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# Analysis of Percentage Relationship of Coral Living with the Effect of Coral Fish in Wangi-Wangi Island, Wakatobi District, South Sulawesi

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**----------*ABSTRACT*----------**

*Coral reef ecosystems are a wealth of marine resources that have an important role in supporting the lives of various aquatic organisms. This is because reef fish go through a phase of life partially or completely on coral reefs, so that coral reefs become a place to live, a place to look for food, a shelter and a place to breed. The types of data collected for the purposes of this study are primary data and secondary data. Primary data collection by observing the field using the Underwater Fish Visual Cencus (UVC) method to find out the types of fish associated with coral reefs. The diversity index of reef fish ranges from 2.96% - 3.97%. This value includes the category of high diversity (H '> 3) because there is a good balance of ecosystems in Fragrant Fragmentation, uniformity index (E) of reef fish ranging from 0.55 to 0.97%, uniformity of species of reef fish at the base of Fragrant Scales -wangi as a whole is considered to be a stable type of fish species. The uniformity of reef fish species on the bottom of Wangi-wangi Island waters as a whole is considered to be a stable species of fish species. The dominance index (C) of reef fish at station 1 to station 10 ranged from 0.04–0.08. From the dominance index value can be interpreted in the community structure of the biota observed that there are no fish species that dominate the waters.*

***KEYWORDS:*** *Coral Reefs, Percentage of Coral Cover; Abundance of Coral Fish*

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## I. BACKGROUND

Diverse reef fish species are used as food fish and ornamental fish. Thousands of Indonesian fishermen depend for their livelihoods on the wealth of fish that live on coral reefs, so there is often a large-scale fishing for reef fish using cyanide and bombs. Coral reef is a habitat that is sensitive to fishing operations (Damayanti, 2005).

The existence of reef fish is closely related to the condition of coral reefs. In certain conditions, fish and coral reefs can benefit from each other. However, the symbiosis can also be harmed. Because of this interaction, there are certain classifications for fish in coral reefs, including indicator, major and target fish. To determine the condition of the coral reef ecosystem, it is necessary to know the pattern of its relationship to the associated biota, in this case the reef fish. This study discusses the relationship between the percentage of coral cover and the abundance of reef fish in Wangi-Wangi Island. Given that Wangi-Wangi Island has great potential in the field of marine resources. This study aims to determine the condition of coral reefs, the percentage of coral cover and the relationship between the percentage of coral cover and the abundance of coral fish in the waters of Wangi-Wangi Island.

The purpose of this study is to determine the condition of coral reef ecosystems, coral fish, limiting factors for coral reef life, and the feasibility of developing other marine tourism and management activities by related parties.

## II. METHODOLOGY

This research was conducted on 01 September - 20 November 2013, located in the waters of the Wakatobi National Park, Wangi-Wangi Island, Wakatobi Regency, Southeast Sulawesi.

**Method of Collecting Data**

Primary data were obtained using a survey method, namely snorkeling on Wangi-Wangi Island in order to determine the observation station to be taken. There are 10 stations that have been determined by the observation location. Of the 10 stations that have been determined, it is estimated that they can represent the condition of coral reefs in the waters of Wangi-wangi Island, Matahora Island and Kamponaone Island. Observations were made at a bottom depth of 6 meters.

For secondary data obtained from related agency data such as Wakatobi National Park, COREMAP II Wakatobi, Central Bureau of Statistics Wakatobi, and literature studies.


**Figure 1.** Position of Wangi-wangi Island Observation Station

**Observation of Coral Reef Conditions**

The method used to determine the condition of coral reefs is the Line Intercept Transect method. All forms of coral growth and other biota below the transect line are recorded to the nearest centimeter (cm). The recording results were then transferred to the life form table format. Coral reef cover data was collected in locations that were frequently visited by fishermen in carrying out fishing activities.

