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Coral Covers and The Abundance of Chaetodontidae in Suaka Alam Perairan of Weh Island Aceh

Nadia Aldyza[1], Ternala Alexander Barus[2*], Miswar Budi Mulya[3], Muhammad Ali Sarong[4], Afkar[5], Fakhrol Andi[6], Rahmad[7], Gilang Yuarza[8]

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[1,2,3,5]Department of Biology, Faculty of Mathematics and Natural Science, Universitas Sumatera Utara, Jl. Bioteknologi No. 1, Unit 7. Medan 20155, [4]Department of Biology Education, Faculty of Teacher Training and Education, Universitas Syiah Kuala, Jl. Tgk. Hasan Krueng Kalee, Darussalam Banda Aceh 23111, [6,7,8] Department of Marine Science, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Jl. Meureubo Darussalam Banda Aceh 23111

e-mail:
[1]*nadia.aldyza@gmail.com*
*[2]*ternala@usu.ac.id*
[3]*miswarbm_bio@usu.ac.id*
[4]*alisarong@fkip.unsyiah.ac.id*
[5]*afkar.peusangan@gmail.com*
[6]*fakrolhamdan@gmail.com*
[7]*rahmad200398@gmail.com*
[8]*yuarzagilang@gmail.com*

**Corresponding author*

Abstract. *Pesisir Timur Pulau Weh (PTPW) is a water natural reserve conservation area located in the eastern part of Weh Island. The condition of coral substrates in PTPW has suffered a lot of damage based on bleaching cases that have hit Sabang waters in 2016. Coral conditions can be measured by looking at the abundance of fish indicators of the Chaetodontidae group. Therefore, this study aimed to measure coral conditions and the abundance of Chaetodontidae coral fish, as well as analyze the relationship between the percentage of coral cover and the abundance of Chaetodontidae coral fish. Data of coral were collected using the Point Intercept Transect method with a length of 50 meters, while the abundance of fish used the Underwater Visual Census technique and the Belt Transect method with a length of 50 meters and a total belt width of 5 meters. The results showed that the coral conditions in PTPW were in poor to fair condition with the highest cover at The Sumur Tiga site (36.83%) and the lowest at The Ujung Kareung site (11.5%). The highest abundance of Chaetodontidae fish was found at Ujung Seuke site (1253.3 ind/ha) and the lowest was found at Anoi Itam site (186.7 ind/ha). The results of the correlation analysis between the percentage of coral cover and the abundance of Chaetodontidae coral fish showed a positive relationship ($r = 0.482$), but it was not significant ($p>0.05$), and the regression equation obtained $Y = 17.16x + 166.52$ with a determination coefficient of 18.3%, which indicated that the correlation between the two variables was very weak.*

Keywords: *abundance, Chaetodontidae, coral cover, coral fish, Weh Island*

Citation

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INTRODUCTION

Weh Island has an area of 153 Km^2 and has become the entrance to the territory of the Western Republic of Indonesia, especially in shipping and international trade activities. Law Number 37 of 2000 states that Weh Island has been designated as an integrated economic development area of Sabang, a free trade area, and a free port (Indonesian Law Number 37 of 2000). It determines Weh Island as the most in-demand recreation center by local and foreign tourists in Aceh.

The waters of Weh Island have mostly been included in conservation zones, one of which is Pesisir Timur Pulau Weh. This is

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based on KEPMEN-KP Number 57 of 2013 which states that Pesisir Timur Pulau Weh (PTPW) is designated as Suaka Alam Perairan (SAP) located in the Eastern part of Weh Island, and has a coastline length of ±15.8 km with an area of 3207.98 hectares (Siregar et al., 2016). Suaka Alam Perairan PTPW area management is carried out by *adat laot* institutions in collaboration with the Sabang City Government as an effort to protect and preserve coral reefs in the waters of Weh Island.

Coral reefs are complex ecosystems that provide a number of benefits for human life (Tuwo & Tresnati, 2020). From the ecological aspect, they support in the field of fisheries that provide food (Brander et al., 2012), while from economic aspect, they help increase people's income through the opening of tourism and recreation areas (Pendleton et al., 2016). In addition, coral ecosystems provide habitat and breeding for marine organisms such as lobsters, crabs, and fish. Coral fish communities are an important part of maintaining balance with the various constituent components of coral reef ecosystems.

