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Identification and inventory of reef fish abundance in West Simeulue MPA, Aceh, Indonesia

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Abstract. The marine protected area of the West Simeulu is one of the MPA that have been reserved by the Aceh Governor as a marine protected areas in 2018. Identification and inventory of reef fish abundance in the MPA West Simeulue can be used as an initial reference to see the effectiveness of this area, so that it can give changes to the West Simeulue MPA. This research was conducted in October 2019 with 9 observation locations. The method used was the under water visual census (UVC) at 2 in depths (shallow and deep). It was found that as many as 30 families with 13.107 individuals from 163 species were found in the West Simeulue MPA with reef fish abundance values of 1.069 ind/ha in the MPA and 906 ind/ha outside the MPA. Pomacentridae and Acanthuridae were the families with the highest number of individuals found, with value of 5.550 and 2.226 individuals, respectively.

1. Introduction

West Simeulue District is one of the sub-districts in Simeulue Regency with the capital of the District is Sibigo. The area of West Simeulue Sub-district reaches 446,07 km² with 4 settlements, consisting of 14 villages and 50 hamlets. West Simeulue is directly adjacent to the Indian Ocean to the north while in the west is Alafan District, in the south is Salang District and the east is Teluk Dalam District and Indian Ocean. In 2018 the Government of Aceh through the governor's decree Number 523/1297/2018 has reserved four Marine Protected Areas in Simeulue (69.053,78 Ha), including the Marine Protected Area of Simeulue Barat (8.233,99 Ha).

The MPA in West Simeulue to realize sustainable management of fish resources and its environment. The objectives of MPA can be achieved if MPA is well managed and provides benefits especially for fisheries. Marine Conservation areas (MCAs) or Marine protected Areas (MPAs) have direct ecological and economical benefits. According to [1] stated that conservation areas can have a positive effect on the state of the ecosystem as indicated by the large abundance of fishes and high diversity of fish species, ranged from small to large fishes in the Northwestern Mediterranean marine conservation area compared to the area was designated as MPA. Angulo [2] also explains that MPA provides direct benefits by contributing to the restoration of overfishing stocks, furthermore MPA is also an effective tool for fisheries management. The economic benefits of the MPA can be directly felt by the high level of sport fishing ecotourism carried out in MPA.



The complexity that exists in fishery activities in West Simeulue waters if it is not managed properly, then the possibility of overfishing either by recruitment or growth overfishing. Fishery activities like this can cause reef fish to be potentially extinct, where the high biodiversity in coral reef areas can cause high levels of fishing to occur in the area when compared to other ecosystems. Hence, it is important to identify and inventory the abundance of reef fish in the West Simeulue MPA.

2. Material and Methods

2.1. Location and Measurement of Specimens

The present study was conducted in the Simeulue Island, Simeulue Regency, West Simeulue District in October 2019. Data collection was carried out at several observation points covering 6 points in the West Simeulue MPA, namely Galakhala Island, Ujung Alawan, Tinggi Island, Malasin, Kecil Island and Raja Island. While 3 points were Open Access area namely Wasu Island, Sinar Bahagia, and Sanggiran, these three locations were control locations.

2.2. Analysis Data

Retrieval of reef fish data was in families level identified using the Indonesian marine reef fish identification book by Allen [3] and the number (abundance) using the belt transect census method (Belt Transect Census) through the underwater visual census (UVC) abundance of fish was recorded at 5 m x 50 m as many as 3 repetitions for fish size > 10 cm and at 2 m x 50 m as many as 3 repetitions for reef fishes size <10 cm.

