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The status of coral reefs and reef fishes of Biloro Village, Southern Buru Regency, Indonesia

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Abstract

This study aimed to analyze coral reef condition and reef fish at Biloro Village, South Buru District. Line transect intercept was used to analyze the life form of coral reef. Reef fish observation was carried out underwater visual fish census. Coral reef condition was assessed the ecological indexes vis. diversity, dominance, and evenness. Marine quality parameter measured namely dissolved oxygen, temperature, pH, salinity, and transparency. The result shows the total number of life coral species richness was 160, with 46 genera, from 16 families. The average coral reef condition was considered good with the percentage of hard coral coverage of 51.78%. The coral reef diversity index range from 2.89-3.03, the evenness index range between 0.88-0.94, and dominance index lies between 0.06-0.8. The total number of reef fish species was 95 with 50 genera, and 19 families with total number of individual amounted to 7,143. There are 11 species of indicator fish, 56 species of major fish, and 28 species of target fish.

Keywords: coral reef, reef fish, ecological index, species structure

Introduction

The coral reef ecosystem is one of the productive ecosystems which have high biodiversity^[1]. This ecosystem has an ecological and economical function^[2, 3]. Being an ecological function, the coral reef serves as a nutrient source, spawning ground, feeding ground, nursery ground, and coastal protection from abrasion. This ecosystem also serves as a shelter and habitat for many fish resources such as coral reef fish, rock lobster, algae, sea cucumber, pearl oyster, of which many have a high economic value. Marine tourism, building material, and active substance for medical and cosmetics also come from this ecosystem^[4, 5]. The potency and status of this ecosystem including fish resources become vulnerable and under threat since the human intervention in this ecosystem for many different purposes.

With no management control, the exploitation of coral reef tends to hazardous the coral reef which leads to collapse. Up to 2018, approximately 1.067 sites in Indonesia has been studied to investigate the coral reef status, 386 sites (36.18%) belongs to poor condition, 366 sites (34.3%) belongs to fair condition, and 245 sites (22.96%) belongs to good condition, and 70 sites (6.56%) belongs to very good condition^[6]. High human activities in the coastal area inhibit coral growth^[4, 7]. High intensity in fishing and an increase in population number are some factors triggering the degradation of the coral reef ecosystem^[8].

The village of Biloro is situated in the coastal area of Kapala Madang Sub-district of the South Buru Regency. Biloro waters are a part of the Coral Triangle region, having coral reef potency which can be used for many different purposes. Field observation revealed that some of the community of Biloro Village uses coral reefs for building materials. The use of coral reefs for building materials can cause damage to this coral reef, and this will lead to the loss of the ecological and economical function of the coral reef. This research, therefore, becomes important to get information about the status of the coral reef and the reef fish, since information concerning the coral reef and the coral reef fishes is limited. The objective of this study was to analyze the coral reef and reef fish condition of Biloro Village.

Materials and methods

This research was conducted in July 2020 at the coastal area of Biloro Village of sub-district Kapala Madang, South Buru Island.

There were four sampling stations for coral reefs and coral reef fishes (Figure 1). Coral reef data was taken using the line intercept transect method following English *et al.*, (1997) [9]. Data obtained was then analyzed using the Life Form program. The free collection was also conducted near the

transect area. The samples/photos of hard coral that cannot be able to identify in situ, was brought to the laboratory and identify later according to coral identification procedures [10, 11, 12].