Most corals in PTPW waters experience death stemming from branched coral types, leaving only massive corals such as Porites. This is reinforced by Muttaqin et al. (2014) that corals with low resistance come from Acropora and Poccilopora, so benthic conditions in PTPW are generally dominated by massive corals. According to the results of an in-depth interview with *Panglima Laot Lhok*, despite the establishment of a conservation zone, fishing activities using toxic materials still continue to occur. This is based on the findings of plastic and used bottles containing toxins in the sea. Muchlisin et al. (2013) stated that fishing activities with potassium tend to be done at night with diving equipment to catch certain types of coral fish.

The coral condition is important to be studied because the unhealthy condition of the coral can have an impact on the marine communities. Substrate conditions and coral variations in waters affect the presence, number, and diversity of coral fish (Nasir et al., 2017). According to Rina (2020), fish indicator Chaetodontidae are closely related in association with corals. It is also in accordance with the statement of Giyanto et al. (2014) that most of the coral fish group Chaetodontidae are polyp eaters and can be used as bioindicators to measure the health of coral reef ecosystems. Research about corals by Muttaqin et al. (2014) in the PTPW area has been conducted post-bleaching in 2010, while the latest coral condition research after bleaching period of 2015-2016 is not yet known for certain data. Hence, the purpose of this study is to measure the condition of coral cover and the abundance of fish indicators in the waters of SAP-PTPW in Sabang, as well as analyze the relationship of cover conditions with the abundance of fish indicator Chaetodontidae.

MATERIALS AND METHODS

Site Location

This research was conducted in the waters of Suaka Alam Perairan - Pesisir Timur Pulau Weh (SAP-PTPW) (Figure 1) which consisted of 6 regional sites of conservation areas, namely Sumur Tiga (site 1), Ujung Kareung (site 2), Reuteuk (site 3), Benteng (site 4), Anoi Itam (site 5), and Ujung Seuke (site 6). The determination of the location was based on the previous research conducted by Najmi et al., 2016. Data collection was carried out in August – September 2021 using direct survey methods.

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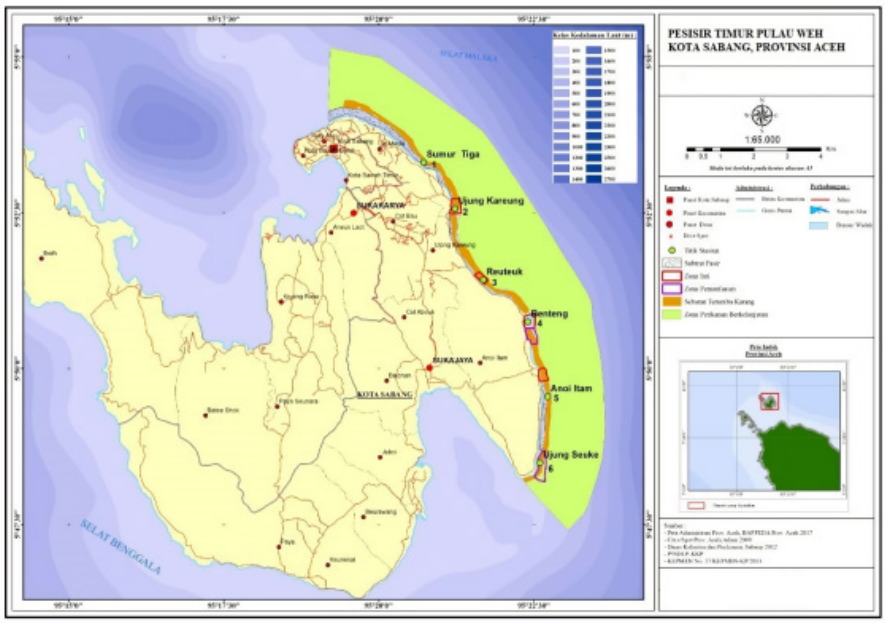

Figure 1. Location of research sites in SAP-PTPW Sabang, Aceh

Coral Reefs and Coral Fish Data Collection

This is exploratory research. Coral reefs data collection was carried out by the Point Intercept Transect (PIT) method with a transect length of 50 meters which was placed parallel to the coastline (Muttaqin et al., 2014). Each site was placed as many as 6 replicas of transects at a depth of 3 to 10 meters. Identification of the genus of coral was carried out on every 50 cm that touched the substrate. The collection of coral fish data was carried out visually in line with coral data observations, but the method used was the Transect Belt with a belt width of 5 meters, so that the area of coral fish observation was 1500 m^2 (6 x 5m x 50m). The coral genera were identified using guidebooks by Suharsono (2008) and Kelley (2009), while fish species were identified using guidebooks by Allen et al. (2003).

