The Analysis of Coral Reef Fishes Abundance Based on Coral Reef Condition in Marine Tourism Park of the Kapoposang Islands, South Sulawesi, Indonesia

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Abstract— The objective of the study was to analyze the relationship between coral reef cover and abundance of reef fish in Marine Tourism Park of the Kapoposang Islands, South Sulawesi. This research was conducted on April 2019. Collecting coral cover data using the Underwater Photo Transect (UPT) method and coral fish data collection using Underwater Visual Census (UVC) with belt transects. The research results of coral fish found in the study site were 15 families and 54 species. The highest abundance of reef fish was found at site I, which was 6280 ind/ha with a percentage of live coral cover of 34% (Moderate), while the lowest abundance was found at site III of 2100 ind/ha with a percentage of live coral cover of 5% (Poor). The relationship between the abundance of reef fish and the percentage of live coral cover can be seen in the results of the regression analysis of the value of $r^2 = 0.942$, this value indicates that there is a close relationship between abundance of reef fish with the percentage of live coral cover, that is if the coral cover percentage is getting better then the number of fish more abundant coral.

Keywords— Coral reef, Kapoposang Islands, Abundance of coral fishes, Marine Tourism Park.

I. INTRODUCTION

Coral fish is a group of fish taxa whose lives are associated with the environment of coral reef ecosystems. Allen and Adrim (2003) suggest that as many as 113 families of fish are coral inhabitants and most of them are Order of Perciformes. The top ten major families of reef fish are *Gobiidae, Labridae, Pomacentridae, Apogonidae, Bleniidae, Serranidae, Murraenidae, Syngnathidae, Chaetodontidae,* and *Lutjanidae*. According to English et al. (1994), These reef fish are grouped according to their status on the three groups: target fish, major fish and indicator fish.

In general, reef fish will adjust to their environment. Each species shows the right habitat preference/suitability which is governed by a combination of food availability, shelter and variations in physical parameters. A large number of species found on coral reefs is a direct reflection of the magnitude of the opportunity provided by habitat (Allen and Steene, 1996).

Oman and Rajasurya (1998) who examined this matter stated that the complexity of the structure, composition and proportion of live coral cover gave a positive correlation to reef fish communities (Nontji, A. 1993).

Coral fish is one group of animals associated with coral reefs, its presence is striking and is found in various micro-habitats on coral reefs. Reef fish live permanently and forage in sedentary areas so that if coral reefs are damaged or destroyed, reef fish will also lose their habitat (Rani et al., 2010).

Marine Tourism Park of the Kapoposang Islands is located in Pangkajene Regency, South Sulawesi Province and one of the islands in the Kapoposang and Sea Surrounding Marine Tourism Park or abbreviated as Kapoposang Islands TWP, which is one of 8 national marine conservation areas under the management of the Kupang National Aquatic Area and 50000 hectares. Allen *et al*, (2003) stated that the presence of fish in the coral reef area was strongly influenced by physical variables (conditions of coral reefs and the environment). Based on this background it is necessary to research the relationship of coral reef cover with an abundance of reef fish. So the purpose of this study is to analyze the relationship between coral reef cover and abundance of reef fish on Kapoposang Island, Pangkajene Islands Regency.

II. METHOD

2.1 Time and Research Location

This research was conducted on April 2019 in the Marine Tourism Park of the Kapoposang Islands, Mattiro Ujung Village, Liukang Tupabbiring Sub-District, Pangkajene and Kepulauan Regency, South Sulawesi Province. The research station was determined as many as 4 observation points which were considered to represent the condition of coral reefs and reef fish on Marine Tourism Park of the Kapoposang Islands. The selection of observation stations is determined based on information from the management of Marine Tourism Park of the Kapoposang Islands and information from the local community overlaid on a map. Look at Figure 1.
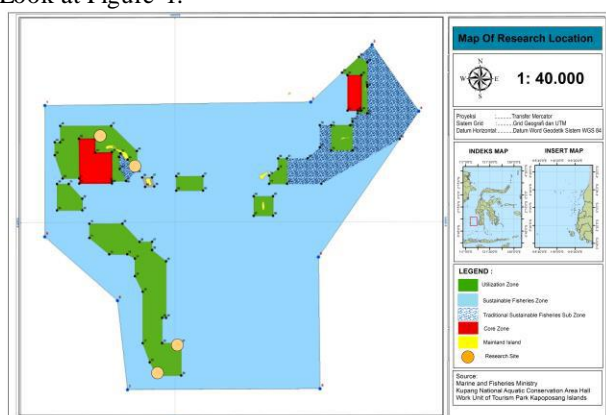

