coral reef fishes census was 350 m^2. The CRHI based on Giyanto [11] was selected reef fishes species to be census using UVC methods, including the resilience function category reef fishes in the coral ecosystem (the majority of herbivore fishes) and the economic coral reef fishes (the majority of carnivore fishes). Seven families of reef fishes were choosing for analyses in CRHI, including three family herbivore fishes (Acanthuridae, Scaridae and Siganidae) and four family carnivore fishes (Haemulidae, Lethrinidae, Lutjanidae and Serranidae). Each family reef fishes were counted individual fishes and estimate the body size length of specific species.

2.4. The Coral Reef Health Index Analysis

The Coral Reef Health Index (CRHI) value is a combination of the current condition of live coral cover, the coral reef resilience, and the biomass of coral fish. The coral cover data were analyzed using CPCe version 4.0 software (Coral Point Count with Excel extension) [13] to know the percentage benthic community cover for each category in each photo frame. The CRHI value is determined by its benthic component. In this case, the percentage of live coral cover (*Acropora* and *Non-Acropora*). In addition, the level of resilience is also a very important factor related to the ability to restore coral reef ecosystems after deteriorating conditions, both autogenic and anthropogenic disturbance (bombs/pesticides/nets). The calculation of the benthic component grouping, according to Giyanto [11] as in Table 2, below.

Table 2. The benthic component grouping based on the cover percentage.

The Benthic Component	Value	Categories
Live Coral cover (%)	LC < 19%	Low
	19 ≤ LC ≥ 35%	Medium
	LC > 35%	High
Resilience Level	FS < 3% U (R ≤ 60 LC > 5%)	High
	FS > 3% U (R ≥ 60 LC < 5%)	Low

Note: LC (Live Coral), FS (Fleshy Seaweed), R (Rubble)

The fish component also determines the CRHI as a function of the coral reef ecosystem. If the coral reef ecosystem's function is appropriately in good condition, the fish biomass will also be higher. The reef fishes assemblages analysis for CRHI has used estimates of species density and average body size or

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total lengths (TL) the herbivorous (Acanthuridae, Scaridae, and Siganidae) families, and also the carnivorous fishes family group (Haemulidae, Lethrinidae, Lutjanidae, Serranidae). The estimated TL of reef fishes was converted into reef fishes biomass with a length-weight relationship with the standard formula $W = a \times L^b$. Where a and b were the specific coefficient each reef fishes species found on the Fishbase.org website. The biomass is the individual weight of target fish per area of the observation area, and its composition is the significant aspect to calculate CRHI. The following is the grouping of fish biomass for determining the index value, referring to Giyanto [11]

Table 3. Classification of reef fish components based on total biomass.

Reef Fishes Component	Value	Categories
Biomass (kg/ha)	Biomass < 970	Low
	970 ≤ Biomass ≥ 1940	Medium
	Biomass > 1940	High

The CRHI value is a combination of the current condition of live coral cover, the level of coral reef resilience, and the biomass of coral fish. The three components were levelling in grouped (high, medium, and low) based on previously collected data. Thus the index value obtained can represent the condition of the coral reef ecosystem accurately. The determination of the CRHI value refers to Giyanto [11] as in Table 4, below.

Table 4. The determination of the CRHI value refers to Giyanto et al. [11].

Live Coral Cover	Resilience Level	Value	Reef Fishes Biomass	Value	Total Value	CRHI
High	High	6	High	6	12	10
High	High	6	Medium	4	10	8
High	High	6	Low	2	8	6
Medium	High	5	High	6	11	9
Medium	High	5	Medium	4	9	7
Medium	High	5	Low	2	7	5
High	Low	4	High	6	10	8
High	Low	4	Medium	4	8	6
High	Low	4	Low	2	6	4
Low	High	3	High	6	9	7
Low	High	3	Medium	4	7	5
Low	High	3	Low	2	5	3
Medium	Low	2	High	6	8	6
Medium	Low	2	Medium	4	6	4
Medium	Low	2	Low	2	4	2
Low	Low	1	High	6	7	5
Low	Low	1	Medium	4	5	3
Low	Low	1	Low	2	3	1

3. Result and Discussion

3.1. The Benthic Cover Condition in Teluk Sebong

The results of the analysis of benthic cover conditions in Teluk Sebong are presented in Figure 2, and the spatial distribution of percentage benthic cover in Teluk Sebong presented in Figure 3.

