Bukti Korespondensi

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Judul Artikel : The Correlation of Coral Cover And Reef Fish Density in Biggest Archipelagos Located in centre of indonesia

Nama Jurnal : Iranian Journal of Ichthyology

Correspondent Process

Tahapan	Keterangan Kegiatan	Tanggal Kegiatan
1	Submission Acknowledgement	22 Januari 2022
2	Submission needing Revision (Comment Reviewer)	03 Maret 2022
3	Revision based on suggestion of Reviewer	20 Maret 2022
	- Re: [IJI] Submission needing Revision (Manuscript Revision)	20 Maret 2022
4	Re: [IJI] Submission needing Revision	30 April 2022
5	Re: [IJI] Submission needing Revision	26 Oktober 2022
6	Acceptance Letter	16 November 2022
7	Accepted article in IJI	25 November 2022
8	Re: Accepted article in IJI	27 November 2022
9	Galley proof [IJI]	31 Desember 2022

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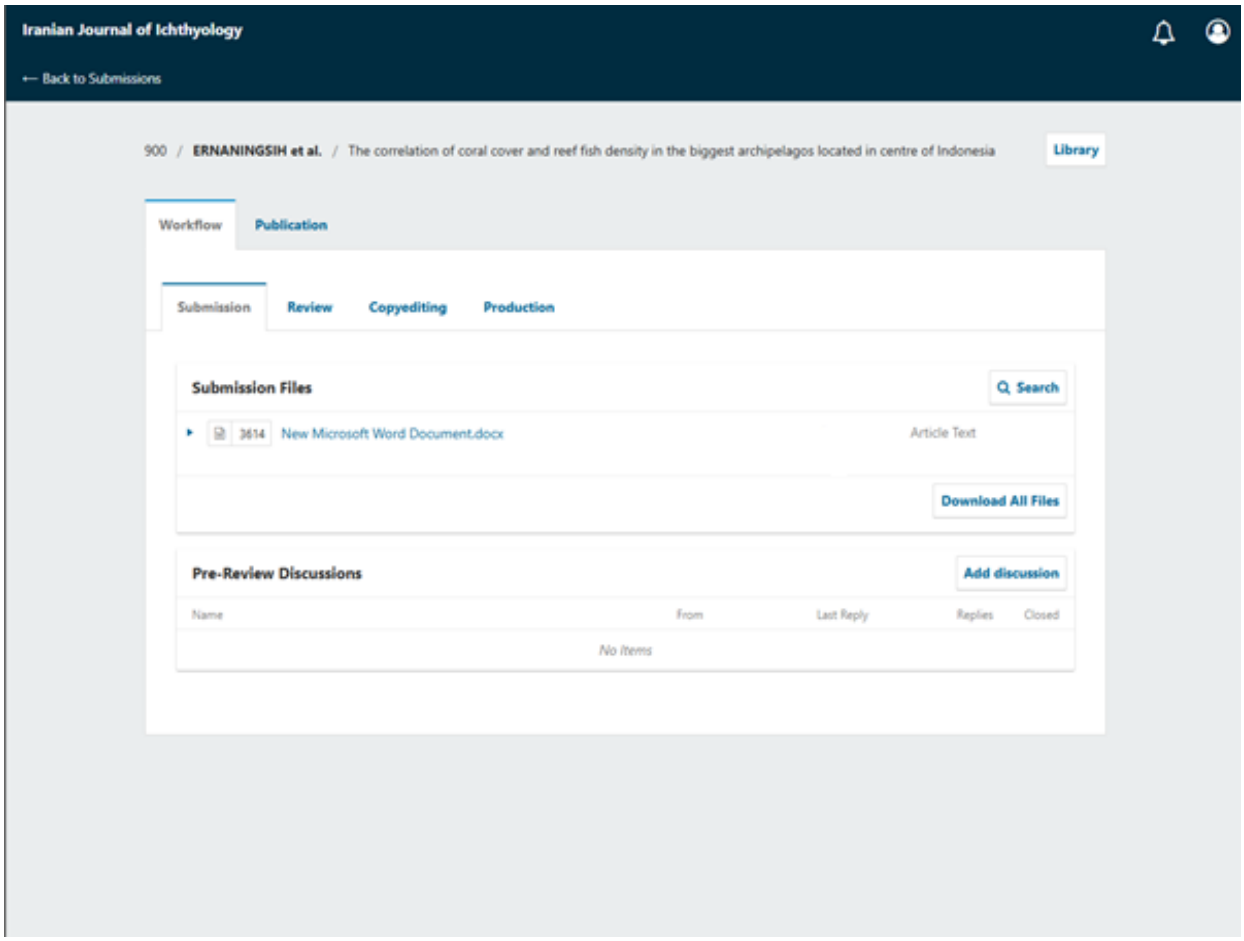
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Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> Thu, Mar 3, 2022 at 3:22 AM
To: ernaumimakassar@gmail.com

Dear Ernaningsih,
We would like to inform you that your submitted manuscript " The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia" to Iranian Journal of Ichthyology, as been peer reviewed by our referees and their comments are enclosed. Please implement the various changes and modifications suggested by the reviewers and submit the revised manuscript within two weeks. Please note that your response must address each referee's comment item by item, leaving no unaddressed comment. However, if you do not agree with any of the listed comments, you may present your argument and give your reasons for disagreeing with the referee. Your prompt attention to these matters will enable us to further process your manuscript at the earliest opportunity.
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Best,
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The Correlation Of Coral Cover And Reef Fish Density In the Biggest Archipelagos located in centre of Indonesia

Abstract

Live coral cover is a measure of the proportion of reef surface covered by live stony materials instead of sponges, algae, or other organisms. These stony corals are the main contributors to a reef's three-dimensional framework structure that provides critical habitat for many organisms. Therefore, this research aims to determine the relationship between the number of live coral cover and the presence of reef fish in one of the biggest archipelagos located in centre of Indonesia. The research method used for the determination of live coral cover was the Point Intercept transect, while the reef fish population were measured using the census technique. The results showed that the average percentage of live coral cover in all station including Sarappo, Lumulumu, and Langkai Island were 43.17%, 52 %, 45.67%, respectively, and were classified into moderate and good. There were 149 reef fish species anf 27 families found at all station during this research. The coral cover was positively correlated with species diversity and the abundance of reef fish in archipelagos of Indonesia.

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Keywords : live coral cover, diversity, abundance, archipelagos.

Introduction

Coral reefs are one of the underwater ecosystems carrying out marine biodiversity with various ecological functions, such as a place for marine organisms to breed, make shelter, feed and maintain stability in ecological conditions, and also a habitat for a variety of marine animals (Maragos et al. 1996, Miththapala 2008, Gattuso et al. 2014). Coral reef ecosystems have very high biodiversity and aesthetic value, such as a tourism area, for wave barrier and controlling coastal erosion (Gattuso et al. 2014). However, their ecosystems are very vulnerable to damage, which in turn affect the existence of organisms living in association with corals. Also, the high access to coral reef area increases its chance of degradation. The causes of such damage include the use of fishing gear that is not environmentally friendly, sedimentation, water pollution, sand mining, and severe tourism activities (Hartoni et al. 2012). Coral reefs have a complex relationship with fish communities. The extent of coral reef exposure to various organism provides a good opportunity and surface for a variety of fish and more organisms to survive. Therefore, increasing the coral reef population and providing sufficient food for them. Several studies on the relationship between coral reefs and fish populations have been carried out, including the research on the correlation between fish, its environment, and biodiversity. Other research were based on the effect of the percentage of coral cover on the structure of fish communities. However, some studies did not find a significant correlation between the coral cover and the number of reef fish populations (Bell and Galzin. 1984). Several recent studies showed that there is a positive correlation between coral cover and reef fish population, specifically the endemic fish (Nugraha et al. 2020, Komyakova et al. 2018; Philpott, et al. 2012). However, the strength of each relationship depends on the organism's level and the type of their habitat (Munday 2004). The habitat's resources are

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also measured at the species level, this is necessary for further study (Andrew 1987). Habitat degradation is found of reducing the targeted species in their catchment area (Wilson et al. 2010). Russ (1991) explained that the most informative indicators of detecting the changes in the catch activity is the decrease of fish diversity through the scarcity of certain local species. it is further explained that the size of the fish is the best indicator for determining the effect of the catch. Fishing activities affect the status of coral reef habitat by two methods, namely directly through destructive fishing and indirectly by increasing the grazing algae (Bouchon et al. 1985; Pet Soede. 2000). The presence of reef fish in their habitats is directly affected by their health and population, which is associated with the availability of food, shelter, and their spawning ground (Andamari *et al*., 2007). The growth and the birth of the fish is very dependent on the environment, when it is in good condition, their population grow until it reaches the limit where growth and development are no longer supported by their ecosystem (Arteaga et al. 1997). The relationship between coral reef conditions and their populations is more specific to the their living habitat. However, this relationship is examined based on the area covered by live coral reefs and their species composition in a habitat.

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Research Method

Study Sites

This research was conducted on three islands at Spermonde Archipelagos, South Sulawesi Province, in Indonesia, namely Sarappo, Lumulumu, and Langkai. Each island had four stations representing the habitats of coral reefs (Figure 1).

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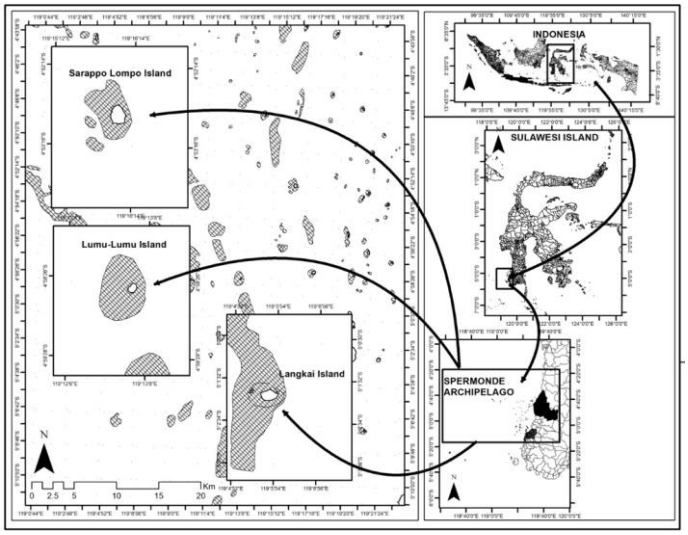


Figure 1. Study site during research in Spermonde Archipelagos, Indonesia

Research Procedure

This study used a primary data, and the coral reef observation was conducted based on the habitat condition using Point Intercept Transect (PIT) method, while reef fish was obtain using belt transect technique (English et al. 1997). To determine the habitats' conditions, the species diversity and abundance, observations were carried out at three island in Spermonde Archipelago, namely Sarappo, Lumulumu and Langkai. The method used for the observation was the Point Intercept Transect (PIT) at the length of 50 meters at 3-7 m depth in reef flat area.

The observations were carried out using visual census method with transect line (English et al. 1997) on each station and was repeated three times. The observations were made with a 50 m transect line with the visibility at a distance of 2.5 m to the left and 2.5 m to the right (observer was in the middle). Specifically, reef fish found in the observed location were recorded according to their species, quantity, and their estimated length. To identify the habitat characteristic grouping between the observed stations, a descriptive analysis was conducted, presenting the results in the form of graphs and images. Meanwhile, fish abundance was determine according to the method of Dartnall and Jones (1986).

Data Analysis

The data analysis for coral cover was distinguished by the characteristic of their habitats or their percentage population, while the dead and lifeform species were calculated using the following formula. From the obtained percentage of lifeform cover, the quality of living coral in that area was determined. The criteria which generally applied to determinig the condition of coral reefs was divided into four categories (English et al. 1997), as follows:

- Damaged : 0-24,9%
- Moderate : 25-49,9%
- Good : 50-74,9%
- Very good : 75-100%

Statistical Analysis

To examine the relationship between live coral cover conditions and their abundance and density, the Pearson's correlation with SPSS ver. 24 was used. The results of the analysis were then tabulated in the table of the relationship between each of these factors.

Result

Coral reef condition

The coral reef condition in three research sites (Sarappo Island, Lumulumu island and Langkai island) was generally classified as moderate or good. The measurement results of the average percentage of coral cover in Sarappo, Lumulumu and Langkai Island were 43.17%, 52 %, 45.67%, respectively (Figure 2). The coral covers in this three research sites were classified into moderate and good. The differences in coral covers were allegedly related to the intensity of fishing activity, such as the use of bombs, toxic materials, and fishing gear, which were not environmentally friendly.

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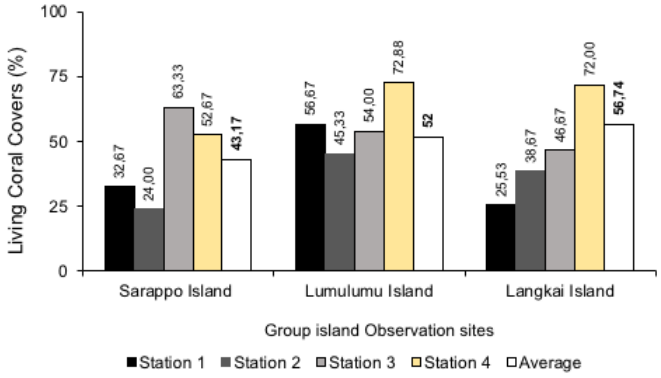


Figure 2. Live coral cover in each station at every island observation sites

The average coral cover also appeared to differ between the study sites. The highest percentage was around 72% on the Langkai Island, especially at station 4. However, this condition was still moderate and good for all stations with an average coral cover of 43%, 52%, and 45% for Sarappo, Lumulumu and Langkai island, respectively. Some striking stations with a deadly percentage (51%) was observed on Lumulumu Island. However, the percentage of dead karag appeared to be much lower with an average of 8%, 30%, and 3% for Sarappo, Lumulumu, and Langkai Island, respectively (Figure 3).

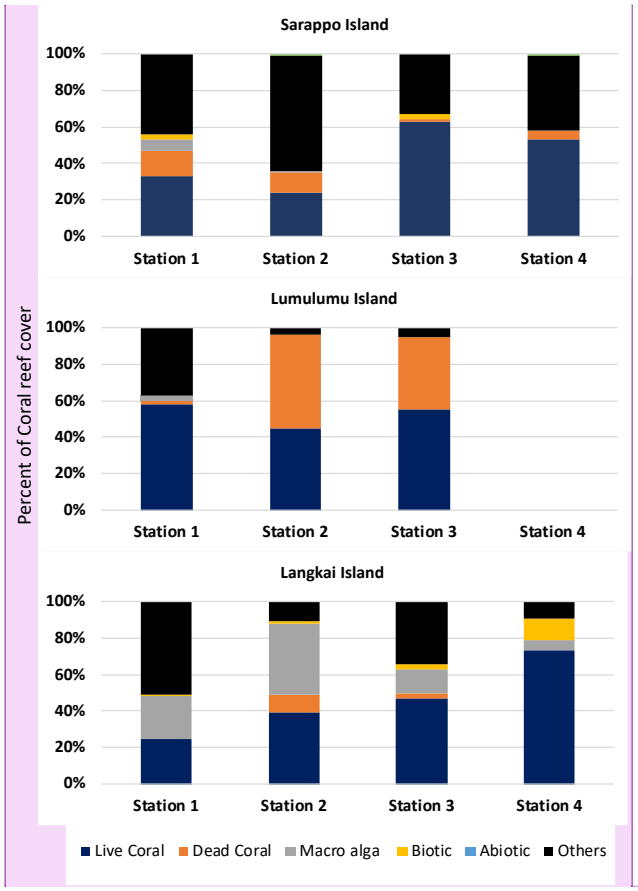


Figure 3. Average of living coral cover at each station in the research site

Reef Fish Diversity

The number of reef fish species found in each location ranged from 39 to 66. However, the existence different species in one location, resulted to the differences in the number and appearance of fish species. From the total population there were 66 genera, 149 species, and 27 families (Table 1). All were classified into 3 groups, namely the target, major, and indicator fish.