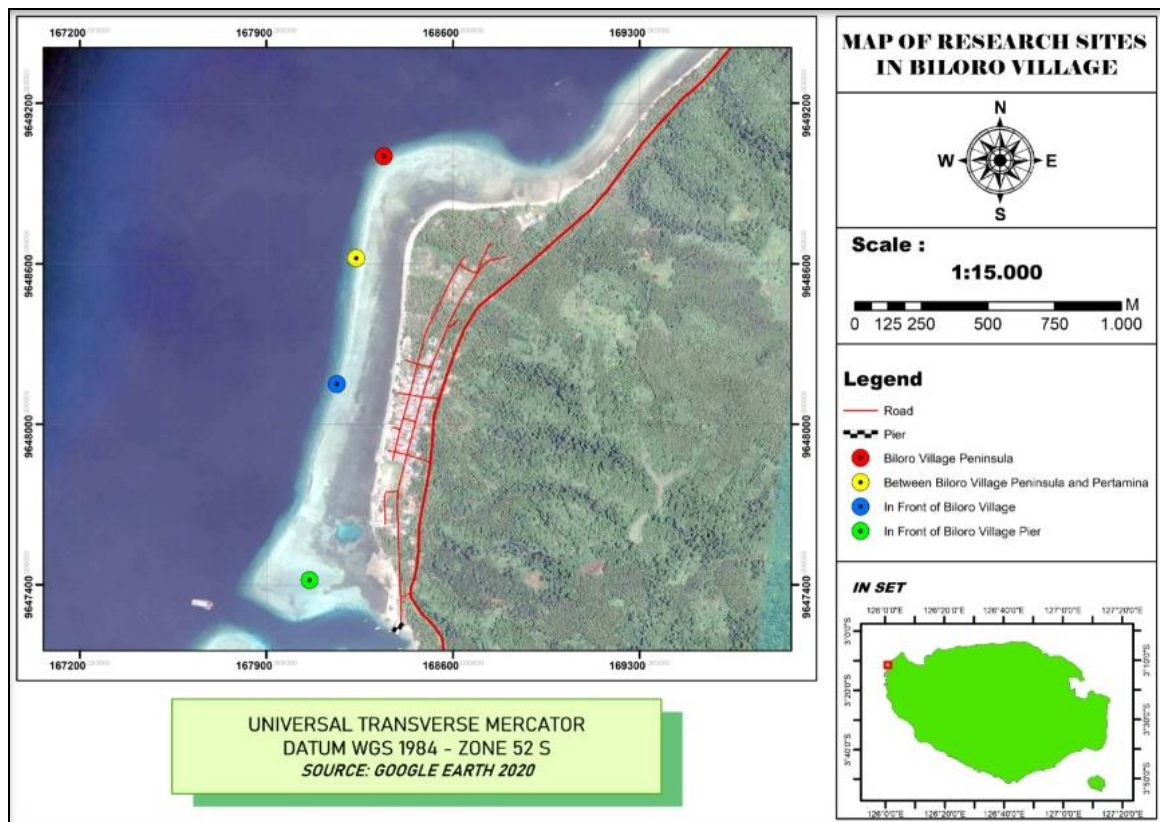


Fig 1: Map of study site

Underwater visual fish census (UVC) was used in studying the coral reef fishes using the line intercept transect method. The transect line of 70 m was deployed aligned with the coastal area at the reef edge. The fish census was taken following the transect line with a width of 2.5 m to the left and right, making the total area censused approximately 350 m². The fish census was conducted at the depth between 3 – 7 m and was counted at three replicates for the precision.

The hard coral condition was assessed using the criteria according to English *et al.*, (1997) [9] as follows:

Very bad condition (category 1) with hard coral percent coverage between 0 – 24%;

Bad condition (category 2) with hard coral percent coverage between 25 – 49.9%;

Good condition (category 3) with hard coral percent coverage between 50 – 74.9%;

Very good condition (Category 4) with hard coral percent coverage between 75 – 100%.

The reef fish of the tropical Pacific identification manual (Allen *et al.*, 2003) was used to identify the reef fishes. Fish species and the abundance was also calculated at each transect. The fish censused was then classified according to the monitoring category and coral reef evaluation (English *et al.*, 1997) [9].

Some ecological indices vis. the Shannon of diversity (H'), index of evenness (E), and Simpson dominance index (D) according to Odum (1971) was used to describe the condition of coral reef performance. The Shannon diversity index was calculated using the following formula:

$$H' = \sum_{i=1}^S P_i \ln P_i$$

Where

H' = diversity index

P_i = proportion of i coral colony

S = number of coral colony found

The index of evenness (E) was calculated following the formula of $E = [H'] / \ln n$ where $\ln n$ is the number of the colony. The E value range from 0 – 1. When $E \leq 0.4$ then the diversity is considered low or under threat, and if $0.4 < E < 0.6$ then the diversity was moderate or the community is in unstable condition, whereas when $E > 0.6$ then the community is in a stable condition.

The Simpson index of dominance (D) was calculated based on the following formula:

$$D = \sum_{i=1}^S P_i^2$$

Where:

P_i = the proportion of i coral reef colony;

S = number of coral reef species found

The D value range from 0 – 1, and when the value

approaching to 1 meaning there is a colony that dominate the other colonies.

