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Diversity and density of crabs in degraded mangrove area at Tanjung Panjang Nature Reserve in Gorontalo, Indonesia

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Abstract. *Lapolo N, Utina R, Baderan DWK. 2018. Diversity and density of crabs in degraded mangrove area at Tanjung Panjang Nature Reserve in Gorontalo, Indonesia. Biodiversitas 19: 1154-1159.* This study was aimed to analyze the diversity and the density of crabs in a degraded mangrove area including in the intact mangrove area and the fishponds (the degraded mangrove area).. The data from this study could be used as supporting data for decision makers to slow down the degradation of mangrove along the area of Tanjung Panjang Natural Reserve. The observed data i.e diversity and density of crabs were collected using the stratified random sampling method (10 m x 10 m plot). Environmental parameters suited to crab habitat were also measured. The samples were taken from 18 spots. The study shows that 20 species of crabs were obtained within the mangrove area, and 11 species were founded within the fishponds area. Interestingly, two species of crabs i.e Varuna yui and Varuna litterata were only founded in fishponds area. The density of crabs in mangrove area ranged between 3.23 ind/300m^2 and 4.52 ind/300m^2, while the density of crabs in fishponds area ranged between 0.16 ind/300m^2 and 0.63 ind/300m^2. Further study revealed that characteristics and the age of mangrove trees affected macrozoobenthic biota (Gastropods, Bivalvia, Mud Lobster, Polychaeta, and shrimp) as well as fish diversity within mangrove in Tanjung Panjang Natural Reserve. These may be important for further restoration program of mangrove ecosystem and the sustainable restocking for conservation purposes.

Keywords: Crabs, degradation, density, diversity, mangrove, Tanjung Panjang Natural Reserve

INTRODUCTION

Mangrove ecosystem is one of the important areas for fauna living in surrounding mangroves because it has various ecological, physical, and economical functions. However, most mangrove forests in Indonesia have been degraded, now. This is due to human activities, such as conversion of mangrove area into fishponds area and several phenomena such as abrasion, sedimentation, and rob flood (Farhana et al. 2016).

Mangrove forests are used as a feeding ground, nursery, and spawning for several aquatic creatures (Harahab 2009). They also have a function to protect some juvenile and fish larva as well as clams from their natural predators. Conversion of mangrove area into fishponds for aquaculture has changed the composition of mangrove tree. As consequences, mangrove trees no longer serve as the feeding ground and the nursery ground for sea creatures. The conversion of mangrove forests into fishponds area could threaten the regeneration of these aquatic creatures.

Tanjung Panjang Natural Reserve in Gorontalo Province, Indonesia is one of mangrove forests that its status is considered to become a degraded mangrove, now. This happens due to the conversion of its area into fishponds. It was estimated that 16 ha of mangrove forest was converted into fishponds in 1994. The fishponds area has significantly increased from 297 ha in 2000 to 7,129 ha in 2015 (Blue Forests 2017). This clearly shows that conversion of mangrove forests into fishponds have significantly increased for the past 15 years.

The conversion of mangrove forests into fishponds and shrimp ponds also degrades the habitat of many aquatic creatures. The degradation of this habitat has brought severe consequences for the biotic environment, including the disturbed population of the aquatic biota, i.e., crabs in that environment. Anggraeni et al. (2015) mentioned that crabs are one of biotas that play a critical role in water habitat. Crabs have relatively stable habitat. Li et al. (2015) indicated that crabs have significant correlation with the flow of energy and species, which used seeds as diet since various species of crabs respond to vegetation differently.

This study was aimed to analyze the diversity and density of crabs along the area of mangrove and fishponds. This study intends to gather the data of crab species within the area of degraded mangrove in Tanjung Panjang Natural Reserves. It is expected that the output of this study will be further used as supporting data for policy-makers to slow down the degradation of mangrove in that area.

MATERIALS AND METHODS

The research site of this study was located in Tanjung Panjang Natural Reserve of Pohuwato District, Gorontalo Province, Indonesia. The research site covers three villages i.e Siduwonge, Patuhu, and Limbula villages

(Figure 1). This study was conducted for three months, from October to December 2017. This study used explorative survey method. Primary and secondary data were collected in this study. Primary data consisted of the identification of all crab species, level of diversity, and density of the crab population by stratified random sampling (Figure 2). While secondary data was obtained from the statistical data of Pohuwato District, and the data from non-government organization (Blue Forests 2017).

