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A STUDY OF CORAL REEF CONDITION AND CORAL REEF FISH BIODIVERSITY IN THE WATERS OF LEMBEH STRAIT

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ABSTRACT

Lembeh Strait marine tourism area in Bitung City of North Sulawesi province has many diving spots because of its specific and unique coral reef. However, it is very seriously threatened by degradation, so it needs a study to monitor the level of damage so that the recovery process can be obtained. This study aimed at determining the distribution of the percentage of the condition of coral reefs and fish biodiversity throughout the Lembeh Strait. This research was carried out in the northern waters of the Lembeh Strait: Mawali waters, Serena Island waters, Tandurusa waters, and Makawidey waters (3-5 m depth). Data were collected by diving using the Underwater Photo Transect (UPT) and Underwater Visual Census (UVS) methods in the transect area of 350 m². The results of the study showed that the condition of coral in the Lembeh Strait had seriously degraded with a mean health level of 23.07% and a damage rate of 76.3%. Generally, the coral reef biodiversity is still relatively low but still warn to be vigilant. The environmental factors still support the survival of coral reefs.

KEY WORDS

Coral reef, biodiversity, underwater photo transect, underwater visual census, Lembeh Strait.

One of the areas that became a marine tourism destination in eastern Indonesia is the Lembe Strait in Bitung, North Sulawesi. There are many diving spots there because Bitung has a specific and unique coral reef ecosystem. The seabed is dominated by black-gray volcanic sand deposits. The most seabed is a gentle slope, so it is rarely found coral reef there. The clearness of the water will make it easy to see the bottom of the waters.

The strategic issues raised as a problem are as follows (Setiawan, 2016):

- The threat of climate change is getting stronger, but the marine and fisheries management system still runs as usual so that it has an impact on reducing attention to the management of coral reef ecosystems;
- Coral reef resources have seriously experienced degradation. The current condition of coral reefs in Indonesia, categorized as good to excellent, is estimated by 29% (Repie E, 2006, Suharsono et al. 1997). In fact, the condition of coral reefs in North Sulawesi, classified as good to excellent, is only 2% (JICA, 2002), so there should be adequate recovery measures;
- The live coral cover shows the medium category (25-49.9%).

The objectives of this study were to be able to:

- Find out the types of coral reefs and fish biodiversity spread on the Lembe Strait at the depth of 3-5 meters;
- Produce a distribution of the percentage of the health and damage of the coral reefs in Lembe Strait at the depth of 3-5 meters.

MATERIALS AND METHODS OF RESEARCH

This research was conducted during July-September 2017 in the northern Lembe Strait: Mawali, Tadurusa, and Makawidey waters and Serena Island in Bitung City (figure 1) with a maximum depth of 3 to 5 meters.

Figure 1 – Research Site

The main equipment used to support this research was: 3 units of scuba diving equipment, underwater digital camera and Pelang digital camera, Roubert boat, reef fish identification book, oxygen measuring device, salinity, brightness, and current speed.

Data were collected by diving using SCUBA equipment, UVC Method, and underwater shooting at 9 to 13 from July to September 2017. The transect line length at each station is 100 m. An observation and data collection was done as the patterns simulated in the figure 2.

Figure 2 – Patterns simulation of data collection and coral shooting

Coral cover data taken by the UVC method was equipped with underwater photos along the interval of 1 meter to observe and record coral reef condition. One day, it takes more than one station consisting of 3 small stations with the output:

$$\text{percentage of category cover} = \frac{(\text{the number of category points})}{(\text{the number initial points})} \times 100\%$$

The UVC method developed by English et al., (1997) is a fast, accurate, effective, and environmentally-friendly method. The results are generally relevant to the objectives of coral reef fisheries management. The most dominant coral reef fish are diurnal (active during the day) and only a small proportion are nocturnal (nighttime active) so the ideal visual census time approach is from 9:00 am to 4:00 pm.

