The composition and abundance of reef fish (Family Chaetodontidae) in Aceh Besar Waters, Aceh, Indonesia

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Abstract. The objective of the present study was to study the composition and abundance of reef fish (Family Chaetodontidae) in coral reef area in Aceh Besar waters. This research was conducted in September 2012 until February 2013. The study was conducted in eight locations in the waters of Aceh Besar district: Amat Ramanyang, LhokKetapang, PulauDituan, Lampuuk, LhokSeudu, Leupung, Pulo Aceh and Lamteng. The fish was recorded using Visual Census Method in two different depth (3-4 m and 6-8m) with three replication in each depth. The result found eight species of fish in 3-4 m depth and 11 species in 6-8 m depth. The total individuals of fish that was found were 83 individuals in 3-4 m deep and 117 individuals in 6-8 m depth. The diversity index in 3-4 m depth ranged 0.3 to 1.1 where this value included in low to medium category and 6-8 m depth ranged 0.3 to 1.6 where this value included in low to medium category.

1. Introduction
Aceh Besar district (located on 5.2° - 5.8° N and 95.0° - 95.8° E) is endowed by plentiful natural resources including coral reefs. Coral reefs are very diverse and productive ecosystem [1-3]. Coral reefs ecosystem provide food, protection and spawning ground for many marine fish and organisms [4]. The coral reefs in Aceh Besar waters are generally in moderate conditions (in average with the percentage of coral cover more than 45%) and were dominated by Acropora branching and massive corals [5]. However, the coral reefs in this region were threatened both by natural and anthropogenic factors. One of the main factors damaged the coral reefs in this region was destructive fishing [5, 6].

One group of organisms that closely related with coral reefs is butterflyfishes (Chaetodontidae). Chaetodontidae family consist of at least 114 species belong to 10 genera, worldwide [7]. Chaetodontidae family is among the well studied fish family globally due to their ecological and commercial value. A number of studies were done especially related to their feeding behavior [8-10]. Chaetodontidae are corallivoryfish both as obligate or facultative corallivores[10] and most species preferentially consuming corals of the genus Acropora and Pocillopora[11]. In addition, the existing of Chaetodontidae in a reef region can be used as indicators of the health of the coral reef ecosystem. An area with high coral cover is very likely to be occupied by more Chaetodontidae compared to
regions with lower coral cover [12]. However, Limited information on Chaetodontidae in Aceh Besar district were available. Hence, the objective of the present study was establishing a baseline data on Chaetodontidae in Aceh Besar to support marine protected areas in Aceh Besar district.

2. Materials and Method

This study was conducted from September 2012 to February 2013. The study was conducted in eight locations in Aceh Besar waters, namely: Amat Ramanyang, Lampuuk, Pulau Dituan, Lhok Ketapang, Lhok Seuduh 1, Lhok Seuduh 2, Deudap 1, Deudap 2, and Lamteung (Figure 1). The fish was recorded using Visual Census Method in two different depth (3-4 m and 6-8m) with three replication in each depth[13]. The fishes were identified and recorded based on [14] and [15].

Abundance of the fishes was calculated using the formula as follows[16]:

\[
D = \frac{n_i}{A}
\]

Where, \(D\) is abundance of the fishes (individuals/m\(^2\)); \(n_i\) is the number of individual each species (ind), \(A\) is sampling area (m\(^2\)).

The diversity index (H\(^\prime\)) was calculated using the formula as follows[16]:

\[
H' = - \sum P_i \ln P_i
\]

Where, H\(^\prime\) is diversity index, \(P_i\) is the proportion of individuals in the \(i^{th}\) species. H\(^\prime\) was used to indicate the diversity of fauna at different sampling sites.

**Figure 1.** Map of the study sites in the district of Aceh (1. Amat Ramanyang 2. Pulau Dituan 3. Lhok Keutapang 4. Deudap 5. Lamteng 6. Lampuuk 7. Leupung 8. Lhok Seudu).
3. Results and Discussion

In total, eight species of Chaetodontidae were recorded in 3-4 m depth and 11 species in 6-8 m depth. The total individuals of fish found were 83 individuals in 3-4 m depth and 117 individuals in 6-8 m depth (Table 1-2). In 3-4 m depth, *Chaetodon vagabundus* was found in all study sites with 26 individuals. This species was spread throughout the waters due to its interest in coral polyps. This species is able to adapt to clear water conditions and turbid waters [17]. While the *Chaetodon punctatofasciatus* and *Chaetodon collare* were only two species found only in one location. *Chaetodon punctatofasciatus* was only found in Pulo Dituan and *Chaetodon collare* was only found in Lhok Seudu. *Chaetodon trifasciatus* was found in 3 sites (Lhok Keutapang, Pulo Dituan and Leupung) with a total of 7 individuals. *Chaetodon ulietensis* was also found in 3 locations in Aceh Besar (Lampuuk, Pulo Aceh, and Lamteng) with the number of individuals found as many as 8 individuals. Similarly to 3-4 m depth, *Chaetodon vagabundus* and *Chaetodon trifasciatus* were the two Chaetodontidae species found in most study sites in 6-8 m.

