

Trophic levels of reef fish community in Badul Island waters after Sunda Strait tsunami

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Abstract. The Sunda Strait tsunami in December 2018 damaged coral reef ecosystems in the Banten coastal area, including Badul Island waters. This condition potentially affects directly to the trophic level of the reef fish community. The purpose of this study was to determine the trophic level of the reef fish community in the waters of Badul Island after a tsunami. The research was conducted in April 2022 at four sampling stations (North, West, South and East) in the Badul Island waters. Reef fish survey using Underwater Visual Census with a 50 m line transect at a depth of 3 – 5 m. Reef fish identified during the study were grouped based on trophic level (carnivore, planktivore, omnivore, herbivore and corallivore). From this research identify 264 individu with 30 species from 17 Family of reef fish. Small waters area around Badul Island made possible reef fish from 4 sampling stations still in same population. The highest abundance of reef fish was found on the west side of Badul Island (128 ind/250 m²). Number species of reef fish founded the highest in East side with 14 species. The highest abundance of reef fish, based on trophic level, was approximately 74 ind/250 m² of carnivore fish on the western side of the island.

1 Introduction

Badul Island is a sandbank island with a beautiful coral reef ecosystem on Sunda Strait. However, the tsunami of December 2018 had a significant impact on the coral reef ecosystem. After the tsunami, the highest coral coverage in Badul Island waters was 24,71% [1]. Meanwhile, low coral coverage can influence marine organisms that live in the ecosystem, especially reef fish. Reef fish are distinguished based on trophic level and feeding habits in the food web, which include herbivorous, omnivorous, coralivorous, planktivorous, and carnivorous fish [2].

Reef fish is a fishery product that has high economic value [3] and has become an iconic attraction for snorkeling and diving tourism [4]. The high diversity of reef fish in coral reef ecosystems has become an interesting marine tourism object with high economic fisheries

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potency. The purpose of this research was to determine the abundance and trophic level composition of reef fish in Badul Island after the tsunami 2018. The trophic level of reef fish is an indicator for resilience capacity of the resilience capacity of coral reefs, especially herbivore fish, by diversity and abundance [5].

2 Method

The Badul Island reef fish community survey conducted in April 2022 at four observation locations represented the geographical wind direction (north, south, east, and west). Benthic coverage in each location has different conditions [1]. The north side has benthic characteristics of coral, macroalgae, rubble, sand, and rock. The benthic characteristics of the east side are sand, rock, and rubble. The south side has little difference from the east side, with the addition of a small coverage of life coral. The west side has the highest life coral coverage compared to the other sides. The observation locations are shown in **Fig. 1**.

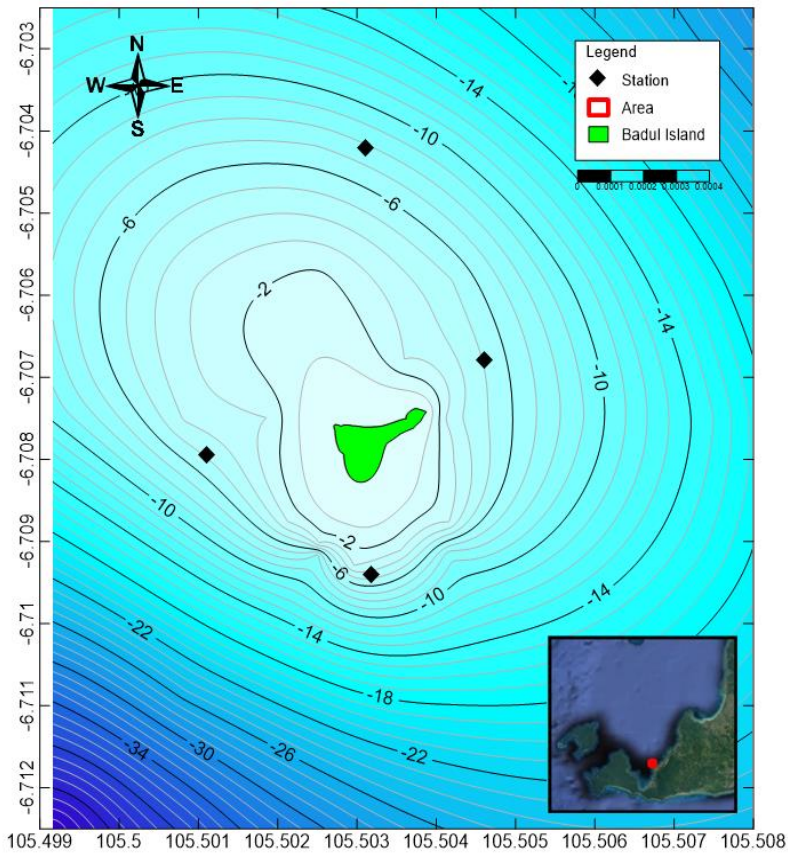


Fig 1. Observation location of reef fish around Badul Island waters, Banten Indonesia.