The percentage of coral cover was calculated by the number of points divided by the total point times a hundred percent (Manuputty & Djuwariah, 2009). The result of the percentage of coral cover was used to determine the condition of the coral reef ecosystems. The condition of coral reef ecosystem was evaluated based on the categories proposed by the Indonesian Ministry of Environment (Minister of Environment) No: Kep-04/MEN-LH/02/2001 (Prasetia et al., 2017). The categories were: poor (0-24.9%), fair (25-49.9%), good (50-74.9%), and excellent (75-100%).

The results of fish data found at the research site were elaborated by looking at the composition and abundance of types. Density abundance was defined as the number of individuals of one type per quadrant meter within each site. The abundance of Chaetodontidae coral fish, through census visual data collection was calculated by the sigma number of individuals of the type of fish divided by area of fish census area (Anshari et al., 2020). The categories for the fish abundance of Chaetodontidae found in SAP-PTPW were determined based on Djamali and Darsono (Riskiani et al., 2019) as follows: very rare (200-1000 ind/ha), rare (1000-2000 ind/ha), less abundant (2000-4000 ind/ha), overflow (4000-10000 ind/ha) and very abundant (>10000).

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Data Analysis

The relationship between the percentage of living coral closure with abundance (Table 3) and the indicator number of fish species (Chaetodontidae) were determined using the Simple Linear Regression Test with the formula Y= a + bx. Data presentation and analysis were carried out with the help of Minitab software version 16 and Excel.

RESULTS AND DISCUSSION

Coral Conditions

Coral conditions in Suaka Alam Perairan Pesisir Timur Pulau Weh had different cover values. From Table 1, the cover conditions percentage from the highest to the lowest were sequentially Sumur Tiga (36.83%), Ujung Seuke (34%), Anoi Itam (25%), Reuteuk (22.33%), Benteng (20.67%), and Ujung Kareung (11.5%). According to Najmi's research (2016), the cover conditions in SAP-PTPW in 2015 at Sumur Tiga was 55%, Ujung Seuke was 48%, Anoi Itam was 45%, Reuteuk was 41%, Benteng was 65%, and Ujung Kareung was 32.17%. The results showed a decrease in cover over the past 6 years in PTPW water areas.

Figure 2 shows that there was a decrease in coral cover ranging from 10% to 40%. This is very worrying because the condition of corals at 6 sites was in moderate and unfavorable conditions (Table 2). The decline of cover conditions could occur due to global bleaching in the period 2015 to 2016. Bleaching phenomena were reported to have occurred in several Indonesian waters (Ampou et al., 2017), such as Aceh, Karimunjawa and Sulawesi (Setiawan et al., 2017). It also occurs in some world waters such as the Great Barrier Reef-Australia (Hughes et al. 2017) and Hawaii (Bahr et al. 2017).

Coral bleaching can occur as a stress response by corals to the environment (Obura, 2005), and makes coral polyps release their symbionous algae, namely zooxanthellae so that corals lose pigment (color substances) and cause internal physiological imbalances. According to observations in the field, the damage that occurs after bleaching in the SAP-PTPW area leaves corals of the genus that have stronger resistance such as coral massive than vulnerable genera such as Acropora branching. Based on some cases of bleaching, it can be seen that bleaching is one of the factors that play a role in widespread coral degradation. In addition to bleaching, the decrease of coral cover in SAP-PTPW area is suspected to be caused by the invasive turf algae that was increasingly widespread so it difficult for corals to do the recruitment. Furthermore, Ulfah et al. (2021) stated that the condition of coral reefs in Indonesia had suffered severe degradation in recent decades.