Fig.1: Map of the research location

2.2 Research Tools and Materials

The tools and materials used in the research can be seen in Table I below:

Table 1:

Tools and materials	Fungsi
Global Positioning System (GPS)	To take a research location point
Scuba	Diving equipment for observing and retrieving coral cover data and abundance of reef fish.
Roller meter (50 m)	To measure transects.
Iron Frame (Size 58x44 cm)	As a coral cover transect to make it easier to see photo boundaries .
Underwater camera	For underwater documentation
Stationery	To record observations in the field.
1 ship	For transportation to the research location.
CPCe software	To analyze coral cover data.

2.3 Data Methods and Analysis

2.3.1. Data Collection Method

This study uses two methods, namely the Underwater Photo Transect (UPT) method for coral cover data collection and the Underwater Visual Census (UVC) Method for retrieving coral fish abundance data.

Underwater Photo Transect method (UPT) is performed by shooting underwater using an underwater digital camera At a distance of about 60 cm from the bottom of the substrate, shooting is carried out in each spacing of 1 m along the transect line 50 m previously determined. To maintain the regularity of the shooting distance which is as far as 60 cm from the substrate, a stick made of pipes measuring 60 cm is used as a tool. The shooting start from the 1st meter on the left side of the transect line (the part closer to the mainland), followed by taking a photo on the 2nd meter on the right side of the transect line (further part by land), and so on so that for long 50 m transect obtained 50 frames ("Frame 1" to "Frame 50"). So for frames with odd numbers (1, 3, 5, ..., 49) taken on the left side of the transect line, while for frames with even numbers (2, 4, 6, ..., 50) taken on the side right of the transect line. Illustrations can be seen in Figure 2 below:
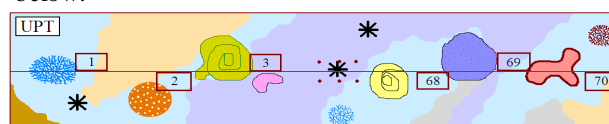

Fig. 2: Illustration in sampling with the UPT method

The underwater visual census method developed by Dartnall and Jones (1986) and English et al. (1994) with modifications. The equipment used is diving equipment (SCUBA), underwater stationery, and rope meter (roll meter). The 50-meter long transect is made parallel to the coastline which is a fast, accurate, effective and environmentally friendly method. The resulting data is relevant to the objectives of reef fisheries management. Do dives to spread the roller meter tape on the coral reef area with a stretch pattern that is parallel to the coastline, where the position of the island is to the left of the meter tape counted from the zero meter point. Meter roll tape stretched for 50 m. The depth of the meter tape placement is between 7 to 10 m or adjusts to the design of the transect location specified in the research objectives and must be at a constant depth.

Record each type and abundance of reef fish (indicator fish, major fish and target fish) found along the 50 m transect line with the right and left borders each 5 m apart so that the observation area covers an area of 250 m 2. Take photos and videos of underwater fish for fish that are difficult to identify directly. Re-identify certain types of fish through photos/videos using a literature book.

2.3.2. Data analysis

2.3.2.1. Percentage of Coral Reef Closure

Analysis of the percentage of coral reef cover and assessment criteria used to see live coral cover conditions refers to Gomez and Yap, 1988 (Table 2):

Table 2: Standard criteria for coral reef damage

Condition	Percentage (%)
Bad	0 - 24.9
Is being	25 - 49.9
Well	50 - 74.9
Very well	75 - 100

2.3.2.2. Abundance of Coral Fish

The formula used to calculate the abundance of reef fish is (Odum, 1971):

$$Xi = \frac{ni}{A} \times 100$$

Information: Xi = Abundance of type I fish (ind/m^2)

ni = number of individuals of type to - i

A = area of sampling area.

