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Reef Fish Diversity in Fish Apartement (Domus Frosiquilo/Equatorial Leaf) and Coral Cover. (Case Study in Jikomalamo Beach. Ternate. North Maluku. Indonesia)

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Abstract

Apartments fish is a development of the installation of basic FADs that have succeeded in increasing the availability of fish stocks. Observations showed that basic FADs had succeeded in collecting demersal fish, even juvenile marine biota were found attached to these basic FADs so that they were very beneficial for marine biota habitat. The location of data collection is divided into two, namely in the fish apartment area and outside the fish apartment area. Data collection on coral reefs and reef fish in apartment fish, the process of collecting data on coral reefs in apartment fish, is carried out by pulling transects vertically to the last limit of the apartment fish area. Collecting data on coral reefs and reef fish outside the apartment fish by placing permanent stakes at the beginning and end of the transect. The 50-meter-long vertical transect was withdrawn after that the data collection process began. The data collection process for reef fish outside the apartment fish was carried out by pulling a transect along a vertical length of 50 meters. The results of this study found as many as 34 species of fish located at two control stations and in apertement fish on Jikomalamo beach. The diversity of reef fish found was moderate. While the types of corals found from life from control station one were ACS 12% CM 5.02% CF 28% ACB 13.64% CS 9.7% SC 3.56% ACT 5.42% ACD 21.82% Types of coral found in the apartment fish CF 43% RB 28% DC 29% while at the second control station ACD 10% ACT 24% CM 15% ACS 3% SC 13% CF 36%.

Keywords: Biodiversity; Marine Fish; Coral Reef; Small Island; Tropical area

Introduction

Reef fish are one of the groups of animals that are directly associated with coral reefs, their presence is conspicuous and found in various micro-habitats on coral reefs. Reef fish live permanently and find food in coral reef areas, so that if coral reefs are damaged or destroyed, reef fish will also lose their habitat [1,2]. Research on reef fish has been reported in several marine areas of Indonesia namely [3] on economically important reef fish [4,5] in the waters of Saleh Bay, West Nusa Tenggara, [6] in the Kayoa archipelago, North Maluku, [7] in the waters of Buleleng Regency, Bali, [8] in the Tikus island Sea, Bengkulu City, [9] in Kendari Island, [10] in the Makian Island Sea, North Maluku, Indonesia, [11] research on reef fish on Maitara Island. North Maluku. Indonesia, [12,13] on reef fish in the shadow reef and broad coral waters of Tikus Island, Bengkulu City. The research report above shows the importance of studying reef fish in a waters, because it is used as an indicator of habitat conditions [11].

Ternate City has the potential for coral reefs, seagrass and mangrove forests [14]. The existence of this ecosystem provides benefits to the community ecologically, economically and socially. Another benefit obtained is the abundance of fish in the area around coral reefs. This is because fish make coral reefs their habitat. Research on reef fish in Indonesia has been widely reported. Jikomalamo beach, which is located in the northern part

of the island of Ternate, has a coral reef ecosystem and species of fish that are very well developed and unique. Based on the results of observations, it can be seen that there are various types of coral and reef fish that live in artificial fish houses on Jikomalamo beach. The laying of artificial reefs of Domus Frosiquilo/equatorial leaves in Jikomalamo has been carried out by the Rupa Reef Foundation in 2019, visually it can be seen that the presence of Domus Frosiquilo artificial reefs/equatorial leaves is one of the advantages for marine biota, especially fish around the coral reef area. In addition, the presence of artificial reefs Domus Frosiquilo / equatorial leaves can be a place of survival for reef fish and associated biota around artificial reefs, but information regarding the number and names of reef fish in and around artificial reefs has not been identified, therefore the author wants to conduct research related to the biodiversity of reef fish on artificial reefs.

Artificial reefs or fish houses are places for shelter, foraging and growing large reef fish. Thus, artificial reefs play an important role as habitat for reef fish and contribute to increasing the productivity of reef fish in the waters. The new habitat becomes a medium for attaching coral animals to contribute to the restoration of coral reef ecosystems. According to [15] that artificial corals also provide living space and create food chains, provide new habitat for target species, protect small or juvenile organisms and as nursery grounds, protect beaches from waves and as shelters for organisms from strong currents and waves. predation, increasing the complexity of the basic habitat so that it functions like a component of the reef's physical environment. Physically, the use of artificial reefs serves to restore habitat and mitigate natural habitat degradation. In addition, fish apartments are also one of the strategic response actions in fisheries management to increase the presence of natural reef fish stocks as catch targets in the reef fisheries process [16].

