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Population Shift of The Family Scaridae: An Ecological Study in The Threatened Habitat of Tikus Island

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***Abstract*— Parrotfishes have an essential role in maintaining the balance and health of coral reef ecosystems by controlling algal growth. However, climate change and human activities have led to the degradation of coastal ecosystems, which are the natural habitat of Scaridae. This research aims to determine the Scaridae family's abundance and investigate the correlation between coral reef cover and the abundance of the Scaridae family on Tikus Island. Observations of fish family scaridae using UVC (Underwater Visual Census), while coral reef cover using the LIT (Line Intercept Transect) method. The highest Scaridae family abundance was at station 1 at 0.06 ind/m2, while the lowest was at station 3 at 0.02 ind/m2. The highest percentage of coral cover was at station 1 at 70.44%, and the weakest at station 3 at 8.18%. The abundance of the Scaridae family strongly correlates with coral cover percentage; higher coral cover leads to greater abundance of Scaridae.**

Keywords— Abundance, Coral Cover, Scaridae family, Tikus Island.

I. INTRODUCTION

Parrotfish is a vital member of the Scaridae family, are highly dependent on the conditions of coral reefs [1]. Generally, green algae attached to coral reefs are the main food of parrotfish [2][3][4]; this makes parrotfish's role in maintaining the continuity and balance of the coral reef ecosystem cannot be underestimated [5].

Tikus Island, a unique natural habitat of parrotfish in the province of Bengkulu, is characterized by its dominance of sand and muddy sand [6]. The coral reef ecosystem, the natural habitat of parrotfish on Tikus Island, is in a state of increasing concern. The decline in the quality of coral reef cover is already negatively impacting many aquatic organisms, including parrotfish. Urgent action is needed to address the main problems of global warming and climate change, which are making the Tikus Island ecosystem increasingly vulnerable to damage. Furthermore, the damage is being exacerbated by various human activities that are not environmentally friendly [7].

Research on parrotfish has been conducted in several locations with different aspects [8] [9] [10]. This research is important as a primary source explaining the relationship between coral reef cover and parrotfish abundance. However, it also provides new perspectives on parrotfish adaptation to degraded coral reef environments. These findings are valuable for supporting sustainable coastal and marine resource management and strengthening ecosystem-based conservation efforts in the face of climate change and threatening human activities.

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II. METHOD

A. Research time and location

This research was conducted in February-April 2021 in Pulau Tikus Waters, Bengkulu and data analysis was carried out at the Fisheries Laboratory, Faculty of Agriculture, Bengkulu University. The research location map is shown in Figure 1.

B. Data Collection Methods

This research uses instruments and materials such as Self Contained Underwater Breathing Apparatus (SCUBA), pencil, sabak, roll m, underwater camera, boat, GPS, reef fish identification book, and laptop, with the object of observation, namely parrotfish.

a. Coral Reef Cover Observations

Data collection on coral reef conditions was carried out using the comprehensive Line Intercept Transect (LIT) method. This method determines the benthic substrate conditions of coral reefs based on the pattern of coral growth forms (Life form). LIT allows researchers to know the type of substrate of the bottom of the water being traveled. The working procedure of the LIT method is by stretching the transect rope (roll m) along 50 m parallel to the shoreline [11]. Coral growth forms (Life Form) and the water bottom substrate under the transect rope are measured and recorded to the accuracy of centimeters (cm) (Figure 2). The condition of coral reefs can be seen based on the percentage of live coral cover, providing a comprehensive understanding of the reef's health and conditions.

