Inventorization of reef fish on Tabuhan Island, Banyuwangi, East Java, Indonesia

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Abstract. Tabuhan Island is one of the underwater tourist destinations in Banyuwangi, East Java Indonesia, with beautiful coral reefs and reef fish. The increase of tourism activities has an impact on the decline of the coral reef ecosystems. This condition will affect the abundance of reef fish. This study aimed to determine the abundance of reef fish in the conservation of Tabuhan Island. The study was conducted in November 2017. The determination of the location used purposive sampling through the Intercept Line Transect (ILT) method, while the observation of the reef fish was conducted using a visual census. The total of the individual reef fish that had been found was gathered from three observation stations, totaling 1,037 individuals, consisting of 21 species from 6 families. Family Apogonidae dominated as many as 49%, Pomacentridae 42%, Labridae 4%, Mulidae and Balistidae 2% and Lutjanidae 1%. Shannon’s diversity index ($H'$) was 2.32, the Equitability index ($E'$) was 0.34 and the dominance index ($C'$) was 0.14. The level of diversity of the reef fish in the waters of Tabuhan Island was moderate with low uniformity and dominance categories.

1. Introduction
Banyuwangi is one of the districts in East Java Indonesia with a coastal area of 175.8 Km. Tabuhan islands is located in Wongsorejo District with an area of 5.33 Ha. This area was used for ecotourism (snorkeling, diving and gathering), traditional fishing and catching ornamental marine fish. Coral reefs are ecosystems that play an important role for marine organisms, as a nursery ground, feeding ground and spawning ground for reef fish and crustaceans [1]. The sustainability of coral reef ecosystems depends on environmental management, such as coastal development and the use of marine resources [2]. Coral reefs are organisms that are sensitive to environmental changes. Furthermore, anthropogenic pressure is the biggest factor causing a decrease in coral cover [3]. According to the results of the study [4], the amount of coral reef cover around Tabuhan Island (Bangsring waters) is 38.33%; the condition of the coral reef cover with these percentages is classified as medium according to [5]. Coral reefs cover will affect the abundance and diversity of reef fish and other organisms. Based on these conditions, there needs to be monitoring of the fish reef fish conducted, as the initial information for the management of the region.

2. Material and methods
2.1. Study area
This study was located on and around Tabuhan Island, Banyuwangi regency, East Java, Indonesia. Tabuhan Island is one of the ten islands in Banyuwangi district. It is an uninhabited island with an area ± 5.33 Ha [4], located on the Bali straits (Figure 1). This island was formerly an area for catching
reef fish and mining coral reefs, but it is now an ecotourism area. The seabed of this island is composed of sand and coral reefs, with the sloping topography of the coast between 3 - 6 meters 200 meters from the shoreline, with the perimeter of the area being the deep sea.

2.2. Data collection and analysis
This research was conducted between August and November 2017 on Tabuhan Island. The determination of the sample stations in this study was done using the purposive sampling method. The method used to make a decision on the sampling stations was the Intercept Line Transect and Reef resources assessment [5]. Station A (8° 2'13.83"S, 114°27'37.65"E) was near to the landing of a local ship, and Station B (8° 27.24"S, 114°27'40.54"E) and Station C (8°28.22"S, 114°27'36.46"E) were snorkeling and diving sites. The assessment of the population of the reef fish was done through the visual census method [7]. The registrar swam 10 meters in a width equal on the right side and left of the observation (5 meters) with an observation time of 5 - 10 minutes for each station. The transect line was drawn parallel to the coastline for 50 meters. The documentation of the reef fish at each station was carried out at a depth between 2 - 5 meters. The equipment used included a mask, swimming fin, noteboard, and Go pro Hero 5 as the underwater documentary film. The results of the census of the identification of reef fish was supported using an identification book by [8]. The whole fish that were found were then grouped into classes, such as the classes of Balistidae and Lutjanidae.

Furthermore, the results from monitoring the reef fish undetermined the value of the reef fish diversity (H'), uniformity index (C') and dominance index (D') on the basis of the calculation according to [9]. The water quality parameters conducted in this study consisted of temperature, salinity, pH, brightness, dissolved oxygen, ammonia (NO₂), nitrate (NO₃) and phosphate (PO₄), which was analyzed in the laboratory according to [10].

3. Result and discussion
3.1. Water quality measurement
Based on the measurement results, the quality of the water in Tabuhan is in the good category, as the water parameter value was still in accordance with the quality standards. This is influenced by the high dilution rate, in which the waters are open areas with strong currents of more than 0.5 ms⁻¹. Besides that, the level of pollution from chemicals is low. This is evidenced by the ammonia content being below 0.1 mg l⁻¹ (Table 1). The parameters that indicate that the waters are still good, such as pH, salinity, temperature, brightness and dissolved oxygen, are still in the optimum category.
Table 1. Water quality measurements.