The time approach pays attention to tidal conditions because low tide often causes high currents. The ideal time is when water starts to rise where fish come out looking for food. The fish association structures in the research area will be observed using UVC

technique by one or two SCUBA divers. To observe this association, it used reef and coral fish monitoring guides issued by the 2014 Cormep-CTI LIPI.

Figure 3 – Quadrant sketch for shooting reef fish

RESULTS AND DISCUSSION

The general observations carried out at 4 sites with a depth of 3-7 meters showed that the average percentage of coral cover conditions was: dead coral cover of 57-83%, damaged coral cover (light and heavy) of 6-14%, good coral cover of 2-8%, and excellent coral cover of 14-27.5%. This condition is illustrated in diagram 2.

Comparison Of Coral Reef Cover At 4 Sites

Figure 4 – Comparison of coral cover in 4 research locations

This coral cover condition, if referred to criteria (1979 UPMSC, in (Papu, 2011)) are already in a very alarming condition because of the damage rate severe.

Separately, the results of the observations in every site (see figure 4) show that live coral cover in the Mawali waters, precisely on the northern side of Lembe Island, is only around 14.6% and the rest is damaged and dead coral by 84.4%. The most dominant type is *Acropora Sp.* while the bottom topography of the waters is filled with debris from coral and sand. This condition triggers *Acropora* to grow. This area is a passenger line and the means of access to small fishing boats. Also, there are several ship docking industries.

The results of the observations in the Tandurusa waters (see Figure 5) showed little difference where live coral cover is around 26.1% and the dead and damaged are 73.9%. The most dominant type is *Acropora Sp.* The topography of the bottom of the waters is filled with debris from coral and sand. This condition causes *Acropora* to live. This area is right in

front of the settlement which is a passenger line and the mean of access to the boats/small fishing boats. This area also has a Navigation port and several ship docking industries.

The results of the observations in the Makawidei waters that face the northern part of the Lembe Strait showed that the live coral cover is only 14.3% and the rest is the dead and damaged coral by 85.7%. The coral colonies that dominate are *Acaropora .cervicornis* with topographical conditions on the bottom of the water filled with debris from fragments of coral and sand. This area is right in front of the settlement which is a passenger line and the mean of access to the boats/small fishing boats. This area is also the place for the withdrawal of the dampar Beach seine.

Figure 5 – Comparison of the percentage of live coral cover in 4 sites

The observation result in Serena island is still relatively better than the other locations. Serena island is located between the mainland of Sulawesi Island and Lembe Island consisting of three small islands. In this area, the live coral cover is 37.3% and the dead and damaged coral cover is 62.7%. The coral colonies that dominate in this water area are *Acaropora cervicornis*. (80%). Meanwhile, the topography of the bottom of the waters is filled with debris from coral and sand.

Visually, the condition of this region is illustrated in the following figure 6.

Figure 6 – Visualization of 4 Research Sites

The observation in the Mawali waters in a quadrant of 350 M² or 70m x 5 m area consisted of 6 species is the second largest amount of abundance with an average of 422 fish. *Myripritis prolina* is the most dominant type by 49.29%, followed by sergeant major (*Abudefduf saxatilis*) of 25.59%, and *Amphirion percula* of 14.45%.

In the waters around the Tandurusa village, there are only 5 species with an average abundance of 261 fish. Besides, the major sergeant is the most dominant species by an average of 119 or 45.59%.

The total number of fish in the waters around the Makawidei village was about 166 fish consisting of 5 species; the most dominant species is *Myripritis prolina* of 30.2%. There is no *caranx* sp found in this area.

In Serena island waters, the highest abundance was 1447 fish. The most dominant species were *Myripritis prolina* of 44.57% and followed by Sergeant Major (*Abudefduf saxatilis*) of 37.46%.

There were only 5-6 species observed in the research sites so it could be assumed that the community structure and the level of diversity were very low. (Setiawan, 2016) through his research in Batuangus waters of Bitung City found that the structure of the fish community consisted of 195 species and the community structure was at a low and moderate level.

