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Correlation of Coral Reef Cover with Catch Results of Target Fish Species in Supiori Waters Papua, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Coral reefs are a habitat for aquatic resources to grow and reproduce to continue their survival. This research aims to analyze coral reef cover and the composition of fish caught in areas around coral reefs on Wandos Beach, Supiori Regency. This research uses a descriptive quantitative approach. Sampling was carried out at six stations with the criteria of station one, two. three and four are fishing areas, station five is a community residential area and station six is a tourist area. The research results found that coral reef cover for all stations was in the poor cover category, ranging from 0.14-0.27%, with the most coral species found being *Acropora* followed by *Coelastrea aspera*. The catch for all stations was 66 fish consisting of 10 species. The highest catch composition of aquatic resources was obtained at station five with the condition of coastal coral reefs near residential areas totaling 43 individuals (65.15%) and the lowest at stations one and six

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each with two individuals (3.03%) with the condition the station is a fishing area. The composition of catch species in coral reef areas is dominated by *Siganus* Sp fish. as many as 37 individuals (56.06%), *Charanx ignobilis* nine individuals (13.63%), *Etelis carbunculus* six individuals (9.09%), *Leptoscarus vaigiensis* five individuals (7.57%), *Lutjanus monostigma, Balistapus undulatus* and *Sphyraena sphyraena* respectively two individuals each (3.03%). *Scomberomorus commerson, Lutjanus campechanus* and *Tylosurus crocodilus* one individuals each (1.51%). Station five with coral reef conditions near residential areas provided the largest catch of rabbitfish (*Siganus* Sp.). The lack of coral cover has an impact on the decreasing availability of fish resources, so that conservation efforts and control of fisheries management that damages coral reef ecosystems are needed.

Keywords: Target fish species; coral reef cover; fish species composition; wandos.

1. INTRODUCTION

The Central Statistics Agency reports that the area of coral reef ecosystems in Indonesia will reach 2.53 million hectares (ha) in 2021. Based on this area, 270.16 ha are conservation areas (Handayani and Citra 2023). One of the roles of the coral reef ecosystem is to have the ability to protect against currents and coastal waves and as a place for snorkeling and diving tourism activities (Sukandar et al. 2017). (Indonesian Institute of Sciences 2014). Until 2013, the condition of coral reefs in Indonesia experienced damage of 30.4% with details of poor 5.29%, very good 27.14% and good 37.18%. (Hadi et al. 2019) reported that damage to Indonesia's coral reef cover in 2019 reached 50%.

Small islands have an important role in terms of natural resources, geography, social, economic, cultural, political, defense and security in Indonesia. Small islands have more than one ecosystem and are very sensitive to change (Goldberg et al. 2020), so changes in one ecosystem can affect other ecosystems. Numfor Island, Biak-Supiori and Padaido Islands, which face directly to the Pacific Ocean, are surrounded by fringing reefs, barrier reefs, patch reefs and atolls, and have economic potential. in the fisheries and marine tourism sectors (Suharsono 2007). Supiori Regency is an expansion district of Biak Numfor Regency, a Regency which was formed by Law Number 35 of 2003 (Dariusman 2016). Wandos Village is in East Supiori District which borders the Pacific Ocean to the north, Wopes Village to the east, Mount Sombunem and forests to the south, and Waryesi Village to the west.

Coral reefs can contribute to improving the economy, social, culture, politics, region, and environment that can be used as a place for marine tourism (Adi et al. 2013). Marine tourism is part of ecotourism with its utilization sources located in coastal areas and its development through a conservation approach (Wainwright and Bellwood 2002). Coral reef ecosystems are one of the important ecosystems in tropical waters as a place for feeding, nursery and spawning ground and are very rich in plasma nutfah. In coral reef ecosystems, there is a process of forming a very complex food chain and network involving various organisms (Tuwo 2011).