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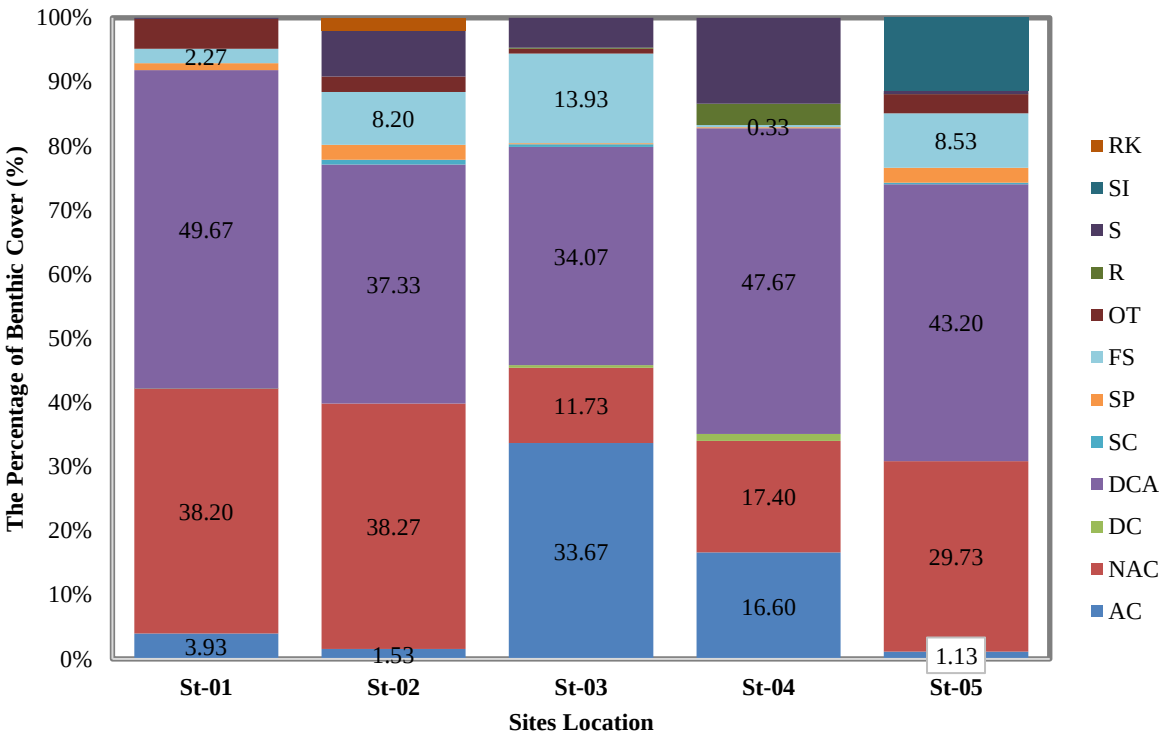

Figure 2. The percentage of benthic cover in Teluk Sebong.

Based on Table, the condition of benthic cover at the sites (St-1) in Berakit provides the Acropora (AC) coral category was 3.93%, non-Acropora coral (NAC) 38.20%, Dead Coral (DC) 0.07%, Dead Coral with algae (DCA) 49.67%, Sponge (SP) 1.07%, Fleshy Seaweed (FS) 2.27%, Others Fauna(OT) 4.60% and sand (S) 0.20%. The Benthic cover condition at sites (St-2) in Pengudang for Acropora (AC) composition was 1.53%, Non-Acropora Corals (NAC) 38.27%, Dead Coral with Algae (DCA) 37.33%, Soft Coral (SC) 0.73%, Sponges (SP) 2.33%, Fleshy Seaweed (FS) 8.20%, Other Fauna (OT) 2.47% and sand (S) 7.13%. The condition of benthic cover at the station (St-3) in ETA Area Lagoi Bay for the category of Acropora (AC) coral is 33.67%, Non Acropora (NAC) 11.73%, Dead Coral (DC) 0.40%, Dead Coral Algae (DCA) 34.07%, Soft Corals (SC) 0.73%, Sponges (SP) 0.20%, Fleshy Seaweed (FS) 13.93%, Other Fauna (OT) 0.80%, Rubble (R) was 0.13% and sand (S) composition was 4.67%. the benthic cover conditions at ETA area Banyan Tree water sites location (St-4) present the category Acropora (AC) 16.60%, Non Acropora (NAC) 17.40%, Dead Coral (DC) 1.13%, Dead Coral Algae (DCA) 47.67%, Sponge (SP) 0.13%, Fleshy Seaweed (FS) 0.33%, Rubble (R) 3.33% and sand (S) 13.40%. The condition of benthic cover at the station (St-5) in ETA area Rawa Island, Acropora (AC) category 1.13%, Non-Acropora (NAC) 29.73%, Dead Coral with Algae (DCA) 43.20%, Sponge (SP) 2.33%, Fleshy Seaweed (FS) 8.53%, Other Fauna (OT) 2.93%, Rubble (R) 0.07% and Sand (S) 0.47% [14].