**Reef Fish Observations**

Observation of reef fish using the underwater visual cencus method. Quantitative observation and counting of reef fish is carried out 5-15 minutes after the transect is laid. Observations of reef fish are carried out during the day when in general reef fish are active. What needs to be considered in observing reef fish is that you should not look back to avoid repeating the data taken. This reef fish data is recorded on slates, which is in the form of data on fish species and their numbers.

**Data Analysis**

**Analysis of the Relationship Between the Percentage of Live Coral Cover and the Abundance of Coral Fish**

Analysis of the relationship between reef fish abundance was used to determine whether there was a correlation between the percentage of live coral cover and the abundance of reef fish. Calculation analysis using a simple linear regression method according to Sudjana (2002), namely:

$$\mathbf{Y = a + bX}$$

Where :

Y : Fish Abundance (ind/$m^2$)

X : Coral Cover (%)

a : Constant

b : Slope

The relationship between the two variables can be seen based on the coefficient $r^2$. If the coefficient of $r^2$ is close to 1, it shows that the relationship between the two variables is positive, on the contrary, if the coefficient of 1 shows that the relationship between the two variables is very weak or may not exist at all (Sudjana, 2002).

Eko. S (2009) states that in order to interpret whether the correlation found is large or small, it must be guided by Table 1.

**Table 1.** Correlation Value

| Coefficient Interval | Relationship Level |
|---|---|
| 0.00 – 0.20 | Very Weak |
| 0.21 – 0.40 | Weak |
| 0.41 – 0.70 | Strong |
| 0.71 – 0.90 | Very Strong |
| 0.91 – 0.99 | Very Strong |
| 1 | Perfect |

**Scoring Analysis of Marine Tourism Parameters**

The results of the coral reef cover measurements are matched with the coral reef cover values, then enter the percentage cover values obtained into the new column in Table 2.

**Table 2.** Filling in the Scoring Score

| No | Parameters | Weight | Value | Score | Total |
|---|---|---|---|---|---|
| 1 | Water Brightness | | | | |
| 2 | Cover of the Coral Community | | | | |
| 3 | Types of Coral Reefs | | | | |
| 4 | Types of Coral Fish | | | | |
| 5 | Flow Velocity | | | | |
| 6 | Depth of Water | | | | |
| Total | | | | | |

## III. RESULTS AND DISCUSSION

**Condition of Coral Fish Community and Fish Diversity in Wangi-Wangi Island Waters**

For all stations, the abundance of reef fish ranged from 200 - 349 ind, for the largest category found in major fish groups (small fish that live around coral ecosystems and including ornamental fish species) with the number of species found ranging from 87 to 171 ind, while For target fish groups, the number of species found ranged from 51 - 128 ind, and for group of indicator fish (typical fish that inhabit coral reefs and are indicators of the level of fertility of waters around coral reef ecosystems) which were found to range from 17 - 34 ind.

The results of observations made at all stations, the abundance of reef fish found from all stations ranged from 0.80 to 1.24 ind/$m^2$, for more details it can be seen in Figure 2.

