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Biodiversity of Cryptofauna (Decapods) and Their Correlation with Dead Coral *Pocillopora* sp. Volume at Bunaken Island, North Sulawesi

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Abstract. Decapod is known as cryptofauna which is also important component of coral reef biodiversity. Dead corals are one of the area which usually used by decapods to live. This research aims to observe the diversity of cryptofauna (decapods) and the correlation between the number of decapods with the volume of dead corals. Ten dead corals, *Pocillopora* sp., were collected at 5 m depth at Bunaken Island. These dead corals were measured their volume and all decapods found were counted and identified up to family level. The richness and abundance were analyzed using ACE (Abundance-Based Coverage Estimates) and Chao 1. The results show that there were in total 474 decapods from 13 families found within all ten dead corals. Xanthidae was showed as the most abundance family among all, with 161 individual. Diversity index of decapods was found at medium category with value of 2.01. Rarefaction curve based on richness and abundance showed an estimation of 13 families. The result also indicated that the asymptote stage was reached on the 10th dead coral samples. The correlation between decapod with the volume of dead coral were showed significant positive correlation ($r = 0.673$, $p<0.05$). This result provides benefits to basic knowledge about diversity of decapod which one of cryptofauna as component fauna have a habitat on coral reef ecosystem.

Keywords: Decapod, Dead Coral, Biodiversity, Bunaken Island

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1. Introduction

Coral reef ecosystems are known as habitat of various organisms with its high biodiversity. One important component of coral reef biodiversity is cryptofauna [1] which include decapods and lives dwelling on the crack and crevices of dead or living coral. Cryptofauna is a small-sized fauna which difficult to distinguish and identify, including several fishes and invertebrates. These organisms usually use the cavity at substrate either temporarily or permanently. Several decapods can create self-cavity on coral reefs while the others are the opportunist occupier of existing space [2]. Decapod is also known as a key character on coral reef ecosystem, which will act as a suppressor for the growth of herbivore animals [3], and also indirectly give contribution on maintaining habitat [4]. Decapod can even be found on dead corals such as *Pocillopora* sp. [5].

The island of Bunaken is a part of Bunaken National Park [6, 7] North Sulawesi is one of the important marine parks in Indonesia. This park is part of the Coral Triangle which is known with its high biodiversity within coral reef ecosystem [8, 9, 10]. Understanding biodiversity and ecosystem health are very crucial especially in establishing proper management of an ecosystem [11, 12, 13] as well as avoiding degradation and endangering organisms [14]. However, little is known on the diversity of cryptofauna especially decapods in dead corals of *Pocillopora* sp., which can be used to estimate the hidden biodiversity at Bunaken island.

Study on life organism on dead coral of *Pocillopora* sp. will also give an overview about their diversity that inhabit the entire coral reefs around it [15]. The aims of this study were to investigate the diversity of cryptofauna decapods, and the correlation between the number and volume of dead coral (*Pocillopora* sp.) collected at Bunaken Island.

2. Material and Methods

Ten dead corals of *Pocillopora* sp. were collected on the reef of Bunaken Island at a depth of 5 m. See Figure 1. Each dead corals was put into plastic bag and brought to the laboratory for further treatments. Sample collection was based on the standard protocol from Plaisance *et al*. [5].