Table 1. Species abundance of reef fish at each island in genus level

Commented [WU12]: What do you mean by biotic, abiotic and others? The readers won't understand what you classified as biotic, abiotic and others. What is the difference among live coral and biotic. What is the difference among dead coral and abiotic. You should define each category clearly.

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Commented [WU14]: What do you mean?

Commented [WU15]: What do you mean by this classification?

No	Genus Level	Sarapo Island				Lumu lumu Island			Langkai Island			
		St1	St2	St3	St4	St1	St2	St3	St1	St2	St3	St4
1	*Ablyglyphidodon*	*	*** *	*	*	*		**				
2	*Abudefduf*		*** **	*	****	******		*****				
3	*Acanthurus*			*	**	*	*	*	*	*	**	*
4	*Aeoliscus*				*	*		*				
5	*Amblyglyphidodn*	*								**		
6	*Amphiprion*						**	*		*	*	*
7	*Anampses*					*	*	**		*		
8	*Anyperodon*							*		*		
9	*Apogon*				*							
10	*Balistapus*							*			*	*
11	*Bodianus*	*										
12	*Caesio*	*	**									
13	*Canthigaster*						*					
14	*Carangichthys*											
15	*Centropyge*							*	*	*		
16	*Cephalopholis*	**	**	*		**				*	*	*
17	*Chaetodon*	**	**	*	**	**				*	**	
18	*Cheilinus*	*	*	*	*	*	*	*				
19	*Cheilodipterus*	*										
20	*Chlorurus*		*		*	*	*	**				
21	*Choerodon*		*	*				**				
22	*Chromis*	*	****					******		*****		*
23	*Chrysiptera*	*	*	*	****	*** *	*	***	***		*** *	*** *
24	*Cirrhilabrus*						*** *	*	*	*** **	*	
25	*Coris*				*							
26	*Cromileptes*	*										
27	*Ctenochaetus*					*						
28	*Dascyllus*	*								*		*
29	*Diproctacanthus*			*	*		*					
30	*Dischistodus*	*	*	*								
31	*Epibulus*	*	*					*	*	*		
32	*Epinephelus*							*	*		*	*
33	*Fistularia*											*
34	*Halichoeres*	*		*	**	*	**	*	**	*	*	*
35	*Hemigymnus*	*		*		*	*	*	*	*		
36	*Heniocus*							*				
37	*Labroides*	*	*	*	*		*		**		*	**
38	*Lethrinus*					*			*			
39	*Lutjanus*	*	*	*	*		*** *	*	*	*	*	
40	*Macropharyngodon*								*		*	*
41	*Monotaxis*					*		*				
42	*Naso*	*				*	*	*				
43	*Neoglyphidodon*	*	*	*		*	**	*		*		
44	*Neoniphon*									*		
45	*Neopomacentrus*		*	*								

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46	*Odonus*								*			*	*
47	*Oxycheilinus*											*	
48	*Paracirrhites*	*	*	*	**	*	*						*
49	*Parupeneus*			*		*		*	*			*	*
50	*Pempheris*			*									
51	*Pentapodus*				*	*		*	*	*			
52	*Platax*						*						
53	*Plectorhincus*	*	*	*	*	*	*	**					
54	*Plectroglyphidodon*							**	*	*			*
55	*Plectropomus*		*			*							
56	*Pomacentrus*	***		****	****	***	***	***	****				
		***	**	*	*	**	**	***	**	***	**	*	
57	*Pseudanthias*	*											
58	*Sargocentron*			*		*							
59	*Scarus*	*	*	*	*	*	*	*	**	*	*		
60	*Scolopsis*	*	**	*	*	*		*	**	*	*	*	
61	*Siganus*		**	*	*	**	**	**	**	**	*		
62	*Stethojulis*			*	*								
63	*Taeniur*				*								
64	*Thalassoma*			*	**	*	*	*	**	*	*	*	
65	*Zanclus*		*		*	*		*	*	*		*	
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Correlation between coral cover and reef fish

The correlation between coral cover with the diversity of reef fish in each observation site showed that Sarappo Island had low coral cover of 32.67% and 24% at stations 1 and 2, with more fish diversity than 3 and 4, and coral cover of 63.33% and 52.67%, respectively (Figure 4)

The pearson correlation test showed that in Sarappo Island, coral cover negatively correlated with the diversity of fish species, i.e., an increase in coral cover was not followed by the rise in the diversity of fish species. Meanwhile, live coral cover in Lumulumu and Langkai island was positively correlated with the diversity of fish species (Table 2).

Table 2. Correlation of live coral with species number and abundance of reef fish in all station

	Abundance	Live Coral
Species Number	.654*	-.314
Abundance		.001
Live Coral		

*. Correlation was significant at the 0.05 level (2-tailed).

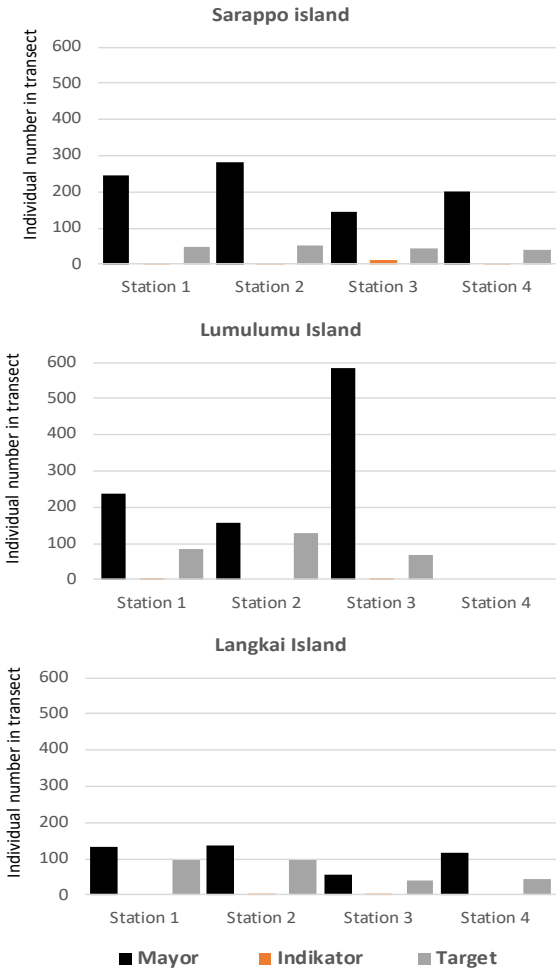


Figure 4. Number of reef fish in categories, namely major, indicator, and target fish

Correlation between live coral cover with the abundance of reef fish

The correlation between live coral cover with the abundance of reef fish in Sarappo, Lumulumu, and Langkai Island was shown in Figure 5.

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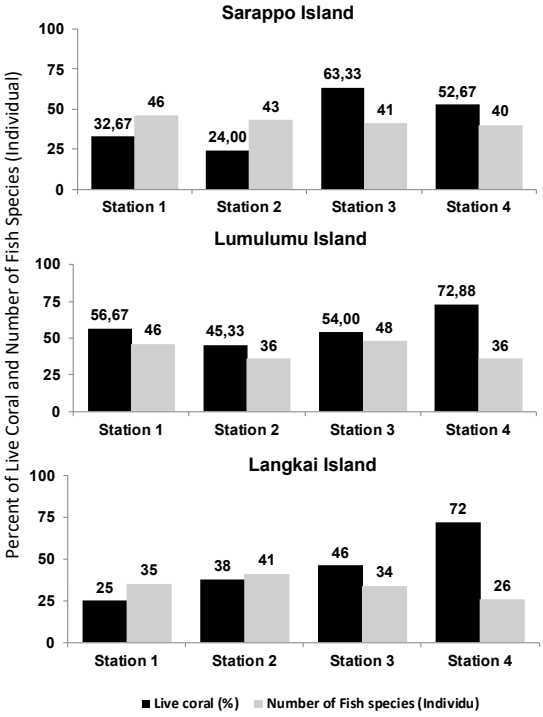


Figure 5. Correlation between live coral cover and diversity of reef

In Sarappo Island, an increase coral cover was not always followed by a rise in the abundance of fish. The Pearson correlation test showed that the live coral cover on the Sarappo Island was negatively correlated with the abundance of fish, while that of Langkai and Lumulumu island were positively related (Figure 6)

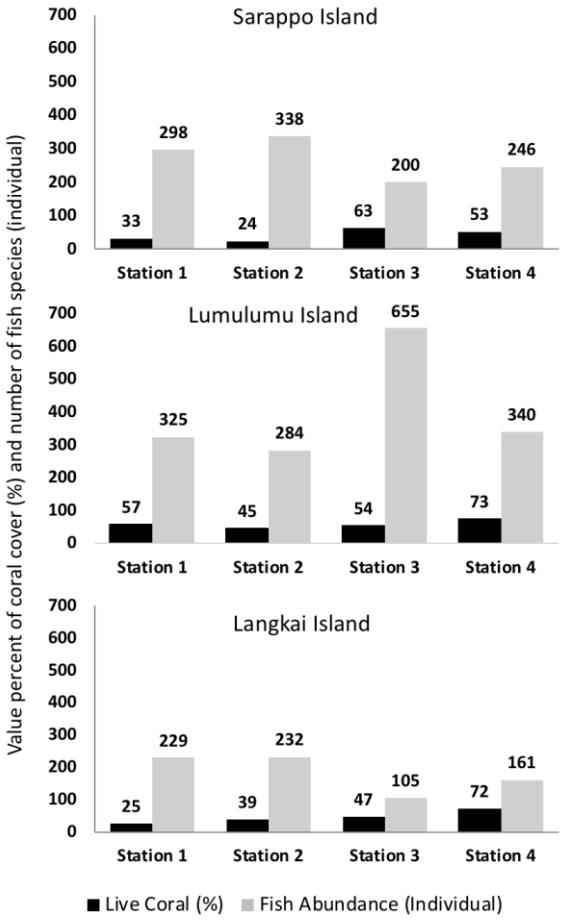


Figure 6. Corelation between live coral cover and abundance of reef fish

Generally, the diversity and density of reef fish was significantly associated with the complexity and their health. The discrepancies in the three island, allegedly associated with the condition of the substrate as shelter and feeding ground for fish thereby affecting thir existence in these places.

Discussion

Riskiani et al. (2019) Conducted a survey at a location close to the study site, and Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found

Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found that at a depth of 7 m, the substrate cover was dominated by abiotic, with the highest percentage of 59.15%. The condition of live coral cover consisted of Acropora and non-Acropora species. In general, coral cover was more of the Acropora species.The dominance of the abiotic substrate was due to the pressure on the corals, such as the use of bombs or poison when fishing, as a result, the condition of the living coral substrate changes drastically and then dies. In general, the percentage of live coral cover was relatively small compared to those that were abiotic and dead. The research in Labuhan Bajau, Indonesia, found that hard corals still reached 81.25%. The observed soft corals and sponges reached 15.625% and 1.875%, respectively. The most common coral genera found at this site were *Porites*, Acropora, Pavona, Favites, Montipora, and Pocillopora in addition to the living non-coral and sponges. The condition of the corals in Labuhan Bajau was included in the group of coral reef communities, and found to be very good, since the cover percentage was high (82,875%) (Wisha et al. 2018). The research conducted at Central Tapanuli, found 52 nests genera scattered in most of the locations and about 90% of them had a distribution associated with live coral cover. while the waters of Mentawai and Bengkulu had more coral species than other locations and the presence of certain species was associated with the stress on their environment (Siringoringo et al. 2019). The lowest coral diversity in Indonesia was probably along the west coast of Sumatra with 48 genera, and after that was the Togean Island which had 57 coral genera. Therefore, the highest number of coral genera was in North Sulawesi (Hoeksema & Putra 2000). In another study, there were 386 species of coral genera on the west coast of Sumatra (Veron et al. 2009). The highest number of coral reef (574 species) in Indonesia was found in Raja Ampat Island, Papua (The Nature Conservancy, 2002).