Based on its function, artificial reefs have been proven as artificial habitats in attracting fish gathering and increasing the catch of fishing communities. However, the ability of artificial reefs to increase the abundance of reef fish is not well documented, this is because after the laying of artificial reefs is no longer carried out with monitoring and assessing the success of artificial reefs both in construction and the presence of reef fish that occupy this artificial habitat. Damage to fish apartments can be caused by extreme marine conditions. Research related to fish apartments in Ternate has been previously reported by [17], finding a positive response of reef fish to fish apartments, where it is proven that there is an increase in abundance and evidenced by the percentage of the number and species of reef fish. With the rationale and description above, the writer is interested in conducting research on the biodiversity of reef fish in Fish Apartment in Jikomalamo, Ternate City. This study will examine the Biodiversity of Coral Fish in Fish Apartments (Domus frosiquilo).

Materials and Methods

Sampling

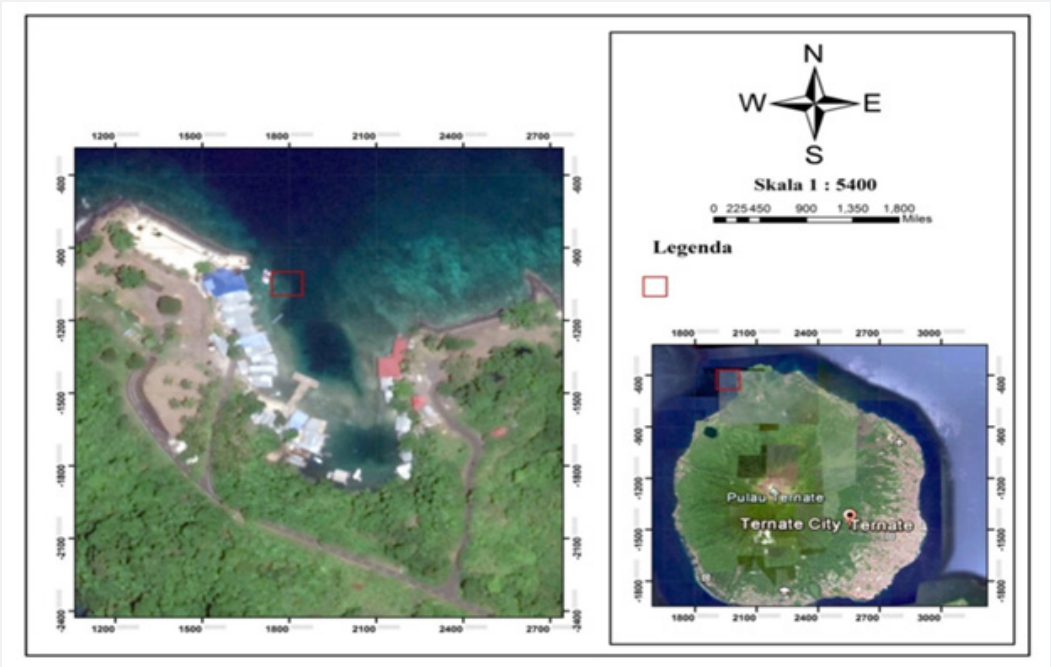

Figure 1: Research Site Fish Apartement in Jikomalamo Beach. Ternate. North Maluku. Indonesia.

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This research was conducted in December 2019-January 2020 in the waters of Jikomalamo Beach, Ternate City, North Maluku Province (Figure 1). Measurement of field data in this study was carried out for 1 (one) month with 4 (four) repetitions of data taken based on the phase of the moon. This measurement is carried out so that the data obtained provide an overview of the condition of reef fish biodiversity with tidal types in the waters of Ternate Island with tidal types. The first measurement was carried out on the new moon, in this study coincided with December 18, 2019. The second measurement was carried out in the first quarter moon phase, in this study coincided with December 25, 2019. The third measurement was carried out at the full moon phase, in this study coincided with the January 1, 2020. The fourth measurement was carried out in the phase of the last quarter moon, in this study coincided with January 10, 2020.

In this study, data collection includes data on coral reefs and data on reef fish. However, the priority is coral fish data, but in this study, we also take coral reef data because coral reefs are the habitat of reef fish. Coral reef data collection was carried out using the line intercept transect method while the coral fish data collection method used was the Underwater Visual Census [18]. In this study, the data collection locations were divided into two, namely in the fish apartment area and outside the fish apartment area. The process of collecting data on coral reefs and reef fish is divided into two parts, while the process of collecting data on corals and reef fish can be seen in (Figure 2).