The determination of the reef fishes abundance were carried out by using the visual census method. The abundance was calculated using the Odum [4]. The abundance value is then converted into ind/ha units, namely:

$$N = \left(\frac{100}{A} \right) \times ni$$

Where: N = Abundance of fish (ind / ha), ni = Number of individuals of type i, A = the area of observation

3. Results and Discussion

3.1. Composition of Reef Fish Family Based on Feeding Habits

The number of reef fish families found in the waters of West Simeulue was 30 families with value of 13.107 individuals from 163 species. The species with the highest number of individuals found in the West Simeulue waters was from the Pomacentridae family with a total of 5.550 individuals along the observation transect. The Pomacentridae family is a family of reef fish that has interesting characteristic features with a relatively small body shape, which only reaches 20 cm and has various body color patterns. These various body shapes and color variations make the Pomacentridae family fish a type of ornamental fish that is very popular with sea water ornamental fish lovers [5]. The Pomacentridae family is a reef fish that is easily recognized because it is often found in a high frequency of presence in coastal areas, especially in reef flat areas. In addition, this family is also included in the omnivorous group so that the existence of this fish family is mostly found in the waters of West Simeulue. Based on [6] the feeding habits of reef fishes can be categorized into 6 groups, namely: Omnivore, Benthic Inverts, Carnivore, Coralivore, Herbivores and Planktivore.

The number of individuals from the Acanthuridae family is the second largest number of individuals found after the Pomacentridae family. The number of individuals from the Acanthuridae family was 2.226 individuals. This family is one of the several families of reef fish that are included in the plant feeding (herbivore). The individuals numbers of the Acanthuridae family is height due to the high availability of algae as food sources in the waters of West Simeulue. In [7] recoded, the abundance of algae-eating fishes at several research locations on Pulau Weh Sabang after coral bleaching due to a positive relationship with the presence of algae, where the percentage of algae cover is increased of 20-

30% after experiencing coral bleaching which resulted in an increase too an abundance of algae-eating fish.

Table 1. Composition and number of individual reef fish based on their feeding habits

Grup/Famili	MPAs						Open Access			Total
	Galakhala Island	Ujung Alawa	Tinggi Island	Malasin	Kecil Island	Raja Island	Wasu Island	Sinar Bahagia	Sanggiran	
Benthic Inverts	87	84	119	89	58	7	110	73	115	742
Diodontidae	0	0	0	0	1	0	0	0	0	1
Labridae	65	50	91	64	34	1	84	51	104	544
Mullidae	4	4	3	1	2	4	1	0	1	20
Scorpaenidae	2	0	0	0	1	0	2	2	0	7
Zanclidae	16	30	25	24	20	2	23	20	10	170
Carnivore	77	83	77	53	20	7	33	117	52	519
Aulostomidae	0	1	0	3	2	0	0	0	0	6
Dasyatidae	0	0	0	0	1	0	0	0	0	1
Lethrinidae	0	10	0	1	0	5	0	0	0	16
Lutjanidae	5	24	8	11	0	1	2	20	20	91
Nemipteridae	21	44	31	37	16	0	28	78	27	282
Pempheridae	0	0	30	0	0	0	0	15	0	45
Serranidae	51	4	8	1	1	1	3	4	5	78
Corallivore	56	51	386	57	95	24	64	117	75	925
Chaetodontidae	56	51	386	57	95	24	64	117	75	925
Herbivore	248	633	429	286	212	7	272	157	371	2615
Acanthuridae	196	555	356	241	197	2	218	111	350	2226
Ehipidae	2	6	0	0	0	0	2	5	0	15
Pomacanthidae	18	7	38	19	9		33	28	8	160
Scaridae	32	65	33	21	6	5	19	13	13	207
Siganidae	0	0	2	5	0	0	0	0	0	7
Omnivore	685	388	1637	547	661	605	1031	576	1186	7316
Balistidae	490	11	542	0	278	1	304	15	20	1661
Holocentridae	0	0	66	3	17	0	4	3	10	103
Pomacentridae	193	377	1029	544	366	604	723	558	1156	5550
Tetraodontidae	2	0	0	0	0	0	0	0	0	2
Planktivore	125	81	59	13	243	128	211	82	1	943
Apogonidae	70	0	0	13	0	108	0	0	0	191
Caesionidae	55	80	58	0	243	20	206	80	0	742
Gobiidae	0	1	1	0	0	0	5	2	1	10

According to [8], herbivore groups play an important role in the resilience of coral reefs by limiting the presence and growth of macroalgae. This will create a balance condition in the coral reef ecosystem, then the presence of fish from other functional groups such as carnivores and coralivores can continue to exist.