The Indo-Australian Islands were the best location to find the richest coral reef biodiversity in the world, covering the northern Australia, Papua New Guinea, Solomon's, Indonesia, and the Philippines. The species richness decreased fivefold compared to the central Pacific region, and decreased further in the east. The decline in reef fish diversity was caused by a decrease in the number of species present in each family. Bell & Galzin (1984) found that the presence of fish was strongly influenced by the condition of living coral. They recorded 115 fish species at 13 locations, moreover, 61 were observed on 250 transects and a further 37 and 17 were added by observation with 100m sections of coral reef. The results showed that there was insufficient evidence, however, some species avoided dead coral areas. Then, 68% of the total number of species recorded were present at sites with few live corals. The number of live corals also influenced their distribution, for example, 29 out of 78 species were associated with only the 2 highest coral cover sites. In contrast, only 4 species (3%) were recorded exclusively from locations without live coral. Thirty-three species (29%) were recorded at sites with and without live coral. The presence of reef fish in the southern waters of Ambon Island was quite varied. In this location, 88 species of reef fish were found and the most dominant were *Balistapus undulatus, Chaetodon kleinii, Ctenochaetus striatus, C. strigosus, Labroides dimidiatus,* and *Paraupeneus multifasciatus* (Limmon et al. 2018). The abundance of fish in an area was often related to the condition of coral reefs. The existence of reef fish, which were generally solitary, and closely related to changes in the environment, especially in relation to the percentage of live coral cover (Feary et al. 2007). Chaetodontidae fish live in association with coral reefs and were very sensitive to changes, such as the damage to coral reefs greatly impact the existence of food and shelter for these fish species

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(Titaheluw 2011). The low percentage of coral reef cover resulted in a low population of fish living on them, and also, a decrease in the abundance of these fish occurred when there was a damage to the coral reef. Live coral was the most important component in coral reef populations, however, the slightest damage to the components of live coral had an impact on the abundance of fish populations and other organisms (Wilson et al. 2006). Fish inhabiting coral reefs were divided into target, major, and indicator groups. These three groups were severely affected by the health and conditions of live coral cover (Madduppa et al. 2012). The decline in the physiological and reproductive activities of fish on coral reefs was strongly associated with the coral cover conditions. The loss of several types of corals or their death had an impact on the nature and behaviour of the reef fish (Pratchett et al. 2004). Even over a long period of time, the continuing decline in the percentage of live corals had an impact on reef fish populations, particularly their diversity and abundance (Wilson et al. 2006). Coremap (2011), obtained live coral cover on Sarappo Island, Indonesia, which ranged between 48% -76%, and 58% - 78%. These conditions were influenced by the environmental factors, such as waves, the presence of coral disease, and climatic change. The same research found that live coral cover on the Lumulumu and Langkai Island were 50.52% and 63.22%. Furthermore, Anwar (2011) reported that the decline in fish stocks in the waters of Makassar was also due to the use of bombs, toxic materials, gears, such as seine, cantrang, and trawl when carrying out fishing activity. The reduction in live coral cover in the three research sites from the previous years, was due to high intensity and destructive fishing. Based on visual observations at the study sites, there were 149 species of reef fish from 27 Families. Especially for grouper fish, as much as 7 species were found, namely *Cephalopholis boenack*, *Cephalopholis micropion*, *Cephalopholis miniata*, *Cephalopholis sonnerati*, *Epinephelus aerolatus*, *Epinephelus merra*, and *Plectropomus maculatus*. Almost all the fish living on coral reef have high dependence, both in terms of protection and feeding. Therefore the number of individuals, both in species and composition was influenced by their environmental conditions. Studies showed that there was a positive correlation between the reef topography and their distribution and abundance. The indicator that showed the existence of the fish in the waters was the presence of living coral reefs (Sudirman & Yusri, 2008). The diversity differences of reef fish species was closely related to the substrate's complexity (McClanahan 1994). The death of coral reef communities changed their restocking process (Davis 2007). Jones et al. (2004) suggested that there was often a strong positive relationship between the coral cover and the reef fish abundance. It was further explained that there were 75% of reef fish that depended on live corals for various needs including feeding, shelter, and hiding. The fish living on coral reefs varied in their degree of dependence, ranging from single to multiple (Mundai 2004; Pratchett et al. 2004). However, the effect of reduced coral abundance did not have an impact on fish populations. Corals vary depending on the level of changes in their compositions and structure. Also, the severe and widespread reduction in live coral cover resulted in large-scale disturbance to reef communities, thereby impacting a wide range of fish species and causing marked decrement in diversity (Wilson, et al. 2006).

The spatial distribution of various reef fish was related to the condition of the bottom substrate. One of the causes of reef fish diversity was their habitat variation, as they were made up of coral, sand, various bays, crannies, and algae meadows (Russel 1996). The habitat diversity explained the increase in the number of reef fish (Kasmi 2012), and also their different environment further influenced their variation (Maharbhakti 2009). The increased fish diversity, as well as the decline in coral cover,

was as a result of an increase in the heterogeneity of their habitat. Therefore, the reef with a moderate level of coral cover, was due to the diverse mix of fish living on them compared to the sub stratum-rock. However, the loss of coral (> 60%) caused the decline in diversity, due to the inability to compensate the local extinction. However, there were some examples where a decrease in live coral cover has a disproportionate effect on the local diversity of fish (Pratchett et al. 2011). The existence of coral cover was an important habitat for the different fish species, since most their populations hold direct recruitment on the stony material. In addition, many fish have the same needs, therefore, creating an active competition, either between different or among the same species (Friedlandera & Parrish, 1998).

Conclusion

The average percentage of live coral cover in Sarappo, Lumulumu and Langkai Island were 43,17±18,0%, 52,00±5,9%, 45,67±19,6%, respectively, therefore, they were classified into the moderate group. There were 149 reef fish species belonging to 66 genus and 27 families. The condition of the coral reefs classified as moderate did not have an impact on the decline in reef fish species. Furthermore, their average number and populations were moderate and even high in the three research islands. Also, their abundance was also moderate or even high when compared to coral fish populations in other areas in Indonesia. Therefore, live coral cover was positively correlated with fish diversity.

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The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in the centre of Indonesia

Abstract

Live coral cover is a measure of the proportion of reef surface covered by live stony materials instead of sponges, algae, or other organisms. These stony corals are the main contributors to a reef's three-dimensional framework structure that provides critical habitat for many organisms. Therefore, this research aims to determine the relationship between the number of live coral cover and the presence of reef fish in one of the biggest archipelagos located in the centre of Indonesia. The research method used for the determination of live coral cover was the Point Intercept transect, while the reef fish population were measured using the census technique. The results showed that the average percentage of live coral cover in all stations including Sarappo, Lumulumu, and Langkai Island were 43.17%, 52 %, 45.67%, respectively, and were classified into moderate and good. There were 149 reef fish species ~~anf~~ and 27 families found at all stations during this research. The coral cover was positively correlated with species diversity and the abundance of reef fish in the archipelagos of Indonesia.

Keywords~~-~~: live coral cover, diversity, abundance, archipelagos.

Introduction

Coral reefs are one of the underwater ecosystems carrying out marine biodiversity with various ecological functions, such as a place for marine organisms to breed, make shelter, feed and maintain stability in ecological conditions, and also a habitat for a variety of marine animals (Maragos et al. 1996, Miththapala 2008, Gattuso et al. 2014). Coral reef ecosystems have very high biodiversity and aesthetic value, such as a tourism area, for wave barriers and controlling coastal erosion (Gattuso et al. 2014). However, their ecosystems are very vulnerable to damage, which in turn affect the existence of organisms living in association with corals. Also, the high access to coral reef area increases its chance of degradation. The causes of such damage include the use of fishing gear that is not environmentally friendly, sedimentation, water pollution, sand mining, and severe tourism activities (Hartoni et al. 2012). Coral reefs have a complex relationship with fish communities. The extent of coral reef exposure to various organism provides a good opportunity and surface for a variety of fish and more organisms to survive. Therefore, increasing the coral reef population and providing~~-~~ sufficient food for them. Several studies on the relationship between coral reefs and fish populations have been carried out, including the research on the correlation between fish, its environment, and biodiversity. Other research ~~were~~ was based on the effect of the percentage of coral cover on the structure of fish communities. However, some studies did not find a significant correlation between the coral cover and the number of reef fish populations (Bell and Galzin. 1984). Several recent studies showed that there is a positive correlation between coral cover and reef fish population, specifically the endemic fish (Nugraha et al. 2020, Komyakova et al. 2018; Philpott, et al. 2012). However, the strength of each relationship depends on the organism's level and the type of ~~their~~ habitat (Munday 2004). The habitat's

resources are also measured at the species level, this is necessary for further study (Andrew 1987). Habitat degradation is found of reducing the targeted species in their catchment area (Wilson et al. 2010). Russ (1991), explained that the most informative indicator of detecting the changes in the catch activity is the decrease of fish diversity through the scarcity of certain local species. it is further explained that the size of the fish is the best indicator for determining the effect of the catch. Fishing activities affect the status of coral reef habitat by two methods, namely directly through destructive fishing and indirectly by increasing the grazing algae (Bouchon et al. 1985; Pet Soede. 2000). The presence of reef fish in their habitats is directly affected by their health and population, which is associated with the availability of food, shelter, and their spawning ground (Andamari *et al*., 2007). The growth and the birth of the fish is very dependent on the environment, when it is in good condition, their population grows until it reaches the limit where growth and development are no longer supported by their ecosystem (Arteaga et al. 1997). The relationship between coral reef conditions and their populations is more specific to their living habitat. However, this relationship is examined based on the area covered by live coral reefs and their species composition in a habitat.

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Research Method

Study Sites

This research was conducted on three islands at Spermonde Archipelagos, South Sulawesi Province, in Indonesia, namely Sarappo, Lumulumu, and Langkai. Each island had four stations representing the habitats of coral reefs (Figure 1).

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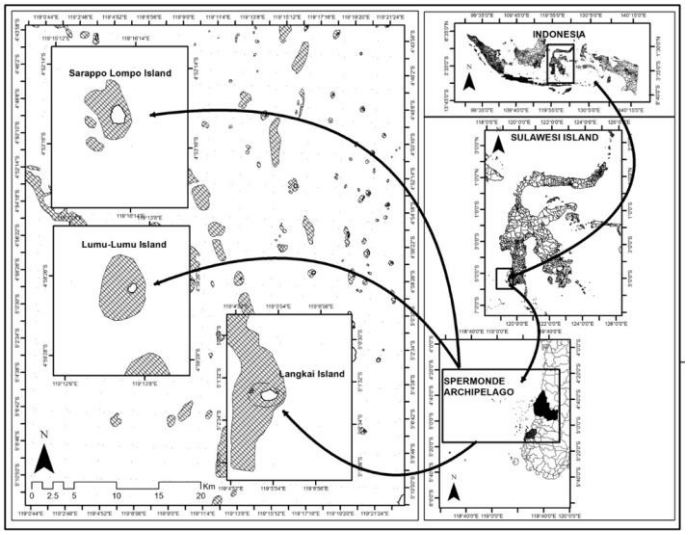


Figure 1. Study site during research in Spermonde Archipelagos, Indonesia

Research Procedure

This study used primary data, and the coral reef observation was conducted based on the habitat condition using Point Intercept Transect (PIT) method, while reef fish was obtained using the belt transect technique (English et al. 1997). To determine the habitats' conditions, the species diversity and abundance, observations were carried out at three islands in Spermonde Archipelago, namely Sarappo, Lumulumu and Langkai. The method used for the observation was the Point Intercept Transect (PIT) at the length of 50 meters at 3-7 m depth in reef flat area.

The observations were carried out using the visual census method with a transect line (English et al. 1997) on each station and was repeated 3 times. The observations were made with a 50 m transect line with visibility at a distance of 2.5 m to the left and 2.5 m to the right (the observer was in the middle). Specifically, reef fish found in the observed location were recorded according to their species, quantity, and their estimated length. To identify the habitat characteristic grouping between the observed stations, a descriptive analysis was conducted, presenting the results in the form of graphs and images. Meanwhile, fish abundance was determined according to the method of Dartnall and Jones (1986).

Data Analysis

The data analysis for the coral cover was distinguished by the character of their habitats or their percentage population, while the dead and lifeform species were calculated using the following formula. From the obtained percentage of lifeform cover, the quality of living coral in that area was determined. The criteria which generally applied to determine the condition of coral reefs was divided into 4 categories (English et al. 1997), as follows:

- Damaged : 0-24,9%
- Moderate : 25-49,9%
- Good : 50-74,9%
- Very good : 75-100%

Statistical Analysis

To examine the relationship between live coral cover conditions and their abundance and density, Pearson's correlation with SPSS ver. 24 was used. The results of the analysis were then tabulated in the table of the relationship between each of these factors.

Result

Coral reef condition

The coral reef condition in three research sites (Sarappo Island, Lumulumu island and Langkai island) was generally classified as moderate or good. The measurement results of the average percentage of coral cover in Sarappo, Lumulumu and Langkai Island were 43.17%, 52 %, 45.67%, respectively (Figure 2). The coral covers in these three research sites were classified into moderate and good. The differences in coral covers were allegedly related to the intensity of fishing activity, such as the use of bombs, toxic materials, and fishing gear, which were not environmentally friendly.

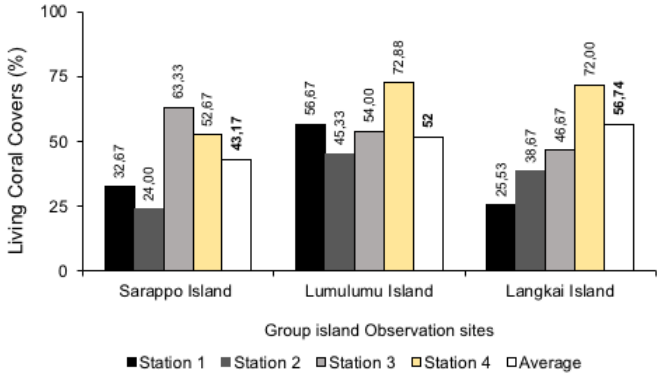


Figure 2. Live coral cover in each station at every island observation sites

The average coral cover also appeared to differ between the study sites. The highest percentage was around 72% on Langkai Island, especially at station 4. However, this condition was still moderate and good for all stations with an average coral cover of 43%, 52%, and 45% for Sarappo, Lumulumu and Langkai island, respectively. Some striking stations with a deadly percentage (51%) were observed on Lumulumu Island. However, the percentage of dead karag appeared to be much lower with an average of 8%, 30%, and 3% for Sarappo, Lumulumu, and Langkai Island, respectively (Figure 3).

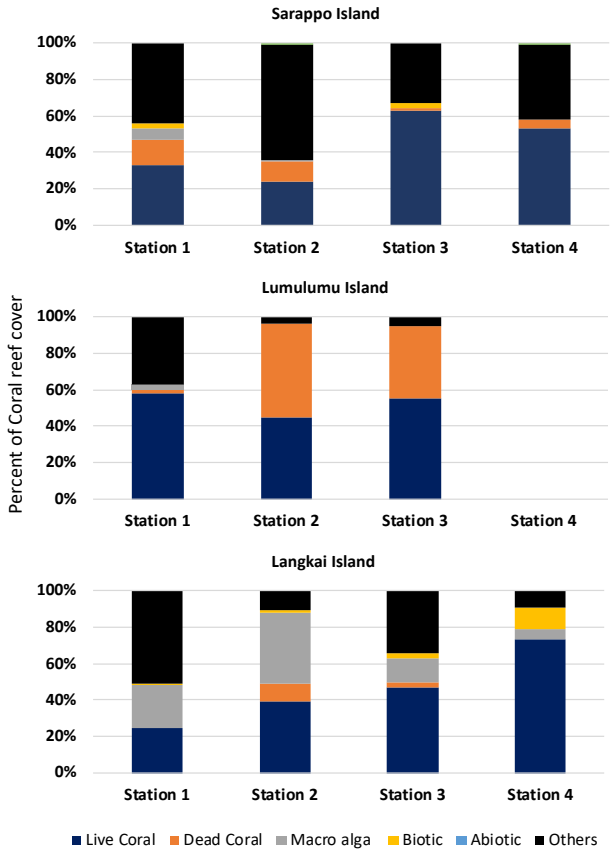


Figure 3. Average of living coral cover at each station in the research site

Reef Fish Diversity

The number of reef fish species found in each location ranged from 39 to 66. However, the existence of different species in one location resulted in differences in the number and appearance of fish species. From the total population, there were 66 genera, 149 species, and 27 families (Table 1). All were classified into 3 groups, namely the target, major, and indicator fish.