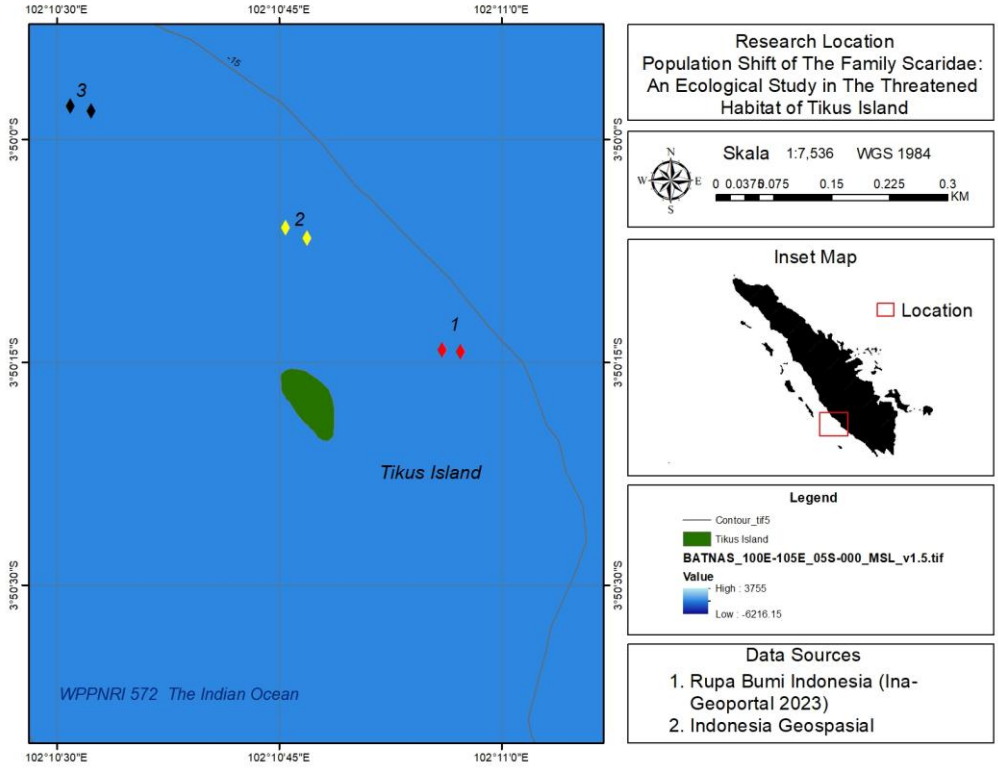
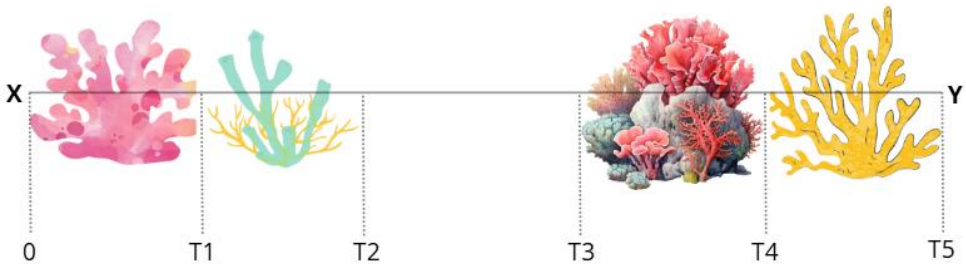


Figure 1. Research location in Tikus Island



Intercept		*Category*
0-T1 =	I_1	*Life form*
T1-T2 =	I_2	*Life form*
T2-T3 =	I_3	*Life form*
T3-T4 =	I_4	*Life form*
T4-T5 =	I_5	*Life form*

Figure 2. Example of coral colony measurements using the Line Intercept Transect method.

b. Coral Fish Observations

Target fish observations using the Underwater Visual Census (UVC) method. The transect used was a 50 m long line transect (Figure 3) with a distance of 2.5 m to the left and 2.5 m to the right, so the observed area was 250 (m2) [12]

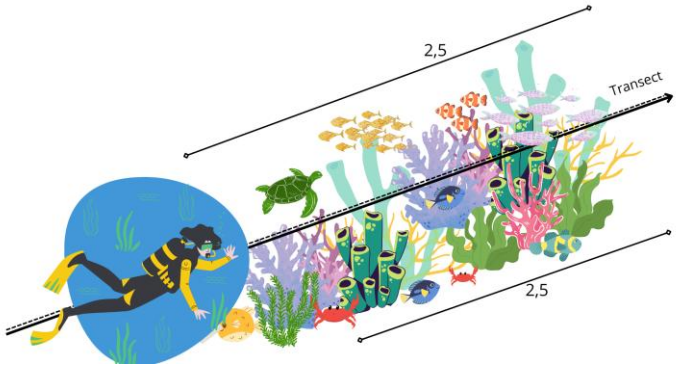


Figure 3. Coral fish data collection methods using *Underwater Visual Census*

C. Data Analysis

a. Scaridae family fish abundance

Reef fish abundance is calculated using the formula [13]:

$$N = \frac{\Sigma Ni}{A}$$

Description:
N : Abundance (Ind/m2)
Ni : Number of individuals (Ind)
A : Observation transect area (m2)

The abundance of reef fish was then classified into the categories of very abundant (> 50 individuals), abundant (20-50 individuals), less abundant (10-20 individuals), rare (5-10 individuals) and very rare (1-5 individuals) [14].

b. Percent coral reef cover

The condition of coral reefs can be seen based on the percentage of live coral cover. Percentage of live coral cover [15].