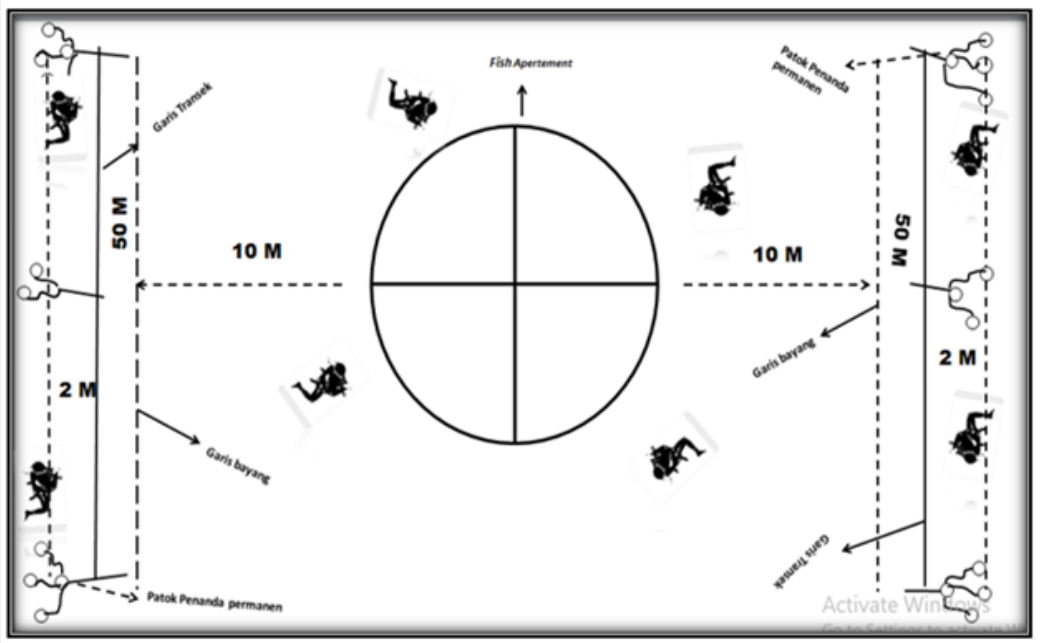

Figure 2: Coral and Coral Fish Data Collection Sketch.

i. Collecting data on coral reefs and reef fish in apartment fish. The process of collecting data on coral reefs in apartment fish is done by pulling transects vertically to the last limit of the apartment fish area. After that, the coral reef data collection process began, while the coral fish data collection process in the apartment fish was carried out by taking pictures and then continued with video for 10 minutes and in the data collection process only 4 divers were needed.

ii. Data collection on coral reefs and coral fish outside the apartment fish. The process of collecting data on coral reefs outside the fish apartment is done by placing permanent stakes at the beginning and end of the transect to mark the next time for data collection. After that, pull the transect vertically along 50 tens of meters after that the data collection process begins. Meanwhile, the data collection process for reef fish outside the apartment fish was carried out by pulling a transect along a vertical length of 50 meters and then leaving for a while after that the data collection process began. In the process of collecting data on coral reefs and reef fish outside the fish apartment, 3 divers are needed.

Analysis Data

Shannon diversity index = H' [19]. The percentage of live coral, dead coral, sand, and broken coral can be calculated using the formula [20].

Results and Discussion

Location Description

Jikomalamo beach is an area of Ternata Island sea which is administratively located in Ternate City, Ternate District, Takome Island Village. Since 2009, this area has been developed as a new

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tourist spot that can be enjoyed and accessed by both domestic and foreign tourists. Morphologically, the waters of Jikomalamo form a bay with a long stretch of reef flat. If measured from the shoreline, the length of the reef flat is 100 m towards the sea. The depth of the reef flat ranges from 0 – 5 m. then the topography changes to a reef slope starting from a depth of 5 to 30 m. Distribution of coral reef ecosystems in the Jikomalamo sea was found at a depth of 3 to 30 m. Geographically, the Jikomalamo sea area which is the location of the study in this research is located at 0051'' 48' N and 127020.17'' 13' E.

Species Composition

Tabel 1: Composition of Coral Fish found in Jikomalamo Beach.

No	Family	Genus	Species	Category
1	Aulostomidae	Aulostomus	Aulostomus maculates	Mayor
2			Aulostomus chinensis	Mayor
3	Pomacentridae	Abudefduf	Abudefduf bengalensis	Mayor
4			Abudefduf vaigiensis	Mayor
5	Acanthuridae	Acanthurus	Acanthurus coeruleus	Target
6			Acanthurus albipectoralis	Target
7			Acanthurus lineatus	Target
8			Acanthurus nigricans	Target
9			Acanthurus triostegus	Target
10	Labridae	Cheilinus	Cheilinus Udulatus	Mayor
11			Cheilinus trilobatus	Mayor
12			Centrisus scutatus	Mayor
13	Chaetodontidae	Chaetodon	Chaetodon vagabundus	Indikator
14			Chaetodon semilarvatus	Indikator
15			Chaetodon trifasciatus	Indikator
16	Pomacentridae	Chromis	Chromis viridis	Mayor
17		Dascyllus	Dascyllus trimaculatus	Mayor
18	Chaetodontidae	Forcipiger	Forcipiger flavissimus	Indikator
19	Pomacentridae	Pomacentrus	Pomacentrus Pavo	Mayor
20			Pomacentrus moluccensis	Mayor
21			Pomacentrus auriventris	Mayor
22			Pomacentrus tripunctatus	Mayor
23			Pomacentrus opisthostigma	Mayor
24	Balistidae	Rhinecanthus	Rhinecanthus aculeatus	Mayor
25		Balistapus	Balistapus undulates	Mayor
26	Ephippidae	Platax	Platax boersii	Mayor
27	Nemipteridae	Scolopsis	Scolopsis bilineatus	Mayor
28	Singanidae	Siganus	Siganus vulpinus	Mayor
29	Nemipteridae	Scolopsis	Scolopsis affinis	Mayor
30	Pomacentridae	Pomacentrus	Pomacentrus Stigma	Mayor
31	Acanthuridae	Zebramosa	Zebrasoma scopas	Target
32			Zebrasoma rostratum	Target
33			Zebrasoma flavescens	Target
34	Zanclidae	Zanclus	Zanclus cornutus	Mayor