Table 1 – The types and percentages of fish abundance in 4 sites

Fish name		The number of individual							
		Mawali		Tandurusa		Makawidey		Serena island	
		Total	(%)	Total	(%)	Total	(%)	Total	(%)
Clownfish <i>Amphirion percula</i>	61	14.45	39	14.94	15	9.04	194	13.41
<i>Myripritis prolina</i>	208	49.29	44	16.86	50	30.12	645	44.57
Sergeant major <i>Abudefduf saxatilis</i>	108	25.59	119	45.59	87	52.41	542	37.46
Starfish	19	4.50	0	0	5	3.01	65	4.49
Bobara	3	0.71	8	3.07	0	0	21	1.45
Bawal hitam or <i>Parastromateus niger</i>	23	5.45	51	19.54	9	5.42	215	14.86
Total		422	-	261	-	166	-	1447	-

The results of the physical and chemical parameters observation show that the condition of the waters is decent for a fish community to grow.

Table 2 – Some oceanographic parameters at the research site

Parameter	Mawali	Tandurusa	Makawidey	Serena
temperature (°C)	27.2 – 28.7,	26.2 – 28.7,	27.2 – 27.7,	27.0 – 28.0
Salinity (‰)	29.0 – 30.5	29.0 – 30.5	29.0 – 31.5	29.5 – 32.5
pH	7.8	7.7	7.5	7.3
current speed(cm/second)	0.0 – 15.4	0.0 – 5.4	0.0 – 45.5	0.0 - 57.0
Brightness (m)	7	7	7	7

The state of the oceanographic parameters (see table 2) shows the following phenomena:

The temperature at the research sites was around 26 - 28°C, which was still in the seawater quality standard that helps in the fish growth process. This is because the current speed, both the frequency and the intensity are on a medium scale.

The salinity score ranged from 29.0 - 32.5 means that the salinity of Lembah strait was still moderate to support the biological survival of fish and coral communities.

pH from those four research sites are: Mawali waters = 7.8; Tandurusa waters = 7.7; Makawidei water = 7.5; Serena island = 7.3. The pH value of the aquatic environment varies, but this pH value is within the standard for safe survival.

The current speed ranging from 5 - 57 cm/sec illustrates that the intensity of the current movement is still on a quiet and medium scale so that it does not affect the coral or fish.

The clearness of the water also affects the presence of biota because the circulation of water follows the tide movements outside the strait. The decrease in water quality occurs during the rainy season because of the large amount of run-off and waste from the land.

The description of the detected oceanographic parameters shows very conducive condition to coral and fish communities to live. However, the real condition of the live coral cover and the fish communities is very alarming. (Setiawan, Tasidjawa, Wantah, Hendri Johanis, & Ratulangi, 2016) proposed that good environmental conditions will have an impact on the survival rates. According to (Thalib A.S , et al 2017), oceanographic parameters, both physical and chemical, show natural and normal conditions in accordance with the sea water standards. This was confirmed by (Patty, 2015) that the levels of phosphate, nitrate, and oxygenator in Lembah Strait waters are still in normal conditions for the coastal waters and good for the life of marine biota.

For this reason, it is reasonably suspected that external factors such as shipping lanes, anchorage locations of ships, passenger liner, and the building of ship docking facilities on land.

CONCLUSION AND SUGGESTIONS

The condition of the reef in the waters (3-5 m depth) in the Lembah Strait has experienced relatively serious degradation where the average level of health or life is 23.07%. Separately, good coral health cover is: Serena Island of 37.25%, Tandurusa waters of 26.1%, Mawali waters 14.65%, and Makawidey waters of 14.3%. The number of reef fish is getting lower but is still at the alert level, while the dominating species are the Sergeant Major. The environmental condition still supports the survival of coral reefs.

Suggestions:

- Long-term monitoring needs to do to predict the impact of changes in the structure of reef cover in various conditions;
- The use of fishing gear to increase fisheries resources can damage and disrupt the growth and recovery of reef habitats. Therefore, there should be regulations that regulate it;
- If the city government of Bitung plans to develop integrated fisheries in the Lembah Strait for the future, it is necessary to make a technical guide that can accommodate all user interests in the reg.

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