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

Description:
Ni: Percentage of i-th coral cover in percent (%)
Li: Length of the life form of the i-th type of coral
L: Total length of the track

c. Relationship between percentage of coral reef cover and Scaridae fish abundance

The relationship between the percentage of coral cover and Scaridae fish abundance was analyzed using simple linear regression [16].

$$Y = a + bX$$

Description:
Y : Dependent variable (coral cover)
X : Independent variable (Scaridae fish)
a : Intercept (the intersection of the regression line with the Y axis)
b : Slope

Relationship between two variables on a scale of -1 to +1. The closer the value is to +1, the stronger the linear relationship between the two variables. If the value is close to -1, the two variables will have a weaker linear relationship. If the R-value is 0, the two variables do not have a linear relationship. The coefficient of determination (R2) states how much influence the independent variable has on the independent variable.

III. RESULTS AND DISCUSSION

3.1 Scaridae family fish abundance

The results showed the presence of Scaridae family in as many as nine species, with 51 individuals spread across various observation points at different depths. At Station I, point 1 (7 m), nine individuals were found, consisting of Colatomus carolinus (4 fish), Scarus quoyi (3 fish), and Scarus japanensis (1 fish). In comparison, at point 2 (7 m), there were 15 individuals, including Colatomus carolinus (4 fish), Scarus quoyi (6 fish), Scarus bowersi (2 fish), Scarus bleekeri (1 fish), Scarus niger (1 fish), and Scarus dimidiatus (1 fish). At Station II, point 3(5 m), eight individuals were found, consisting of Scarus quoyi (4 tails), Scarus bowersi (1 tail), and Scarus sordidus (3 tails). In comparison, point 4 (5 m) recorded seven individuals, including Colatomus carolinus (2 tails), Scarus quoyi (2 tails), Scarus bowersi (2 tails), and Scarus dimidiatus (1 tail). Station III, point 5 (2 m) had five individuals, consisting of Scarus quoyi (2 individuals), Chlorurus percipillatus (1 individual), and Scarus japanensis (2 individuals). In comparison, point 6(2 m) also found five individuals, consisting of Colatomus carolinus (2 individuals), Scarus quoyi (2 individuals), and Scarus dimidiatus (1 individual). This distribution shows variation in the number of individuals at each point, with Scarus quoyi and Colatomus carolinus dominating some locations.

TABLE 1.
SPECIES OF THE SCARIDAE FAMILY IN TIKUS ISLAND.

No.	Species	Station I		Station II		Station III	
		1	2	3	4	5	6
1.	*Colatomus carolinus*	4	4	0	2	0	2
2.	*Scarus quoyi*	3	6	4	2	2	4
3.	*Chlorurus Percipillatus*	0	0	0	0	1	0
4.	*Scarus bowersi*	1	2	1	2	0	0
5.	*Scarus sordidus*	0	0	3	0	0	0
6.	*Scarus bleekeri*	0	1	0	0	0	0
7.	*Scarus niger*	0	1	0	0	0	0
8.	*Scarusdimidiatus*	0	1	0	1	0	1
9.	*Scarus japanensis*	1	0	0	0	2	0
	Total (Ind)	9	15	8	7	5	7
	Abudance (Ind/m^2)	0,036	0,06	0,032	0,028	0,02	0,028

Parrotfish dominate and are the most conspicuous part of the herbivorous fish community. Most species occupy corals and feed on short epilithic algae that cover the coral substrate. Herbivorous fish abundance decreased as water depth increased. Herbivorous fish prefer shallow areas because photosynthetic activity in these areas is high-speed, so food is always available to metabolize

and grow. The abundance of Scaridae family fish is shown in Figure 4.