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Reef fish biodiversity is defined as the richness of reef fish species. Reef fish biodiversity was determined based on data on the number of fish species found in the research location, namely in the Jikomalamo sea. According to [21] the diversity of reef fish has a relationship with the diversity of species and the percentage of coral cover. The higher the percentage of coral cover, the higher the percentage of reef fish cover and reef fish abundance [21]. We found 16 families of reef fish (Table 1) in coral reef ecosystems and artificial reefs (Domus Frosiquilo) as habitats for growth and development. Domus frosiquilo is a medium placed in the coral reef ecosystem area of the Jikomalamo sea which aims to become a fish house. The results of this study found that these 16 families utilize coral reef ecosystems and artificial reefs as their habitat. According to [22] reef fish make coral reef ecosystems a habitat for growth and development (nursery ground), a place to find food (feeding ground) and a place to lay eggs (spowning). Artificial coral (artificial reef) is a medium created by humans as a form of engineering habitat for reef fish placed in coral reef ecosystems [23]. Artificial coral also functions as a medium for coral growth that serves as a medium for restoration of coral reef ecosystem areas.

Observations made at the two control stations and in the fish apartment showed that the number of families and species of reef fish was very diverse, this was probably because the types of coral reefs on Jikomalamo beach were still quite good, and the condition of the waters was still in quite good condition. In addition, the substrate condition and coral diversity are quite high, affecting the abundance of reef fish. [24] said that substrate conditions and variations in coral reefs in a water have an influence on the presence, number and diversity of reef fish. This of course has an influence on the presence of aquatic biota associated with coral reefs. Reef fish obtained in this study can be grouped into three groups, namely indicator fish, target fish, and major fish. The indicator fish groups are from the Chaetodontidae family as many as 3 species, the target fish groups are from the Acanthuridae family as many as 8 species and the major fish groups from the Pomacentridae family as many as 8 species, Labridae 3 species, Zanclidae 1 species, Nemipteridae 2 species, Singanidae 1 species, Ephippidae 1 species , Balistidae 2 species, Aulostomidae 2 species.

Diversity of fish species

Analysis of reef fish diversity index at each station on the new moon when the first data collection, namely stations I, Domus and station II, determined the values that varied. Station I on the new moon at high tide obtained a fish diversity value of 2.81 while station 1 on the new moon at low tide obtained a diversity value of 2.60. at station II on the new moon at high tide the diversity value is 2.66, at the new moon at low tide station II gets a diversity value of 2.84 (Figure 3). while at domus the diversity value at the new moon at high tide is 2.36 and at the new moon at low tide the diversity index of reef fish in the domus obtained a diversity value of 2.61. Based on the fish diversity index category, the value found at the new moon at high tide and low tide during the first data collection was in the medium category (H'<3) [25] The condition of coral reefs also influences the presence and diversity of reef fish species diversity of reef fish is a stable community meaning that the distribution of the number of each species at each observation station is even or uniform [26], this indicates that the Jikomalamo sea still have a good aquatic environment, besides that the exploitation of reef fish is still very low. Similar results were also found [6] in the Kayoa Island Sea, [8] in the waters of Tikus Island, Bengkulu, [10] in the Makian Island Sea, North Maluku Province, [9] in Kendari Waters, [27] in the waters of Bunaken National Park. and [24] in the waters off the island of Batee, Aceh. The presence of reef fish that varies in large numbers at each observation location has an influence on the level of diversity in the Jikomalamo Sea.

