The Inventory and Condition of Coral Reefs in Mamburit Island of Kangean Sumenep

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Abstract: *The Inventory of coral reefs is one step to find out the coral cover in one area. The purpose of this study is to know the diversity of species, the percentage of live coral cover and the condition of coral reefs in Mamburit Island as a basic data to make Sumenep as maritime tourism destination. The data of coral reefs was collected using Line Intercept Transect (LIT) which stretched transect lines along 100 m and perpendicular with the shoreline. The data was collected based on clockwise and four stations that were on the east, north, west and south of the island.The percentage of live coral cover was estimated by using cox formula and categories of coral reefs condition based on category level. Based on observation, there were11 corals lifeforms in Mamburit Islandwhich had fringing reef typesfrom the coast towards the edge and forming reef flat. Station I was dominated by Coral Massive (CM). It was about 28,55%.Station II was Acropora Branching (ACB).It was about 22,11%.Station III was Acropora Branching (ACB).It was about 16,93%. And station IV was Acropora Branching (ACB).It was about 18,4%. There were 4 types of segrass at station III and IV such asSyringodium isoetifolium, Holdule uninervis, Enhalus acoroides, and Cymodocea serrulata. Percent cover at station I was 76, 92% and 73, 18% at station II. It meant that the condition of coral reefs at station I was very good and station II was good.At station III; it was 32, 83% and 35, 34% at station IV. It meant that the conditions of coral reefs were damaged.*

Keywords: *inventory, condition, coral reefs.*

1. INTRODUCTION

Coral reefs have function in protecting beaches, habitat for reef fish, feeding, spawning and expansion for biotic of the sea [14].According to Sudiono [16], the increasing of society needs towards coral become a threat to the coral reefs.So, for the good reef management, it must have a basic data status of coral reefs, continuous monitoring, strategic planning and management of society which prioritize the conservation nor the growth of society economic.

Kangean is one of the islands in Sumenep.Geographically, Kangean was located between $6\,^0\,50$ `LS-115 ^{0} 25 'BT. Kangean consists of several islands, they are Sadulang besar, Sadulang kecil, Pagerungan besar, Pagerungan kecil, Sapeken, Sepanjang, Saubi, Paliat, Sepapan, Sasiil, Sepangkur, Sabuntan, Saebus, Saor, and Mamburit[7].

Geographically, Mamburit Island was located in the west of Kangean which has an area ± 206.83 ha. The Society profession is mostly fishermen. Mamburit Island has a kind of sloping beach, the white sand and a good ecosystem.It can be proved by the growth of mangroves, seagrasses and coral reefs.So, it is potential to be used as a maritime tourism object. Coral reef is one of the sea ecosystemsthat can be damaged easily. Where as it is unique to be used as a maritime tourism object [13]. The existence of maritime tourism object is expected to reduce and save coral reef ecosystems from damage caused by human activities. It is also expected that after getting the benefits of coral reefs which many tourists come to enjoy its beauty, they have raising awareness to protect and preserve it.

Kangean has the big maritime living resources such as fish and coral reefs. Up to now, the fish are exploited by society in Mamburit Island. So, it gives the bad impact to the coral reefs. The damage of coral reefs is running fast due to bombing, the use of cyanide and the use of coral reefs as thematerial of home and road building. While the existence of coral reefs give a big benefit for Kangean as a maritime tourism destination in Indonesia. The objective of this research is to know the diversity of species, the percentage of live coral cover and the condition of coral reefs in Mamburit Island as a basic data to make Sumenep as maritime tourism destination.