Previous research related to coral reef cover and catches has been conducted by (Puspitasari et al. 2014) who found live coral cover ranging from 21-56.5% with damaged to good categories in the waters of Lemukutan Island. Other researchers such as (Rizqy et al. 2023) obtained coral cover ranging from 5.9-51.8% in the waters of Harapan Island, Seribu Islands with catches dominated by reef fish (Neoglyphidodon melas) which are algae-eating fish.

Coral reefs also have ecological characteristics as a source of nutrients for marine biota, physical protection from waves, spawning grounds, play areas and nurturing for marine biota. However, it also has an economic function as a tourist attraction, as a producer of building construction materials and lime making, as a producer of active ingredients for medicines and cosmetics and as a natural laboratory to support education and research (Wahib and Luthfi 2019). This research is very interesting and important to do because of the very high intensity of fishing in the coral reef area which is the center of the world's coral triangle in supporting biodiversity and fisheries productivity at the research location. However, in reality, the community has difficulty obtaining catches due to damage to the coral reefs. This study aims to analyze the relationship between coral reef cover and target fish catches in Wandos waters, Supiori Regency.

2. MATERIALS AND METHODS

This research was carried out from May to July 2024 in the coral reef area in Wandos coastal waters, East Supiori District, Supiori Regency, Papua Province. The research used 6 (six) stations each with coordinates, station one S: 0°43'10" ; E: 135°46'23", second station S: 0°42'48" ; E: 135°46'38", station three S: 0°42'58" ; E: 135°46'49", station four S: 0°42'41" ; E: 135°46'55", station five S: 0°42'43" ; E: 135°47'06" and station six S: 0°42'32" ; E: 135°47'11". Underwater observations to record coral types and monitor coral reef cover. Coral reef cover data was collected using the LIT (*Line Intercept Transect*) method. LIT (*Line Intercept Transect*) is a method used in coral reef monitoring surveys (Veron 2002, 15. United Nation Environment Protection). The length of the transect used is 50 m, which is installed paralel to the depth contour which is parallel to the coastline. Observations were made by recording the type of live coral at each station.

Data collection was carried out at six stations with different environmental conditions, namely stations one to four are fishing areas, station five is a coral reef near a residential area and station six is a tourist area. Coral types from the research location were identified using the Coral Finder Tool Kit (United Nation Environment Protection). The condition of coral reefs is estimated using the percentage approach of live coral reef cover with condition categories (Marine Science 1993, Nurhasinta 2019).

$$Ni = \frac{Li}{L}\ x\ 100\ \%$$

N

Where:

Ni = percentage of live coral reef cover (%)
Li = length of coral colony extending the line transect (cm)
L = length of transect line (cm)

Based on the percentage value of live coral reef cover, the condition of coral reefs can be determined, such as the grouping carried out by the Oceanographic Research Center of the Indonesian Institute of Sciences (Puslit Oceanography-LIPI) (Odum 1992). The criteria for assessing live coral cover are 75-100% very good, 50-74.9% good, 25-49.9% moderate and 0-24.9% poor. Information on the composition of fish catches was obtained through surveys carried out by local fishermen using handline at each station, with calculations using the formula proposed by (Siringoringo et al. 2014) namely,

$$KJ = \frac{ni}{N}\ x\ 100$$

Where:

KJ : fish species composition (%)
Ni : number of individuals of each fish species
N : number of individuals of all fish species

3. RESULTS AND DISCUSSION

3.1 Coral Reef Cover

Based on the results of identifying coral reef species from all transects, the species, number, cover value and status of coral reef cover were found (Table 1). The coral reefs found consisted of *Coelastrea aspera*, *Acropora* and *Stichodactyla gigantea* (*sea anemone*) species. *Acropora* was the most common species found for each station and the least was *Stichodactyla gigantea* and was found only at stations three and five. However, the cover status for all species of coral found was in the poor cover category. The results of the analysis of coral reef cover based on the level of cover according to the for each station obtained values in the poor cover category (Table 1).

