The diversity of marine macroinvertebrates in Aceh Besar waters, Aceh, Indonesia

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Abstract. The objective of the present study was to study the diversity of marine macroinvertebrates in coral reef area in Aceh Besar waters. This research was conducted in September 2012 until February 2013 in nine locations in the waters of Aceh Besar district, namely: AmatRamanyang, Lampuuk, PulauDituan, LhokKetapang, LhokSeudu 1, LhokSeudu 2, Deudap 1, Deudap 2, and Lamteung. The macroinvertebrates were recorded using three repeated 20 m belt transect in two different depths (2-4 m and 4-8 m) in each site. The result showed 46 species of macroinvertebrates belonging to seven phyla were recorded. The diversity index in research station ranged between 0.88 - 2.26 (low to medium category).

1. Introduction
Geographically, Aceh Besar located on 5.2° - 5.8° N and 95.0° - 95.8° E. Aceh Besar district has abundant natural resources, including coral reefs ecosystem. Coral reefs are very diverse and productive ecosystem [1-3]. A healthy coral reefs ecosystem provide food, shelter and spawning area for fish and other marine organisms [4]. One group of organisms that closely associated with coral reefs are macroinvertebrates. Marine macroinvertebrates consist of a number of phyla, such as Echinodermata, Coelenterate, molluscs and etc. Echinodermata is the major macroinvertebrates found in coral reefs ecosystem [5]. In addition, macroinvertebrates play an important role in aquatic ecosystem, among others as a bio-indicator [6]. Macroinvertebrates also have an important economic value. A number of macroinvertebrates (such as sea cucumbers species) were known to have important economic value in Indonesian fisheries [7].

Limited information on macroinvertebrates in Aceh Besar district were available, among others a study done by [8] that limited in the estuary area of Kuala Gigieng, Aceh Besar. Information on macroinvertebrates composition is very important, not only for scientific purposes but also for the management and conservation of coastal resources. Hence, the objective of the present study was establishing a baseline data on macroinvertebrates in Aceh Besar to support marine protected areas in Aceh Besar district especially in the main coast of Aceh.
2. Materials and Method
This study was conducted from September 2012 to February 2013. The study was conducted in nine locations in the waters of Aceh Besar district, namely: Amat Ramanyang, Lampuuk, Pulau Dituan, Lhok Ketapang, Lhok Seudu 1, Lhok Seudu 2, Deudap 1, Deudap 2, and Lamteung (Figure 1). The macro invertebrate was recorded using 3 repeated 20 m belt transect in two different depths (2-4 m and 4-8 m) in each site[10]. The macroinvertebrates were identified and recorded based on[11].

The diversity index ($H'$) was calculated using the formula as follows[12]:

$$H' = - \sum P_i \ln P_i$$

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

![Figure 1](image_url)  
**Figure 1.** Map of the study sites in the district of Aceh (1. Amat Ramanyang 2. Tuanku Island 3. Lhok Keutapang 4. Deudap 5. Lamteng 6. Lampuuk 7. Lhok Seudu 1 8. Lhok Seudu 2).

3. Results and Discussion
In total, 46 macroinvertebrate species belonging 12 classes in seven phyla were recorded in Aceh Besar waters. Echinodermata was the highest phylum found in Aceh Besar(68%) followed by Mollusks, Sponge, and Annelid (8%) while, Crustacea (5%), Cnidaria (2%) and Chordata (1%) were the lowest (Figure 2). In addition, Table 1 showed the list of macroinvertebrates found in each research station. Phylum Echinodermata, which consists of five classes, namely Crinoidea, Asterioidea, Echinoidea, Holothuridae, and Ophiuroidea. A total of 14 species of macroinvertebrates from the phylum Echinodermata were found in Aceh Besar, namely: Camanthinas clageli, Camanthus sp., Crinoïdes sp., Achtantaster planctii, Oculitanovaginiae, Linckialaeavigata, Stephanometra echinus, Diademasingale, Diademasetosum, Echinostrephus calamaris, Echinotritacalamaris, Echinostrephus molaris, Holothuria atra and Ophiotrix purpurea. Two classes of Mollusk were recorded in this study, namely: Gastropods and bivalves which consists of 14 species. While Crustacea, Chordata, Cnidaria, Sponge, and Annelid found only in one class.
The high number of Echinodermata were found in the area of coral reef marine waters Aceh Besar allegedly due to the phylum Echinodermata prefers rocky substrates, it can be seen at the observation station which has a rocky substrate conditions [13]. It was presumed that Echinodermata got enough food supplies from coral reefs since this group acted as scavengers or detritus feeder. This result is comparable with the study conducted by [14] in the area of the island Kemujan, Central Java. They found that Echinodermata was the most abundant phylum with four classes recorded.

Figure 2. Macroinvertebrates composition in Aceh Besar waters.