The Badul Island reef fish community was surveyed by using an underwater visual census. The census was conducted on a 50 m line transect parallel to the shoreline. Line transects were placed at water depths of 3 – 5 m. Reef fish in area around 2.5 m each (above, right and left) side of line transect observed using underwater camera (Canon G16 with housing). The camera recorded the video from the starting point of the line transect to the

end. In addition to the recorded video, the observer took a picture of the fish in the static position. Video and picture already taken from survey site analyzed visually to identify the species and trophic level of fish (Omnivore, Carnivore, Herbivore, Coralivore, and Planktivore) using [6] and from www.fishbase.com. Fish abundance estimation from video and picture divided the total abundance of fish, each species abundance of fish, and each trophic level abundance of fish. The abundance used units of individual number of fish per observation area ($50 \text{ m} \times (2 \times 2.5 \text{ m}) = 250 \text{ m}^2$). Some oceanographic parameters were measured in terms of sea surface temperature, pH, salinity, water brightness, velocity, and direction of currents.

3 Result and discussion

The oceanographic parameters measured at the four observation locations were not significantly different. Sea surface temperature ranges between $30 \text{ }^\circ\text{C}$ and 31°C ; this condition normally occurs at location because in a previous study [7-8] in the same month from the previous year showed the same range value of sea surface temperature. Value of pH in location ranging between 7.8- 8.5, from [9] average pH value in Sunda Strait is 8.25 this condition influenced by lower value of dissolve inorganic carbon (DIC). Salinity in location existing between 31-32 PSU, [9] mentioned that the salinity value in the Sunda Strait between 28-34 PSU depends on the location influenced by runoff from the river and water mass from the Java Sea. The water brightness at location is in the optimal condition, and the bottom of the water is clearly seen from the surface. This condition same with previous study [10]. The ocean current of Badul waters has a velocity around $0.03 - 0.05 \text{ m/s}$ and flows in the southeast direction. Current velocity and direction in the Sunda Strait are influenced by certain factors, such as tides, wind, and water depth [11].

From the survey, we identified 264 individual reef fishes. The highest abundance of reef fish was found on the west side of the island at $128 \text{ ind}/250 \text{ m}^2$. The lowest abundance on the north side was $10 \text{ ind}/250 \text{ m}^2$. The abundance of reef fish around Badul Island is shown in **Fig. 2**.

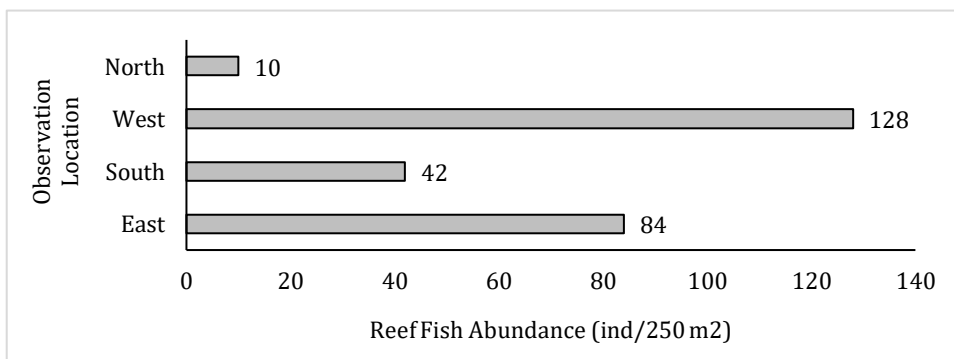


Fig 2. Abundance of reef fish around Badul Island waters.

The abundance of reef fish in Badul Island after the tsunami was lower than that before the tsunami, [12] founded that the lowest reef fish abundance in Badul Island was around $250 \text{ ind}/250 \text{ m}^2$. In this study, the highest reef fish abundance was $128 \text{ ind}/250 \text{ m}^2$. This condition was also observed in Japan after the tsunami 2011, coastal fish abundance decreased in the first year after the tsunami and increased over time, but fluctuated each month [13]. This condition is also potentially influenced by decreasing coral coverage on Badul Island after the tsunami [1]. This is because coral conditions influence reef fish abundance and species richness [14].

In this study, we found 29 species of reef fish from 15 families: Acanthuridae (two species), Blenniidae (one species), Carangidae (one species), Chaetodontidae (three species), Haemulidae (one species), Labridae (three species), Leiognathidae (1 species), Lethrinidae (1 species), Lutjanidae (1 species), Mullidae (1 species), Nemipteridae (1 species), Pomacentridae (7 species), Pseudochromidae (1 species), Scaridae (4 species), and Zanclidae (1 species). The species richness around Badul Island is shown in **Fig. 3**.