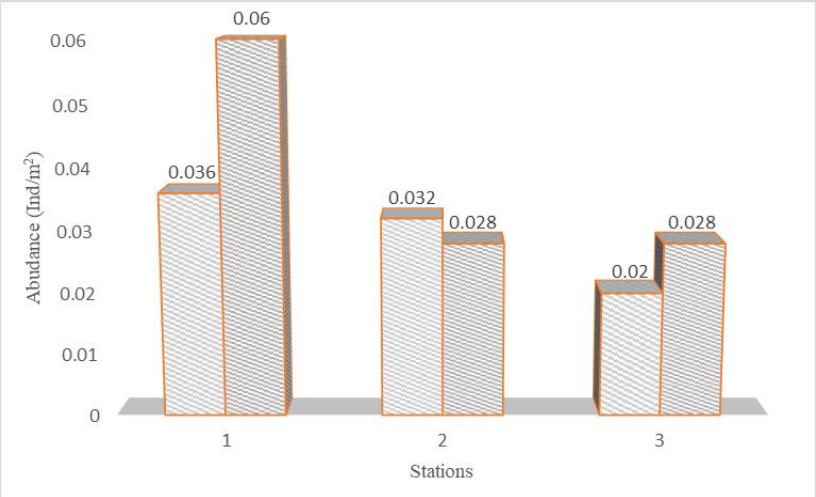


Figure 4. Abudance of Famili *Scaridae* in Tikus Island

The results showed that the highest abundance was found at station 1 Point 2 at 0.06 ind/m2, with fish dominating at this station Scarus quoyi species. The lowest was at station 3 point 5 at 0.02 ind/m2, with a general distribution of fish populations evenly distributed throughout the observation station. The abundance of fish from the Scaridae family is supported by eating habits to clean algae, thus helping the growth process of living hard corals. The Chlorurus genus in food tropics is an herbivorous fish with an excavator type that removes substrates by biting and plays a key role in bioerosion, while the Scarus genus is a scraper type that removes algae, sediments, and other materials by carefully cutting the substrate [17]. The high number of fish individuals from the Scaridae family at Station 3 point 5 is the high abundance, particularly the species Scarus quoyi and Colatomus carolinus (table 1), according to Tambunan [18], who stated that the presence of herbivorous fish in coral reef ecosystems plays an important role in maintaining coral communities by reducing competition with algae and enhancing coral recruitment survival.

3.2 Percentage of Live Coral Cover

Coral reef ecosystems are one of the potentials in Tikus Island. Tikus Island is surrounded by a vast expanse of coral reefs with sand and muddy sand sediment types. Coral reefs at each research location in the Tikus Island Waters of Bengkulu consist of hard coral, dead coral, algae, soft coral, and abiotic [19]. The condition of coral reefs at each research location was analyzed based on the percentage of live coral cover.

TABLE 2.
PERCENTAGE OF CORAL REEF COVER

No	Category habitat	Coral Cover (%)					
		Station I		Station II		Station III	
		1	2	3	4	5	6
1	Live corals	63,86	70,44	27,10	50,50	8,18	30,74
2	Other Biota	0,54	2,26	0,70	0,00	0,00	0,00
3	Dead corals	24,06	17,48	30,86	15,72	47,24	21,78
4	Algae	0,00	0,00	0,00	0,00	4,86	0,00
5	Abiotic	11,54	9,82	41,34	33,78	39,72	47,48
	Total	100,00	100,00	100,00	100,00	100,00	100,00

The results of this study illustrate that the highest percentage of live coral cover is at station I point 2 (70.44%) and the lowest at station III point 5 (8.18%) (Table 2). The coral reef ecosystem at station I is classified as good, ranging from 50 - 74.9%. Coral reef ecosystem at station II point 3 is classified as moderate with a 25.0 - 49.9% range. At station II point 4, the coral reef ecosystem is classified as good, ranging from 50.0 - 74.9%. At station III, point 6 is classified as moderate, with a range of 25.0 - 49.9%, according to the criteria for determining the condition of coral reefs based on [20]. The low human activity in the Station 1 area protects the coral reef ecosystem from damage so that it can be preserved.

The opposite condition occurs at station 3 point 5 with a low percentage (8.18%), so the ecosystem in this area is classified as poor because it is in the range of 0.0-24.9%. The percentage of dead coral cover at station II point 1 (24.06%), station I point 2 (17.48%), station II point 3 (30.86%), station II point 4 (15.72%), station III point 5 (47.24%) and station III point 6 (21.78%). The observation station data shows that the highest percentage of dead coral cover is at station III point 5 (47.24%) and the lowest at station I point 2 (17.48%). Damage to coral

reefs that occur cannot be separated from environmentally unfriendly fishing activities such as the use of chemicals, fish bombs [21], and illegal fishing [22].

3.3 Relationship of Coral Fish Abundance of the Scaridae Family Based on Live Coral Cover

The abundance of different fish at each station is thought to be caused by differences in the percentage of live coral cover, as the primary habitat for foraging influences the survival of reef fish. Research conducted by Isdianto [23], showed that the highest fish abundance was at stations with good coral reef conditions compared to stations with poor coral reef conditions. The results of the percentage of live coral cover with parrotfish abundance found from each point is Shown in Figure 5.