Table 1. List of macroinvertebrates in Aceh Besar

| No. | Macroinvertebrates       | Sites |
|-----|--------------------------|-------|
|     | Phylum Echinodermata     | 1     |
|     | Class Crinoidea          | 2     |
| 1   | Camanthina selegeli      | -     |
| 2   | Camanthus sp.            | -     |
| 3   | Crinoids sp              | +     |
|     | Class Asteroidae         | 4     |
| 4   | Achantaster plancki      | -     |
| 5   | Cucleita novaguinae      | +     |
| 6   | Linckia laevigata        | +     |
| 7   | Stephanometra echinus    | -     |
| No. | Macroinvertebrates                | Sites |
|-----|-----------------------------------|-------|
| 1   | Class Echinoidea                  |       |
| 2   | Diadema saxatile                  | -     |
| 3   | Diadema setosum                   | +     |
| 4   | Echinostrephus calamaris          | -     |
| 5   | Echinotrix calamaris              | +     |
| 6   | Echinostrephus molaris            | +     |
| 7   | Class Holothuridae                |       |
| 8   | Holothuriaatra                    | +     |
| 9   | Class Ophiuroidea                 |       |
| 10  | Ophiothrix purpurea               | -     |
| 11  | Phylum Mollusk                    |       |
| 12  | Class Gastropoda                  |       |
| 13  | Chicoreus torrefactus             | -     |
| 14  | Conus sp.                         | -     |
| 15  | Cypraea linneaus                  | -     |
| 16  | Drupella rugosa                   | -     |
| 17  | Lambis sp.                        | -     |
| 18  | Phylidia varicosa                 | -     |
| 19  | Phyllidiella zeylonica            | -     |
| 20  | Pteria penguin                    | -     |
| 21  | Tectus niloticus                  | -     |
| 22  | Trochus maculatus                 | -     |
| 23  | Class Bivalvia                    |       |
| 24  | Hyotissa hyotis                   | -     |
| 25  | Hippopus porcellanus              | -     |
| 26  | Tridacna maxima                   | +     |
| 27  | Tridacna squamosa                 | +     |
| 28  | Phylum Crustacea                  |       |
| 29  | Class Malacostraca                |       |
| 30  | Dardanus sp.                      | -     |
| 31  | Etisus splendidus                 | -     |
| 32  | Homarus americanus                | +     |
| 33  | Panulirus versicolor              | -     |
| 34  | Saron neglectus                   | -     |
| 35  | Stenopus hispidus                 | -     |
| 36  | Phylum Chordata                   |       |
| 37  | Class Ascidian                    |       |
| 38  | Didemnum molle                    | -     |
Table 1. Continue...

| No. | Macroinvertebrates                      | Sites |
|-----|-----------------------------------------|-------|
|     | Phylum Cnidaria                         |       |
|     | Class Hydrozoa                          |       |
| 36  | *Aglaophenia cupressina*                | -     |
| 37  | *Gymnangium sp.*                        | -     |
| 38  | *Lyctocarpus philippinus*               | -     |
|     | Phylum Porifera                         |       |
|     | Class Demospongia                       |       |
| 39  | *Euspongia sp.*                         | -     |
| 40  | *Haliclona sp.*                         | -     |
| 41  | *Phakelia ventilabrum*                  | -     |
| 42  | *Spongilia sp.*                         | -     |
| 43  | *Thalysias sp.*                         | -     |
| 44  | *Xestopongia testudinaria*              | -     |
|     | Phylum Annelida                         |       |
|     | Class Polychaeta                        |       |
| 45  | *Sabellastre sp.*                       | -     |
| 46  | *Spirobranchus giganteus*               | +     |

*Note:* (+) = found, (-) = not found. 1 = Amat Ramanyang; 2 = Tuanku Island; 3 = Lhok Ketapang; 4 = Deudap 1; 5 = Deudap 2; 6 = Lamteung; 7 = Lampuuk; 48 Lhok Seudu 1; 9 = Lhok Seudu 2.

Based on the criteria of Shannon-Wiener index, the diversity index of macroinvertebrate in Aceh Besar ranged from 0.88 to 2.26 (low to moderate category). Figure 3 showed that the value of the diversity index ($H'$) was highest in Lhok Ketapang (2.26) followed by Deudap 1 (1.94), Deudap 2 (1.86), Lhok Seudu 1 (1.79), Lhok Seudu 2 (1.76) and Lampuuk (1.18) respectively. Lamteng had the lowest diversity index with a value of 0.88. The Macroinvertebrates found in Lhok Ketapang were more diverse or varied compared with the other stations.

![Figure 3](image-url)  
*Figure 3.* The diversity index of macroinvertebrates found in Aceh Besar waters.
4. Conclusions
The diversity of macroinvertebrates were identified in marine waters Aceh Besar consists of 46 species of seven phyla macroinvertebrates, namely from the phylum Echinodermata, Mollusk, Crustacea, Chordata, Cnidaria, Porifera, and Annelids. Macroinvertebrates diversity indices in marine waters Aceh Besar ranged from 0.88 to 2.26 (low to moderate), where observation stations with the highest diversity index was at LhokKetapang. Providing baseline data of coral reefs condition in Aceh Besar may become a good support to the establishment of marine protected areas. Marine protected areas are giving the opportunity to coral to be survived and support eco friendly industries such as marine tourism.

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