| Parameter      | Unit   | Value      | Standard |
|----------------|--------|------------|----------|
| Temperature    | °C     | 29 – 30    | 18 – 30  |
| Brightness     | Cm     | 125        | + 200    |
| Current velocity| Ms⁻¹  | 0.2 – 0.9  |          |
| Salinity       | grl⁻¹  | 34         | 33 – 34  |
| pH             | -      | 8          | 7 – 8.5  |
| DO             | mg l⁻¹ | 8.6        | 4        |
| Nitrate        | mg l⁻¹ | 0.2        | 0.35     |
| Phosphate      | mg l⁻¹ | 0.01       | 0.10     |
| Ammonia        | mg l⁻¹ | -          | 0.01     |

3.2. Composition of the reef fish

Table 2. The composition of the reef fish found at the observation stations.

| No | Family       | Species                              | Station | Total |
|----|--------------|--------------------------------------|---------|-------|
| 1  | Labridae     | Cheilinus trilobatus                 | A 2     | B 7   | C 12  | 21    |
|    |              | Epibulus insidiator                  |         |       |       |       |
|    |              | Coris batuensis                      |         |       |       |       |
| 2  | Lutjanidae   | Lutjanus monostigma                 | A 1     | B 1   | C 7   | 9     |
| 3  | Mulidae      | Parupeneus trifasciatus              |         |       |       |       |
|    |              | Parupeneus cyclostomus               |         |       |       |       |
|    |              | Parupeneus macronema                 | A 1     | B 1   | C 5   | 7     |
| 4  | Apogonidae   | Apogon selei                         | A 6     | B 18  | C 100 | 124   |
|    |              | Cheilodipterus isostigmus            | A 4     | B 23  | C 64  | 91    |
|    |              | Apogon cyanosoma                     | A 41    | B 74  | C 25  | 140   |
|    |              | Sphaeramia nematoptera               |         |       |       |       |
| 5  | Balistidae   | Rhinecanthus aculeatus               |         |       |       |       |
|    |              | Rhinecanthus verrucosus              |         |       |       |       |
|    |              | Balistidae undulates                 |         |       |       |       |
| 6  | Pomacentridae| Dascylus trimaculatus                | A 1     | B 3   | C 13  | 17    |
|    |              | Abudefduf sexfasciatus               | A 6     | B 12  | C 22  | 40    |
|    |              | Abudefduf septemfasciatus            |         |       |       |       |
|    |              | Abudefduf vaigiensis                 |         |       |       |       |
|    |              | Chromis atripectoralis               | A 2     | B 4   | C 23  | 29    |
|    |              | Amphiprion bicinctus                 |         |       |       |       |
3.3. Abundance of the reef fish

The results of the research conducted on Tabuhan Island, Banyuwangi Regency, showed the reef fish species found at the three observation stations. The observations found there to be 21 species from 6 families (Table 2), and the composition of all species consisted of 49% Apogoniidae, 42% Pomacentridae, 4% Labridae, 2% Mulidae and Balistidae, and 1% Lutjanidae (Figure 2).

**Figure 2.** Composition of reef fish.

|                     | 1   | 1   | 4   | 6   | Total |
|---------------------|-----|-----|-----|-----|-------|
| Dascyllus aruanus   |     |     |     |     | 6     |
| Chrysiptera springeri | 98  | 4   | 21  | 123 | 667   |

3.4. Domination of species / family

The abundance of reef fish at all of the observation stations was 667 individuals total, with the highest fish abundance being at station C with 344 individuals from 20 species. The station with the lowest reef fish density was at station B with a total of 152 individuals from 18 species. However, the lowest number of species was found at station A with the number of individuals being 161 out of 11 species (Figure 3). Station A was an area with low abundance and the lowest number of species from all stations; this is due to the fact that this area is a local ship landing area. The level of damage to the coral reefs at this station therefore affects fish abundance.

The high density of the reef fish at each station is dominated by *apogon seleii* sp from the family of Apogoniidae. This species is a carnivorous fish with a maximum length of 8-10 cm with their preferred reef habitat being around seagrass or seaweed. The abundance of reef fish is influenced by the cover and health of the coral reefs as a place to find food, breed and take refuge. According to [11], the presence and diversity of the reef fish is determined by the condition of the coral reefs; the higher the coral cover, the more coral fishes are found.
3.5. Biodiversity index
The index of diversity (H') of the reef fish in the waters of Tabuhan Island was 2.32. According to [9], the value of diversity 1 ≤ H ≤ 3 includes the medium category, the stability of the medium community and the spread of medium species. Based on the value of H' in Tabuhan waters, it could be interpreted that the diversity of fish was in the medium category. The coral fish uniformity index (E) was 0.34; this indicates that the reef fish community is in a depressed state and that it has low uniformity value. According to [9], fish uniformity values (E') between 0 - 0.4 show low uniformity and stressed communities. Furthermore, the value of the dominance index (C') of the reef fish was 0.14; this value is a low representation of species dominance against other species.

4. Conclusion
Six coral fish families were found on Tabuhan islands in the monitoring period, with the largest families being of *apogonidae* and *pomacentridae*. The condition of the diversity index (H') in Tabuhan Island was 2.32, or the moderate category, the uniformity index (E) 0.34 or pressured community was poor and the dominance index (C) was 0.14. or in the low domination category.

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