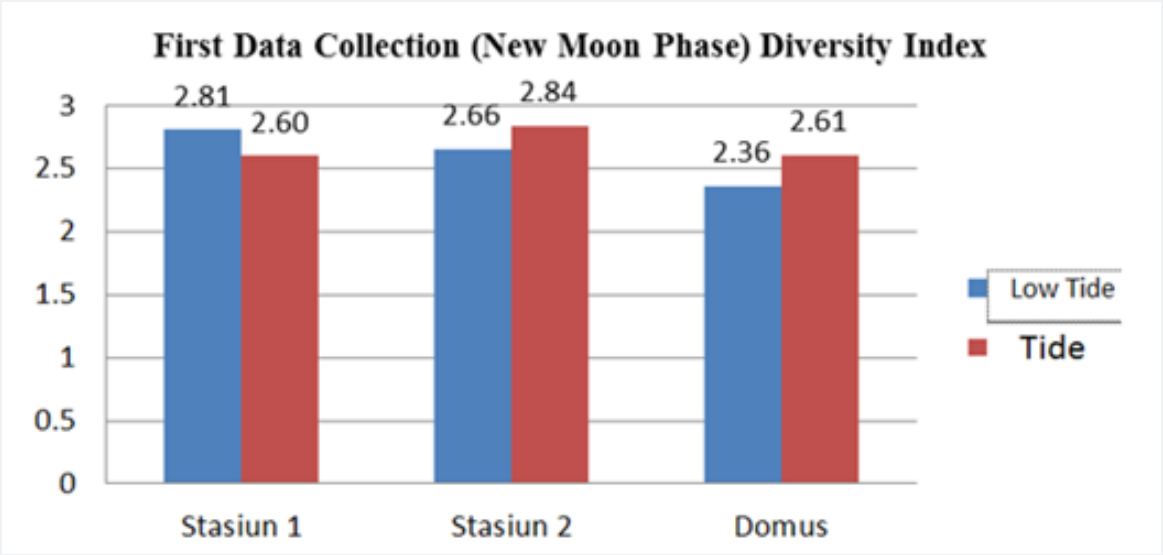

Figure 3: diversity index at the time of first data collection.

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Second Data Collection (First Quarter Month Phase): Station I in the first quarter of the moon at low tide got a fish diversity value of 2.60 while station I in the first quarter of the month at high tide got a diversity value of 2.96, station II in the first quarter of the moon at low tide got a diversity value of 2.26, in the first quarter In the month at high tide, station II obtained a diversity value of 2.98, while in domus the diversity value in the first quarter of the month at low tide was 2.35 and in the first quarter of the month at high tide the diversity index of reef fish in the domus obtained a diversity value of 2.37 (Figure 4). The results of the analysis of the reef fish diversity index at each station in the first quarter of the month when the second data collection, namely stations I, Domus and station II, determined varying values. Based on the reef fish diversity index category, the value found in the first quarter of the month at high tide and low tide during the first data collection is in the medium category (H'<3) [25].

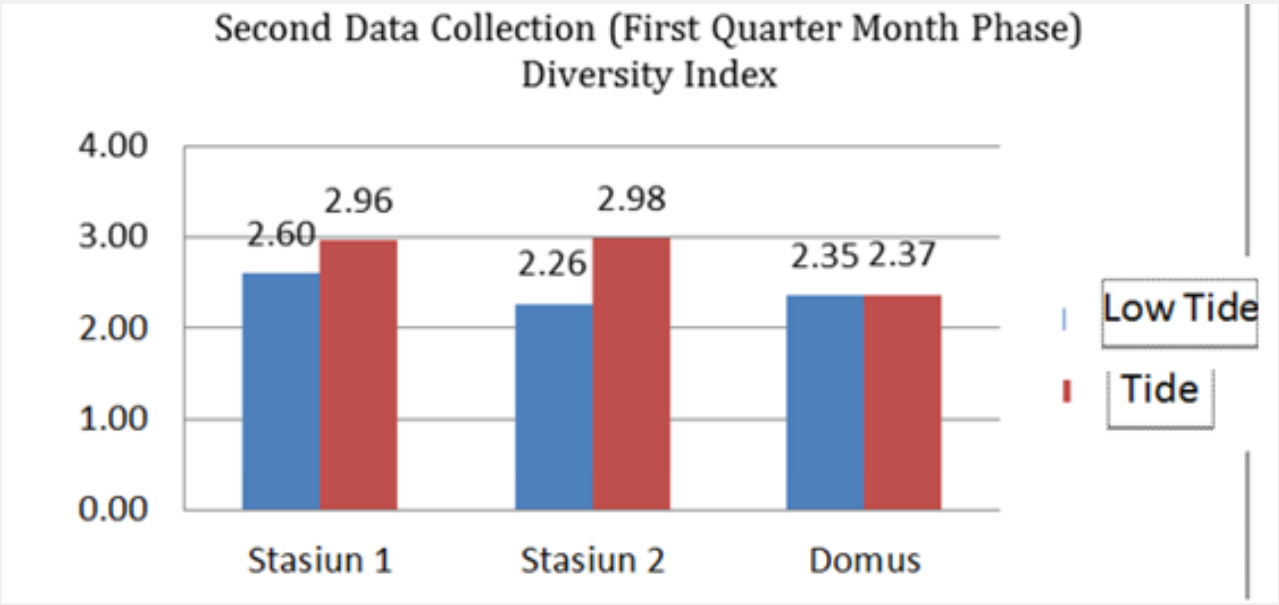

Figure 4: Diversity index at the time of the second data collection.