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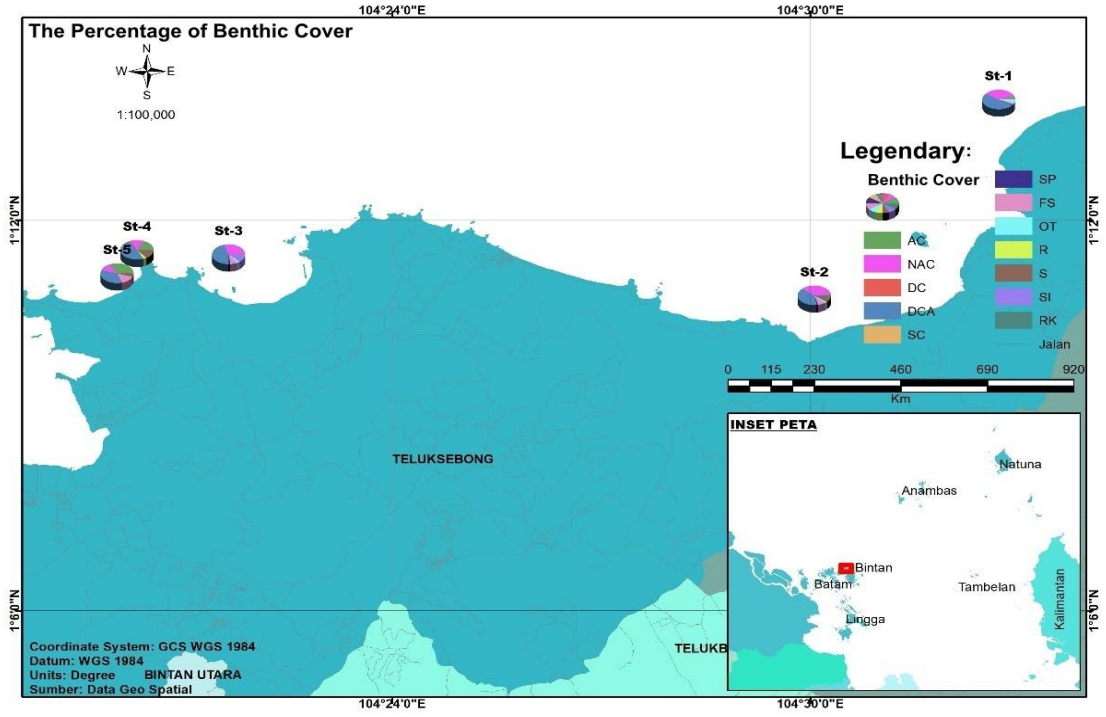

Figure 3. The spatial distribution percentage of benthic cover in Teluk Sebong.

3.2. The Condition of Living Coral Cover in Teluk Sebong

The analysis results of the condition of live coral cover presented in Figure 4 and the spatial distribution of live coral cover in Teluk Sebong are presented in Figures 5. The condition of the live coral cover in the waters of Sebong Bay ranges from 30.87 ± 3.08. % to 45.40 ± 3.77%. The condition of live coral cover at the sites St-1 was 42.13 ± 2.01% and based on the category from Giyanto [11,12] the condition of coral cover in St-1 sites location is included in the high category. The condition Live coral cover at the site St-2 Pengudang was 39.80 ± 3.47% with high coral cover category [11]. The live coral cover in the site St-3 of Lagoi Bay waters is 45.40 ± 3.77% with a high coral cover category [11]. Live coral cover at the sites St-4 Banyan Tree was 34.00 ± 3.90% with medium coral cover category [11]. The Live coral cover in site St-5 in Rawa Island was 30.87 ± 3.08% with a medium cover category [11].