Table 1. The percentages of coral reef in SAP-PTPW Sabang

Sites	Location	Cover (%)	Condition
Site 1	Sumur Tiga	36.83	Fair
Site 2	Ujung Kareung	11.5	Poor
Site 3	Reuteuk	22.33	Poor
Site 4	Benteng	20.67	Poor
Site 5	Anoi Itam	25	Fair
Site 6	Ujung Seuke	34	Fair

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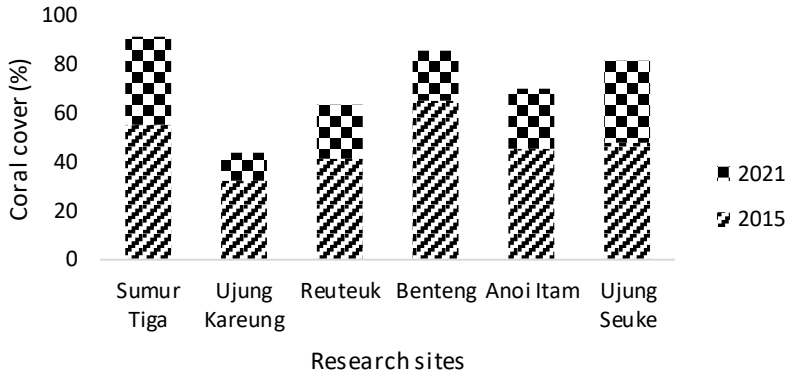

Figure 2. Comparison of coral cover in 2015 and 2021 in the SAP-PTPW area. (Data research in 2015 by Najmi, (2016), and 2021 by research result.

Table 2. Coral fish of Chaetodontidae (ind)

Spesies	Site1	Site 2	Site 3	Site 4	Site 5	Site 6	Total
Chaetodon citrinellus	-	12	1	-	-	1	14
Chaetodon collare	-	-	12	3	-	2	17
Chaetodon falcula	2	-	-	-	-	-	2
Chaetodon meyeri	1	2	-	1	1	3	8
Chaetodon trifasciatus	7	-	-	-	-	4	11
Chaetodon vagabundus	2	2	2	-	-	-	6
Forcipiger longirostris	8	21	14	3	-	26	72
Forcipiger flavissimus	-	-	3	-	-	1	4
Hemitaurichthys zoster	80	63	29	51	27	151	401
Heniochus pleurotaenia	2	-	-	-	-	-	2
The number of presence of each species	7	5	6	4	2	7	
The number of total species	102	100	61	58	28	188	

The Abundance of Coral Fish Chaetodontidae

The results found 10 species of fish from the family Chaetodontidae in SAP-PTPW (Table 2). The most abundant species of coral fish were *Hemitaurichthys zoster* as many as 401 individuals, which were found in all sites, while the least found was *Chaetodon falcula* as many as 2 individuals which were only found at Sumur Tiga.

Through the calculation of the abundance of Chaetodontidae coral fish, only Ujung Seuke site had rare criteria (>1000) while the other 5 sites had very rare criteria (Table 3). This was suspected because the Ujung Seuke area is located at the very end of the Eastern region and has strong currents/waves so not many community activities are carried out in the area, both shipping and fishing activities. According to Advani et al., (2015), fishing has an impact on marine ecosystems with depletion of fish populations and changing the structure of communities, so that reduced fishing activity can provide opportunities for abundant coral fish conditions.

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Table 3. Abundance of coral fish Chaetodontidae

Sites	Location	Ind/ha	Criteria
ST1	Sumur Tiga	680	Very rarely
ST2	Ujung Kareung	666.7	Very rarely
ST3	Reuteuk	406.7	Very rarely
ST4	Benteng	386.7	Very rarely
ST5	Anoi Itam	186.7	Very rarely
ST6	Ujung Seuke	1253.3	Rarely

The Correlation of Coral Cover with Coral Fish Chaetodontidae

The analysis results using Minitab 16 found that there was a positive relationship between the percentage of coral cover and the abundance of coral fish Chaetodontidae with a correlation coefficient value (r) of 0.428, even though it was not significantly (p-value = 0.398). This was in line with the coefficient of determination value (R-square) which was only 18.3% (Figure 3). It indicated that the abundance of coral fish indicators were not always affected by high coral cover conditions. For instance, The Ujung Seuke site had a higher fish abundance than other sites, namely 1253.3 ind/ha, but the cover percentage was only 34%. Meanwhile, at Ujung Kareung site, the abundance of coral fish indicators was still relatively good at 666.7 ind/ha even though it had the lowest coral cover site (11.5%). Then, Anoi Itam Site had an indicator coral fish abundance of 186.7 ind/ha, but the coral cover was higher than Ujung Kareung which was 25%.