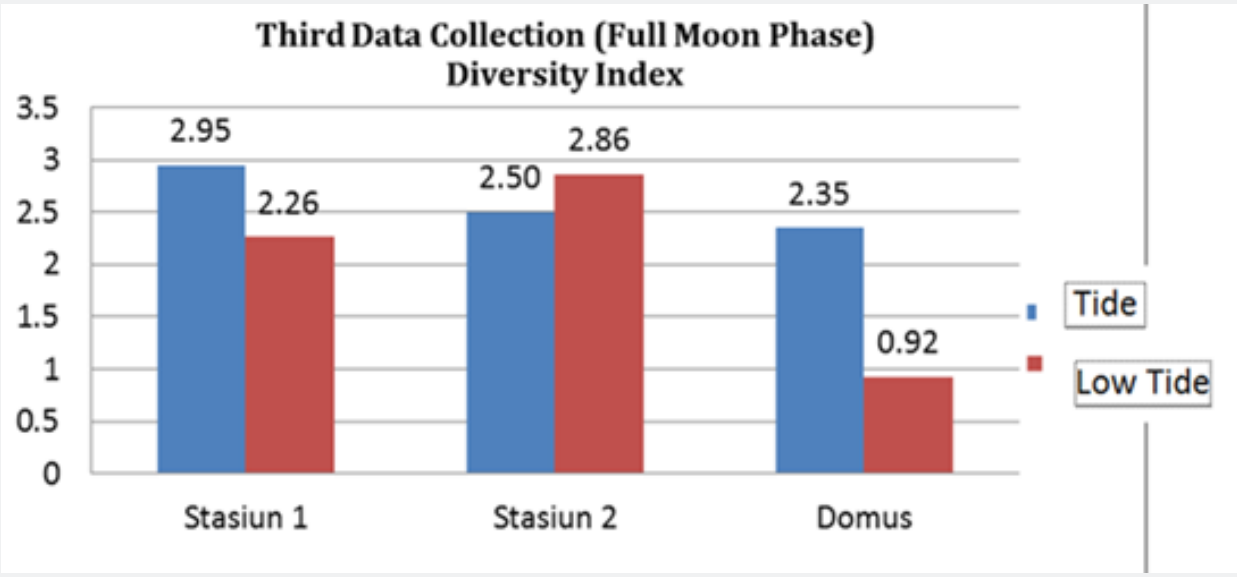

Figure 5: Diversity index at the time of the third data collection.

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Third Data Collection (Full Moon Phase): Station I at full moon at high tide has a diversity value of 2.95 while station I at full moon at low tide has a diversity value of 2.26, Station II at full moon at high tide has a diversity value of 2.50, at full moon at low tide Station II obtained a diversity value of 2.86, while in domus the diversity value on the full moon at high tide was 2.35 and at the full moon at low tide the diversity index of reef fish in the domus obtained a diversity value of 0.92 (Figure 5).

The results of the analysis of the diversity index of reef fish at each station at the time of the third data collection, namely stations I, Domus and station II, determined varying values. Based on the reef fish diversity index category, the value found at the full moon during high tide and low tide for the first data collection is in the medium category (H'<3) [25].

Fourth Data Collection (Last Quarter Moon Phase): Station I in the last quarter of the month at low tide got a fish diversity value of 2.41 while station I in the last quarter of the month at high tide got a diversity value of 2.95, station 2 in the last quarter of the month at low tide got a diversity value of 2.79, in the last quarter of the month at high tide station II obtained a diversity value of 2.26, while in the last quarter of the domus month the diversity value at low tide was 2.70 and in the last quarter of the month at high tide the diversity index of reef fish in the domus obtained a diversity value of 2.78 (Figure 6).