3.2. Abundance of Reef Fish

The highest average of reef fish abundance were found at the Raja Island. Where the average value of reef fish abundance at this location were 1.511,6 ind/ha in both of them. At shallow depth, the abundance of reef fish reached 1.421,42 ind / ha and the depth reaches 1.546,66 ind/ha. Meanwhile, for Tinggi Island location, the abundance of reef fish at shallow depths was 1.729,05 ind/ha and the deep depth only reached 1.136,44 ind/ha with an average abundance was 1.320,11 ind/ha.

In general, the abundance of reef fish in the MPA West Simeulue was 1.069 ind/ha, while the abundance of reef fish outside the conservation area was not too different, namely 906 ind/ha. [9] found an abundance of reef fish in the conservation area of the east coast of Weh Sabang Island as much as 12.147 ind / ha and outside the conservation area as many as 8.075 ind/ha in 2013. The abundance of fishes were also recorded in the waters of the Krueng Raya Aceh Besar as much as 2710 ind / ha in 2013 and 313 ind/ha in 2016 [10] while in 2018 the waters of the Krueng Raya experienced an increase in the abundance offish, reaching 630 ind/ha [11, 12].

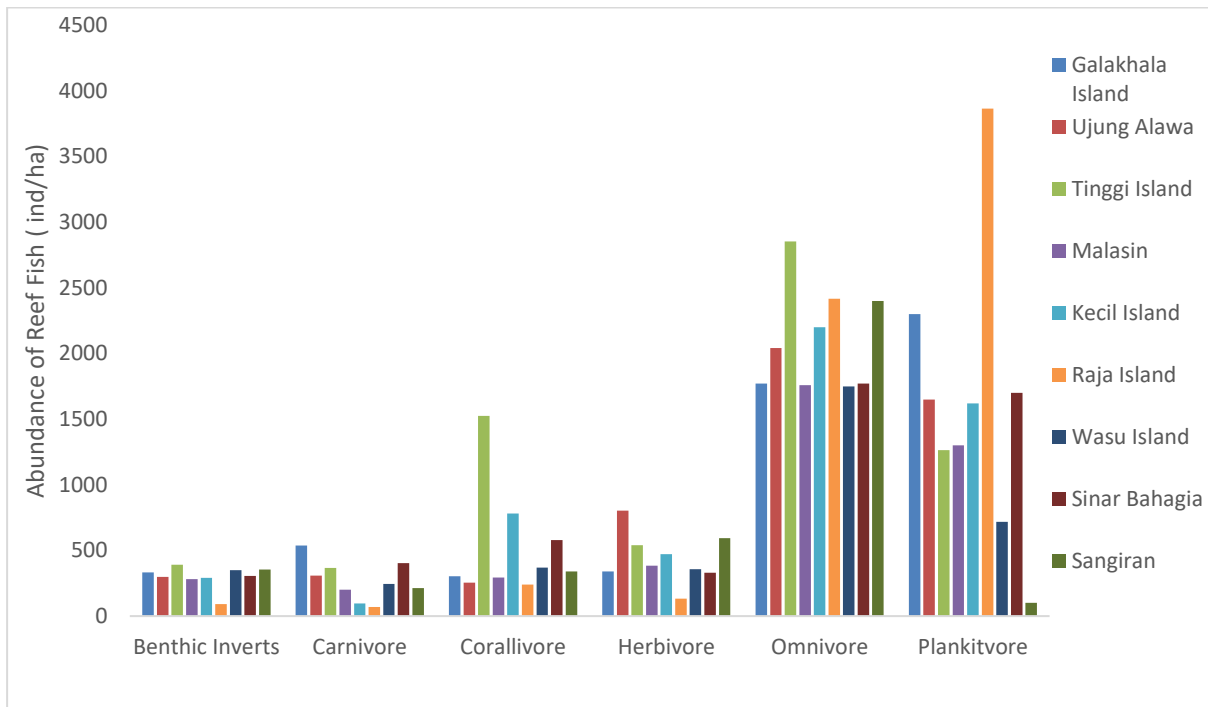


Figure 1. Abundance of reef fish based on feeding habits