Results and Discussion

Marine environmental condition

The marine environmental water parameters measured during this study covering, dissolved oxygen (DO), temperature, pH, seawater current, and water transparency. The dissolved oxygen obtained at the four stations during the observation range between 6.6 – 7.2 mg/l (Table 1). According to the decree of the Ministry of Environmental of the Republic of Indonesia Nr 51, 2004 for marine biota, this value is considered is under a suitable standard. The temperature recorded during the observation range from 28.50 °C to 29.8 °C (Table 1). The value obtained was considered suitable for marine biota including coral to grow. The research conducted on the coral of *Acropora formosa* revealed that the temperature for this species range between 27-30 °C and suitable for coral growth and reproduction [13]. Study on the marine environment condition in Talise Island, North Sulawesi also found the temperature of a similar range with this area [14].

Table 1: Marine environment quality at the sampling station

Station	DO (mg/l)	Temperature (C ^o)	pH	Salinity (ppt)	Current (m/sec)	Transparency (meter)
1.	7.2	29,6	7,94	36	0,16	17
2.	6,6	29,8	7,85	36	0,03	17
3.	7,1	28,8	8,10	36	0,05	17
4.	6,7	28,5	7,91	36	0,13	23

The pH value recorded during this study in all four sampling stations lies between 8.5 – 8.10 (Table 1), and this was considered suitable for marine biota to live. The value of less than 4.8 and higher than 9.2 is assumed to indicate that the area is being polluted [15]. The value obtained during the study was far beyond the polluted criteria, therefore, in terms of pH parameter, the Biloro waters are still considered as in suitable conditions. Other parameters recorded during the study can be found in Table 1, and all the values are under the suitable condition for marine biota to live, growth, and reproduce [16, 17].

The hard coral species composition

The total number of life hard coral species found in this study was 160 species, belongs to 46 genera, and 16 families (Figure 2). The result shows that of all hard coral genus found in Indonesia, approximately 56% of genera 27% species was found in this area. The highest species richness was found in Station 1, whilst the lowest was found in Station 2. The family with the highest number of species was Acroporidae (48 species), and the lowest one was Fungidae (12 species). Some coral species can distribute throughout all transect, but there are some which are only found in several transects. Figure 3 shown an example Species like *Acropora humilis*, *A. chytorea*, *A. Hyachintus*, *A. diverikata*, *Coelosoris mayeri*, *Pachyseris speciosa*, *Physogyra lichtenstein*, *Diploastrea heliopora*, *Echinopora gemmacea*, *E. lamellosa*, are an example of live hard coral species found to distribute in all the transect. Figure 3 shows an example of live hard coral species found in all the transects. This distribution indicates that this hard coral species was generally to distribute in Indonesia water [11], and can adapt to a various environmental condition which might be different from one area to another.

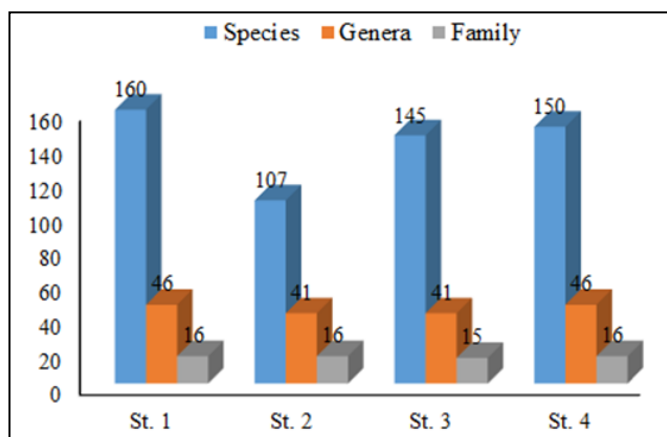


Fig 2: Distribution of life coral richness at Biloro waters represented by four sampling station.

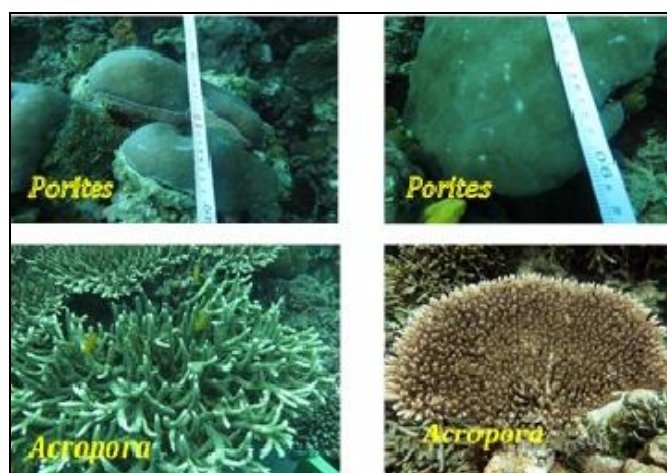


Fig 3: Some of dominated hard coral found in study site.