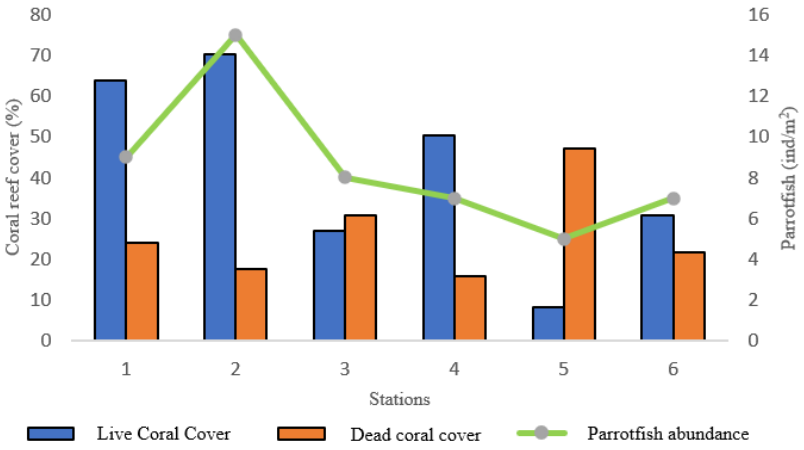


Figure 5. Percentage Coral Cover and Parrotfish Abundance.

The highest fish abundance was found at station I point 2 with a value of 15 ind/250m^2 with a percentage of coral cover of 70.44%. Moreover, the lowest fish abundance was found at station III point 5 with a value of 5 ind/250m^2 with a percentage of coral cover of 8.18%. It can be seen that when coral cover is high, the abundance of fish will also be high, and vice versa. The higher the percentage value of coral cover, the higher the presence of reef fish. When the coral cover is high, the abundance of fish will also be high, and the opposite [24].

The presence of reef fish in the waters highly depends on the reef's health, as indicated by the percentage of live coral cover. This is possible because parrotfishes live in association with the shape and type of reef as a place to live, protect, and find food. In addition to reef health, diverse reef conditions such as sandy, muddy, rocky areas, landforms, cliffs, and caves create ideal living niches for reef fishes [25].

The analysis results using simple linear regression obtained the regression equation Y = - 4.7324 + 1368.7x, where the dependent variable (Y) is the Scaridae abundance variable and the independent variable (X) is the coral reef cover variable. The coefficient value of Scaridae abundance is 1368.7. The coefficient of determination (R2) obtained is 0.6255 or 62.5 percent. The relationship pattern between the percentage of live coral cover and reef fish abundance in the form of a linear line is Shown in Figure 6.

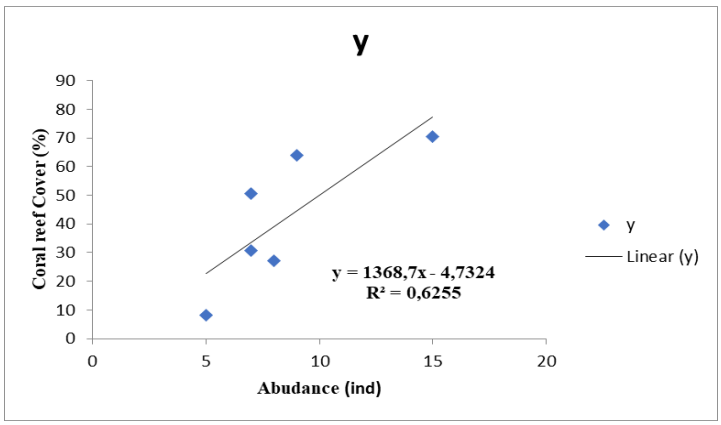


Figure 6. Relationship between Parrotfish Abundance and Coral Reef Cover.

The relationship is stated as none if the correlation coefficient value is 0%, there is a very weak relationship is 0-25%, a moderate relationship is 25-50%, a strong relationship is 50-75%, a powerful relationship is 75-99%, and perfect if 100%. From the results of the data analysis, information was obtained on the value of the correlation coefficient (R) of 0.62, which means that the abundance of old fish and the abundance of coral reefs on Tikus Island have a positive and relatively strong relationship. Kusuma [26], also obtained similar results

with a value of R= 0.61. Another study was conducted by Rosdianto [27] with a value of R = 0.7213. These results indicate that complexity and coral cover are interrelated with coral reef fish abundance

IV. CONCLUSION

This study concluded that Scarus quoyi and Colatomus carolinus are the most dominant species. The highest abundance is Station I (0.06 ind/m2), and the lowest is Station III (0.02 ind/m2). The abundance of the family Scaridae and coral reef cover on Tikus Island had strong correlates.

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