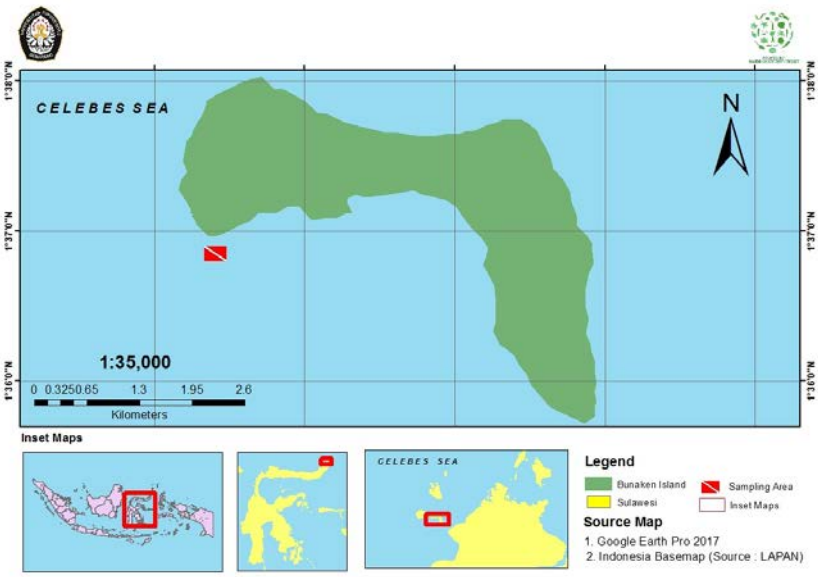

Figure 1. Sampling location at Bunaken Island, North Sulawesi, Indonesia

Measurement of the volume was done by putting each dead coral into bucket filled with water, and measures its volume using water displacement method [5]. While decapod samples were collected first by shaking dead corals in the bucket full of water and collect all organisms found. Each dead corals then were broken into small pieces using hammer and all organisms found were collected. These organisms then were sorted using morphological characters and identified up to family level based on Poore [16].

After being classified, decapods were put into a clove oil, photographed and being documented both the number and family names.

Diversity Indices of decapod were calculated using Shannon-Weaver formula [17], and diversity estimation were calculated using Chao 1 and ACE (Abundance-Based Coverage Estimates) analysis using software Estimates V.9.1.0 [18]. The correlation between the diversity of decapod and the volume of dead coral were calculated using software SPSS with bivariate Spearman analysis and 95% ($p<0.05$) confident interval.

3. Result and Discussion

Total number of decapods found within ten dead corals of *Pocillopora* sp. collected at Bunaken Island were 474 indiviual from 13 families (Figure. 2).

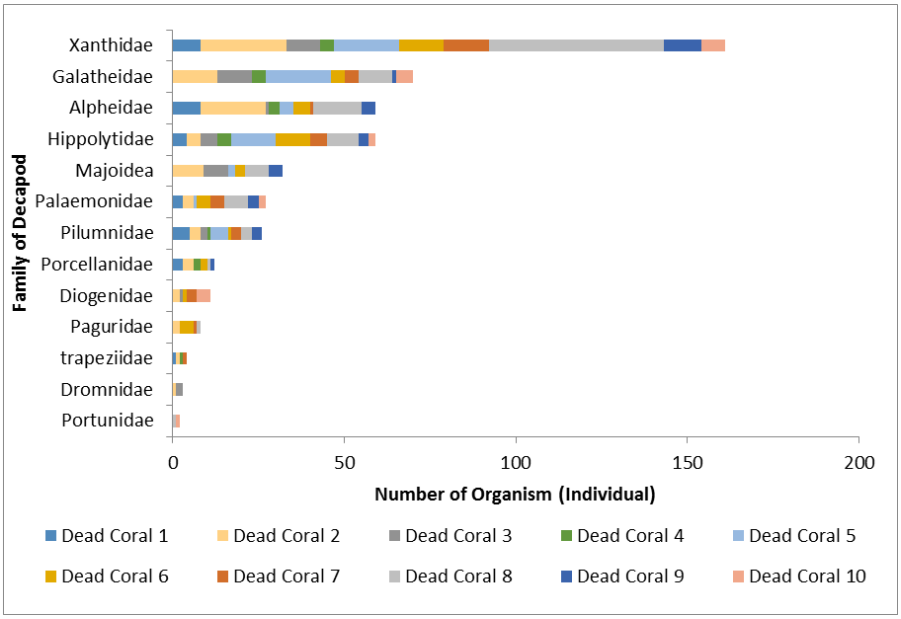

Figure 2. Family of decapod abundance on dead coral of *Pocillopora* sp. (Individual).

The most common and abundance family found was Xanthidae with 161 individual (Figure 2). This family was found at all ten dead corals of *Pocillopora* sp. on this location which have characteristic as branching coral. Xanthidae is the organisms that commonly found at dead coral with branching lifeform [19]. Both of these families are grazer of algae or detritus feeder [16]. When a coral died, it will be overgrown by sessile organisms (crustose algae and moss, bryozoan, sponge, and foraminifera) which will be the source of food for decapod [20].

Index of decapod diversity showed the value of 2.01 which indicated medium diversity [21]. The same research about decapod diversity index have been done by Pertiwi *et al*. [15] at Menjangan Besar Island, Karimunjawa and Pemuteran, Bali, the result of their study showed the value 1.9 at Menjangan Besar Island, and 2.35 at Pemuteran, Bali which indicated low diversity. These results suggest that diversity from reef crustacean found in Bunaken Island is more diverse than Menjangan Besar Island, Karimunjawa. These different values of diversity may be caused by coral conditions, geographic influences, and the diversity of other organism between areas [22]. Other possible causes are the availability of food and environmental influences, because both are very influential on the existence of an organism [23-24].