Table 1. Species abundance of reef fish at each island in genus level

No	Genus Level	Sarapo Island				Lumu lumu Island				Langkai Island		
		St1	St2	St3	St4	St1	St2	St3	St1	St2	St3	St4
1	Ablyglyphidodon	*	*** *	*	*	*		**				
2	Abudefduf		*** **	*	****	******		*****				
3	Acanthurus			*	**	*	*	*	*	*	**	*
4	Aeoliscus				*	*		*				
5	Amblyglyphidodn	*								**		
6	Amphiprion						**	*		*	*	*
7	Anampses					*	*	**		*		
8	Anyperodon							*		*		
9	Apogon				*							
10	Balistapus							*			*	*
11	Bodianus	*										
12	Caesio	*	**									
13	Canthigaster						*					
14	Carangichthys											
15	Centropyge							*	*	*		
16	Cephalopholis	**	**	*		**				*	*	*
17	Chaetodon	**	**	*	**	**				*	**	
18	Cheilinus	*	*	*	*	*	*	*				
19	Cheilodipterus	*										
20	Chlorurus		*		*	*	*	**				
21	Choerodon		*	*				**				
22	Chromis	*	****					******		*****		*
23	Chrysiptera	*	*	*	****	*** *	*	***	***		*** *	*** *
24	Cirrhilabrus						*** *	*	*	*** **	*	
25	Coris				*							
26	Cromileptes	*										
27	Ctenochaetus					*						
28	Dascyllus	*								*		*
29	Diproctacanthus			*	*		*					
30	Dischistodus	*	*	*								
31	Epibulus	*	*					*	*	*		
32	Epinephelus							*	*		*	*
33	Fistularia											*
34	Halichoeres	*		*	**	*	**	*	**	*	*	*
35	Hemigymnus	*		*		*	*	*	*	*		
36	Heniocus							*				
37	Labroides	*	*	*	*		*		**		*	**
38	Lethrinus					*			*			
39	Lutjanus	*	*	*	*		*** *	*	*	*	*	
40	Macropharyngodon								*		*	*
41	Monotaxis					*		*				
42	Naso	*				*	*	*				
43	Neoglyphidodon	*	*	*		*	**	*		*		
44	Neoniphon									*		
45	Neopomacentrus		*	*								

46	Odonus							*			*	*	
47	Oxycheilinus										*		
48	Paracirrhites	*	*	*	**	*	*					*	
49	Parupeneus			*		*		*	*		*	*	
50	Pempheris			*									
51	Pentapodus				*	*		*	*	*			
52	Platax						*						
53	Plectorhincus	*	*	*	*	*	*	**					
54	Plectroglyphidodon							**	*	*		*	
55	Plectropomus		*			*							
56	Pomacentrus	*** ***	**	**** *	**** *	*** **	*** **	*** ***	**** **	***	**	*	
57	Pseudanthias	*											
58	Sargocentron			*		*							
59	Scarus	*	*	*	*	*	*	*	**	*	*		
60	Scolopsis	*	**	*	*	*		*	**	*	*	*	
61	Siganus		**	*	*	**	**	**	**	**	*		
62	Stethojulis			*	*								
63	Taeniur				*								
64	Thalassoma			*	**	*	*	*	**	*	*	*	
65	Zanclus		*		*	*		*	*	*		*	
66	Zebrasoma							*	**	*	*	*	

Correlation between coral cover and reef fish

The correlation between coral cover with the diversity of reef fish in each observation site showed that Sarappo Island had the low coral cover of 32.67% and 24% at stations 1 and 2, with more fish diversity than 3 and 4, and coral cover of 63.33% and 52.67%, respectively (Figure 4)

The ~~pearson~~ Pearson correlation test showed that in Sarappo Island, coral cover negatively correlated with the diversity of fish species, i.e., an increase in coral cover was not followed by the rise in the diversity of fish species. Meanwhile, live coral cover in Lumulumu and Langkai island was positively correlated with the diversity of fish species (Table 2).

Table 2. Correlation of live coral with species number and abundance of reef fish in all station

	Abundance	Live Coral
Species Number	.654*	-.314
Abundance		.001
Live Coral		

*. ~~Correlation~~ The correlation was significant at the 0.05 level (2-tailed).

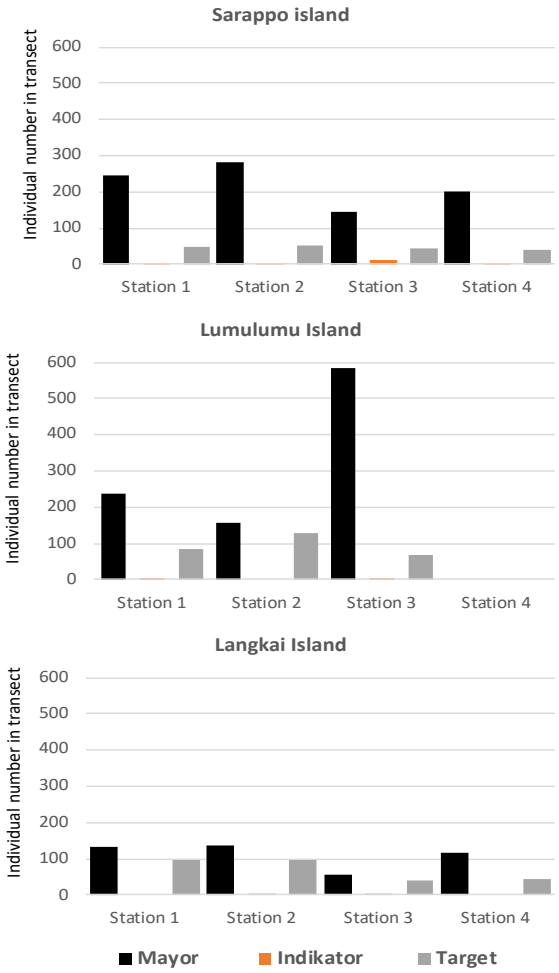


Figure 4. Number of reef fish in categories, namely major, indicator, and target fish

Correlation between live coral cover with the abundance of reef fish

The correlation between live coral cover with the abundance of reef fish in Sarappo, Lumulumu, and Langkai Island was shown in Figure 5.

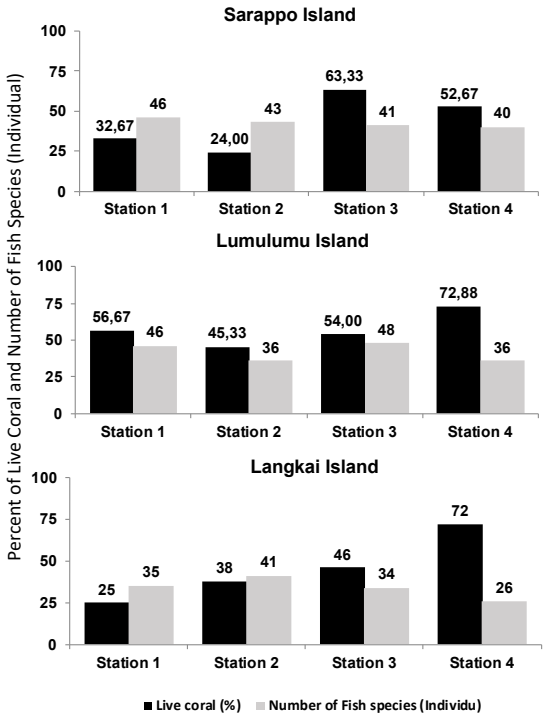


Figure 5. Correlation between live coral cover and diversity of reef

In Sarappo Island, an increase in coral cover was not always followed by a rise in the abundance of fish. The Pearson correlation test showed that the live coral cover on the Sarappo Island was negatively correlated with the abundance of fish, while that of Langkai and Lumulumu island were positively related (Figure 6)

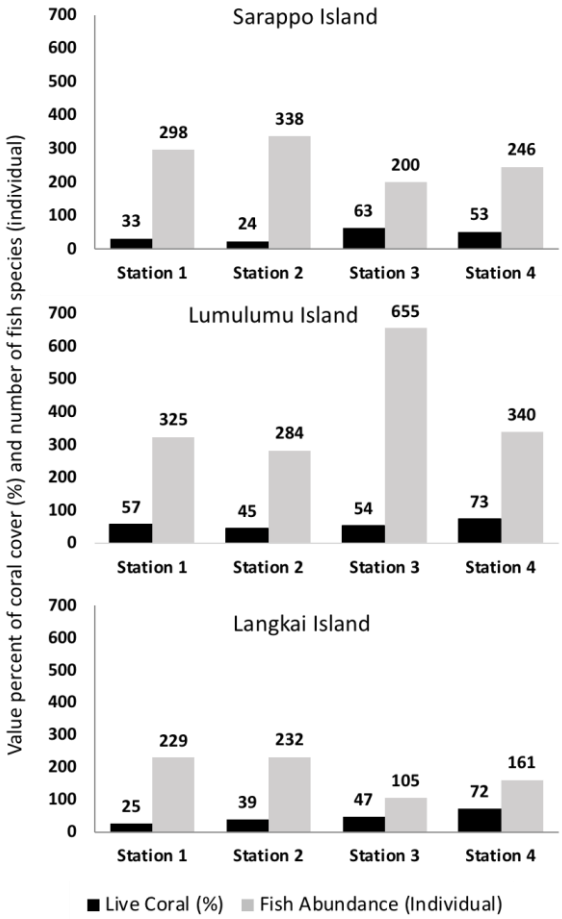


Figure 6. Correlation between live coral cover and abundance of reef fish

Generally, the diversity and density of reef fish were significantly associated with the complexity and their health. The discrepancies in the three islands are allegedly associated with the condition of the substrate as shelter and feeding ground for fish thereby affecting their existence in these places.

Discussion

The locations were found to be dominated by abiotic components and live coral cover. Furthermore, they were islands representing the coral reef community and were parts of the largest archipelagos in Indonesia. They consisted of various coral reef ecosystems in moderate condition, however, in some locations, they were seen in a good and bad state. The sloping coral reefs located on each edge of the

island were dominated in the research location. Riskiani et al. (2019) surveyed a location close to the study site, and found that at a depth of 7 m, the substrate cover was dominated by abiotic, with the highest percentage of 59.15%. The condition of live coral cover consisted of Acropora and non-Acropora species. In general, coral cover was more of the Acropora species. The dominance of the abiotic substrate was due to the pressure on the corals, such as the use of bombs or poison when fishing, as a result, the condition of the living coral substrate changes drastically and then dies. In general, the percentage of live coral cover was relatively small compared to those that were abiotic and dead. The research in Labuhan Bajau, Indonesia, found that hard corals still reached 81.25%. The observed soft corals and sponges reached 15.625% and 1.875%, respectively. The most common coral genera found at this site were Porites, Acropora, Pavona, Favites, Montipora, and Pocillopora in addition to the living non-coral and sponges. The condition of the corals in Labuhan Bajau was included in the group of coral reef communities, and found to be very good, since the cover percentage was high (82,875%) (Wisha et al. 2018). The research conducted at Central Tapanuli found 52 nests genera scattered in most of the locations and about 90% of them had a distribution associated with live coral cover. while the waters of Mentawai and Bengkulu had more coral species than other locations and the presence of certain species was associated with the stress on their environment (Siringoringo et al. 2019). The lowest coral diversity in Indonesia was probably along the west coast of Sumatra with 48 genera, and after that was the Togean Island which had 57 coral genera. Therefore, the highest number of coral genera was in North Sulawesi (Hoeksema & Putra 2000). In another study, there were 386 species of coral genera on the west coast of Sumatra (Veron et al. 2009). The highest number of coral reefs (574 species) in Indonesia was found in Raja Ampat Island, Papua (The Nature Conservancy, 2002).

The Indo-Australian Islands were the best location to find the richest coral reef biodiversity in the world, covering northern Australia, Papua New Guinea, Solomon's, Indonesia, and the Philippines. The species richness decreased fivefold compared to the central Pacific region and decreased further in the east. The decline in reef fish diversity was caused by a decrease in the number of species present in each family. Bell & Galzin (1984) found that the presence of fish was strongly influenced by the condition of living coral. They recorded 115 fish species at 13 locations, moreover, 61 were observed on 250 transects and a further 37 and 17 were added by observation with 100m sections of coral reef. The results showed that there was insufficient evidence, however, some species avoided dead coral areas. Then, 68% of the total number of species recorded were present at sites with few live corals. The number of live corals also influenced their distribution, for example, 29 out of 78 species were associated with only the 2 highest coral cover sites. In contrast, only 4 species (3%) were recorded exclusively from locations without live coral. Thirty-three species (29%) were recorded at sites with and without live coral. The presence of reef fish in the southern waters of Ambon Island was quite varied. In this location, 88 species of reef fish were found and the most dominant were *Balistapus undulatus, Chaetodon kleinii, Ctenochaetus striatus, C. strigosus, Labroides dimidiatus,* and *Paraupeneus multifasciatus* (Limmon et al. 2018). The abundance of fish in an area was often related to the condition of coral reefs. The existence of reef fish, which were generally solitary, and closely related to changes in the environment, especially in relation to the percentage of live coral cover (Feary et al. 2007). Chaetodontidae fish live in association with coral reefs and were very sensitive to changes, such as the damage to coral reefs greatly impact the existence of food and shelter for these fish species

(Titaheluw 2011). The low percentage of coral reef cover resulted in a low population of fish living on them, and also, a decrease in the abundance of these fish occurred when there was damage to the coral reef. Live coral was the most important component in coral reef populations, however, the slightest damage to the components of live coral had an impact on the abundance of fish populations and other organisms (Wilson et al. 2006). Fish inhabiting coral reefs were divided into the target, major, and indicator groups. These three groups were severely affected by the health and conditions of live coral cover (Madduppa et al. 2012). The decline in the physiological and reproductive activities of fish on coral reefs was strongly associated with the coral cover conditions. The loss of several types of corals or their death had an impact on the nature and behaviour of the reef fish (Pratchett et al. 2004). Even over a long time, the continuing decline in the percentage of live corals had an impact on reef fish populations, particularly their diversity and abundance (Wilson et al. 2006). Coremap (2011), obtained live coral cover on Sarappo Island, Indonesia, which ranged between 48% -76%, and 58% - 78%. These conditions were influenced by environmental factors, such as waves, the presence of coral disease, and climatic change. The same research found that live coral cover on the Lumulumu and Langkai Island was 50.52% and 63.22%. Furthermore, Anwar (2011) reported that the decline in fish stocks in the waters of Makassar was also due to the use of bombs, toxic materials, gears, such as seine, cantrang, and trawl when carrying out fishing activity. The reduction in live coral cover in the three research sites from the previous years was due to high intensity and destructive fishing. Based on visual observations at the study sites, there were 149 species of reef fish from 27 Families. Especially for grouper fish, as much as 7 species were found, namely *Cephalopholis boenack*, *Cephalopholis micropion*, *Cephalopholis miniata*, *Cephalopholis sonnerati*, *Epinephelus aerolatus*, *Epinephelus merra*, and *Plectropomus maculatus*. Almost all the fish living on the coral reef have high dependence, both in terms of protection and feeding. Therefore the number of individuals, both in species and composition was influenced by their environmental conditions. Studies showed that there was a positive correlation between the reef topography and their distribution and abundance. The indicator that showed the existence of the fish in the waters was the presence of living coral reefs (Sudirman & Yusri, 2008). The diversity differences of reef fish species were closely related to the substrate's complexity (McClanahan 1994). The death of coral reef communities changed their restocking process (Davis 2007). Jones et al. (2004) suggested that there was often a strong positive relationship between the coral cover and the reef fish abundance. It was further explained that there were 75% of reef fish depended on live corals for various needs including feeding, shelter, and hiding. The fish living on coral reefs varied in their degree of dependence, ranging from single to multiple (Mundai 2004; Pratchett et al. 2004). However, the effect of reduced coral abundance did not have an impact on fish populations. Corals vary depending on the level of changes in their compositions and structure. Also, the severe and widespread reduction in live coral cover resulted in large-scale disturbance to reef communities, thereby impacting a wide range of fish species and causing marked decrement in diversity (Wilson, et al. 2006).