The observed reef fish communities were grouped into three main groups (English et al. 1994), namely: Target fish, namely economically important fish and commonly caught consumption. Usually, groups of target fish make coral reefs a place for spawning and nesting / nurturing areas. The target fishes are represented by the family *Serranidae* (grouper), *Lutjanidae* (snapper), *Lethrinidae* (Emperor fish), *Nemipteridae* (Surgeon fish)*, Caesionidae* (Fusilier fish), *Siganidae* (Rabit fish)*, Haemulidae* (Sweetlips fish), *Scaridae* (parrotfish), and *Acanthuridae* (Surgeon fish). Indicator fish, which are typical types of reef fish that inhabit coral reef areas and are indicators of the ecosystem of the area. Indicator fish is represented by the Family *Chaetodontidae* (Buterfly fish). Major fish groups are small fish species, generally, 5-25 cm long, with diverse colouring characteristics so that they are known as ornamental fish. Major fish groups are generally found to be abundant, both in the number of individuals and species. Criteria for assessing the condition of reef fish based on fish abundance categories are presented in Table 3.

Table 3: Categories of assessment of coral reef conditions based on the percentage of fish abundance

Abundance (ind / ha)	Criteria
200-1000	Very rarely
1000 - 2000	Rarely
2000 - 4000	Less abundant
4000 - 10000	Overflow
> 10000	Very abundant

Source: Djamali and Darsono, 2005.

2.3.2.3. Regression Analysis

To find out the relationship between percentage of coral cover and abundance of reef fish, a simple linear regression equation model is used, namely the equation as follows:

$$Y = a + bX$$

Where:

Y = Response variable or dependent variable

X = predictor variable or causal factor variable (independent)

a = constant

b = regression coefficient

III.   RESULT AND DISCUSSION

3.1. Condition of the Coral Reef

Based on the results of research conducted on 4 observation sites, the percentage of the condition of benthic coral cover at a depth of 7 m is presented in Figure 3.
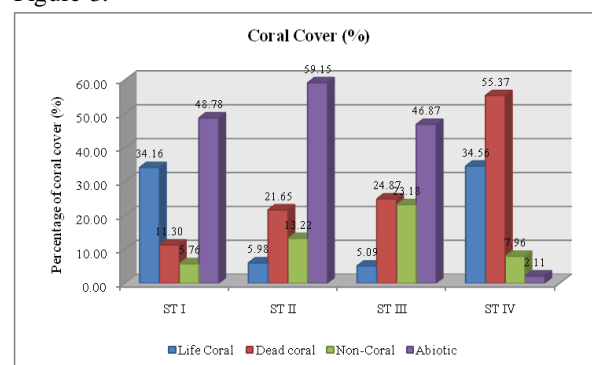

Fig. 3: Percentage of live coral cover

The percentage of live coral cover at each site generally varies. The lowest percentage of live coral cover at 7 m depth is at site III which is equal to 5.09%, while the highest percentage of live coral cover is at the site IV with a value of 34.5 6%.

The results of the coral analysis as shown in Figure 3 show varied values. At a depth of 7 m, the substrate cover is dominated by abiotic, with the highest percentage of 59.15% in Site II located on the southeastern part of Marine Tourism Park of the Kapoposang Islands. The condition of living coral cover on Marine Tourism Park of the Kapoposang Islands consists of a type of Acropora coral and non-Acropora. In general, coral cover more types of Acropora are compared non- Acropora type coral. The dominance of large abiotic substrates this indicates pressure on corals like the use of bombs or poisons, which cover the substrate that used to be is a living coral, then dies to cover the abiotic type substrate.

In general, the percentage of coral cover life is small compared to dominance by abiotic and dead corals with sand type and rubble indicating human activity damaging,

whether it's due to fishing not environmentally friendly by using bombs and poisons by the community and the effects of tourism activities. Besides that, natural factors that last long like global warming and climate change and erratic weather conditions can kill the reef is runny, so that is left over only fragments of the reef.