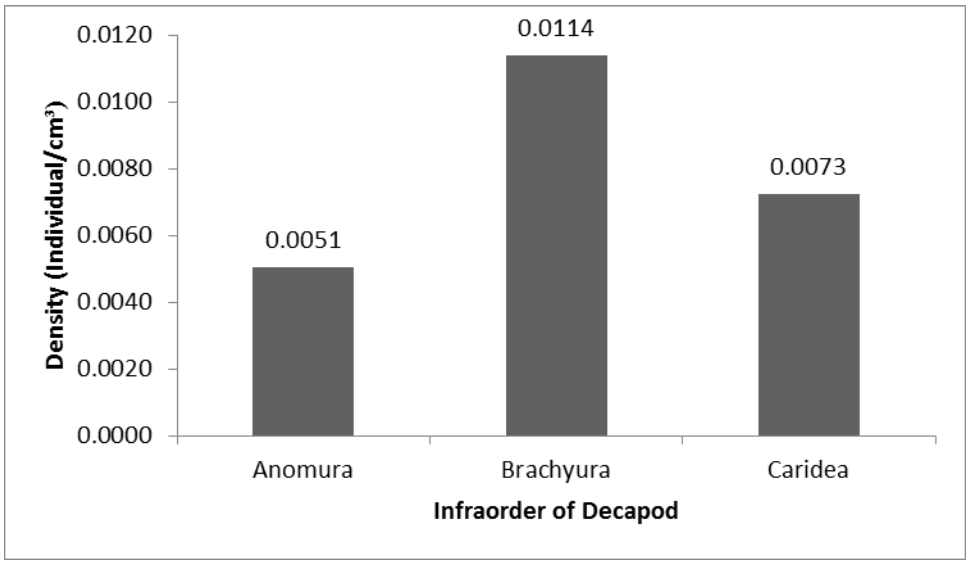

Figure 3. Density of Decapod Infraorder (individual/cm^3) which found within ten dead corals, *Pocillopora* sp., collected at Bunaken Island.

There were 3 infraorders of decapods found on this location. The highest density of infraorder was Brachyura with 0.0114 individual/cm^3. This infraorder was the most common since it was found in all ten dead corals. Brachyura is known as crab which has characteristic of living as semi-terrestrial and host obligate will settle at one location of dead coral *Pocillopora* sp. [25]. On the other hand, Caridea and Anomura are infraorder that moves to other substrates if their habitat is no longer sufficient for their lives, such as room and food availability. Wibowo *et al*. [26] showed that Caridea and Anomura are facultative organisms, they will move to another location such as moving to a deeper location as it grows.