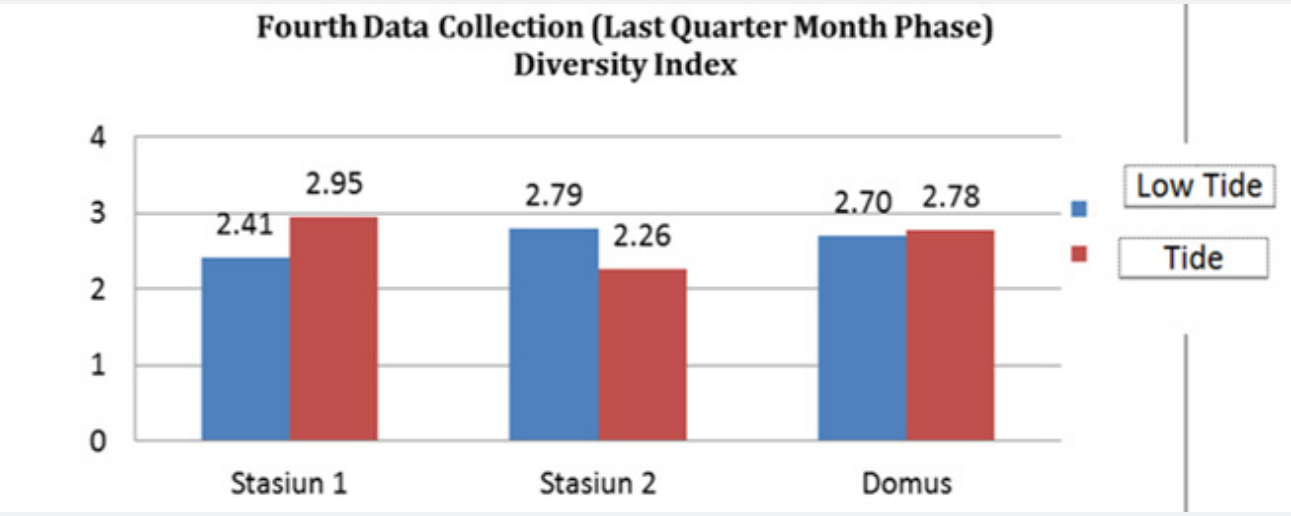

Figure 6: Diversity index at the time of the fourth data collection.

The results of the analysis of the reef fish diversity index at each station in the last quarter of the month when four data were collected, namely stations I, Domus and station II, determined varying values. Based on the fish diversity index category, the values found in the last quarter of the month at high tide and low tide for the first data collection are in the medium category (H'<3) [25]. According to [28] that the diversity of reef fish species in an area has a close relationship with the presence of coral reefs in the area. Fish tend to cluster in certain coral growth forms, for example, some major fish from the Pomacentridae family tend to have branched coral areas, this is due to a structured environment due to complex reef shapes. Reef fish communities are closely related to coral reefs as their habitat, so a high percentage of dead coral will directly or indirectly lead to a marked decrease in the number of fish species and other individuals associated with coral reefs. Each group of fish, each has a different habitat, but there are many species that can occupy more than one habitat.

This diverse habitat can explain the high number and types of fish in coral reef ecosystems, especially in Indonesia [29]. The spatial distribution of reef fish is related to the characteristics of the habitat and the interactions among the fish communities themselves, both in terms of relationships between individuals within a species or between species. The spatial distribution of several types of fish is significantly determined by the characteristics of certain habitats. For example, coral polyp-eating fish Chaetodon octofasciatus will inhabit coral reef habitats that have a high percentage of live coral [30]. Environmental characteristics such as current, brightness, water temperature, and depth also play a role in fish distribution.

Persentase Tutupan Karang Di Dalam Fish Apertement

Corals found in the fish apertement area of Domus frosiquilo, the growth form with the highest percentage of cover was coral with a life form (growth form) Coral Folious (CF) or leaf coral. The folious coral found at the study site is a type of coral Montipora capricornis. According to [31] Montipora Capricornis is a type of coral that is often found on reef flats near protected shores. Colonies are sheets like leaves, sunken corallites, no tubercle and papilla are visible so that the surface looks smooth (Figure 7).

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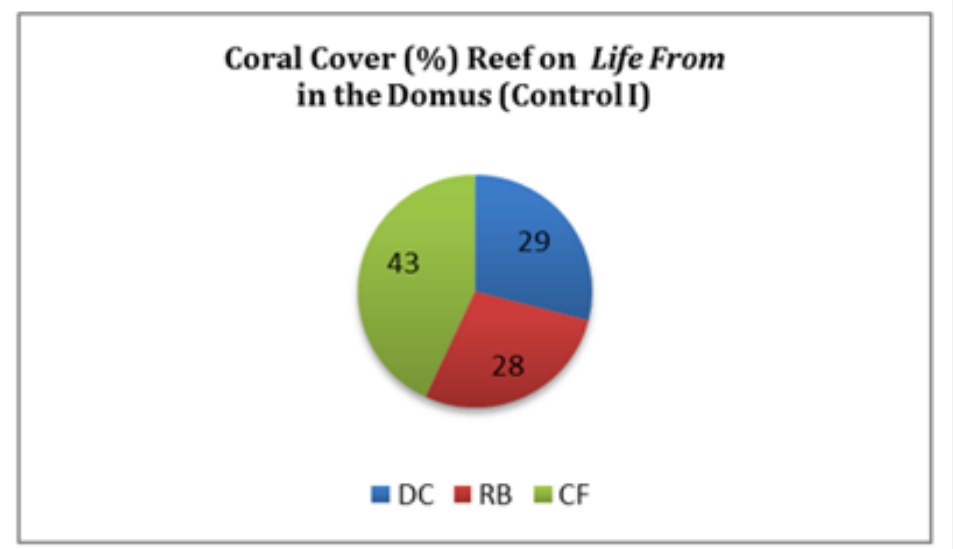

Figure 7: Coral Cover (%) Reef on Life from in the Domus Frosiquilo.