2. MATERIAL AND METHOD

The experiment was conducted in Kalisangka, Arjasa, Mamburit Islands, Sumenep on 07th – 29th September 2013 (Figure 1). The data of Coral was collected using Line Intercept Transect (LIT), which stretched transect lines along 100 meters and perpendicular with the shoreline. The methods of collecting coral data can be seen in Figure 2. According to Suhartati [18], the data is collected based on clockwise and four stations that are on the east, north, west and south of the island. So, it is assumed to represent the existance of coral reefs in the island.
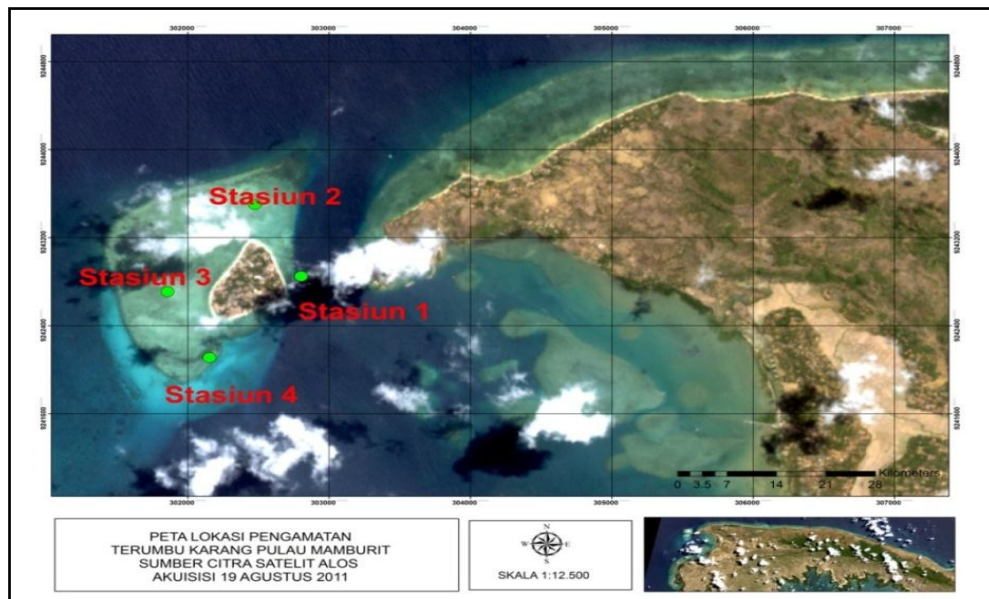

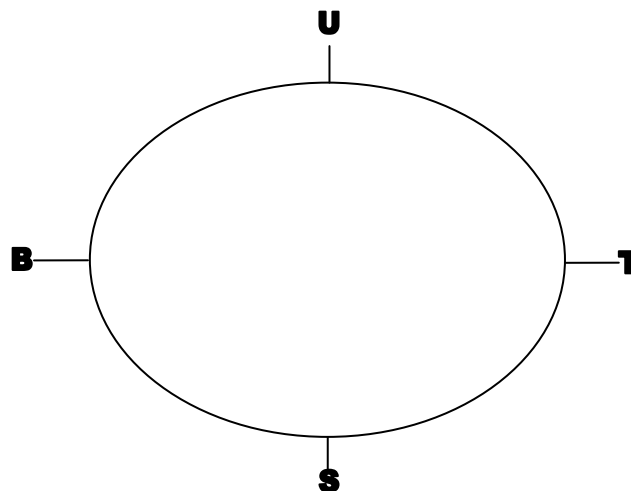**Fig1.** *The Map of research sites of Mamburit Island*

Fig2. *Determination of research station*

The percentage of Coral cover based on the lifeform was estimated for each station with transect length 100 m and perpendicular with the shoreline.Along the transect line, species of coral were recorded and photographed to facilitate identification easily. The observations of biotic and coral lifeform can be seen in Table 1[15]. The observations were made by recording the type of life form in waters of Mamburit Island and comparing with figure of identification and coral reefs code.