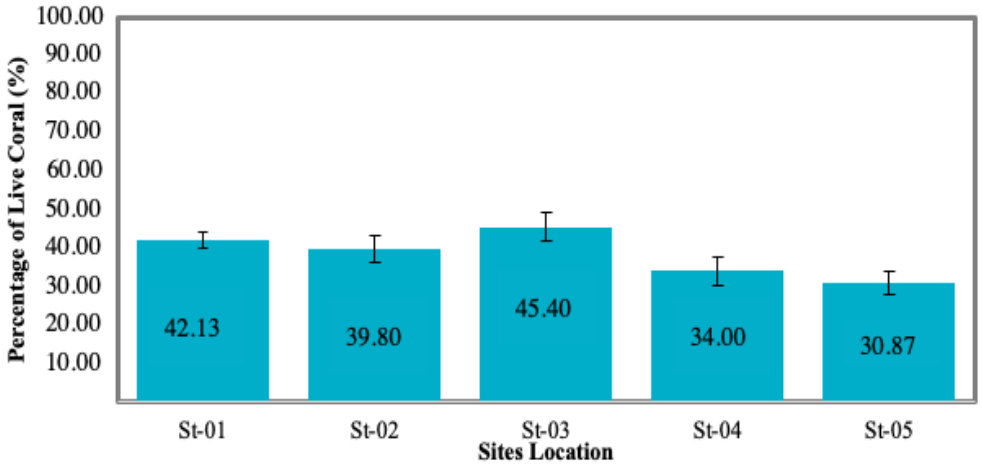

Figure 4. The spatial distribution percentage of benthic cover in Teluk Sebong.

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Based on the results of research from Prasyad [15], it shows that the condition of live coral cover on the north coast of Bintan Island is in the high cover category with a percentage coral cover ranging from 41.1% - 51.9%, while according to research from Abrar et al. conducted in the Bintan Island Marine Protected Area (KKP) in 2018 the percentage of live coral cover ranged from 19.93% - 55.33% in the medium to high category, with an average live coral cover of 37.60% with the high category [16].