The spatial distribution of various reef fish was related to the condition of the bottom substrate. One of the causes of reef fish diversity was their habitat variation, as they were made up of coral, sand, various bays, crannies, and algae meadows (Russel 1996). The habitat diversity explained the increase in the number of reef fish (Kasmi 2012), and also their different environment further influenced their variation (Maharbhakti 2009). The increased fish diversity, as well as the decline in coral cover,

was a result of an increase in the heterogeneity of their habitat. Therefore, the reef with a moderate level of coral cover was due to the diverse mix of fish living on them compared to the sub-stratum-rock. However, the loss of coral (> 60%) caused the decline in diversity, due to the inability to compensate for the local extinction. However, there were some examples where a decrease in live coral cover has a disproportionate effect on the local diversity of fish (Pratchett et al. 2011). The existence of coral cover was an important habitat for the different fish species since most of their populations hold direct recruitment on the stony material. In addition, many fish have the same needs, therefore, creating an active competition, either between different or among the same species (Friedlandera & Parrish, 1998).

Conclusion

The average percentage of live coral cover in Sarappo, Lumulumu and Langkai Island were 43,17±18,0%, 52,00±5,9%, 45,67±19,6%, respectively, therefore, they were classified into the moderate group. 149 reef fish species were belonging to 66 genus and 27 families were found. The condition of the coral reefs classified as moderate did not have an impact on the decline in reef fish species. Furthermore, their average number and populations were moderate and even high in the three research islands. Also, their abundance was moderate or even high when compared to coral fish populations in other areas in Indonesia. Therefore, live coral cover was positively correlated with fish diversity.

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Correspondent Process

Tahapan	Keterangan Kegiatan	Tanggal Kegiatan
1	Submission Acknowledgement	22 Januari 2022
2	Submission needing Revision (Comment Reviewer)	03 Maret 2022
3	Revision based on suggestion of Reviewer	20 Maret 2022
	- Re: [IJI] Submission needing Revision (Manuscript Revision)	20 Maret 2022
4	Re: [IJI] Submission needing Revision	30 April 2022
5	Re: [IJI] Submission needing Revision	26 Oktober 2022
6	Acceptance Letter	16 November 2022
7	Accepted article in IJI	25 November 2022
8	Re: Accepted article in IJI	27 November 2022
9	Galley proof [IJI]	31 Desember 2022

Author(s) Response to the Peer Review Comments

Reviewer 1

No	Date	Comment Reviewer	Response
1	20 Maret 2022	1. Discuss possible reasons for this result.	We are already make it and discuss it in discussion.
		2. There is not any verb in this sentence.	Rewrite it (Therefore, increasing the coral reef population and providing sufficient food for them)
		3. Mention and refer to these several studies (Several studies on the relationship between coral reefs and fish populations have been carried out, including the research on the correlation between fish, its environment, and biodiversity)	Several studies on the relationship between coral reefs and fish populations have been carried out, including the research on the correlation between fish, its environment, and biodiversity (Harahap et al. 2019, Luiz et al. 2015, Samoilys et al. 2022)
		4. What is the reference of this sentence? (Other research were based on the effect of the percentage of coral cover on the structure of fish communities)	Other research was based on the effect of the percentage of coral cover on the structure of fish communities (Herawati et al. 2021).
		5. You write “some” but there is just one reference However, some studies did not find a significant correlation between the coral cover and the number of reef fish populations (Bell and Galzin. 1984).	However, some studies did not find a significant correlation between the coral cover and the number of reef fish populations (Bell and Galzin. 1984, Samoilys et al. 2022)
		6. Rewrite this sentence (Habitat degradation is found of reducing the targeted species in their catchment area)	Habitat degradation has an impact on reducing the number of reef fish species, especially target fish species.
		7. What do you mean? it is further explained that the size of the fish is the best indicator for determining the effect of the catch	sorry, we are delete it
		8. Rewrite this sentence The growth and the birth of the fish is very dependent	Fish population growth is highly dependent on the environment. In suitable water conditions, it will affect good

		on the environment, when it is in good condition, their population grow until it reaches the limit where growth and development are no longer supported by their ecosystem	growth to the optimum limit of population growth.
		9. If this the aim of your study, it is not written clear at all. Please rewrite it.	The relationship between coral reef conditions and their populations is more specific to the their living habitat. However, this relationship is examined based on the area covered by live coral reefs and their species composition in a habitat. For this reason, this study will try to explore information related to the relationship between coral reef conditions and reef fish populations, in particular the relationship based on the area of living coral reefs and species composition of reef fish.
		10. Make a table and write geographical coordinates of the stations.	Answer Table 1. The coordinates of the research station. No | Sampling station | Coordinate point Sarappo Lompo Island 1. Station 1 S5° 02.090' E119° 05.192' 2. station 2 S4° 52.951' E119° 15.656' 3. station 3 S4° 52.654' E119° 15.574' 4. station 4 S4° 52.428' E119° 15.861' Lumulumu Island 1. station 1 S4° 58.435' E119° 13.028' 2. station 2 S4° 58.143' E119° 12.791' 3. station 3 S4° 58.158' E119° 12.640' 4. station 4 S4° 58.402' E119° 12.512' Langkai Island 1. station 1 S5° 02.182' E119° 05.838' 2. station 2 S5° 02.232' E119° 05.691' 3. station 3 S5° 02.219' E119° 05.347' 4. station 4 S5° 02.090' E119° 05.192'
		11. How did you collect this data for every station?The differences in coral covers were allegedly related to the intensity of fishing activity, such as the use of bombs, toxic materials, and fishing gear, which were not environmentally friendly.	We are not collection such kind of data. We must delete the comment.
		12. Information for Figure 3. What do you mean by biotic, abiotic and others? The readers won't understand what you classified as biotic, abiotic and others. What is the difference among live coral	We are explained in figure legend: Figure 3. Average of living coral cover at each station in the research site (live coral are corals (soft corals and hard corals) that are found alive, Dead coral are corals (soft coral and hard coral) that are found in a non-living condition, marco algae is a group of seaweed found around coral

		and biotic? What is the difference among dead coral and abiotic? You should define each category clearly	reefs, Biotic is a population of living organisms other than corals and macroalgae, abiotic is a stretch of dead rock and coral, others is a stretch of sand and small rocks).
		13. What references did you use to identify fishes?	The number of reef fish species found in each location ranged from 39 to 66.
		14. What do you mean? However, the existence different species in one location, resulted to the differences in the number and appearance of fish species.	To explain the number and categories of reef fish that we found, we tried to provide an explanation that was sequential according to the number and category of reef fish. category of reef fish we add an explanation in the method. for that we replace the sentence with : The number and types of reef fish in each location are characterized by differences in size, behavior and living characteristics.
		15. What do you mean by this classification? All were classified into 3 groups, namely the target, major, and indicator fish	We describe in a method to provide an understanding of the classification and categories of fish in coral reef areas. The registered fish species were Reef fish can be categorized into three main groups (English et al, 1997): 1) target fish groups, 2) indicator fish, and 3) large fish groups. The abundance of reef fish species is calculated in individual units/meter2. The target fish groups are fish species that have economic value, are very important in their presence on coral reefs and are targeted for fishing. This group of fish makes coral reefs as spawning grounds. The indicator fish group is a type of reef fish that usually lives in coral reef areas and is an indicator of the fertility of coral reef ecosystems. While the major fish groups are groups of small fish, size 5-25 cm, have different colors. These fish are usually ornamental fish. This group of fish is generally found

			in large numbers and types and tends to be territorial. The name of genus should be written italic. Ablyglyphidodo Thank you Its Done You should explain the result of figure 5 here Figure 5. During the research, the high percentage of live coral cover was not significantly related to the number of reef fish species. On Lumu-lumu Island, the percentage of live coral cover was around 63% and had 41 individual fish species, while on Langkai Island, which had live coral cover of about 72%, the number of reef fish was around 26 individuals. The correlation between live coral cover with the abundance of reef fish in Sarappo, Lumulumu, and Langkai Island was shown in Figure 5.
		16. This is your result First sentences in Discussion	The percentage of live coral cover at the study site is quite high with a percentage of up to 72%, although in some locations it still looks quite low at around 43%. The presence of live coral is not correlated with the number of reef fish populations. This condition shows that high live coral cover has a low number of reef fish.
		17. What is the reference of this sentence? In general, the percentage of live coral cover was relatively small compared to those that were abiotic and dead.	Hudatwi and Umroh (2018)
		18. What do you mean? The research in Labuhan Bajau, Indonesia, found that hard corals still reached 81.25%. The observed soft	The population of coral reefs in Labuan Bajo there is a striking difference in live coral cover between hard and soft coral groups, which is 81.25%. and 15.625%, respectively

		corals and sponges reached 15.625% and 1.875%, respectively.	Porites, Write the genera italic Its Done

Reviewer 2

No	Date	Comment Reviewer	Response
		1. The hypothesis of the study should be better explained in this part. The importance of the techniques used in the study should be explained. References published before 2010 should be updated or removed	Thank you very much. At the end of the sentence in the introduction, we have replaced and updated it with a sentence that explains why it is important for us to carry out this research. We have explained the appropriate and more specific method for this research, especially in determining species and explaining fish sampling. We have also added an explanation of how to determine the number of fish per station. We have also added an additional explanation regarding the classification of fish obtained by category (English et al, 1997). For reference, some of the existing opinions have been added to the latest literature. however, not all explanations relevant to the statement concerned, are available with the most recent literature. So that some who use the literature before 2010 we still use. This is to provide a strong reason for the importance of carrying out this research.
		2. The map of each region should be given separately.	In the map we have separated for each island by inserting the necessary station images. And to make it easier for readers to see the ordinate points, we have also provided the ordinate points in table 1.

Correspondent Process

Tahapan	Keterangan Kegiatan	Tanggal Kegiatan
1	Submission Acknowledgement	22 Januari 2022
2	Submission needing Revision (Comment Reviewer)	03 Maret 2022
3	Revision based on suggestion of Reviewer	20 Maret 2022
	- Re: [IJI] Submission needing Revision (Manuscript Revision)	20 Maret 2022
4	Re: [IJI] Submission needing Revision	30 April 2022
5	Re: [IJI] Submission needing Revision	26 Oktober 2022
6	Acceptance Letter	16 November 2022
7	Accepted article in IJI	25 November 2022
8	Re: Accepted article in IJI	27 November 2022
9	Galley proof [IJI]	31 Desember 2022

Gmail Ibu Erna UMI <ernaumimakassar@gmail.com>

Re: [IJI] Submission needing Revision

1 message

Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> Sun, Mar 20, 2022 at 11:45 PM
To: Ibu Erna UMI <ernaumimakassar@gmail.com>

On 2022-03-20 08:25, Ibu Erna UMI wrote:

> Dear Atta Mouludi-Saleh
>
> Thank you very much for your understanding, I am appreciated it.
> I do my best to revise my manuscript based on the reviewer's suggestion
> Please find in attachment for my revision manuscript and answering comment from the reviewer
> There are two files in the attachment
>
> Best regards
>
> Erna
>
> On Wed, Mar 16, 2022 at 1:03 AM Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> wrote:
>
> > On 2022-03-15 07:06, Ibu Erna UMI wrote:
> >
> > > Dear Atta Mouludi-Saleh
> > > Really sorry for the late response. I just open my email. cause almost one week we have to rest. and fortunately, I am now in good condition. I will revise it soon and send it to you. I agree to make the revisions based on suggestions.
> > > Best regards
> > >
> > > Erna
> > >
> > > On Thu, Mar 3, 2022 at 3:22 AM Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> wrote:
> > >
> > > > Dear Ernaningsih,
> > > > We would like to inform you that your submitted manuscript " The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia" to Iranian Journal of Ichthyology, as been peer reviewed by our referees and their comments are enclosed. Please implement the various changes and modifications suggested by the reviewers and submit the revised manuscript within two weeks. Please note that your response must address each referee's comment item by item, leaving no unaddressed comment. However, if you do not agree with any of the listed comments, you may present your argument and give your reasons for disagreeing with the referee. Your prompt attention to these matters will enable us to further process your manuscript at the earliest opportunity.
> > > > Your prompt response is greatly appreciated. Please send me the edited version via an email as soon as possible.
> > > > Our decision is: Revision Required
> > > >
> > > > Best,
> > > > Executive Manager:
> > > >
> > > > Atta Mouludi-Saleh
> > >
> > > Dear Ernaningsih,
> > >
> > > Thank your for your reply we look forward to hearing from you, please send us the revised version soon.
> > >
> > > Best,
> > >
> > > Atta
>
> Dear Ernaningsih
>
> Many thanks for editing your manuscript, i sent it to Editor for final decision. I'll let you know soon.

Best,

Atta

2 attachments

770-3266-1-5-20220218(Rev01).docx
5746K

Comment Revision for Reviewer.docx
25K

The Correlation Of Coral Cover And Reef Fish Density In the Biggest Archipelagos located in centre of Indonesia

Abstract

Live coral cover is a measure of the proportion of reef surface covered by live stony materials instead of sponges, algae, or other organisms. These stony corals are the main contributors to a reef's three-dimensional framework structure that provides critical habitat for many organisms. Therefore, this research aims to determine the relationship between the number of live coral cover and the presence of reef fish in one of the biggest archipelagos located in centre of Indonesia. The research method used for the determination of live coral cover was the Point Intercept transect, while the reef fish population were measured using the census technique. The results showed that the average percentage of live coral cover in all station including Sarappo, Lumulumu, and Langkai Island were 43.17%, 52 %, 45.67%, respectively, and were classified into moderate and good. There were 149 reef fish species anf 27 families found at all station during this research. The coral cover was negatively correlated with species diversity and the abundance of reef fish in archipelagos of Indonesia.

Keywords : live coral cover, diversity, abundance, archipelagos.