Table1. *The Categories of corals lifeform*

Category	Code	Explanation
Coral Stone:		
Dead Coral	DC	white up to dirty white
Dead Coral with Algae	DCA	Dead coral which still looks in shape but it had been grown by algae.
Acropora Branching	ACB	At least 2 branches. Ex. *Acropora palmata*
Encrusting	ACE	The basic plate from form *Acropora.i.*which is immature
		Sturdy shaped hump / wedge
Submassive	ACS	Branching is not up to 20. Ex. *A. Humilis*
Digitate	ACD	Flat plate such as a table
Tabular	ACT	
Non-*Acropora* Branching		Branching is ± 20
Encrusting	CB	Attaching at the substrate as a laminar
Foliose	CE	The shape resembles a leaf.
Massive	CF	Spherical or large stones / levee
Submassive	CM	Forming a small column, wedge or tubers
Mushroo	CS	Solitary
Mellepor	CMR	Fire coral
Heliopora	CME	Blue coral
Tubipora	CHL	
	CTU	
Others fauna		
jurSoft Coral	SC	Soft coral
Sponges	SP	
Zoanthids	ZO	
Others	OT	Ascidians, anemones, gorgonians, the chemical giant, sea cucumbers, sea urchins.
Algae :		
Algae Algal Assemblage	AA	Consists of more than one species
Coralline		
Algae	CA	
Halimeda	HA	
Macroalgae	MA	Red, brown
Turf Algae	TA	Soft Algae filament, often found in the region of *damselfish*
Abiotic :		
Sand	S	Sand
Rubble	R	Irregular rubble
Silt	SI	Mud
Water	WA	Cracks more than 50 cm
Rock	RCK	Foundation coral including limestone, rock.

Percentage of live coral cover was estimated by using cox formula [20]:

Percen cover (PC) = $\dfrac{Total\ Of\ long\ intersep\ per\ species}{total\ of\ long\ transect}$ x 100%

Categories of coral reefs condition based on category level (table 2)[17].

Table2. *Level of coral reefs condition (Sukarno,1993)*

Percent Cover / PC (%)	Category
0 – 24	Heavy Damage
25 – 49	Damage
50 – 74	Good
75 -100	Very Good

3. RESULT AND DISCUSSION

Based on observation, there were 11 corals life forms in Mamburit Island. According to Armando *et al.,* [2], coral reef speciesfound in the steep coastal area were ACB and CM. The water parameter that strongly supportedthe coral growth was water transparency.It became a major factor in the growth of coral reefs.Besides that, the depth also affectedthe coral growth. Around 2-6 meters, the coral species that were found were*Acropora Branching* (ACB), *Heliopora* (CHL), and *Acropora Sub massive* (ACS). Arround 8-15 meters, they were *Coral foliose* (CF), *Coral massive* (CM).

Based on observation, there were 10 types of corals life form at station I and it was dominated by coral massive (CM) was about 28,55%.While coral submassive (CS) was minim, it was 0,22% (Figure 3).
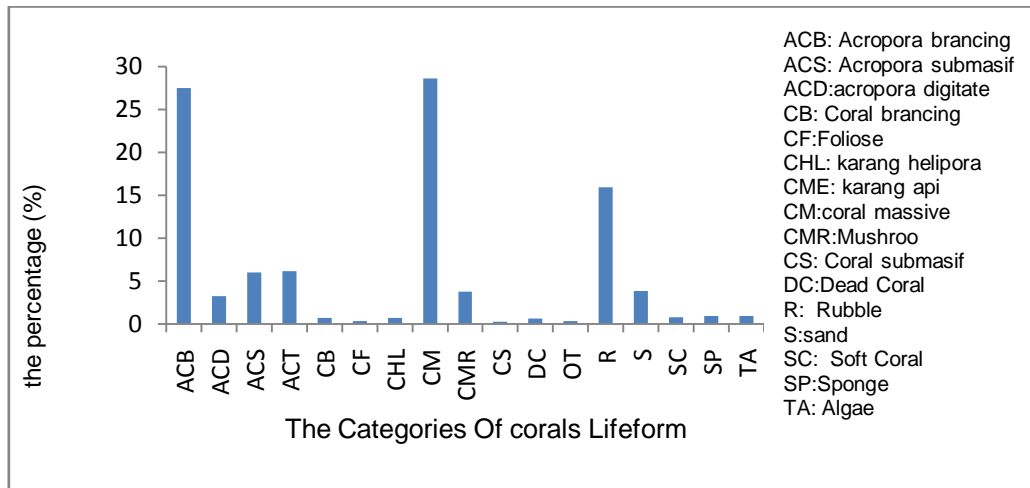