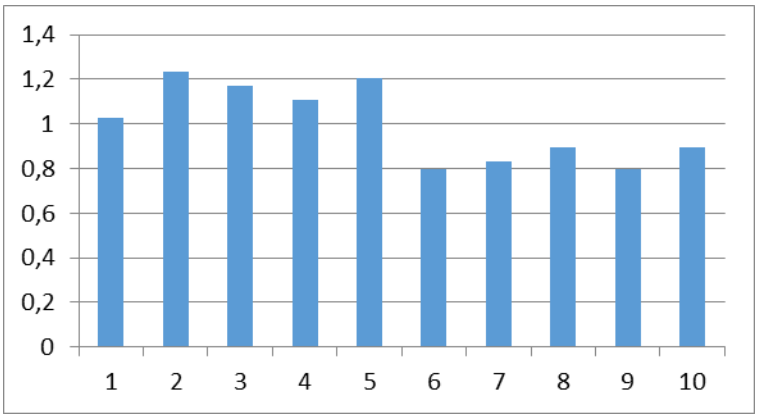


**Figure 2.** Diversity Index (H), Uniformity (E) and Dominance (C) at each Observation Station

From the graph above, the highest coral fish abundance is at station 2 which is 1.24 ind/$m^2$, this is because the condition of coral reefs at this station has a cover of 66.62% and is in the good category. While the smallest abundance of fish is found at station 6, which is 0.80 ind/$m^2$, this is in accordance with the condition of coral reefs at this station with a cover of 50.40% and is also in the good category.

From the observations at all stations, it was found that 15 families and 73 species of reef fish were included in 3 major categories, namely major, target and indicator. The families found included *Chaetodontidae, Acanthuridae, Balistidae, Caesionidae, Cirrhitidae, Labridae, Pomacantidae, Pomacentridae, Tetraodontidae, Zanclidae, Acanthuridae, Caesionidae, Carangidae, Labridae, Scaridae, Serranidae,* and *Singanidae*. Of the 16 families, the most found was the *Acanthuridae* family with 7 species of 337 individuals included in the category of target fish groups.

**Diversity Index**

At all observation stations the value of coral fish diversity index (H') ranged from 2.96 to 3.97%. Where the diversity index at station 1 was 3.29%, station 2 was 3.97%, station 3 was 3.59%, station 4 was 3.31%, station 5 was 3.79%, station 6 was 3.02 %, station 7 was 3.22%, station 8 was 2.96%, station 9 was 3.02 and station 10 was 2.96.

**Uniformity Index (E)**

At all observation stations, the uniformity index (E) of reef fish ranged from 0.55 to 0.97%. Where the uniformity index at station 1 was 0.61%, station 2 was 0.75%, station 3 was 0.67%, station 4 was 0.63%, station 5 was 0.77%, station 6 was 0.62 %, station 7 was 0.63%, station 8 was 0.55%, station 9 was 0.62%, and station 10 was 0.55%.

**Dominance Index (C)**

At each observation station, the domination index value (c) of karag fish ranged from 0.04 to 0.17%. Where the domination index at station 1 was 0.05%, station 2 was 0.09%, station 3 was 0.12%, station 4 was 0.17%, station 5 was 0.14%, station 6 was 0.05 %, station 7 was 0.05%, station 8 was 0.04%, station 9 was 0.05% and station 10 was 0.04%. For more details, the domination index value can be seen in Figure 3.