Introduction

Coral reefs are one of the underwater ecosystems carrying out marine biodiversity with various ecological functions, such as a place for marine organisms to breed, make shelter, feed and maintain stability in ecological conditions, and also a habitat for a variety of marine animals (Maragos et al. 1996, Miththapala 2008, Gattuso et al. 2014). Coral reef ecosystems have very high biodiversity and aesthetic value, such as a tourism area, for wave barrier and controlling coastal erosion (Gattuso et al. 2014). However, their ecosystems are very vulnerable to damage, which in turn affect the existence of organisms living in association with corals. Also, the high access to coral reef area increases its chance of degradation. The causes of such damage include the use of fishing gear that is not environmentally friendly, sedimentation, water pollution, sand mining, and severe tourism activities (Hartoni et al. 2012). Coral reefs have a complex relationship with fish communities. The extent of coral reef exposure to various organism provides a good opportunity and surface for a variety of fish and more organisms to survive. Therefore, increasing populations and expanses of coral reef communities can provide sufficient food for reef fish. Several studies on the relationship between coral reefs and fish populations have been carried out, including the research on the correlation between fish, its environment, and biodiversity (Harahap et al. 2019, Luiz et al. 2015, Samoilys et al. 2022). Other research were based on the effect of the percentage of coral cover on the structure of fish communities (Herawati et al. 2021). However, some studies did not find a significant correlation between the coral cover and the number of reef fish populations (Bell and Galzin. 1984, Samoilys et al. 2022). Several recent studies showed that there is a positive correlation between coral cover and reef fish population, specifically the endemic fish (Nugraha et al. 2020, Komyakova et al. 2018; Philpott, et al. 2012).

However, the strength of each relationship depends on the organism's level and the type of their habitat (Munday 2004). The habitat's resources are also measured at the species level, this is necessary for further study (Andrew 1987). Habitat degradation has an impact on reducing the number of reef fish species, especially target fish species (Wilson et al. 2010). Russ (1991) explained that the most informative indicators of detecting the changes in the catch activity is the decrease of fish diversity through the scarcity of certain local species. Fishing activities affect the status of coral reef habitat by two methods, namely directly through destructive fishing and indirectly by increasing the grazing algae (Bouchon et al. 1985; Pet Soede. 2000). The presence of reef fish in their habitats is directly affected by their health and population, which is associated with the availability of food, shelter, and their spawning ground (Andamari *et al*., 2007). Fish population growth is highly dependent on the environment. In suitable water conditions, it will affect good growth to the optimum limit of population growth (Arteaga et al. 1997). The relationship between coral reef conditions and their populations is more specific to their living habitat. For this reason, this study will try to explore information related to the relationship between coral reef conditions and reef fish populations, in particular the relationship based on the area of living coral reefs and species composition of reef fish.

Research Method

Study Sites

This research was conducted on three islands at Spermonde Archipelagos, South Sulawesi Province, in Indonesia, namely Sarappo, Lumulumu, and Langkai. Each island had four stations representing the habitats of coral reefs (Figure1).

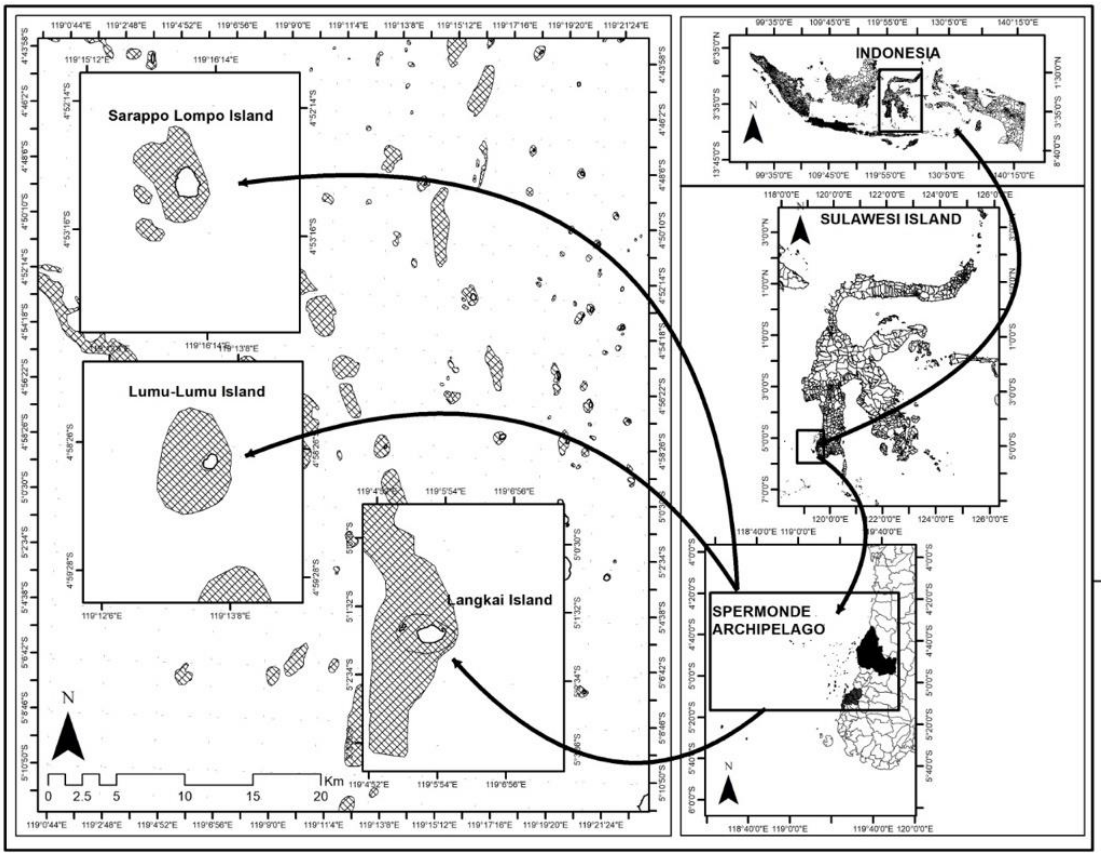


Figure 1. Study site during research in Spermonde Archipelagos, Indonesia

The coordinates of each station can be seen in Table 1.

Table 1. The coordinates of the research station.

No	Sampling station	Coordinate point
	Sarappo Lompo Island	
1.	Station 1	S5° 02.090' E119° 05.192'
2.	station 2	S4° 52.951' E119° 15.656'
3.	station 3	S4° 52.654' E119° 15.574'
4.	station 4	S4° 52.428' E119° 15.861'
	Lumulumu Island	
1.	station 1	S4° 58.435' E119° 13.028'
2.	station 2	S4° 58.143' E119° 12.791'
3.	station 3	S4° 58.158' E119° 12.640'
4.	station 4	S4° 58.402' E119° 12.512'
	Langkai Island	
1.	station 1	S5° 02.182' E119° 05.838'
2.	station 2	S5° 02.232' E119° 05.691'
3.	station 3	S5° 02.219' E119° 05.347'
4.	station 4	S5° 02.090' E119° 05.192'

Research Procedure

This study used a primary data, and the coral reef observation was conducted based on the habitat condition using Point Intercept Transect (PIT) method, while reef fish was obtain using belt transect technique (English et al. 1997). To determine the habitats' conditions, the species diversity and abundance, observations were carried out at three island in Spermonde Archipelago, namely Sarappo, Lumulumu and Langkai. The method used for the observation was the Point Intercept Transect (PIT) at the length of 50 meters at 3-7 m depth in reef flat area.

The observations were carried out using visual census method with transect line (English et al. 1997) on each station and was repeated three times. The observations were made with a 50 m transect line with the visibility at a distance of 2.5 m to the left and 2.5 m to the right (observer was in the middle). Specifically, reef fish found in the observed location were recorded according to their species, quantity, and their estimated length. To identify the habitat characteristic grouping between the observed stations, a descriptive analysis was conducted, presenting the results in the form of graphs and images. Meanwhile, fish abundance was determine according to the method of Dartnall and Jones (1986).

Reef fish can be categorized into three main groups (English et al, 1997): 1) target fish groups, 2) indicator fish, and 3) large fish groups. Fish identification was carried out using Kuiter (1992); Matsuda and Allen (1987). The abundance of reef fish species is calculated in individual units/meter2. The target fish groups are fish species that have economic value, are very important in their presence on coral reefs and are targeted for fishing. This group of fish makes coral reefs as spawning grounds. The indicator fish group is a type of reef fish that usually lives in coral reef areas and is an indicator of the fertility of coral reef ecosystems. While the major fish groups are groups of small fish, size 5-25 cm, have different colors. These fish are usually ornamental fish. This group of fish is generally found in large numbers and types and tends to be territorial.

Data Analysis

The data analysis for coral cover was distinguished by the characteristic of their habitats or their percentage population, while the dead and lifeform species were calculated using the following formula. From the obtained percentage of lifeform cover, the quality of living coral in that area was determined. The criteria which generally applied to determinig the condition of coral reefs was divided into four categories (English et al. 1997), as follows:

- Damaged : 0-24,9%
- Moderate : 25-49,9%
- Good : 50-74,9%
- Very good : 75-100%

Statistical Analysis

To examine the relationship between live coral cover conditions and their abundance and density, the Pearson's correlation with SPSS ver. 24 was used. The results of the analysis were then tabulated in the table of the relationship between each of these factors.

Result

Coral reef condition

The coral reef condition in three research sites (Sarappo Island, Lumulumu island and Langkai island) was generally classified as moderate or good. The measurement results of the average percentage of coral cover in Sarappo, Lumulumu and Langkai Island were 43.17%, 52 %, 45.67%, respectively (Figure 2). The coral covers in this three research sites were classified into moderate and good.

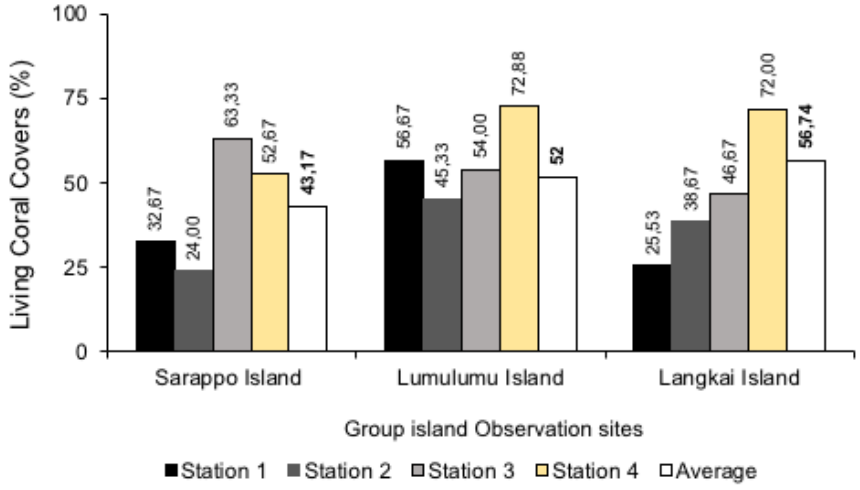


Figure 2. Live coral cover in each station at every island observation sites

The average coral cover also appeared to differ between the study sites. The highest percentage was around 72% on the Langkai Island, especially at station 4. However, this

condition was still moderate and good for all stations with an average coral cover of 43%, 52%, and 45% for Sarappo, Lumulumu and Langkai island, respectively. Some striking stations with a deadly percentage (51%) was observed on Lumulumu Island. However, the percentage of dead coral appeared to be much lower with an average of 8%, 30%, and 3% for Sarappo, Lumulumu, and Langkai Island, respectively (Figure 3).

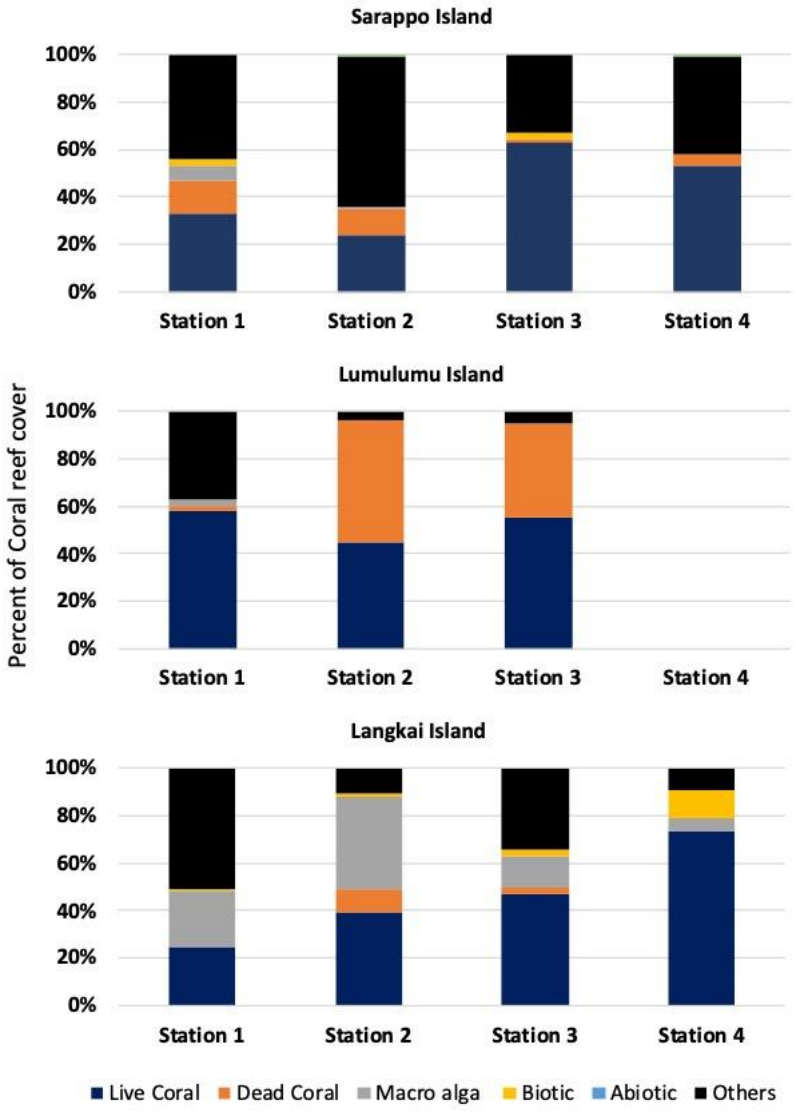


Figure 3. Average of living coral cover at each station in the research site(live coral are corals (soft corals and hard corals) that are found alive, Dead coral are corals (soft coral and hard coral) that are found in a non-living condition, marco algae is a group of seaweed found around coral reefs, Biotic is a population of living organisms other than corals and macroalgae, abiotic is a stretch of dead rock and coral, others is a stretch of sand and small rocks)

Reef Fish Diversity

The number of reef fish species found in each location ranged from 39 to 66. The number and types of reef fish in each location are characterized by differences in size, behavior and living characteristics. From the total population there were 66 genera, 149

species, and 27 families (Table 2). All were classified into 3 groups, namely the target, major, and indicator fish (English et al. 1997).