| Table 1. List of Chaetodontidae found in Aceh Besar (3-4 m) |
| No. | Spesies | Sites 1 | Sites 2 | Sites 3 | Sites 4 | Sites 5 | Sites 6 | Sites 7 | Sites 8 | Total ind |
|-----|---------|--------|--------|--------|--------|--------|--------|--------|--------|----------|
| 1   | *Chaetodon vagabundus* | + | + | + | + | + | + | + | + | 26 |
| 2   | *Chaetodon trifasciatus* | - | + | - | - | + | - | - | - | 7 |
| 3   | *Chaetodon ulietensis* | - | - | - | - | + | - | + | + | 8 |
| 4   | *Chaetodon collare* | - | - | + | - | + | - | - | - | 3 |
| 5   | *Chaetodon ulietensis* | - | - | - | + | - | - | - | - | 4 |
| 6   | *Chaetodon moyleri* | - | - | - | - | + | - | - | - | 6 |
| 7   | *Chaetodon punctatofasciatus* | - | - | + | - | - | - | - | - | 23 |
| 8   | *Chaetodon xanthurus* | + | - | - | - | - | - | - | + | 6 |
| Total |         |        |        |        |        |        |        |        |        | 83 |

Note: (+) = found, (-) = not found. 1= Amat Ramanyang; 2= Lhok Keutapang; 3= Pulo Dituan; 4= Lampuuk; 5= Lhok Seudu; 6= Leupung; 7= Pulo Aceh; 8= Lamteng.

The highest abundance of Chaetodon fish at a depth of 3-4 meters was found in Pulo Dituan (0.093 ind/m²). While the lowest value was obtained in the Lampuuk with an abundance value 0.007 ind/m². At a depth of 6-8 meters, the highest abundance value was obtained in Lhok Keutapang waters with an abundance value of 0.083 ind/m², and the lowest value of abundance obtained in Lampuuk (0.010 ind/m²) (Table 3). Lhok Keutapang and Pulo Dituan had higher coral cover percentage in Aceh Besar (59.49% and 54.86%, respectively)[5]. As Chaetodontidae are reef-associated fishes, this observation was expected since they easily found in these areas. In contrast, Lampuuk had lower coral cover percentage (33.93%)[5]. In their study, [18] reported the depletion of coral cover in Australia was responsible to the decline of Chaetodontidae abundance.

| Table 2. List of Chaetodontidae found in Aceh Besar (6-8 m) |
| No. | Spesies | Sites 1 | Sites 2 | Sites 3 | Sites 4 | Sites 5 | Sites 6 | Sites 7 | Sites 8 | Ind |
|-----|---------|--------|--------|--------|--------|--------|--------|--------|--------|-----|
| 1   | *Chaetodon vagabundus* | + | + | + | + | + | + | + | + | 27 |
| 2   | *Chaetodon trifasciatus* | - | + | - | + | + | + | + | + | 19 |
| 3   | *Chaetodon ulietensis* | - | + | - | - | + | - | - | - | 18 |
| 4   | *Chaetodon lunulatus* | - | - | - | + | - | - | - | - | 10 |
| 5   | *Chaetodon collare* | - | - | - | + | - | + | - | - | 6 |
| 6   | *Chaetodon xanthurus* | - | - | - | - | + | - | - | - | 6 |
| 7   | *Chaetodon moyleri* | - | - | - | - | - | - | - | - | 1 |

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The diversity index in 3-4 m depth ranged 0.3 to 1.1 (low to medium category) and 6-8 m depth ranged 0.3 to 1.6 (low to medium category). The diversity index is a value that describes the stability of the community in an ecosystem. If the observed diversity index is high, the number of species in these waters is diverse. In contrarily, but if the diversity value is low, the species in the waters are few or not diverse.