3.2. Abundance of Coral Fish

Hallacher (2003) suggested that fish coral is a group of fish taxa whose lives associated with the environment of the reef ecosystem coral. Based on its role in the coral reef ecosystem, reef fish are divided into three groups, namely the target fish is economically important and commonly caught for consumption. Indicator fish is a type of reef fish that is typical of inhabiting coral reefs and is an indicator of the fertility of the ecosystem of the area. Indicator fish is represented by the family Chaetodontidae (kepe-kepe fish). Major fish are small species of fish, generally 5 to 25 cm, with various colouring characteristics that are known as ornamental fish (English et al, 1997).

Observations abundance of reef fish do in TWP Islands Kapoposang using Underwater Visual Census (UVC) on a 4 point site observation found 15 families of reef fish that is *Chaetodontida* (Angelfish), *Apogonidae* (Cardinalfish), *Balistidae* (Triggerfish), *Labrida*e (Wrasse) , *Mullidae* (Goatfish) , *Pomacanthidae* (angle fish), *Pomacentridae* (damselfish), *Zanclidae* (Moorish idols) , *Acanthuridae* (Surgeon fish) , *Caesionidae* (Fusilier fish) , *Haemulidae* (Sweetlips fish), *Lutjanidae* (Snapper), *Scaridae* (Parrotfish), *Serranidae* (Grouper), *Siganidae* (Rabit fish).

The abundance and composition of reef fish at a depth of 7 m is presented in Figure 4.
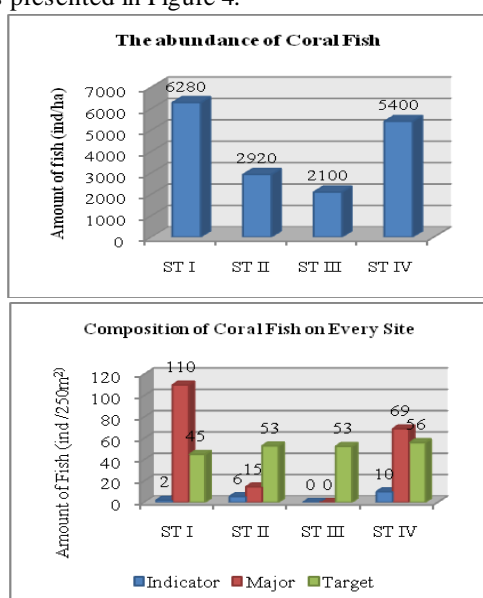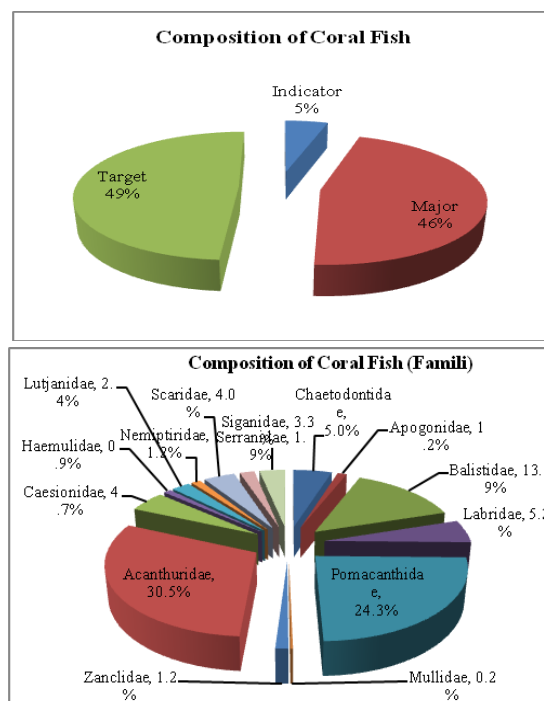

Fig.4: The abundance of reef fish

Fig. 5: Composition and abundance of reef fish

Based on Figure 4, the highest number of fish abundance is in Site I with 6280 individuals/hectare and abundance of reef fish which is at least at Site III, which is 2100 individuals/hectare. Of all the sites on Kapoposang Island, the dominant fish group is the target fish, which is 49% of the total number of reef fish dominated by the Acanthuridae and Scaridae families found in all sites. According to Adrim (2012), the type of Scaridae (parrotfish) is not commonly consumed, but because the body is relatively large in size the group of fish can be turned into targets and hunted by fishermen for consumption.