Table 2. Species abundance of reef fish at each island in genus level

No	Genus Level	Sarapo Island				Lumu lumu Island			Langkai Island			
		St1	St2	St3	St4	St1	St2	St3	St1	St2	St3	St4
1	*Ablyglyphidodon*	*	*** *	*	*	*		**				
2	*Abudefduf*		*** **	*	****	******		*****				
3	*Acanthurus*			*	**	*	*	*	*	*	**	*
4	*Aeoliscus*				*	*		*				
5	*Amblyglyphidodn*	*								**		
6	*Amphiprion*						**	*		*	*	*
7	*Anampses*					*	*	**		*		
8	*Anyperodon*							*		*		
9	*Apogon*				*							
10	*Balistapus*							*			*	*
11	*Bodianus*	*										
12	*Caesio*	*	**									
13	*Canthigaster*						*					
14	*Carangichthys*											
15	*Centropyge*							*	*	*		
16	*Cephalopholis*	**	**	*		**				*	*	*
17	*Chaetodon*	**	**	*	**	**				*	**	
18	*Cheilinus*	*	*	*	*	*	*	*				
19	*Cheilodipterus*	*										
20	*Chlorurus*		*		*	*	*	**				
21	*Choerodon*		*	*				**				
22	*Chromis*	*	****					******		*****		*
23	*Chrysiptera*	*	*	*	****	*** *	*	***	***		*** *	*** *
24	*Cirrhilabrus*						*** *	*	*	*** **	*	
25	*Coris*				*							
26	*Cromileptes*	*										
27	*Ctenochaetus*					*						
28	*Dascyllus*	*								*		*
29	*Diproctacanthus*			*	*		*					
30	*Dischistodus*	*	*	*								
31	*Epibulus*	*	*					*	*	*		
32	*Epinephelus*							*	*		*	*
33	*Fistularia*											*
34	*Halichoeres*	*		*	**	*	**	*	**	*	*	*
35	*Hemigymnus*	*		*		*	*	*	*	*		
36	*Heniocus*							*				
37	*Labroides*	*	*	*	*		*		**		*	**
38	*Lethrinus*					*			*			
39	*Lutjanus*	*	*	*	*		*** *	*	*	*	*	
40	*Macropharyngodon*								*		*	*
41	*Monotaxis*					*		*				
42	*Naso*	*				*	*	*				
43	*Neoglyphidodon*	*	*	*		*	**	*		*		
44	*Neoniphon*									*		
45	*Neopomacentrus*		*	*								

46	*Odonus*							*				*	*
47	*Oxycheilinus*											*	
48	*Paracirrhites*	*	*	*	**	*	*						*
49	*Parupeneus*			*		*		*	*			*	*
50	*Pempheris*			*									
51	*Pentapodus*				*	*		*	*	*			
52	*Platax*						*						
53	*Plectorhincus*	*	*	*	*	*	*	**					
54	*Plectroglyphidodon*							**	*	*			*
55	*Plectropomus*		*			*							
56	*Pomacentrus*	*** ***	**	**** *	**** *	*** **	*** **	*** ***	**** **	***	**		*
57	*Pseudanthias*	*											
58	*Sargocentron*			*		*							
59	*Scarus*	*	*	*	*	*	*	*	**	*	*		
60	*Scolopsis*	*	**	*	*	*		*	**	*	*	*	
61	*Siganus*		**	*	*	**	**	**	**	**	*		
62	*Stethojulis*			*	*								
63	*Taeniur*				*								
64	*Thalassoma*			*	**	*	*	*	**	*	*	*	
65	*Zanclus*		*		*	*		*	*	*		*	
66	*Zebrasoma*							*	**	*	*	*	

Correlation between coral cover and reef fish

The correlation between coral cover with the diversity of reef fish in each observation site showed that Sarappo Island had low coral cover of 32.67% and 24% at stations 1 and 2, with more fish diversity than 3 and 4, and coral cover of 63.33% and 52.67%, respectively (Figure 4)

The pearson correlation test showed that in Sarappo Island, coral cover negatively correlated with the diversity of fish species, i.e., an increase in coral cover was not followed by the rise in the diversity of fish species. Meanwhile, live coral cover in Lumulumu and Langkai island was negatively correlated with the diversity of fish species (Table 3).

Table 3. Correlation of live coral with species number and abundance of reef fish in all station

	Abundance	Live Coral
Species Number	.654*	-.314
Abundance		.001
Live Coral		

*. Correlation was significant at the 0.05 level (2-tailed).

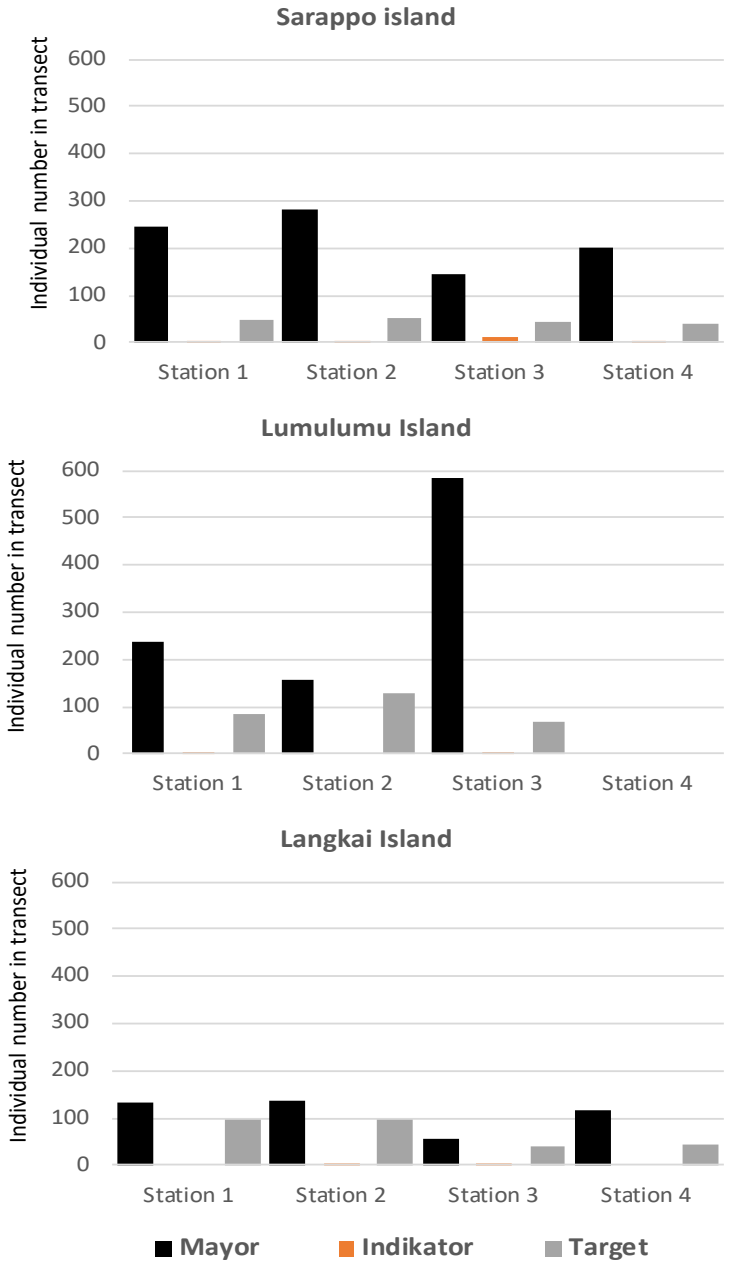


Figure 4. Number of reef fish in categories, namely major, indicator, and target fish

Correlation between live coral cover with the abundance of reef fish

During the research, the high percentage of live coral cover was not significantly related to the number of reef fish species. On Lumu-lumu Island, the percentage of live coral cover was around 63% and had 41 individual fish species, while on Langkai Island, which had live coral cover of about 72%, the number of reef fish was around 26 individuals. The correlation between live coral cover with the abundance of reef fish in Sarappo, Lumulumu, and Langkai Island was shown in Figure 5.

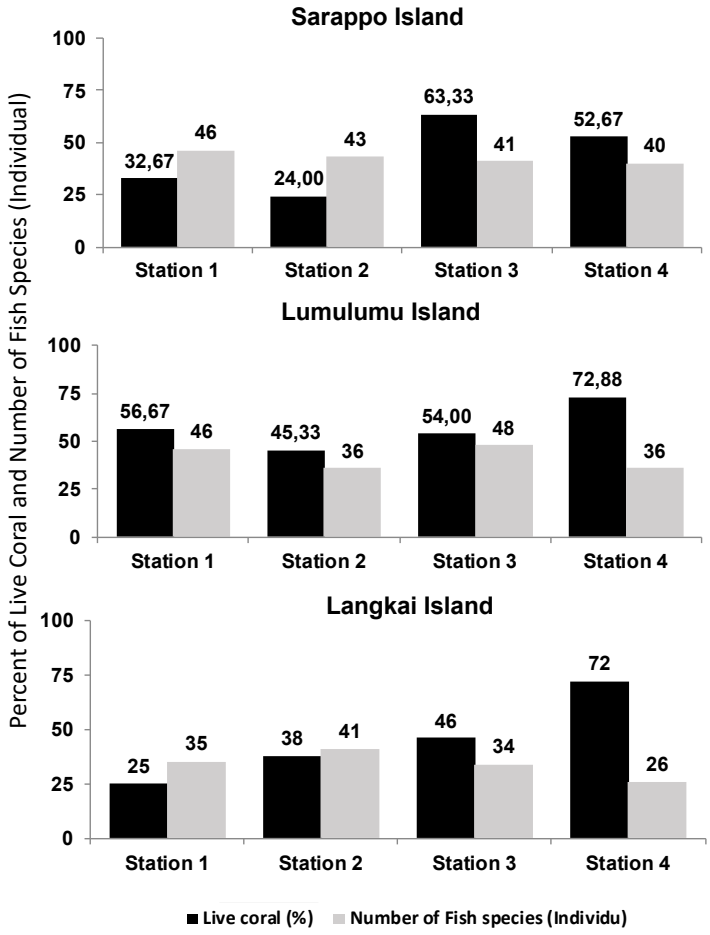


Figure 5. Correlation between live coral cover and diversity of reef

In Sarappo Island, an increase coral cover was not always followed by a rise in the abundance of fish. The Pearson correlation test showed that the live coral cover on the Sarappo Island was negatively correlated with the abundance of fish, while that of Langkai and Lumulumu island were negatively related (Figure 6)

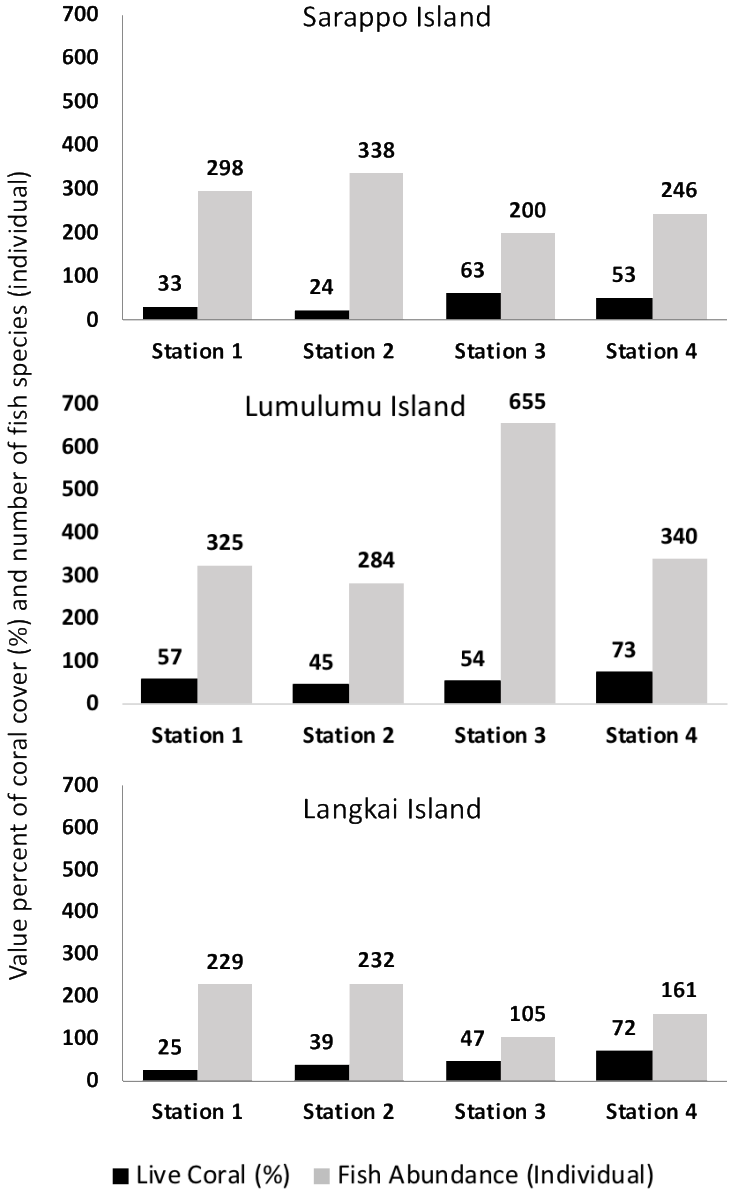


Figure 6. Corelation between live coral cover and abundance of reef fish

Generally, the diversity and density of reef fish was significantly associated with the complexity and their health. The discrepancies in the three island, allegedly associated with the condition of the substrate as shelter and feeding ground for fish thereby affecting thir existence in these places.

Discussion

The percentage of live coral cover at the study site is quite high with a percentage of up to 72%, although in some locations it still looks quite low at around 43%. The presence of live coral is not correlated with the number of reef fish populations. This condition shows that high live coral cover has a low number of reef fish. Riskiani et al. (2019) Conducted a survey at a location close to the study site, and found that at a depth of 7 m, the substrate cover was dominated by abiotic, with the highest percentage of

59.15%. The condition of live coral cover consisted of Acropora and non-Acropora species. In general, coral cover was more of the Acropora species.The dominance of the abiotic substrate was due to the pressure on the corals, such as the use of bombs or poison when fishing, as a result, the condition of the living coral substrate changes drastically and then dies. In general, the percentage of live coral cover was relatively small compared to those that were abiotic and dead (Hudatwi and Umroh 2018). The population of coral reefs in Labuan Bajo there is a striking difference in live coral cover between hard and soft coral groups, which is 81.25%. and 15.625%, respectively. The most common coral genera found at this site were Porites, *Acropora, Pavona, Favites, Montipora*, and *Pocillopora* in addition to the living non-coral and sponges. The condition of the corals in Labuhan Bajau was included in the group of coral reef communities, and found to be very good, since the cover percentage was high (82,875%) (Wisha et al. 2018). The research conducted at Central Tapanuli, found 52 nests genera scattered in most of the locations and about 90% of them had a distribution associated with live coral cover. while the waters of Mentawai and Bengkulu had more coral species than other locations and the presence of certain species was associated with the stress on their environment (Siringoringo et al. 2019). The lowest coral diversity in Indonesia was probably along the west coast of Sumatra with 48 genera, and after that was the Togean Island which had 57 coral genera. Therefore, the highest number of coral genera was in North Sulawesi (Hoeksema & Putra 2000). In another study, there were 386 species of coral genera on the west coast of Sumatra (Veron et al. 2009). The highest number of coral reef (574 species) in Indonesia was found in Raja Ampat Island, Papua (The Nature Conservancy, 2002).