Notes: DC =Dead Coral, RB = Ruble Coral dan CF = Coral foliose

Percentage of coral cover at control station II: Based on the results of the analysis of the percentage of coral cover data using lite form at control station 2, it was found that corals with the highest growth form in lite from were coral foliose (CF) which was the type of coral with the highest percentage cover, which was 36%, the percentage of coral cover in lite from was Acropora submassive (ACS) with a value of 3% (Figure 8).

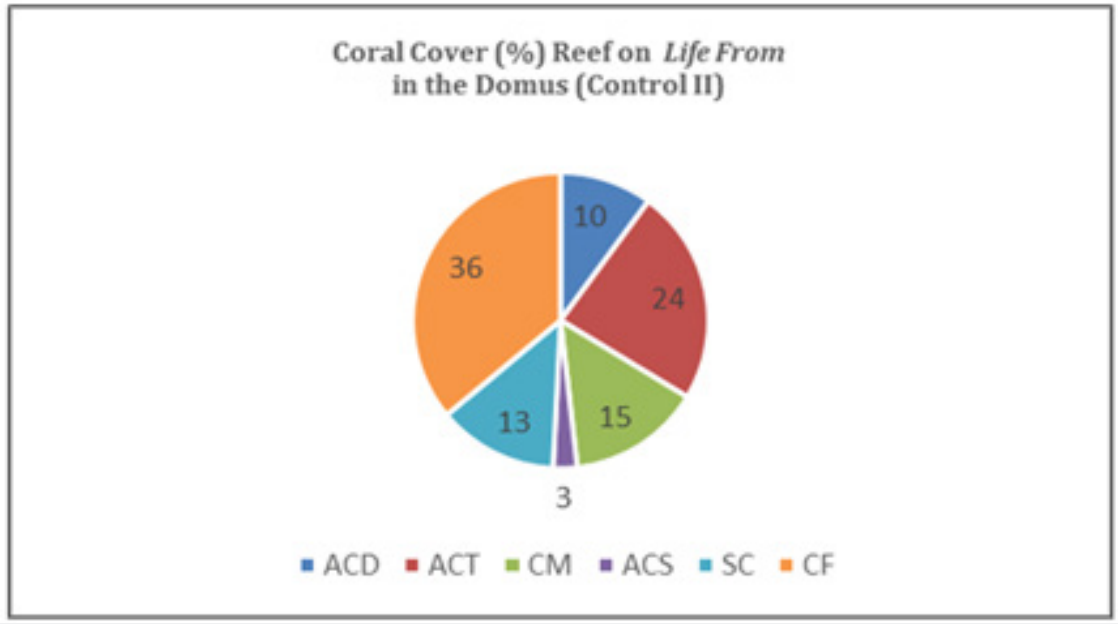

Figure 8: Percentage of Coral Cover at Control Station 2.

Notes: ACD = Acropora Digitate. ACT = Acropora Tublet CM = Coral Musrom ACS = Acropora Submassive SC = Soft coral CF = Coral Foliose.

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Globally, coral reefs can be found in tropical and sub-tropical areas. Most are north and south of the equator. Its distribution covers an area in 100 countries with an area in 2010 of around 600,000 km2. According to [26] coral reefs as an environment function as a place to live, shelter, find food and breed biota that live either from the coral reef itself or from the surrounding waters. [21] explained that coral reefs are found in shallow water or coastal environments. Maximum coral reef growth requires clear waters, with warm water temperatures, large wave movements and smooth water circulation and avoid sedimentation processes. Artificial reefs are one form of effort to overcome and rehabilitate damage that occurs to natural coral reefs. Manufacture of artificial reefs is an engineering structure that is deliberately lowered into the sea to resemble a fish habitat, which aims to change the desolate waters of fish to become bustling with fish.

The existence of artificial reefs is applied to be able to provide an ecological function, namely by providing a new habitat. Artificial coral reefs can increase the abundance of fish because this location can be a location for fish shelters and a source of food on coral reefs that are important for fish that inhabit them. According to [7] Artificial reefs allow the creation of an ecosystem that resembles a real coral reef which invites many potential fish to live. The fish on the artificial reef are ultimately used, so it is hoped that the original coral reef ecosystem will be able to grow without being disturbed and restore its balance. Fish that gather on artificial reefs are caused by the process of colonization and succession. Colonization is a process of placement or occupancy of an area or place by an organism, while succession is a process of changing one or a group of organisms by another with a different composition and structure. The rapid growth of algae (Perifiton) in Kampung Baru Village is marked to always increase within a period of 3 months. The presence of Periphyton attached to artificial reefs is a source of food resulting in fish gathering both in number and species [7].

Conclusion

Reef fish were found in 16 families and the diversity was in the moderate category. The percentage of coral cover in the fish apartment area by life from has a cover percentage that varies, including DC 29%, RB 28% and CF 43%. The dominant reef fish found at the research location was the Abudefduf Vaiigiensis species, which is a major fish.

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