Coral reef ecosystem status

Benthic life form component covering life coral, dead coral, algae, other fauna, and abiotic component (sand, rubble, silt, and rock) describes the condition of coral reef status. The result displayed in Figure 4 shows that the highest percentage of hard coral was found at station 1 (60.87%), followed by station 2 (60.24%), meanwhile the lowest percent coverage was found at station 3 (35.23%). The average coral reef status falls into the good condition category with a value of 51.78%. All the remaining coral status based on the hard coral composing component can be seen in Figure 4. The dominant of other fauna component belongs to a group of soft coral with the species of *Isis hippuris* and *Simularia sp* (Figure 5).

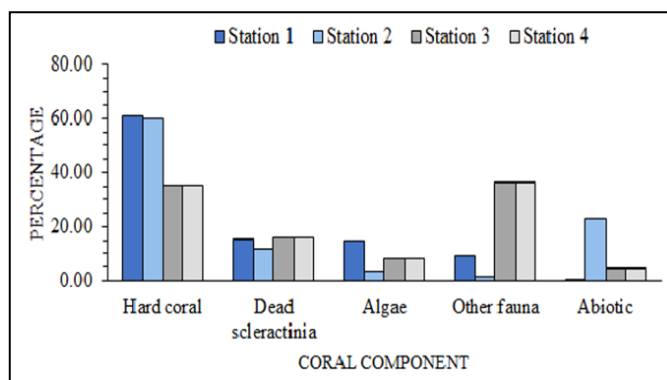


Fig 4: The state of coral reef according to hard coral percent coverage and other component configuring the reef at Biloro waters

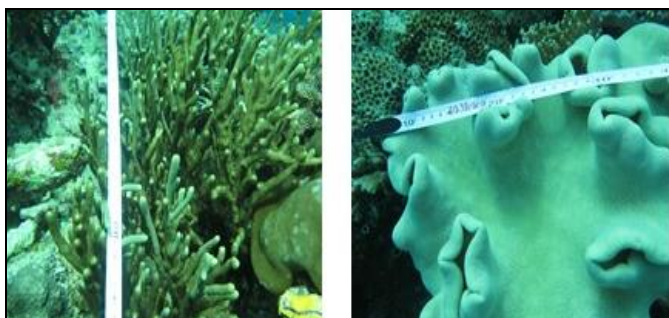


Fig 5: Other dominant fauna component found at study site

Apart from hard coral and soft coral component, dead scleractinian consists of dead coral and dead coral covered with algae amounted to 13.6%. This indicates that there were activities that damage the coral reef apart from natural mortality. Field observation showed that local people of Biloro Village use massive coral for building construction, and some use a poisonous substance in fishing activity. Studies have shown that many coral reef status is under heavy anthropogenic stressor.

The condition of live coral in Ambon Bay in 2012, for example, was 39.06%, which decreased to 31.43% in 2015 [18].

Condition of coral reefs based on ecological indices

The result shows that the index of diversity (H') of the coral reef range from 2.89 – 3.03. The highest diversity index was found at Station 1, whilst the lowest value was found at Station 3 (Tabel 1).

The index of evenness (E) range from 0.88 – 0.94 with the highest one was found at Station 1, and the lowest one was found at Station 2 (Table 1). When the value of H' falls between 1–3 suggesting that the organism in that particular area is under moderate ecological pressure. The result in Table 2 shows that the H' value was slightly below 3 except for Station 1 which was slightly above 3.

These values imply that the coral reef condition at Biloro waters seems under moderate pressure ecologically. This coral reef condition could arise from the use of hard coral for building material and some destructive fishing activities took place in this area. The species dominance index (D) falls between 0.06 – 0.08, describing no dominant species found in this area.

Table 2: The index of diversity (H'), dominance (D), and evenness (E)

Station	(H')	(D)	(E)
1	3.03	0.06	0.92
2	2.95	0.08	0.88
3	2.89	0.07	0.94
4	2.95	0.07	0.89

Coral reef fish composition

Four sampling station was set to analyze and describe the coral reef fishes in Biloro waters. Table 3 summarize coral reef fish composition found in this area. This table shows a variation in fish composition between the station in terms of species, genera, family, and fish number.