Fig. 1 shows that the number of corals of the Acropora species reached 63 (0.54%) and dominated, followed by Coelastrea aspera. Acropora and Coelastrea aspera were found at all stations, while *Stichodactyla gigantea* was only found at stations three and five. The dominance of certain corals is an indication that there are environmental factors that do not support coral growth. The dominance of certain corals is an indication that there are environmental factors that do not support coral growth, such as temperature, salinity, depth, currents and tides. (Fachrul 2007) revealed that environmental factors affect coral reefs such as sedimentation will inhibit zooxanthellae for photosynthesis which will inhibit coral growth. (Luthfi et al. 2017) revealed that current factors also affect coral reefs because they can carry sediment on the surface or at the bottom of the water. (Supriyadi et al. 2017) argued that health disorders also play a role in inducing coral disease. (Luthfi et al. 2018) that the growth of living corals is more diverse, indicating that environmental conditions are more favorable for the growth of many types of coral.

Table 1. Coral species, number, cover value, cover status and number of fish caught

Stations	Spesies of coral reefs			Amount	Covers value	Covers status	Number of fish (individulas)
	Ca	A	Sg				
1	8	10	0	18	0,18	Poor	2
2	6	8	0	14	0,14	Poor	9
3	4	7	2	13	0,13	Poor	2
4	12	16	0	28	0,28	Poor	7
5	6	8	3	18	0,18	Poor	43
6	13	14	0	27	0,27	Poor	3
Amount	49	63	5	118	1,18		66

Where: Ca = Coelastrea aspera, A = Acropora, Sg = Stichodactyla gigantea

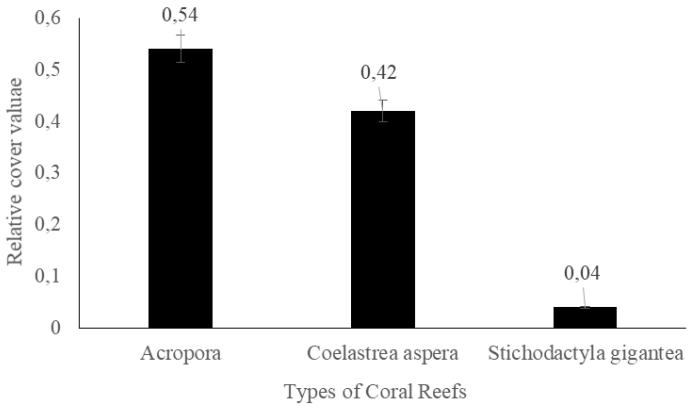

Fig. 1. Relative cover values based on coral species

Poor coral reef cover has an impact on decreasing biodiversity, thereby reducing the ecological function of coral reefs, which can lead to reduced economic and tourism potential. Poor coral reef cover can be caused by natural factors and due to human activities. Natural factors relate to coral disease, changes in oceanographic conditions, predation by organisms or storms that can destroy coral structures. Meanwhile, factors resulting from human activities include coral bleaching, destructive fishing, marine pollution, sedimentation and tourism activities. Poor coral cover percentage, as an indicator of low coral complexity, low live coral diversity, so that no type of coral dominates (Siringoringo and Hadi 2013). Low live coral cover can be caused by natural factors and artificial factors caused by the activities of the surrounding community around the waters which have an impact on the balance of the coral reef ecosystem (Thovyan et al. 2017).

The Acropora species of coral is found at all stations and is classified as dominant, presumably because this coral has a high growth rate, efficient reproductive ability, has the ability to tolerate a wide range of environments and has morphological variations that enable it to adapt to ever-dynamic environmental conditions. Meanwhile, Stichodactyla gigantea (sea anemone) was very rarely found during research, which is thought to be related to habitat preferences, has high sensitivity to environmental changes, may not be able to compete for space, has limited distribution or may be exploited by humans because of its beauty.