The Indo-Australian Islands were the best location to find the richest coral reef biodiversity in the world, covering the northern Australia, Papua New Guinea, Solomon's, Indonesia, and the Philippines. The species richness decreased fivefold compared to the central Pacific region, and decreased further in the east. The decline in reef fish diversity was caused by a decrease in the number of species present in each family. Bell & Galzin (1984) found that the presence of fish was strongly influenced by the condition of living coral. They recorded 115 fish species at 13 locations, moreover, 61 were observed on 250 transects and a further 37 and 17 were added by observation with 100m sections of coral reef. The results showed that there was insufficient evidence, however, some species avoided dead coral areas. Then, 68% of the total number of species recorded were present at sites with few live corals. The number of live corals also influenced their distribution, for example, 29 out of 78 species were associated with only the 2 highest coral cover sites. In contrast, only 4 species (3%) were recorded exclusively from locations without live coral. Thirty-three species (29%) were recorded at sites with and without live coral. The presence of reef fish in the southern waters of Ambon Island was quite varied. In this location, 88 species of reef fish were found and the most dominant were *Balistapus undulatus, Chaetodon kleinii, Ctenochaetus striatus, C. strigosus, Labroides dimidiatus,* and *Paraupeneus multifasciatus* (Limmon et al. 2018). The abundance of fish in an area was often related to the condition of coral reefs. The existence of reef fish, which were generally solitary, and closely related to changes in the environment, especially in relation to the percentage of live coral cover (Feary et al. 2007). Chaetodontidae fish live in association with coral reefs and were very sensitive to changes, such as the damage to coral reefs greatly impact the existence of food and shelter for these fish species (Titaheluw 2011). The low percentage of coral reef cover resulted in a low population of fish living on them, and also, a decrease in the abundance of these fish occurred when

there was a damage to the coral reef. Live coral was the most important component in coral reef populations, however, the slightest damage to the components of live coral had an impact on the abundance of fish populations and other organisms (Wilson et al. 2006). Fish inhabiting coral reefs were divided into target, major, and indicator groups. These three groups were severely affected by the health and conditions of live coral cover (Madduppa et al. 2012). The decline in the physiological and reproductive activities of fish on coral reefs was strongly associated with the coral cover conditions. The loss of several types of corals or their death had an impact on the nature and behaviour of the reef fish (Pratchett et al. 2004). Even over a long period of time, the continuing decline in the percentage of live corals had an impact on reef fish populations, particularly their diversity and abundance (Wilson et al. 2006). Coremap (2011), obtained live coral cover on Sarappo Island, Indonesia, which ranged between 48% -76%, and 58% - 78%. These conditions were influenced by the environmental factors, such as waves, the presence of coral disease, and climatic change. The same research found that live coral cover on the Lumulumu and Langkai Island were 50.52% and 63.22%. Furthermore, Anwar (2011) reported that the decline in fish stocks in the waters of Makassar was also due to the use of bombs, toxic materials, gears, such as seine, cantrang, and trawl when carrying out fishing activity. The reduction in live coral cover in the three research sites from the previous years, was due to high intensity and destructive fishing. Based on visual observations at the study sites, there were 149 species of reef fish from 27 Families. Especially for grouper fish, as much as 7 species were found, namely *Cephalopholis boenack*, *Cephalopholis micropion*, *Cephalopholis miniata*, *Cephalopholis sonnerati*, *Epinephelus aerolatus*, *Epinephelus merra*, and *Plectropomus maculatus*. Almost all the fish living on coral reef have high dependence, both in terms of protection and feeding. Therefore the number of individuals, both in species and composition was influenced by their environmental conditions. Studies showed that there was a positive correlation between the reef topography and their distribution and abundance. The indicator that showed the existence of the fish in the waters was the presence of living coral reefs (Sudirman & Yusri, 2008). The diversity differences of reef fish species was closely related to the substrate's complexity (McClanahan 1994). The death of coral reef communities changed their restocking process (Davis 2007). Jones et al. (2004) suggested that there was often a strong positive relationship between the coral cover and the reef fish abundance. It was further explained that there were 75% of reef fish that depended on live corals for various needs including feeding, shelter, and hiding. The fish living on coral reefs varied in their degree of dependence, ranging from single to multiple (Mundai 2004; Pratchett et al. 2004). However, the effect of reduced coral abundance did not have an impact on fish populations. Corals vary depending on the level of changes in their compositions and structure. Also, the severe and widespread reduction in live coral cover resulted in large-scale disturbance to reef communities, thereby impacting a wide range of fish species and causing marked decrement in diversity (Wilson, et al. 2006).

The spatial distribution of various reef fish was related to the condition of the bottom substrate. One of the causes of reef fish diversity was their habitat variation, as they were made up of coral, sand, various bays, crannies, and algae meadows (Russel 1996). The habitat diversity explained the increase in the number of reef fish (Kasmi 2012), and also their different environment further influenced their variation (Maharbhakti 2009). The increased fish diversity, as well as the decline in coral cover, was as a result of an increase in the heterogeneity of their habitat. Therefore, the reef with a moderate level of coral cover, was due to the diverse mix of fish living on them

compared to the sub stratum-rock. However, the loss of coral (> 60%) caused the decline in diversity, due to the inability to compensate the local extinction. However, there were some examples where a decrease in live coral cover has a disproportionate effect on the local diversity of fish (Pratchett et al. 2011). The existence of coral cover was an important habitat for the different fish species, since most their populations hold direct recruitment on the stony material. In addition, many fish have the same needs, therefore, creating an active competition, either between different or among the same species (Friedlandera & Parrish, 1998).

Conclusion

The average percentage of live coral cover in Sarappo, Lumulumu and Langkai Island were 43,17±18,0%, 52,00±5,9%, 45,67±19,6%, respectively, therefore, they were classified into the moderate group. There were 149 reef fish species belonging to 66 genus and 27 families. The condition of the coral reefs classified as moderate did not have an impact on the decline in reef fish species. Furthermore, their average number and populations were moderate and even high in the three research islands. Also, their abundance was also moderate or even high when compared to coral fish populations in other areas in Indonesia. Therefore, live coral cover was negatively correlated with fish diversity.

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Correspondent Process

Tahapan	Keterangan Kegiatan	Tanggal Kegiatan
1	Submission Acknowledgement	22 Januari 2022
2	Submission needing Revision (Comment Reviewer)	03 Maret 2022
3	Revision based on suggestion of Reviewer	20 Maret 2022
	- Re: [IJI] Submission needing Revision (Manuscript Revision)	20 Maret 2022
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9	Galley proof [IJI]	31 Desember 2022

Gmail **Ibu Erna UMI <ernaumimakassar@gmail.com>**

Re: [IJI] Submission needing Revision

1 message

Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> Sat, Apr 30, 2022 at 1:28 PM
To: Ibu Erna UMI <ernaumimakassar@gmail.com>

On 2022-04-30 07:57, Ibu Erna UMI wrote:

> Dear Atta
> many thank
> I am waiting any update of your information
> I am really hopes good news related our submission
> many thanks
>
> Erna
>
> On Sun, Mar 20, 2022 at 11:45 PM Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> wrote:
>
> > On 2022-03-20 08:25, Ibu Erna UMI wrote:
> >
> > > Dear Atta Mouludi-Saleh
> > >
> > > Thank you very much for your understanding, I am appreciated it.
> > > I do my best to revise my manuscript based on the reviewer's suggestion
> > > Please find in attachment for my revision manuscript and answering comment from the reviewer
> > > There are two files in the attachment
> > >
> > > Best regards
> > >
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> > >
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> > > > On 2022-03-15 07:06, Ibu Erna UMI wrote:
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> > > > > Really sorry for the late response. I just open my email. cause almost one week we have to rest. and fortunately, I am now in good condition. I will revise it soon and send it to you. I agree to make the revisions based on suggestions.
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> > > > > On Thu, Mar 3, 2022 at 3:22 AM Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> wrote:
> > > > >
> > > > > > Dear Ernaningsih,
> > > > > > We would like to inform you that your submitted manuscript " The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia" to Iranian Journal of Ichthyology, as been peer reviewed by our referees and their comments are enclosed. Please implement the various changes and modifications suggested by the reviewers and submit the revised manuscript within two weeks. Please note that your response must address each referee's comment item by item, leaving no unaddressed comment. However, if you do not agree with any of the listed comments, you may present your argument and give your reasons for disagreeing with the referee. Your prompt attention to these matters will enable us to further process your manuscript at the earliest opportunity.
> > > > > > Your prompt response is greatly appreciated. Please send me the edited version via an email as soon as possible.
> > > > > > Our decision is: Revision Required
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> > > > > > Best,
> > > > > > Executive Manager:

> > > Atta Mouludi-Saleh
>
> Dear Ernaningsih,
>
> Thank your for your reply we look forward to hearing from you, please send us the revised version soon.
>
> Best,
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> Atta

Dear Ernaningsih

Many thanks for editing your manuscript, i sent it to Editor for final decision. I'll let you know soon.

Best,

Atta

Thank you for your reply if you could and possible please send me again your revised version of manuscript (Edited version bsed on reviewer's comment).

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Atta

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9	Galley proof [IJI]	31 Desember 2022

Gmail

Ibu Erna UMI <ernaumimakassar@gmail.com>

Acceptance Letter [IJI]

1 message

atta.mouludisaleh@ut.ac.ir <atta.mouludisaleh@ut.ac.ir> Wed, Nov 16, 2022 at 5:37 PM
To: ernaumimakassar@gmail.com

Dear Dr. Ernaningsih Ernaningsih
We are pleased to inform you that based on the comments made by respected reviewers, revised versions sent by you, and doing some corrections and journal formatting by me your paper entitled: "The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia" has been accepted for publication in Iranian Journal of Ichthyology.
You will receive the edited version and Galley proof soon for correction (if any). Publication of your paper is scheduled for one of the next issues of Iranian Journal of Ichthyology. Thank you for considering IJI for publishing your valuable manuscripts.
Yours Sincerely,

Professor Hamid Reza Esmaeili
Editor-in-chief of IJI
Ichthyology and Molecular Systematics Laboratory, Department of Biology, College of Sciences, Shiraz University, Shiraz, Iran.
hresmaeili22@gmail.com
hresmaeili@shirazu.ac.ir

Correspondent Process

Tahapan	Keterangan Kegiatan	Tanggal Kegiatan
1	Submission Acknowledgement	22 Januari 2022
2	Submission needing Revision (Comment Reviewer)	03 Maret 2022
3	Revision based on suggestion of Reviewer	20 Maret 2022
	- Re: [IJI] Submission needing Revision (Manuscript Revision)	20 Maret 2022
4	Re: [IJI] Submission needing Revision	30 April 2022
5	Re: [IJI] Submission needing Revision	26 Oktober 2022
6	Acceptance Letter	16 November 2022
7	Accepted article in IJI	25 November 2022
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Gmail

Ibu Erna UMI <ernaumimakassar@gmail.com>

Accepted article in IJI

1 message

atta.mouludisaleh@ut.ac.ir <atta.mouludisaleh@ut.ac.ir> Fri, Nov 25, 2022 at 2:01 PM
To: ernaumimakassar@gmail.com

Dear Dr. Ernaningsih
Regarding accepted submission (The correlation of coral cover and reef fish density in the biggest archipelagos located in center of Indonesia) in Iranian Journal of Ichthyology, please send us the author names and their ORCID numbers soon.
Best,
Átta

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Gmail **Ibu Erna UMI <ernaumimakassar@gmail.com>**

Re: Accepted article in IJI

1 message

Ibu Erna UMI <ernaumimakassar@gmail.com> Sun, Nov 27, 2022 at 9:00 AM
To: atta.mouludisaleh@ut.ac.ir

Dear Atta Thank you very much
Here, in attachment file for the author of our manuscript

Best Regards

Ernaningsih

On Fri, Nov 25, 2022 at 2:01 PM <atta.mouludisaleh@ut.ac.ir> wrote:

> **Dear Dr. Ernaningsih**
> Regarding accepted submission (The correlation of coral cover and reef fish density in the biggest archipelagos located in center of Indonesia) in Iranian Journal of Ichthyology, please send us the author names and their ORCID numbers soon.
> Best,
> Átta

Author The Correlation Of Coral Cover And Reef Fish .docx
16K

The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia

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2. Budimawan : Faculty of Marine Science and Fisheries, Hasanuddin University.Jl. Perintis Kemerdekaan Km 10, Makassar 90245, Indonesia
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Email : asbar.asbar@umi.ac.id

5. Ma'ruf KasimFaculty of Fishery and Marine Science, Halu Oleo University, Jl. Mokodompit, Andounohu, Kendari, Southeast Sulawesi, Indonesia
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Cooresponding Author :
Ernaningsih ernaningsih.aras@umi.ac.id

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Ibu Erna UMI <ernaumimakassar@gmail.com>

[ORCID] Verify your email address

1 message

ORCID <support@verify.orcid.org> Sun, Nov 27, 2022 at 7:56 AM
To: ernaumimakassar@gmail.com

ORCID

To verify your email address, click the following button and sign into your ORCID record. If you can't click the button, copy and paste the link below into your browser's address bar:

Verify your email address

https://orcid.org/verify-email/czJES3lURE5NS2lVOE05TVpsamhGN1RiL2dBSnpVNW5mUmN2RnZFMUhYMnpJWjhLcjl3K09iQjAvUi9URmRlVQ?lang=en

Your 16-digit ORCID identifier is 0000-0003-1509-0646, and your full ORCID iD and the link to your public record is https://orcid.org/0000-0003-1509-0646 (primary email address: ernaningsih.aras@umi.ac.id).

If you did not add this email address to your ORCID record, please contact us immediately by replying to this email.

DID YOU KNOW? The ORCID Registry is always evolving. Stay up-to-date on the latest at our blog: https://orcid.org/blog

If you have any questions or need help, visit https://orcid.org/help or contact us at https://support.orcid.org/hc/en-us/requests/new

Warm Regards,
The ORCID Team
https://orcid.org/

You have received this email as a service announcement related to your ORCID Account.

email preferences | privacy policy | ORCID, Inc. | 10411 Motor City Drive, Suite 750, Bethesda, MD 20817, USA | ORCID.org

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Gmail **Ibu Erna UMI <ernaumimakassar@gmail.com>**

Galley proof [IJI]

1 message

Atta Mouludi-Saleh <atta.mouludisaleh@ut.ac.ir> Sat, Dec 31, 2022 at 2:57 AM
To: ernaumimakassar@gmail.com
Cc: ernaningsih.aras@umi.ac.id

Dear Dr. **Ernaningsih**
Please check the galley proof of your accepted article in IJI in 3 days. The purpose of the proof is to check for typesetting or conversion errors and the completeness and accuracy of the text, tables and figures. The article will be published online after receipt of the corrected proofs.

Best,
Atta

2 attachments

9-2--2022-5.docx
2261K

Author The Correlation Of Coral Cover And Reef Fish .docx
15K

All authors must be provided their ORCID codes.
Please provide complete names of your co-authors.

The Correlation Of Coral Cover And Reef Fish Density In Biggest Archipelagos located in centre of Indonesia

1. Ernaningsih : Faculty of Fisheries and Marine Science, Muslim University of Indonesia, Jl. Urip Sumoharjo Km.05, Makassar, Southeast Sulawesi, Indonesia.
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