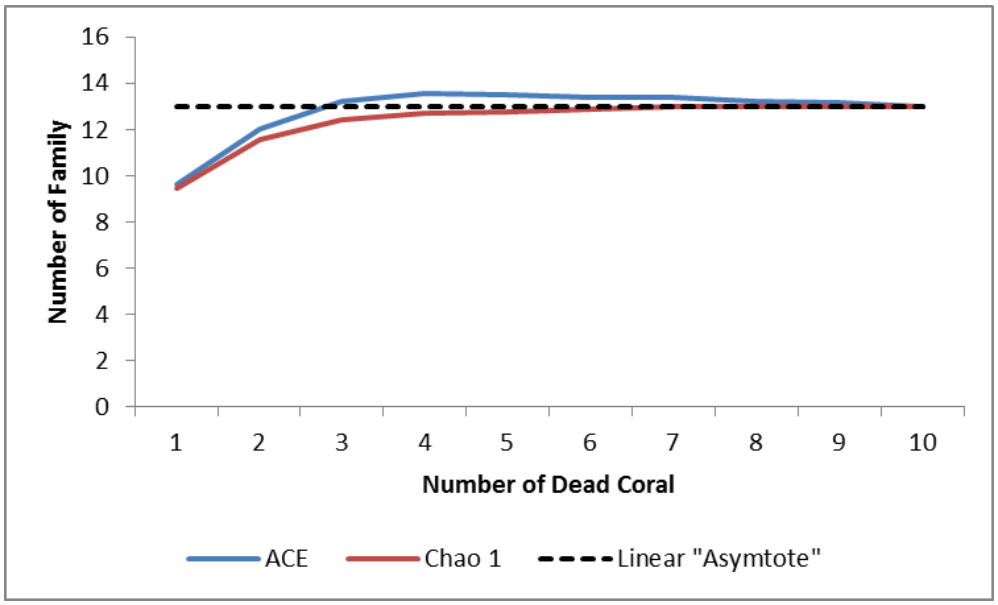

Figure 4. Result of ACE and Chao 1 calculations

Estimation analysis using ACE and Chao 1 showed the maximum number of family found was 13. The rarefaction curve showed an asymptote stage at the 10th dead coral, which indicates that the addition of dead coral samples will not change the number of family found (Figure 4.). Pertiwi *et al.* [15] study

shows that at Menjangan Besar, Karimunjawa Island the rarefaction result of ACE and Chao 1 that rarefaction curve an asymptote after sampling by 14 dead corals and only found 11 decapod families. Research conducted by Head *et al*. [27] at Chagos island, Central Indian Ocean stated that decapod abundance variation taken from five dead corals are not effecting to presence or decapod abundance which living on coral reefs at these area. The result of this research may still underestimate the diversity of the entire coral reef within Bunaken Island, since it is the samples were collected only from one location and using only one particular specific organism (decapods). The identification until species level may also change and increase the diversity estimation of an area [28].

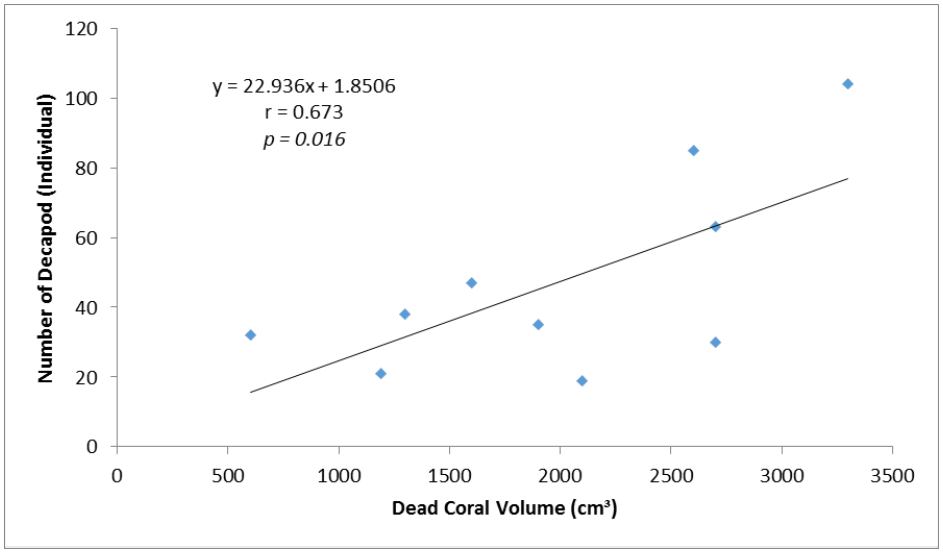

Figure 5. The correlation between the volume of dead corals with number of decapods

There is a significant positive correlation between volume of dead coral with number of decapods found ($p<0.05$). See Figure 4. This correlation clearly shows that the number of decapods is influenced by the size of dead corals. The complexity of coral reefs habitat such as variation sources of food and cavity of dead corals as good habitat are also influencing the number of decapods.

When corals died, the skeleton will be overgrown by sessile organism which is also the source of decapods food, and the skeletons were full of cracked and formed cavity [21]. Research conducted by Abele and Patton [29] showed that a significant correlation between the number of decapods with the sized of coral *Pocillopora damicornis*. Area may influence the species richness in at least three ways by [30] are (1) an increase in area may be correlated with an increase in habitat heterogeneity; (2) an increase in area may permit larger population sized and reduce the probability extinction; (3) an increase in area may simply increase the sample size. Habitats are heterogeneity associated to complexity [28]. Coral reef is complexity habitat with high biodiversity [31].

4. Conclusion

In conclusion, the estimation coral reef association of decapod diversity which found within ten dead corals at Bunaken Island indicated a medium diversity with 13 families. The correlation between number of decapod with the volume of dead coral *Pocillopora* sp. indicated a significant correlation. These results provide an addition to the overall biodiversity coral reef association of decapod at Bunaken Island and basic knowledge with aspect ecology of habitat decapod on coral reef ecosystems.

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