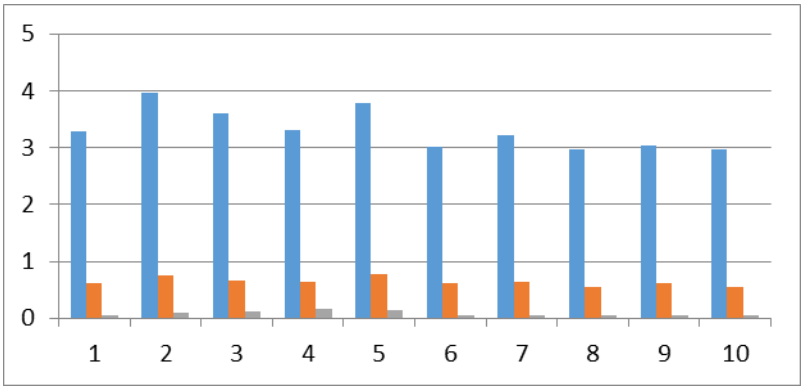


**Figure 3.** Diversity Index (H), Uniformity (E) and Dominance (C) of Reef Fish at each Observation Station

**Correlation of Percentage of Coral Reefs and Abundance of Coral Fish**

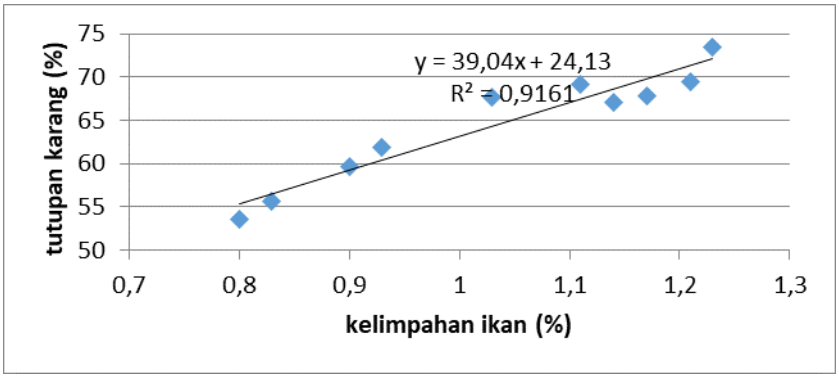


**Figure 4.** Correlation of Percentage of Coral Reefs and Abundance of Coral Fish

From Figure 4, a linear equation can be found about the relationship between reef fish and coral reef cover, namely y = 39.04x + 24.13 with r = 0.916 or correlation of determination = 91% of the linear equation, it means that every addition of coral reef cover is as much as x meter, then it produces coral fish as much as 39.04 ind/$m^2$.

**Potential of Coral Reefs for Marine Tourism on Wangi-wangi Island**

The total number of scores obtained for the suitability of marine tourism activities for station 1, station 2, station 3, station 4, station 5, station 6, station 7, station 8, station 9 and station 10 is 84, each value obtained

consists of brightness. 100% waters with a total value of 20, coral community cover 73.5% at station 1, 61.9% at station 2, 69.09% at station 3, 67.85% at station 4, 67.70%, at station 5, 53.56% at station 6, 69.41% at station 7, 55.65% at station 8, 67.08% at station 9, 59.63% at station 10 with a total value of 15 each, the type of coral reef obtained the total score score was 16 for all observation stations. The type of reef fish obtained a total score of 12, current speed of 12, and a depth of 9 because the depth of the observation was between 3 to 6 meters, for the scoring value of all observation stations can be seen in Table 3.

**Table 3.** Total Score and Category Criteria for Tourism

| Observation Station | Parameters | | | | | | Total Score | Category Criteria |
|---|---|---|---|---|---|---|---|---|
| | Water Brightness (100%) | Cover of the Coral Community (%) | Life Form Type | Types of Coral Fish | Flow Velocity (m/s) | Depth | | |
| 1 | 100 | 73.5 | 14 | 40 | 0.14 | >3-6 | 84 | S1 |
| 2 | 100 | 61.9 | 17 | 41 | 0.15 | >3-6 | 84 | S1 |
| 3 | 100 | 69.09 | 17 | 38 | 0.16 | >3-6 | 84 | S1 |
| 4 | 100 | 67.85 | 15 | 41 | 0.15 | >3-6 | 84 | S1 |
| 5 | 100 | 67.7 | 17 | 42 | 0.14 | >3-6 | 84 | S1 |
| 6 | 100 | 53.56 | 14 | 30 | 0.15 | >3-6 | 84 | S1 |
| 7 | 100 | 69.41 | 17 | 30 | 0.14 | >3-6 | 84 | S1 |
| 8 | 100 | 55.65 | 17 | 34 | 0.15 | >3-6 | 84 | S1 |
| 9 | 100 | 67.08 | 17 | 30 | 0.16 | >3-6 | 84 | S1 |
| 10 | 100 | 59.63 | 17 | 42 | 0.14 | >3-6 | 84 | S1 |

Information :
S1 (Perfectly Fit) : 80 – 100
S2 (Appropriate) : 60 – (≤80)
S3 (Conditional Compliant) : 35 – (≤60)
N (It is not in accordance) : <35

All observation stations are included in the S1 category, which is very suitable for coastal tourism. In this category is characterized by the absence of special limiting factors that hinder the treatment given. All existing physical parameters make this area very suitable for the development of coastal tourism, this assessment is given on the supporting parameters such as shallow seabed depth, sandy seabed material, not fast or safe currents, good brightness, sandy beach type, land. open space interspersed with coconut trees and easy drinking water. This category is very suitable for coastal tourism, not for marine tourism, such as for diving and snorkeling.