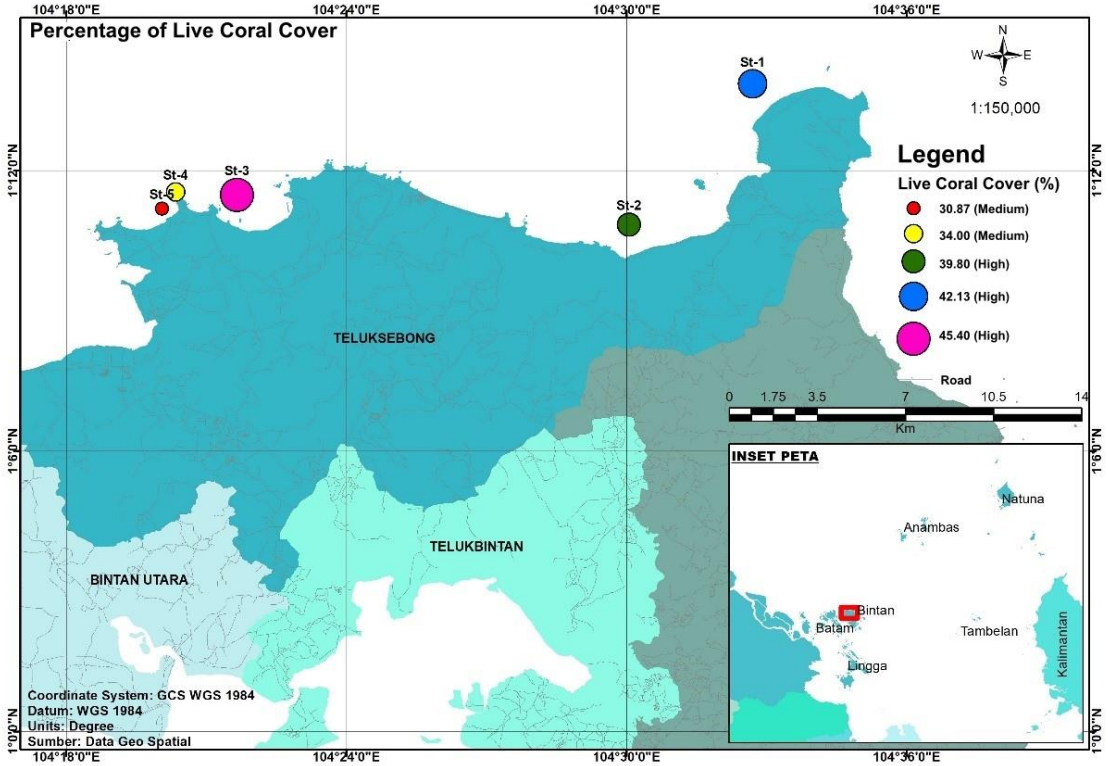

Figure 5. The spatial distribution percentage of live coral cover in Teluk Sebong.

3.3. The Condition of Reef Fishes Biomass in Teluk Sebong

The spatial distribution and analysis of reef fish biomass in the Teluk Sebong were presented in Table 5 and Figure 6. The biomass of reef fish in Teluk Sebong ranges between 9.26 to 108.60 kg/Ha and all of the site's location was in Low categories of reef fishes biomass.

Table 5. The spatial distribution and analysis of reef fish biomass in the Teluk Sebong.

Sites	Location	Biomass (kg/ha)			Biomass categories
		Herbivore Fishes	Carnivore Fishes	Total target Fishes	
St-1	Berakit	22.44	3.47	25.91	Low
St-2	Pengudang	49.38	44.72	94.10	Low
St-3	Lagoi Bay	14.35	21.48	35.83	Low
St-4	Banyan Tree	105.11	2.96	108.07	Low
St-5	Rawa Island	5.10	4.16	9.26	Low

Based on the results of research conducted by Abrar et al. conducted in Marine Protected Area (MPA) in Bintan island at 2018, the reef fish biomass ranged from 3.79-1917.12 kg / Ha with categories between

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low to moderate biomass category, but the average biomass of reef fish was 221 kg/ha with a low biomass category [16]. The coral reef fish is associated and inhabit in coral reef ecosystems. On excellent coral reefs condition, the reef fishes abundance and biomass were more expected higher. According to Giyanto [11], the unhealthy coral reef ecosystem also the relation with poor coral reef fish biomass will be found.