Fig3. *The Percentage of corals lifeform at Station I of Mamburit Island*

The Factors that influence coralslife form were the type of beach and the substrate effect. Besides that, there were other faunathat were found such as OT (0.32%). Corals lifeform at station II was not too different from station I. It was also influenced by the type of beach and the substrate effects. Coralslife form at station II was dominated by ACB (22.11%), while CMR was minim, it was about 0.08% (Figure 4) . The high of ACB was influenced by the type of sloping beach and water conditions. Berverly *et al.* [4] said that the coral that grew at sloping beach were ACB and ACD around 2 - 8 meters.
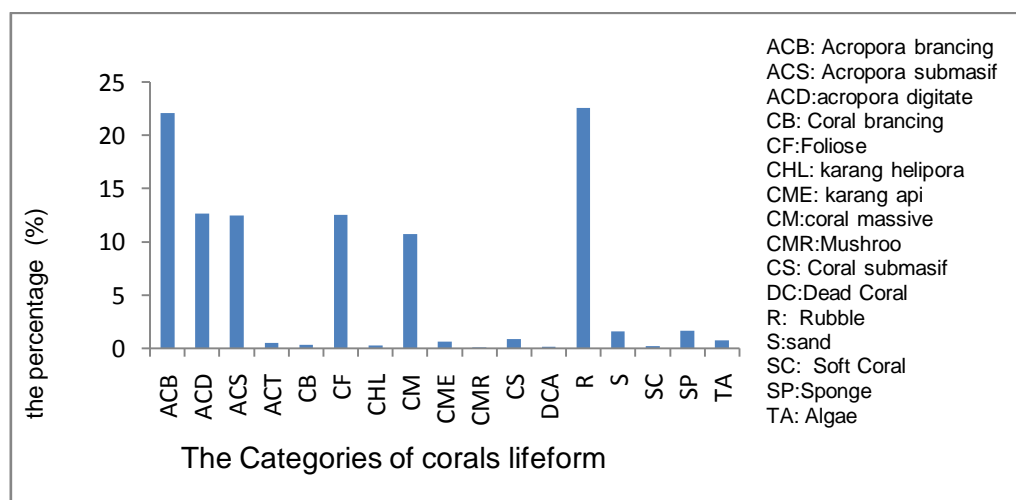

Fig4. *The Percentage of corals lifeform at Station IIof Mamburit Island*

Based on observations at stations III and IV, the topography of the beach wastoo different from stations I and II.The type of beach at station III was a sloping beach with muddy sand substrate. There were many seagrasses around 1 - 5 meters with 100 m perpendicular from the shoreline,so the existence of coral reefs was less. There were 2 corals lifeforms at station III. It

was ACB and CM. But, it was dominated by ACB (16.93%). According to Michael [8],the coral reefs that grow with many seagrasses are ACB and CM.
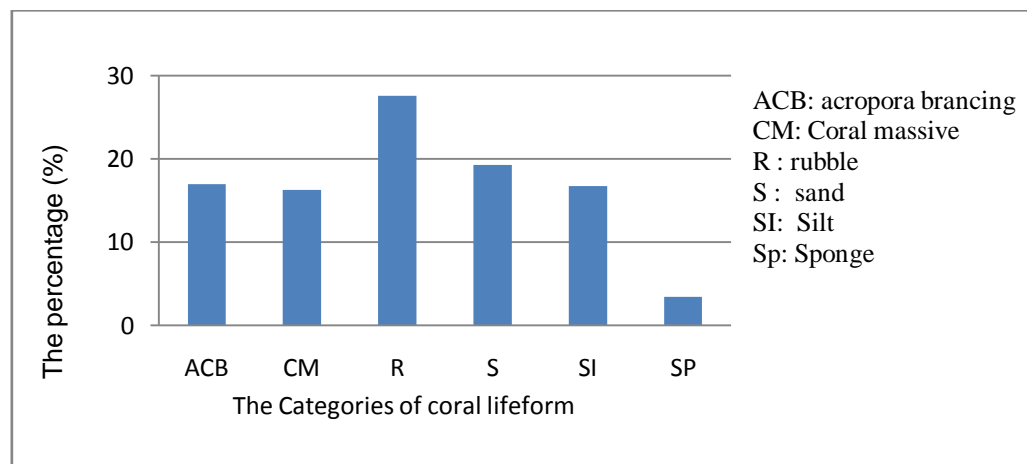