**Causes of Damage to Coral Reefs**

Damage to coral reefs was caused by taking coral reefs. Rocks are taken to build the foundation of the house and the sloping stone wall on the shore. This is done by the community because there are no stones for the foundation of the house and the beach protection from being hit by waves. Taking coral reefs is indeed carried out on corals that are already dead, but it is not impossible for corals that are still alive. Taking coral can also change the pattern of water currents so that erosion and sedimentation will occur in certain places.

**Destructive Fishing**

Fishing activities using explosives are still carried out clandestinely. The use of explosives in fishing is still carried out by residents who are included in marine conservation areas. Generally carried out because of their ignorance, that these activities will damage the coral reef ecosystem.

Cyanide fishing is still carried out but not much. This fishing activity is carried out because it is driven by high fish commodity prices and seeks convenience in catching. Such arrests are still being carried out because they still do not know the losses caused by these activities and are carried out by residents outside the marine conservation area.

There is also a collection of invertebrates from coral reefs, the most common of which is collecting sea cucumbers and shellfish. Collection of sea cucumbers is carried out around coral reefs at low tide. The activity of collecting sea cucumbers causes damage to coral reefs, due to being stepped on or caused by other things.

**Management Efforts carried out on Wangi-wangi Island**

Wakatobi Regency is one of the districts resulting from the division of Buton Regency which has been stipulated in Law of the Republic of Indonesia Number 29 of 2003 concerning the Establishment of Bombana Regency, Wakatobi Regency and North Kolaka Regency in Southeast Sulawesi Province and was ratified in

Jakarta on December 18, 2003. Wakatobi Regency has 4 large islands, namely Wangi-wangi Island, Kaledupa Island, Tomia Island and Binongko Island which were formerly known as Tukang Besi Islands.

Wangi-wangi Islands are part of the small islands of the 5 major islands in Indonesia where small islands are defined based on two main criteria, namely the area of the island and the number of inhabitants that inhabit it. The definition of small islands which is adopted nationally is in accordance with the Decree of the Minister of Marine Affairs and Fisheries No. 41/2000.

Based on the type, small islands are divided into continental islands, volcanic islands and coral islands. Each of these island types has a unique biophysical environment, so it needs to be considered in the study and determination of its management to be sustainable. This will also affect the settlement patterns that develop on small islands based on activities in accordance with these biophysical environmental conditions. For example, a small island typology is more dominant in the direction of aquaculture development, so it is likely that the developing settlement pattern is fishing communities.

In addition to having a very large function for almost all marine life, coral reef ecosystems that are on the bottom of the water, sometimes coral reefs are also often used as objects of livelihood for some people who do not think about environmental sustainability, such as mining corals for building materials and ornamental corals. Fishing activities using prohibited and environmentally unfriendly equipment. In addition, there is a lack of awareness of the fishing community, especially boat owners who throw anchors carelessly when fishing.

The enactment of Law No. 22 of 1999 concerning Regional Government has raised several issues in the management of small islands, namely:

1. Empowerment and increase the participation of regional and community institutions in the framework of managing small islands.
2. Pressure on natural resources and the environment in order to increase regional income.
3. Availability of data, information and regulations needed in making policies related to the management of small islands.
4. Cooperation between regions in managing small islands in the field of security, resource utilization and environmental quality improvement.

Community-Based Marine Protected Areas (DPL BM) are community efforts to maintain and improve the quality of coral reef ecosystem resources and at the same time maintain and improve the quality of other resources associated with coral reefs (Bengen, 2000).