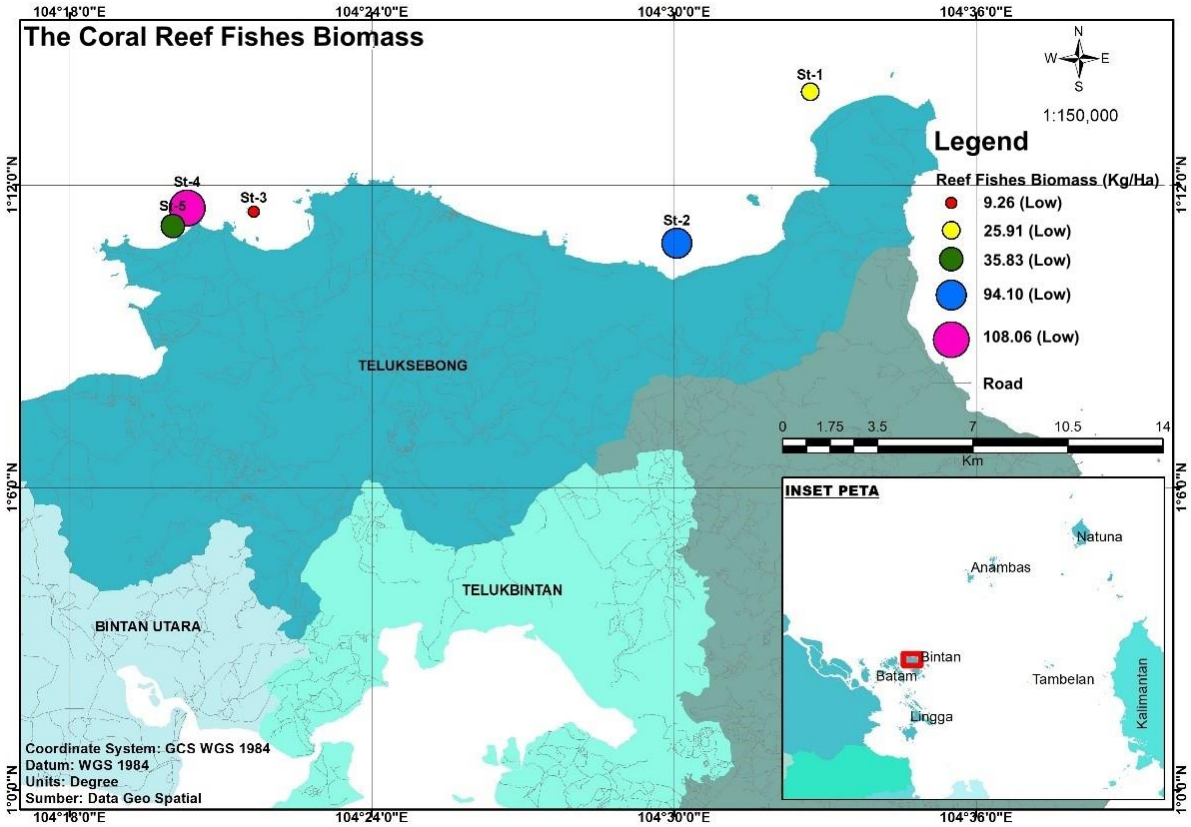

Figure 6. The spatial distribution reef fishes biomass in Teluk Sebong.

3.4. Resilience Level of Coral Reef Ecosystem in Teluk Sebong

The analysis results from the level of resilience and the spatial distribution resilience level coral reef ecosystem in Teluk Sebong were presented in Table 6 and Figure 8, respectively. The resilience level of the coral reef ecosystem in Teluk Sebong is included between the low to high resilience category. The site's location in Berakit shows the resilience level of the coral reef ecosystem was in the high category with the percentage (FS) 2.27 ± 0.62%, (R) 0%, and (LC) 42.13 ± 2.01%. In Pengudang sites location, the level of resilience of coral reef ecosystems was in the low category with the percentage (FS) 8.20 ± 1.25%, (R) 0%, and (LC) 39.80 ± 3.47%. Lagoi Bay site location shown the level of resilience of the coral reef ecosystem is in a low category, with the percentage (FS) 13.93 ± 1.94%, (R) 0.13 ± 0.09%, and (LC) 45.40 ± 3, 77%. Banyan Tree sites location shown the level of resilience of coral reef ecosystems is in the high category, with a percentage (FS) of 0.33 ± 0.17%, (R) 3.33 ± 1.88%, and (LC) 34.00 ± 3, 90%, and the location of the last site in Rawa Island shown the level of resilience of coral reef ecosystems is in the low category with the percentage (FS) 8.53 ± 1.62%, (R) 0.07 ± 0.07%, and (LC) 30.87. ± 3.08%.

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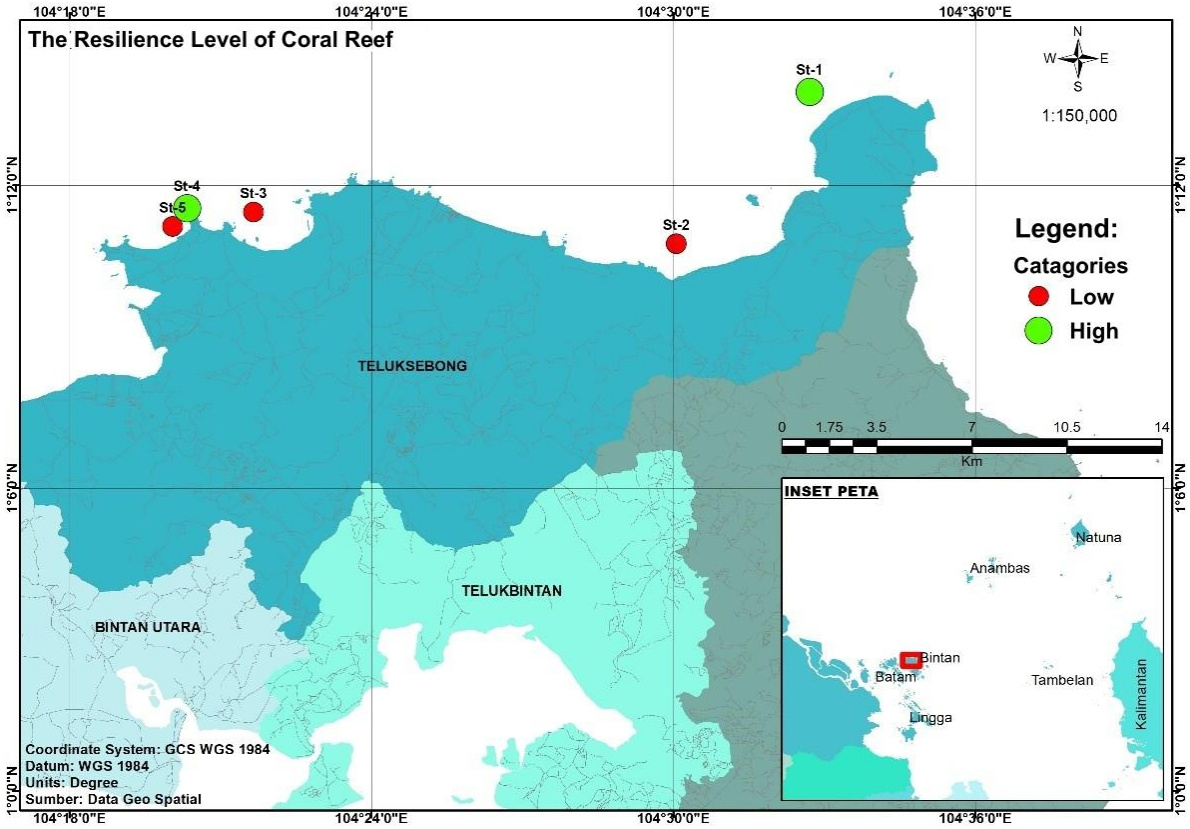