Indicator fish were found only 5% of the 4 sites on Marine Tourism Park of the Kapoposang Islands which were dominated by the Chaetodontidae family. Reese (1981) and Hourigan et al. (1988) suggested that fish belonging to the Chaetodontidae family group had strong associations with corals and could be used as indicators of coral health. During the study, indicator fish from the Chaetodontidae family were found in 5 species and were dominated by the *Chaetodon Kleiini* species. This type of fish is spread in all sites in Marine Tourism Park of the Kapoposang Islands. The same thing was stated by Adrim (2011) who conducted research on Bawean Island and found that there were several relatively prominent types of reef fish on the island, namely *Chaetodon octofasciatus, Chaetodon kleinii, Chaetodon trifasciatus, Heniochus chrysostomus* and *Chelmon rostratus*.

Major fish species were found as much as 46% and were dominated by the type Pomacanthidae (angelfish). Most of the fish are from fish species that have a relatively small body size, and in nature play an important role in the food chain, especially as a food supply for carnivorous fish. Also found are several types of fish that are beautiful body colours that have the potential to be used for diving tours.

Different fish abundance at each station is thought to be caused by differences in the percentage of live coral cover which has an effect on the survival of reef fish. The results of the study of Roberts and Ormond (1987) in the Red Sea coral reef area of Saudi Arabia, suggest that the abundance of reef fish is directly proportional to the value of habitat complexity on coral reefs. The more space, gaps and wrinkles of coral reefs, the more reef fish will inhabit the area in search of protected areas, shelter and upbringing.

3.3. Relation of Percentage of Coral Cover with Abundance of Coral Fish

The relationship of living coral conditions with an abundance of reef fish was calculated using simple correlation analysis. From the calculation results, it can be seen that there is a positive relationship between live coral cover and abundance of reef fish. The correlation coefficient produced is $R^2 = 0.942$ and can be said to have a fairly strong and positive relationship. Graph the relationship between live coral cover and abundance of reef fish can be seen in Figure 6.
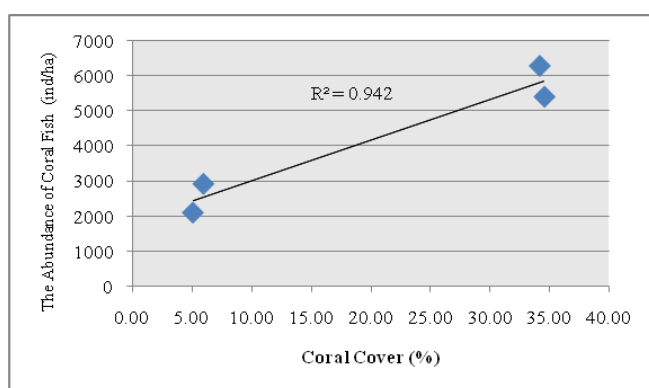

Fig. 6: Relationship between coral cover conditions and the abundance of reef fish

The results of the regression analysis showed that the percentage of live coral cover and associated significantly with the abundance of reef fish. Coral reefs and fish have very strong interactions. The interaction of reef fish with coral reefs can be divided into three forms (Choat et al., 1991), namely direct interaction, as a shelter from predators or predators, especially for young fish. Then the interaction in foraging includes the relationship between reef fish and biota that live on corals including algae. And the last is indirect interaction as a result of the coral structure and hydrological and sedimentary conditions.

This is also in accordance with the research conducted by Muniaha (2016) in Villages in the Village Tanjung Tiram, Konawe Selatan Regency, which shows that the abundance shows links to coral reef conditions, relationships abundance of reef fish, rugosity and conditions coral reefs have a close relationship with a value of $r^2 = 0.997$, if the percentage of coral cover is getting better then the density will be high and cause reef fish to become more abundant in a waters.

IV. CONCLUSION

The percentage of coral cover at 4 sites in Marine Tourism Park of the Kaposang Islands is in the poor to the moderate category with the percentage of live coral cover ranging between 5.09% - 34.56%. The abundance of reef fish is in the category of less abundant to abundant which is around 2100 ind/ha - 6280 ind/ha. The relationship between the condition of coral reefs and the abundance of reef fish is to have a close relationship with a value of $r^2 = 0.942$ so that if the percentage of coral cover gets better, the number of reef fish will be more abundant.

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