Fig5. *The Percentage of corals lifeform at Station III of Mamburit Island*

Live coral cover at station III was less than abiotic. From the figure 5, it showed that the percentage of abiotic was about 63,48% which consisted of rubble (27.57%), sand (19.21%) and silt (16.7%). The high of rubble, sand and silt was influenced by the type of beaches and substrate muddy sand.Based on observation, there were 3 corals life forms at station IV. Coral cover at station IV was not too different from station III wich had sloping beach and substrate muddy sand, so, there were a view of coral at station IV. It was also affected by the existence of many seagrasses which reached 1,5 ha. According to Ariyani and Ayu [1], corals can grow in agood water quality and rocky sand subtrate and they need enough light penetration. Types of coral found at station IV with a distance of 100 meters perpendicular from the shorelinewere CM (18,4%), ACB (15,16%) and ACD (1,78%). There were also other animal such as sponge (1,86%) (Figure 6).
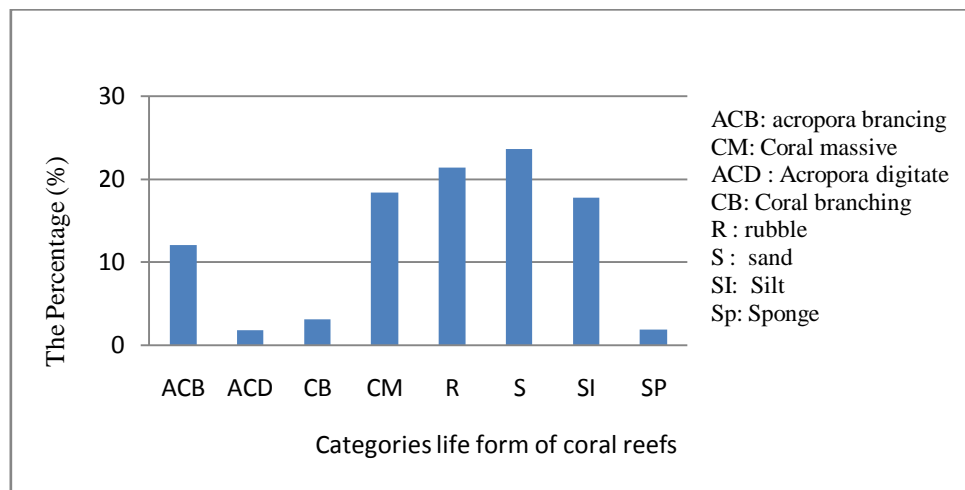

Fig6. *The Percentage of corals lifeform at Station IVof Mamburit Island*

Based on observation, water parameter estimation can be seen at table 3.