(Lalang et al. 2022) argues that environmental changes such as the impact of sedimentation in waters can affect coral growth by covering the surface of the polyps, causing death, decreasing growth rates, and reducing water clarity, thus disrupting the physiological processes of corals, especially in the process of photosynthesis, and causing corals to expend large amounts of energy to clean sediment from the surface.

3.2 Composition of Fish Catch Types

There were 66 fish caught during the research for all stations using handline fishing gear, consisting of 10 species of fish target and all of them were classified as bony fish. The composition of the catch was dominated by 37 rabbitfish (*Siganus* Sp.) (56.06%), followed by 9 (13.64%) redfish (Etelis carbunculus), 6 red fish (Etelis carbunculus) (9.09%) and murmer parrotfish (Leptoscarus vaigiensis) as many as 5 (7.58%) (Fig. 2).

The composition of fish species caught based on stations showed that at station five there were 43 fish and it was dominated by baronang fish (Siganus sp), followed by station four at eight fish, dominated by six fish (*Charanx ignobilis*) and at station two there were eight fish. which is dominated by the fish species Etelis carbunculus (Fig. 2). Stations one, three and six provided the lowest catches. The number of catches after being tested using the two-sample t-test assuming equal variances showed that stations one, two, three and four were fishing areas that were no different from station five, which was a station close to residential areas with a calculated $t_{calculated} < t_{table}$ (0.0492 < 0.1565). Stations one, two, three and four with different fishing area criteria were different from station six, which was a tourist area with a $t_{calculated} < t_{table}$ (15.8750 > 6.3882). Likewise, stations five and six obtained different catches with a $t_{calculated} < t_{table}$ (322.8750 > 6.3882).

This shows that community activities at each station contribute to the amount of fish caught. (Buhari et al. 2021) argues that coral reefs are the most significant factor influencing fish catches.

The condition of coral reef cover for all stations is classified as poor cover so there is no difference between stations. However, there are differences in catch results based on station conditions, namely stations as fishing areas, stations close to residential areas and stations that are tourist hotspots. Differences in catches between research station conditions are thought to be related to the contribution of human activities at each station, habitat conditions, fishing pressure carried out by the community, regulations related to management or because of the presence of dominant species. (Lestaluhu 2023) revealed that the abundance and diversity of reef fish species depend on live coral cover, substratum diversity, and structural diversity and the area of coral reefs.

Rabbitfish (*Siganus* Sp) are more commonly caught at station five with coral reef conditions located near residential areas, thought to be due to several factors, including food availability, intensive fishing activities, limited habitat, changes in fish behavior or because of ecosystem pressure at the location. another arrest. Residential settlements produce organic waste flowing into the sea which can increase primary productivity around coral reefs thereby attracting plankton which is the main food for rabbitfish (Siganus sp). The close distance to settlements makes access easier and causes fishing to occur more frequently.

On the other hand, limited habitat due to degradation factors due to pollution, sedimentation and other human activities causes rabbitfish to gather at certain points, making it easier to catch them. Fishing interactions carried out by the community can have an impact on changes in movement patterns, causing fish to move to places where it is easier to catch them. (Öhman and Rajasuriya 1998, Anderson 2002) argue that the catches obtained in coral areas are the result of a positive relationship between coral fish and their habitat, which is caused by the functional aspects of the structure and composition of the habitat which provides shelter and food for coral fish. Damage to coral reef ecosystems contributes to a decline in biodiversity and socio-economics for coastal communities (Ulfah et al. 2020).