Figure 7. The resilience level of coral reef in Teluk Sebong.

According to Giyanto et al. (2017), if a coral reef ecosystem has a fleshy seaweed cover (FS)> 3% and a high rubble (R) cover (> 60%), and followed by a very low live coral cover (LC) (<5%), then the coral reef ecosystem has a low level of resilience (recovery) [11]. However, if a coral reef ecosystem has a fleshy seaweed cover (FS) <3% and rock cover (R) is high (<60%), followed by a very low live coral cover (LC) (> 5). %). The coral reef ecosystems have a high level of resilience (recovery). Pengudang, Lagoi Bay Waters and Rawa Island sites location has a low level of resistance due to the high percentage of fleshy seaweed (FS)> 3%. The dense cover of fleshy seaweed impact on the lower the level of resilience or the potential for recovery of coral reef ecosystems from damage. The high cover of fleshy seaweeds also will interfere with coral growth.

Table 6. Resilience level of coral reef ecosystem in Teluk Sebong.

Sites	Location	Fleshy Seaweed (FS) (%)	Rubble (R) (%)	Live Coral (LC) (%)	Resilience Level Categories
St-1	Berakit	2.27 ± 0.62	0.00	42.13 ± 2.01	High
St-2	Pengudang	8.20 ± 1.25	0.00	39.80 ± 3.47	Low
St-3	Lagoi Bay	13.93 ± 1.94	0.13 ± 0.09	45.40 ± 3.77	Low
St-4	Banyan Tree	0.33 ± 0.17	3.33 ± 1.88	34.00 ± 3.90	High
St-5	Rawa Island	8.53 ± 1.62	0.07 ± 0.07	30.87 ± 3.08	Low

3.5. Coral Reef Health Index (CRHI) in Teluk Sebong

The coral reef health index (CRHI) value in Berakit was six because the location has a high coral cover category and a high level of resilience (recovery) with low fish biomass. Pengudang have a CRHI value

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was four, due to the location has a high coral cover category with a low level of resilience (recovery) and low fish biomass. The Lagoi Bay has a CRHI value of four due to the location has a high coral cover category with a low level of resilience (recovery) and low fish biomass. Banyan Tree has a CRHI value of 5, and this is because the location has a moderate coral cover category with a high level of resilience (recovery), and low fish biomass. Rawa Island has the lowest CRHI value of 2, due to the location has a moderate coral cover category, a low level of resilience (recovery), and low fish biomass.

