The abundance of herbivorous and coralivorous fishes during and after coral bleaching in Krueng Raya Waters, Aceh Besar District

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Abstract. This study aims to determine the community structure changes and to determine the abundance of herbivorous fish and coralivorous fish in Krueng Raya waters during and after the occurrence of coral bleaching. This research was conducted in three stages: June 2016, October 2016, and February 2017. There are 3 locations for data collection, including Benteng Inong Balee, Ahmad Rhang Manyang, and Lhok Mee in Mesjid Raya Sub-District, Aceh Besar District. Reef fish abundance data were collected at a depth of 3-6 meters using the visual census technique (VCT) - belt transect method. The study results show that there were six families, 17 genera, and 47 species belonging to the herbivorous and coralivorous fish groups. The most abundant family was the Chaetodontidae family, while the least fish family was the Kyphosidae family. The highest abundance of corallivorous fish was found at station 2 in October 2016, with a value of 509 ind/ha. The lowest was found at station 3 in October 2016, with a value of 182 ind/ha. The highest abundance of herbivorous fish was found at station 3 in February 2017, with a value of 498 ind/ha. The lowest was found at station 3 in October 2016, with a value of 150 ind/ha.

1 Introduction

Coral reefs are a typical ecosystem found in shallow tropical waters, with primary productivity and high diversity. An indication of good ecosystem health can be seen from the recovery level, namely the ability of the ecosystem to repair itself after experiencing damage [1]. One factor affecting the recovery rate of coral reef ecosystems is the availability of hard substrates as a place for coral larvae to attach [1,2]. Especially for coral reef ecosystems, the level of recovery of coral reef ecosystems is an essential indication of its management. This information is needed to assess the vulnerability of coral reefs to be managed and estimate the length of the ecosystem repair process, whether through restoration or rehabilitation [3,4].

Reef fish are essential resources in coral reef ecosystems and are the most abundant organisms in coral reef ecosystems. Therefore, reef fish have an essential role as a supporter of existing relationships in coral reef ecosystems. The existence of reef fish is strongly influenced by the condition and health of coral reefs, which can be assessed from the percentage of live coral cover [5]. The diversity of reef fish will decrease if coral reefs are damaged. [6], stated that of the estimated 12,000 marine fish species in the world, approximately 7,000 species (58.3%) are fish that live in coral reef areas.

Herbivorous and coralivorous fish can control the dynamics of macroalgae on coral reefs, which is one of the bioindicators of coral reef ecosystems during and after coral bleaching. Therefore, consider their important ecological and economic functions, herbivorous fish and reef fish are required to continuously monitor and assess their condition. Furthermore, monitoring these fish and their habitats must always be carried out correctly and appropriately. So that, appropriate conclusions can be drawn to take policies and strategic steps, especially for managers and other related stakeholders.

2 Research Methodology

2.1 Time and Place

This research was conducted in three stages: June 2016, October 2016, and February 2017. There are 3 locations for data collection: Benteng Inong Inong Balee, Ahmad Rhang Manyang, and Lhok Mee in Krueng Raya District, Aceh Besar District.

2.2 Research Methods

Reef fish data were collected at a depth of 3-6 meters using the visual census technique (VCT) - belt transect

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[7]. The observation area is 2.5 meters on the right and left along the transect for fish with a size above 10 cm, and 1 meter on the right and left along the transect for fish with a size below 10 cm. Identification of reef fish refers to the Reef Fish Identification Guide Book [5].

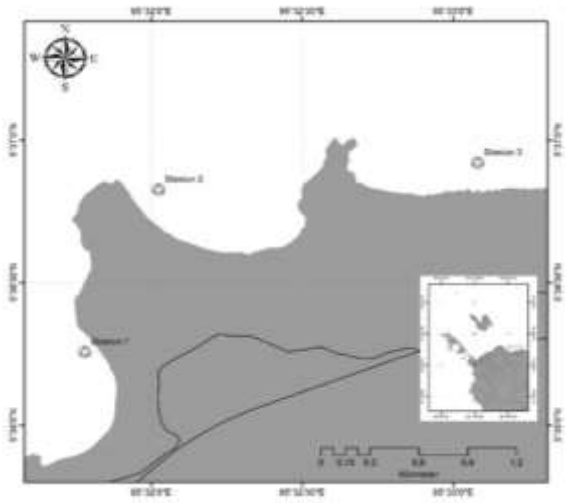

Fig. 1. Map of research location.

3 Results and Discussion

Based on the results of research that have been carried out, there are six families, 17 genera, and 47 species found to belong to the herbivorous and coralivorous fish groups (Appendix 1). The most commonly found family is the Chaetodontidae family, a family of the corallivorous fish group. Meanwhile, the fish family that was the least found was the Kyphosidae family, a herbivorous fish family. Only one family of fish was included in the corallivore category, namely Chaetodontidae. While five families of fish belonging to the herbivorous category were found, namely Acanthuridae Kyphosidae, Pomacanthidae, Scaridae, and Siganidae (Table 1).