The results of a simple linear regression analysis show that coral reef cover and catches in the Wandos waters of Papua show a correlation coefficient (r) value of 0.5494 and a coefficient of determination (R2) value of 0.3091 (Fig. 3). This provides information that coral reef cover contributes to coral fish catches by 30.91%, which means that the higher the percentage of coral reef cover, the more coral fish catches will increase. The correlation coefficient (r) value of 0.5494 means that the relationship between live coral reef cover and catches is in the sufficient category (Siringoringo and Hadi 2013). The level of close relationship between live coral reef cover and catches at the research location is thought to be caused by the percentage of coral reef cover being classified as deficient. The striking relationship between coral reef cover and rabbitfish catches at station five is an indicator that the coral reef ecosystem adjacent to residential areas is a good habitat for rabbitfish (Tanjung 2024).

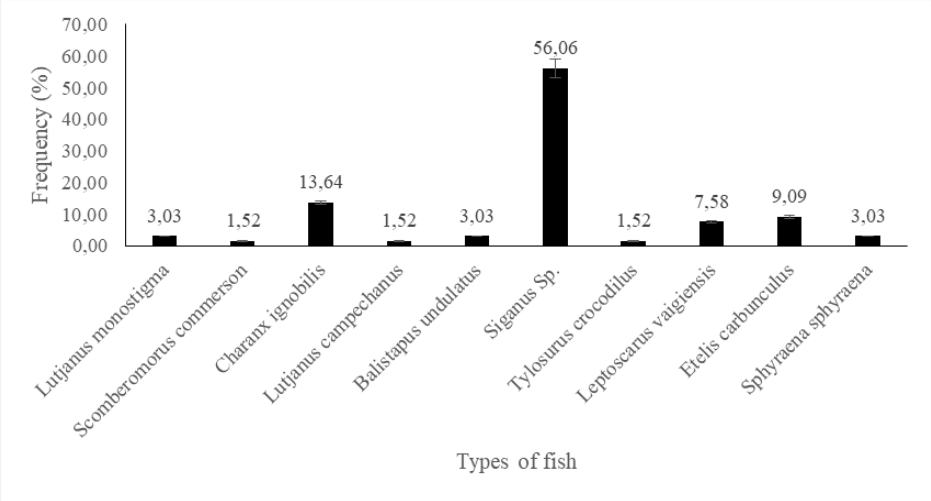

Fig. 2. Composition of fish species caught during the research

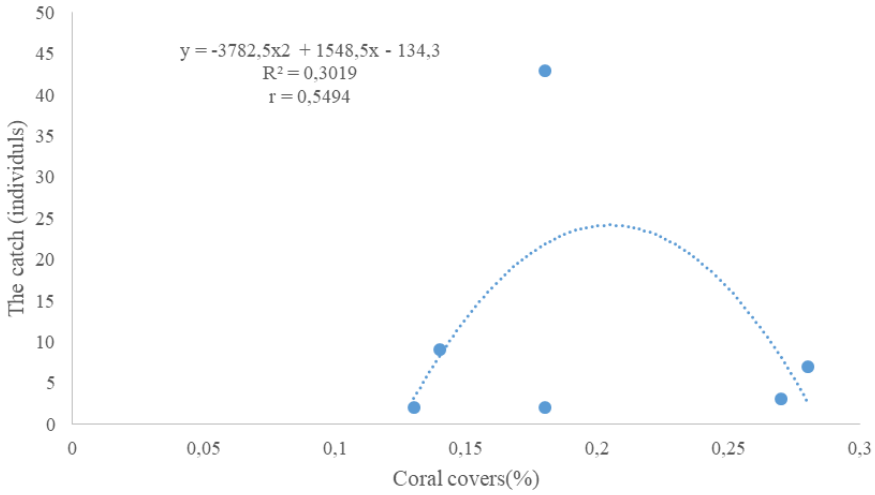

Fig. 3. Correlations between coral reef cover and fish catch

4. CONCLUSION

Coral cover for all stations is in the poor or rare category with the dominant coral type found being Acropora. The number of catches between stations was different and the highest catch was found at station five of the rabbitfish (*Siganus* Sp). There is a positive relationship between coral cover and fish catches.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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