The development of DPL BM in Wangi-Wangi Island is very prospective considering that this area consists of 110 very small islands with shallow waters and beautiful coral reefs. Coral reefs in fragrance play an important role in supporting the lives of the people, because more than 70% of them work as fishermen.

The wangi-wangi area itself has several zoning that are prohibited from carrying out all fisherman activities from fishing to removing anchors in the area, the area is named DPL (Marine Protected Area) wangi-wangi, where in this area the preservation of fish and coral reefs is still very well maintained, and there is a Coral Garden or Coral rehabilitation carried out by the NGO wangi-wangi in collaboration with the Marine Office.

The fishing gear used in Wangi-wangi are fishing rods, muroami nets, (mini purse seines) and mogong nets. The operation of muroami and mogong nets can damage coral reef ecosystems because their operations are like trawling, which is the pulling of nets to the bottom of the water, which causes damage to coral reefs. In addition, muroami nets use prerek tools (sticks with chains or stones under them) which are beaten on the reefs so that the fish will be scared and swim into the nets, from several interviews we have conducted with people who smell good.

The efforts made by the Wangi-Wangi fishing community are to protect each other, remind each other, and monitor the waters of Wangi-Wangi Island, so that fishermen who use tools that are not environmentally friendly can be prevented. Wangi-wangi also has an NGO that is under the auspices of Marine.

The village representative body or Wangi-wangi also makes local regulations to save the coral reef ecosystem. Local regulations on the maintenance and management of coral reef ecosystems that have been agreed upon (local people), this regulation divides the areas of Wangi-Wangi Island waters that can be caught and areas that are prohibited from fishing.

This regulation prohibits the use of Bomb, Potassium and coral harvesting and limits fishing using muroami nets and mogong nets, because the operation of these fishing gear damages the coral reef ecosystem. Due to the limitation of fishing grounds using the two nets, the government has provided another place to improve the economy of the community by establishing several shop houses at tourist objects in Wangi-wangi with management carried out by the local community.

The enactment of this regulation is quite successful in being implemented in Wangi-wangi because it can improve the community's economy and provide more benefits and knowledge to the community about the benefits of sustainable management, for sanctions imposed on people who violate or carry out fishing activities

in these prohibited areas will be imposed sanctions, starting from warning letters to detention of fishing gear and vessels used for operation.

## IV. CONCLUSION

1. The type of coral reef in Wangi-Wangi Island waters is classified as fringing reef. In general, the condition of coral reefs is classified into the moderate to good category. The average percentage of live coral cover (life form) at the bottom of the waters of station 1 to station 10 is 64.61%.
2. When viewed from the average range of aquatic environmental parameters at all observation stations are still in good enough condition for coral reef growth such as the average temperature measurement is 28 to 31oC, salinity of 32 to 34 ‰, brightness to the bottom of the waters at each observation station, and current velocity ranges from 0.13 to 0.14 m/s, which is carried out periodically for 4 weeks in the morning, afternoon, and evening in all observation stations.
3. The waters of Wangi-wangi Island at station 1, station 2, station 3, station 8, and station 10 are included in the S2 category, which is quite suitable for marine tourism. The categories are quite suitable for diving and snorkeling tourism. Meanwhile, station 4, station 5, station 6, station 7, and station 9 are included in the S1 category, which is very suitable for coastal tourism. This category is very suitable for beach tourism, not for marine tourism, such as for diving and snorkeling.
4. Efforts made by the fishing community of Wangi-Wangi Island are to guard each other, remind each other, and monitor the coastal waters of Wangi-Wangi Island, so that fishermen who use non-environmentally friendly tools can be prevented, POKMASWAS (Community Supervisory Group) Wangi-wangi Island act to protect coral reefs from various kinds of damage, keep the island clean and preserve nature, especially from destructive fishing activities.

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