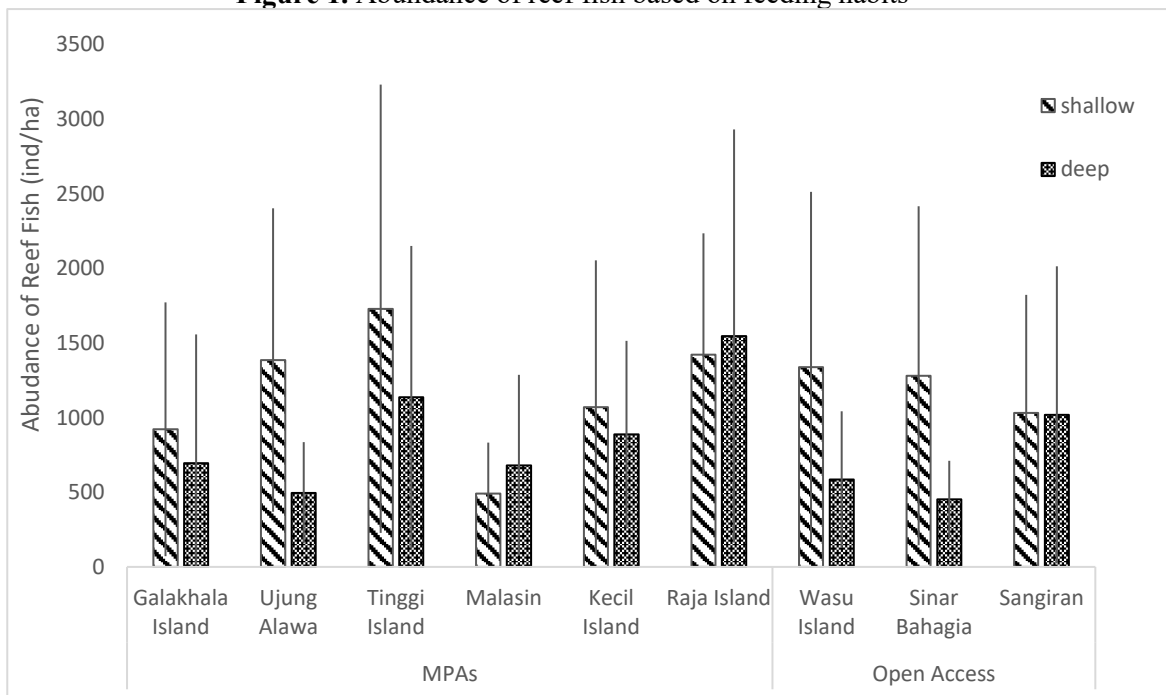


Figure 2. Abundance of reef fish in MPAs and open access (mean ± SE)

The high and low abundance value of reef fish in certain locations can be caused by several factors. These factors include complexity, habitat type, depth, distance to the beach, season and level of exploitation. The difference in abundance value obtained from the observation is influenced by environmental factors. Different aquatic environments will have different effects on reef fish communities [13]. Fish abundance is related to habitat characteristics, especially coral cover and

complex topographic characteristics [14]. This is supported by the existence of a complex arrangement of substrates that form various shelters for various fauna [15].

4. Conclusion

The results of observations in the West Simeulue MPA found that as many as 30 families with 163 species have been recorded and the number reached 13.107 individuals. The Pomacentridae and Acanthuridae were the families with the highest number of individuals found in this MPA. The results of the observations also showed that the abundance value of reef fish in the MPA was 1.069 ind / ha, while outside the MPA the abundance of reef fish reached 906 ind / ha.

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