Table3. *The estimation of water Parameter*

Number	Parameter	St 1	St 2	St 3	St 4
1	Temperature	28,6°C	29,5°C	29,8°C	29,4°C
2	pH	7,4	7,5	7,3	7,3
3	DO	7,2	6,9	7,9	7,8
4	Salinity	36,8‰	36,9‰	36,2‰	35,9‰
5	Current flow	12,1m/s	12,9m/s	15,4m/s	15,3m/s
6	(Transparancy	Penetrate to the Seabed			

Based on the data at table 3,it showed that the temperature, pH, DO, salinity, Current flow, and transparancy were not too different in each station. The fluctuation of temperature is not extreme. It was about 28-30°C, degree of acidity (pH) was 7,3-7,5, Dissolved Oxygen (DO) was 7,2-7,9, Salinity was 35,9‰-36,9‰, current flow up to 14 cm/s. And based on transparency estimation, it was known that the light penetrated until the seabed. In general, quality of water parameter was good and supported thecoral growth.According to Chou and Tun [6], the optimal temperature for coral growth is about $22 – 32$ºC. The temperature can give effects to fisiology activity of coral [3]. pH can give negatif effects to metabolism and respiration if the pH is very bases. DO is very important for respiration process. The fluctuation of DO is caused by the water sirculation and current flow (up to 14 cm/s).

The result of salinity estimation was about 35,9‰ – 36,9‰. According to Riyan [13],coral reefs can grow on 30 - 35 ‰. It showed that water salinity in Mamburit island was high. The salinity was high because the research was held on summer.Coral reefs can adapt at salinity out of normal range. But, it can disturb the coral growth [19].The water transparancy became a major factor in the growth of coral reefs. Based on observation, the transparancy in Mamburit Island was very high, it was known that the light penetrated until the seabed.The Condition Of Percen Cover (PC) In Mamburit Island can be seen at table 4.

Table4. *The Condition Of Percen Cover (PC) In Mamburit Island*

NO	Location	Cordinate	The means of PC	Category
1	Station I	S $06^0$50'30.96"	76,92%	Good
		E $115^0$13'17.25		
2	Station II	S $06^0$50'17.91"	73,18%	Good
		E $115^0$13'10.88		
3	Station III	S $06^0$50'27.24"	32,83%	Damage
		E $115^0$13'01.74		
4	Station IV	S $06^0$50'40.64"	35,34%	Damage
		E $115^0$12'59.37.		

Based on the data at table 4, it was known that the condition of percent cover at station I and station II was in a good category, butbased on observation, there wereabiotics was about 24,16 % which consisted of rubble (22,59%) and sand (1,57%) at station II. The high of rubble was caused by human factors such as the use of cyanide, anchors, bombs and shipwreck. Based on observation, there was still a wreck at station 2. According to Nababan [10], the damage that was caused by humans can increase the coral damage. Coral reefs damages are naturally caused by the increasing of sea water surfacestemperatures which reaches 4-6 ^{0} C. So, it can lead to bleaching coral massively [5].

The damage of coral reefs at station II is necessary to be rehabilitated through transplantation and illumination to the community of Mamburit Island about the importance of coral reefs. So,it is expected to restore the condition of coral reefs. According to Kenchington [9],the damage of coral reefs which reaches 24.16% is more suitable to be used as a conservation area nor the growth of society economic. The condition of Percent cover at station III and IV was in damage level category. Based on observation, there was 21, 40% of rubble that was caused by human activities such as bombing fishing, the use of cyanide and anchor. According to Richmond [11],the damage of coral reefs caused by nature and human can not be avoided. But, based on the data of live coral cover percentage, it was assumed that coral cover at station I was still in a good conditions.

4. CONCLUSION

There were 11 species of coral reefs which had fringing reef types from the coast towards the edge and forming reef flat.Station I was dominated by Coral Massive (CM). It was about 28,55%. Station II was Acropora Branching (ACB). It was about 22,11%. Station III was Acropora Branching (ACB). It was about 16,93%. And station IV was Acropora Branching (ACB). It was about 18,4%. At station III and IV, there were 4 types of the segrass such as Syringodium isoetifolium, Holdule uninervis, Enhalus acoroides, and Cymodocea serrulata. Percent cover at station I was 76,92% and 73,18% at station II. It meant that the condition of coral reefs at station I was very good and station II was good. At station III, it was 32,83% and 35,34% at station IV. It meant that the conditions of coral reefs were damaged.

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