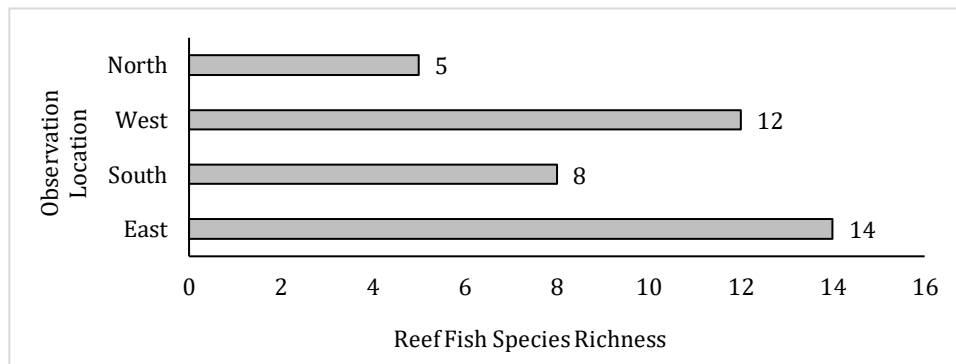


Fig. 3. Species richness of reef fish around Badul Island waters.

Fig. 3 shows that the highest species richness around Badul Island was 14 species on the east side and the lowest was 5 species on the north side. Before the tsunami, reef fish species richness on Badul Island was approximately 40 species on one side [12]. Coral damage to Badul Island has allegedly influenced species richness. This condition also occurred in Costa Rica, where reef fish species richness decreased spatially and temporally following coral damage [15].

Sequentially, the highest reef fish species found on Badul Island were *Pinjalo pinjalo*, *Selaroides leptolepis*, and *Chlorurus bleekeri*. The reef fish species *P. pinjalo* and *S. leptolepis* can be classified as target fish because both species have economic value and are often found in fish markets in several countries [16 – 19]. *C. bleekeri* is an indicator species because it has a role as an herbivorous species in coral reef ecosystems and is also a fishing target species in several locations [20].

Based on the trophic level, reef fish are classified as omnivores, herbivores, coralivores, carnivores, and planktivores. This class represents the trophic level in the food web of coral reef ecosystems. The abundance of reef fish based on trophic level in Badul Island waters is shown in **Fig. 4**.

As shown in **Fig. 4**, the highest reef fish abundance based on trophic level was that of carnivorous reef fish. Carnivorous reef fish play an important role in coral reef ecosystems to maintain species diversity at lower trophic levels. The presence of carnivorous reef fish in coral reef ecosystems is far from coastal (not fringing reef) higher than fringing reef [21]. The second highest abundance was observed in the omnivorous reef fish. The trophic level of reef fish plays an important role in increasing the resilience of coral reef ecosystem [22].

Before the tsunami, the reef fish condition in Badul Island waters by [12] mentioned that the highest abundance of trophic level reef fish was planktivorous on the north side and herbivorous on the south side. The shifting of trophic level reef fish abundance is influenced by coral reefs or benthic conditions, presence of prey, and oceanographic parameters [12, 21, 22, 23].

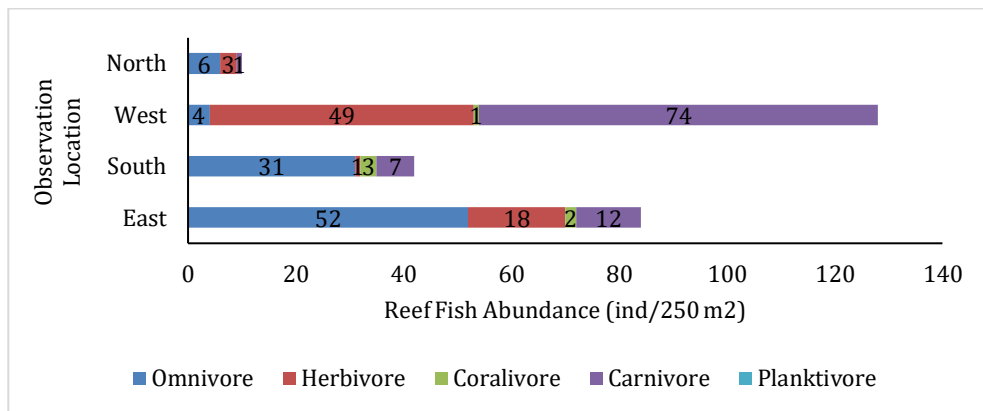


Fig 4. Abundance of reef fish based on trophic level around Badul Island waters.

4 Conclusion

The highest reef fish abundance on Badul Island after Tsunami was 128 ind/m². Based on trophic level, the composition of reef fish sequentially from the highest is carnivores, omnivores, herbivores, and coralivore fish.

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