The coral substrate covered with turf algae that appeared in almost every site was suspected to be the cause of the weak correlation, so that only a few of Chaetodontidae family fish were found. The insignificant case between the percentage of coral cover and the abundance of Chaetodontidae coral fish is also similar to the results of Prasetyanda (2011), and Nurjirana & Burhanuddin (2017) studies. The remaining determination coefficient of 81.7% indicated that the abundance of coral fish could be influenced by other factors beyond the variables tested. Another factor could be the availability of food. For obligate coral predators such as *C. collare*, *C. meyeri* and *C. trifasciatus* fish that are polyp eaters were found very little, sequentially *C. collare* 17 ind, *C. trifasciatus* 11 ind and *C. meyeri* 8 ind. The small number of reef predatory fish caused by the low area of coral cover, then *C. trifasciatus* were only found at stations that had high covers such as Sumur Tiga and Ujung Seuke.

Certain coral predators ate corals that were not too wide even though the corals were found in small or rare quantities, then there are certain coral fish that are facultative which were found at the research site, i.e. *C. citrinellus*, *C. falcula*, *C. vagabundus*, *F. longirostris*, *F. flavissimus*, and *H. zoster*. Hence, although the coral cover in SAP-PTPW is low, chaetodontidae group fish do not decrease too much because they have other alternative foods such as benthic algae, small crustaceans, and polychaeta. According to Pratchett et al. (2006), Chaetodontidae fish can survive in the decline conditionof hard coral cover as Chaetodontidae fish are able to eat in addition to coral polyps (facultative corallivore). In addition, other factors that are assumed to affect fish abundance can be influenced by human activity (Nugraha et al., 2019), environmental conditions, and aquatic nutrition (Nugraha et al., 2020).

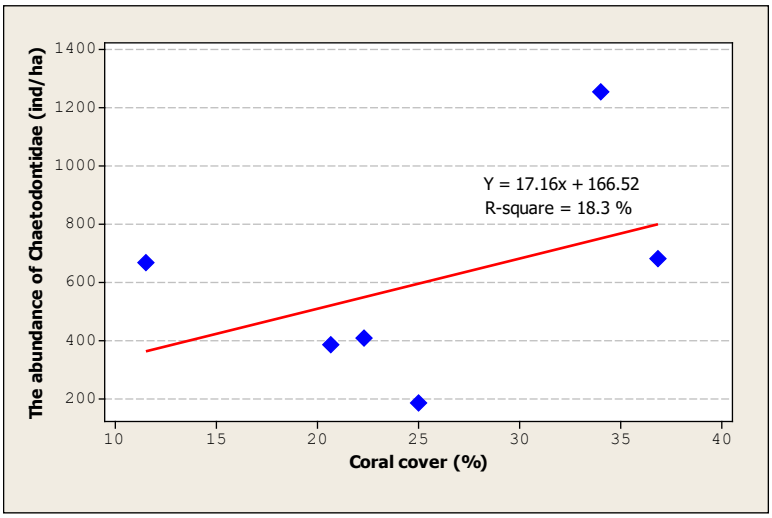

Figure 3. Linear regression graph of the percentage of coral cover with the abundance of Chaetodontidae coral fish.

CONCLUSION

Coral conditions in the SAP-PTPW area (on average) are in poor condition, while the abundance of Chaetodontidae family fish is in a very rare condition. The correlation between the percentage of coral cover and the abundance of Chaetodontidae coral fish is positively correlated but it is not significant and has a very weak relationship.

AUTHOR CONTRIBUTION

N.A., A.A., F.A., R.R., G.Y. Designed the research, collected data in the field, performed the measurements, and aided in interpreting the results. N.A., A.A. wrote the manuscript and analyzed the data. T.A.B., M.B.M, M.A.S. supervised the work.

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CONFLICT OF INTEREST

We have no conflicts of interest to disclose.

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