Table 3. The diversity index and abundance of Chaetodontidae in Aceh Besar.

| Sites            | H’          | Abundance (ind/m²) |
|------------------|-------------|-------------------|
|                  | 3-4 m 6-8 m | 3-4 m 6-8 m       |
| Amat Ramanyang   | 0.637 1.089 | 0.010 0.033       |
| Lhok Keutapang   | 1.011 0.826 | 0.020 0.083       |
| Pulo Dituan      | 0.550 1.005 | 0.093 0.037       |
| Lampuuk          | 0.693 0.993 | 0.007 0.010       |
| Lhok Seudu       | 0.358 0.347 | 0.023 0.040       |
| Leupung          | 1.157 1.292 | 0.053 0.060       |
| Pulo Aceh        | 0.849 1.633 | 0.030 0.080       |
| Lamteng          | 0.549 0.562 | 0.037 0.013       |

4. Conclusions
In total, eight species of Chaetodontidae recorded in 3-4 m depth and 11 species in 6-8 m depth. *Chaetodon vagabundus* and *Chaetodon trifasciatus* were the common Chaetodontidae fish found in Aceh Besar. The present study provide the baseline data on Chaetodontidae in Aceh Besar to support marine protected areas in Aceh Besar district.

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References
[1] Burke L, Reytar K, Spalding M and Perry A 2011 *Reefs at risk revisited*: World Resources Institute (WRI), Washington D.C.
[2] Hughes T P, Bellwood D R and Connolly S R 2002 Biodiversity hotspots, centres of endemism, and the conservation of coral reefs *Ecology Letters* 5 775-84
[3] Hughes T P, Baird A H, Bellwood D R, Card M, Connolly S R, Folke C, Grosberg R, Hoegh-Guldberg O, Jackson J B C, Kleypas J, Lough J M, Marshall P, Nyström M, Palumbi S R, Pandolfi J M, Rosen B and Roughgarden J 2003 Climate change, human impacts, and the resilience of coral reefs *Science* 301 929-33
[4] Buddemeier R W, Kleypas J A and Aronson R B 2004 Coral reefs & global climate change. Potential contributions of climate change to stresses on coral reef ecosystems. (USA, 56 pp: Pew Center on Global Climate Change, Arlington)
[5] Fadli N, Muchlisin Z A, Affan M and Rahimi S 2014 The status of coral reefs in Aceh Besar district, Aceh Province, Indonesia AACL Bioflux 7 365-71
[6] Baird A H, Campbell S J, Anggoro A W, Ardiwijaya R L, Fadli N, Herdiana Y, Kartawijaya T, Mahyiddin D, Mukminin A, Pardede S T, Pratchett M S, Rudi E and Siregar A M 2005 Acehnese Reefs in the Wake of the Asian Tsunami Current Biology 15 1926-30
[7] Fessler J L and Westneat M W 2007 Molecular phylogenetics of the butterflyfishes (Chaetodontidae): Taxonomy and biogeography of a global coral reef fish family Molecular Phylogenetics and Evolution 45 50-68
[8] Gregson M A, Pratchett M S, Berumen M L and Goodman B A 2008 Relationships between butterflyfish (Chaetodontidae) feeding rates and coral consumption on the Great Barrier Reef Coral Reefs 27 583-91
[9] Berumen M L and Pratchett M S 2008 Trade-offs associated with dietary specialization in corallivorous butterflyfishes (Chaetodontidae: Chaetodon) Behavioral Ecology and Sociobiology 62 989-94
[10] Sano M 1989 The butterflyfishes: success on the coral reef, ed P J Motta (Dordrecht: Springer Netherlands) pp 195-204
[11] Cole A J, Pratchett M S and Jones G P 2008 Diversity and functional importance of coral-feeding fishes on tropical coral reefs Fish and Fisheries 9 286-307
[12] Bouchon-Navaro Y and Bouchon C 1989 Correlations between chaetodontid fishes and coral communities of the Gulf of Aqaba (Red Sea) Environmental Biology of Fishes 25 47-60
[13] English S, Wilkinson C and Baker V 1997 Survey manual for tropical marine science: Australian Institute of Marine Science, Townsville. 309 pp
[14] Allen G R and Adrim M 2003 Coral reef fishes of Indonesia Zoological Studies 42 1-72
[15] Kuiter R H 1992 Tropical reef-fishes of the Western Pacific: Indonesia and adjacent waters (Jakarta: Penerbit PT Gramedia Pustaka Utama)
[16] Krebs C J and Krebs C 1994 Ecology: the experimental analysis of distribution and abundance vol 4: HarperCollins College Publishers New York
[17] Myers R F 1999 Micronesian reef fishes: Coral Graphics
[18] Pratchett M S, Wilson S K and Baird A H 2006 Declines in the abundance of Chaetodon butterflyfishes following extensive coral depletion Journal of Fish Biology 69 1269-80