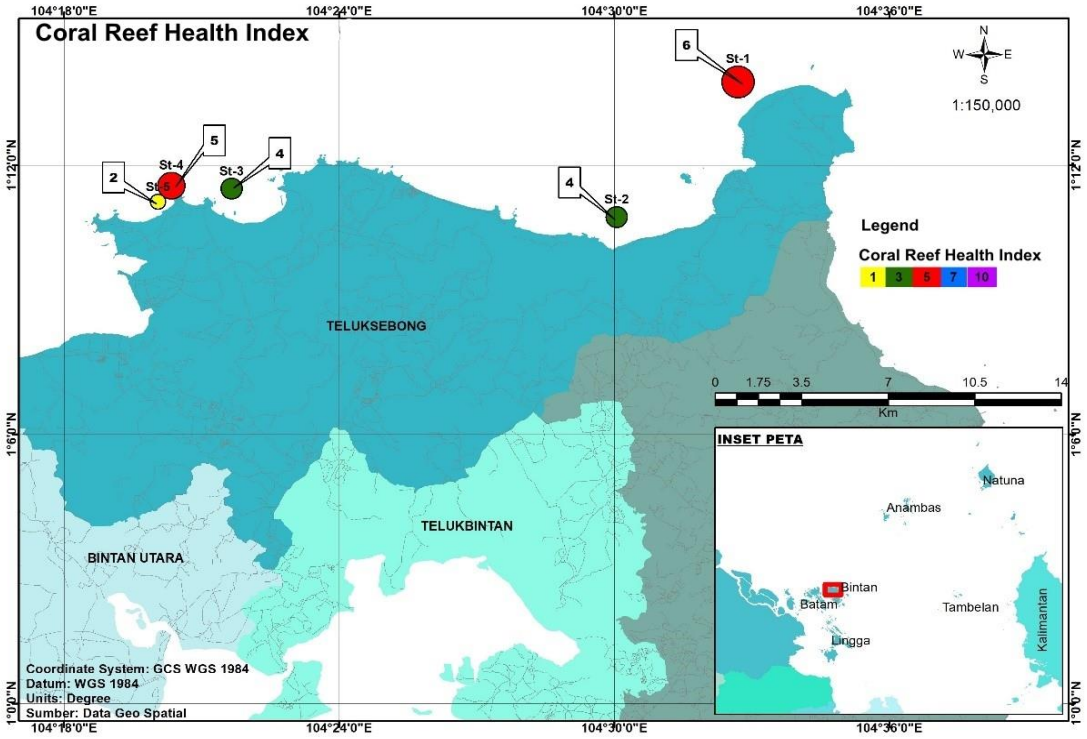

Figure 8. The spatial distribution of Coral Reef Health Index (CRHI) in Teluk Sebong.

Based on the analysis of the coral reef health index in Bintan, according to Giyanto et al. (2017), the CRHI value in Bintan Island ranges between 2 to 6 [11]. In comparison, research conducted by Abrar et al. in the Marine Protected Area (MPA) Bintan Island in 2018 showed the CRHI score ranged from 2 to 8 [16]. According to Hadi et al. (2018), CRHI is a value that reflects the current condition of live coral cover and its recovery potential and associated ecological functions [17]. This condition is more reflective of the actual condition of coral reefs because it involves several essential parameters, such as the percentage of live coral cover (LC), rubble (R), fleshy seaweed (FS), and reef fish biomass as an ecological ecosystem Function of Coral reef ecosystem. The coral reef fishes index value in Teluk Sebong can be seen in Table 7.

Table 7. Coral reef fishes index value in Teluk Sebong.

Sites	LC (%)	LC Categories	R (%)	FS (%)	Resilience Categories	Reef Fishes Biomass (kg/ha)	Biomass Categories	CRHI
St-01	42.13	High	0.00	2.27	High	25.92	Low	6
St-02	39.80	High	0.00	8.20	Low	94.11	Low	4
St-03	45.40	High	0.13	13.93	Low	35.83	Low	4
St-04	34.00	Medium	3.33	0.33	High	108.07	Low	5
St-05	30.87	Medium	0.07	8.53	Low	9.26	Low	2

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4. Conclusion

From the research results, the research of Coral Reef Health Index (CRHI) in Teluk Sebong shown the condition of live coral cover in the location of each site had categories medium to the high group. The condition of reef fish biomass in Teluk Sebong shown the location of each site had low biomass categories. The level of resilience of the coral reef ecosystem in Teluk Sebong had low and high categories and the CRHI values in Teluk Sebong shown the highest CRHI index was 6 in Berakit (non-ETA area), and the lowest CRHI value was 2 in Rawa Island (ETA Area).

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