The Pomacentridae being the most abundant family found in Station 1. From 12 families found, two families i.e. Caesionidae and Acanthuridae which belong to the target species were found in great numbers.

Table 3: Coral reef fish composition found in Biloro waters.

	Station 1	Station 2	Station 3	Station 4
Species	40	59	29	42
Genera	30	36	20	30
Family	12	17	13	15
Number	1,223	4,810	371	739

The family Chaetodontidae which belong to indicator family lives in association with coral reef was found substantially in Station 2. The butterfly fishes has the role in indicating the health of coral reef and the presence of this fish indicating healthier coral reef in this station. Station 3 was the station with the lowest number of species. This station is close to the harbor where higher human activities took place. The coral reef condition in this station was also in slightly poor condition compared to the other 3 stations, not surprisingly the coral reef fish composition in this station was less compared to other stations in Biloro waters. This study shows that the total number of coral reef species found in this area was 90 species belong to 50 genera and 19 families. Species found with the high individual number was *Pterocaesio tile* and *Caesio cuning* from the family of Caesionidae. Among 19 reef fish families found, Pomacentridae was the reef fish with the highest number of species followed by Labridae (17 species) Species distribution and composition vary between area and time [19, 20, 21]. Study on reef fishes composition in Speramonde Islands, Souh Sulawesi in 2017 found 202 species with 30 families [22], whilst study in Liuk Island of Bulukumba District, Indonesia, found 222 reef fishes belonging to 88 genera and 34 families [23]. In Bete Island of Peukan Bada District, Indonesia, the total number of reef fish found was 106, which belongs to 44 genera and 21 families [24]. There were 42 families which consist of 116 genera and 293 species of reef fish found in southern waters of Ambon Island [21]. Based on management objective, reef fishes can be grouped into 3 classifications viz. target species (economic importance and consumption), indicator species which strongly associated with coral reef, and major species [25]. In this study. It was found that there were 28 species of target reef fish fall into 16 genera, and 8 families, with the number of individual, amounted to 2,499 individuals. The indicator reef fish amounted to 11 species with 3 genera and 1 family, and the number of individu reaches 54 individuals. The number of major fish was 56 species with 31 genera, and 10 families and the individu found reaching 4,590 individuals. A study by Cinnawara et al (2015) [26] in Easter Luwu Water and Nasir et al (2017) [24] in Batee Island both in Indonesia also found different compositions among target, indicator, and major reef fishes. These differences could be due to the size of the area sampled as well as the condition of the coral reef. Figure 6 shows the percentage of the target, indicator, and major reef fishes from Biloro waters.

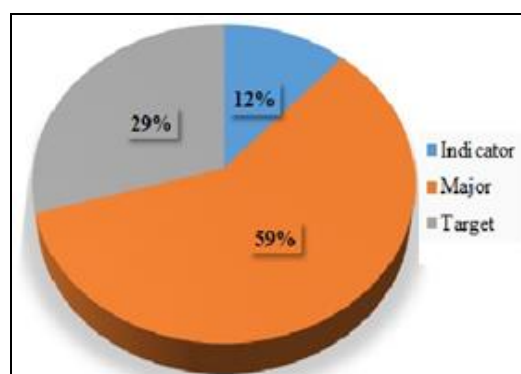


Fig 6: The percentage of coral reef fish at Biloro Village waters.

Coral reef fish vary between site and time, and alter by many factors like fishing intensity, pollution, climate change and others^[27, 28]. Some target species which frequently found in the vast group like the yellowtail (*Caesionidae*). This group of fish with the species of *Pterocaesio tile* and *Caesio cunning* and the species of *Naso hexacanthus*, *Naso thynnoides* of the family of *Acanthuridae* was found abundantly throughout all the study stations.

Conclusion

There are 160 species of live coral, 46 genera, and 16 families found during the study in Biloro waters, South of Buru Island. The coral condition varies between stations with the average percentage of hard coral cover is 51.78% and considered is in a good condition. Based on ecological indexes it was found that there were quite high diversity and no dominance of coral reef species indicating a steady condition. There are 7,143 coral reef fish found belongs to 95 species, 50 genera, and 19 families. Of all the reef fish found 11 species belong to indicator species, 56 belong to target species, and the 28 belong to major species.

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