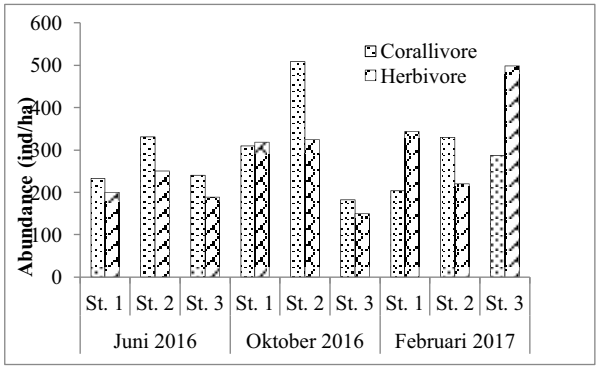

Fig. 2. The abundance of Coralivorous and Herbivorous Fish in Mesjid Raya Sub-District

The abundance value of fish shown in Table 1 shows that there are only two families of fish that are always found at each station and time of observation. The fish are from the Acanthuridae and Chaetodontidae families. The highest average fish abundance value came from the Chaetodontidae family, with 292 ind/ha values. In contrast, the lowest average fish abundance value came from the Kyphosidae family, which was 41 ind/ha. Other fish families also have different values, such as families Acanthuridae and Pomacentridae with values of 282 ind/ha and 270 ind/ha, while Scaridae and Siganidae only have an abundance of 89 ind/ha and 73 ind/ha, respectively. According to Madduppa [8], based on its role, fish from the family Acanthuridae are major fish whose habitat is in coral reef ecosystems and has schooling characteristics.

3.1 The abundance of Herbivorous and Coralivorous Fish

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The abundance of corallivorous and herbivorous showed a fairly varied value at each research location. The abundance of corallivorous fish species was most abundantly found at station 2 in October 2016, reaching 509 ind/ha. In contrast, the lowest abundance was found at station 3 in October 2016 with 182 ind/ha. The high abundance of corallivorous fish indicates that the condition of coral reefs at station 2 is quite good, around 50% - 74.9% [10]. While at Station 3, the condition of coral reefs is in the moderate category, which is around 25% - 49.9%. This condition shows that coral reefs have a very close relationship with biota and have an important role in their lives [11].

In addition, there was a natural phenomenon, namely the warming of sea surface temperatures in June which caused mass coral bleaching in several locations in the Aceh Besar area, including the research site [12]. Allen [13] stated that when environmental changes threaten coral reef ecosystems, fish with high mobility will tend to move to look for coral reef locations that are still good. At the same time, coral reefs cannot avoid threats that originate from coral reef's environmental changes.

The abundance of herbivorous fish had different numbers at each station, where the highest average number of fish was found at station 3 in February 2017 with a value of 498 ind/ha. In contrast, the lowest value was found at station 3, with an average abundance of herbivorous fish of 100 ind/ha. In general, it can be seen that the herbivorous fish abundance graph has the same model as the coralivorous fish abundance graph but has a different value. This condition indicates that the presence of herbivorous and corallivorous fish are related to each other. This is following the functional group where the number of individuals, types, and sizes of herbivorous fish play a crucial role in coral reef resilience, which functions as a controller of algae growth. The same is true for fish of the Coralivorous

group. There is a positive correlation between the functional groups of obligate coral indicator fish and the percentage of coral reef cover [12, 15,16,].

Overall, the most dominant herbivorous fish group came from the Acanthuridae family, with an average abundance value of 282 ind/ha. Acanthuridae is a major fish that lives in groups (schooling) with the primary habitat in coral reef ecosystems [18, 19].

4 Conclusion

Based on the research results conducted in the waters of Krueng Raya, Mesjid Raya District, Aceh Besar Regency, six families, 17 genera, and 47 species were found to belong to the herbivorous and coralivorous fish

Table 1. Number of families of coralivorous and herbivorous fish in Krueng Raya waters

No	Family	Group	June 2016			October 2016			February 2017			Number of individuals
			St. 1	St. 2	St. 3	St. 1	St. 2	St. 3	St. 1	St. 2	St. 3	
1	Acanthuridae	Herbivorous	195	271	164	300	410	100	358	220	521	282
2	Chaetodontidae	Coralivorous	233	331	240	310	509	182	203	330	287	292
3	Kyphosidae	Herbivorous	0	0	0	373	0	0	0	0	0	41
4	Pomacanthidae	Herbivorous	205	120	400	750	153	0	400	0	400	270
5	Scaridae	Herbivorous	0	0	0	184	0	200	160	0	80	69
6	Siganidae	Herbivorous	0	0	200	300	0	0	160	0	0	73
Number of individuals			106	120	167	369	179	80	214	92	215	171

groups. The highest abundance of corallivorous fish was found at station 2 in October 2016, with a value of 509 ind/ha. In contrast, the lowest abundance of corallivorous fish was found at station 3 in October 2016, with a value of 182 ind/ha. The highest abundance of herbivorous fish was found at station 3 in February 2017, with a value of 498 ind/ha. In contrast, the lowest abundance of herbivorous fish was found at station 3 in October 2016, with a value of 150 ind/ha.

Acknowledgement. The author is very grateful to the thesis supervisor, who has helped and reminded the author of mistakes. Furthermore, the Faculty of Marine Affairs and Fisheries staff, Syiah Kuala University, have helped. In addition, Ocean Diving Club has facilitated research and research teams with help and friends who have encouraged writing. The writing of this manuscript is supported by the Matching Fund – Kedaireka funded by the Ministry of Education, Culture, Research, and Technology Indonesia awarded to the Research Center for Marine Sciences and Fisheries, Universitas Syiah Kuala.

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