The data was collected using stratified-random sampling method. Each research stations had three quadrants of sampling plots with the dimension of 10 m x 10 m (100 m^2). In each plot, the crab samplings were taken using three quadrants with the size of 1 m x 1 m (1 m^2), with the total of nine quadrants per zone. Further, the observation was conducted in every 100 m^2 plots to find the unavailable crab samples in 1 m^2 (Chapman 1998).

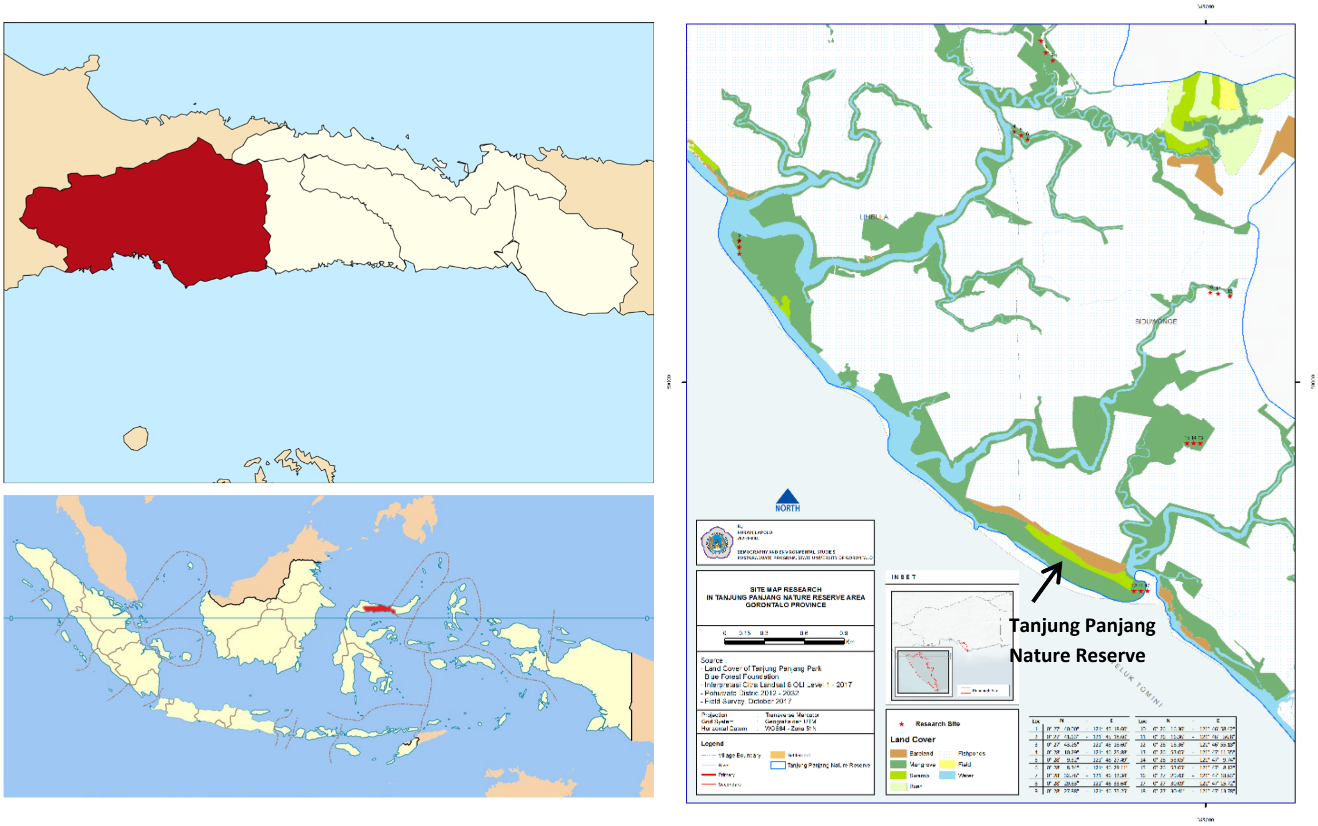

Figure 1. Research sitemap within the area of Tanjung Panjang Natural Reserve of Pohuwato District, Gorontalo Province, Indonesia

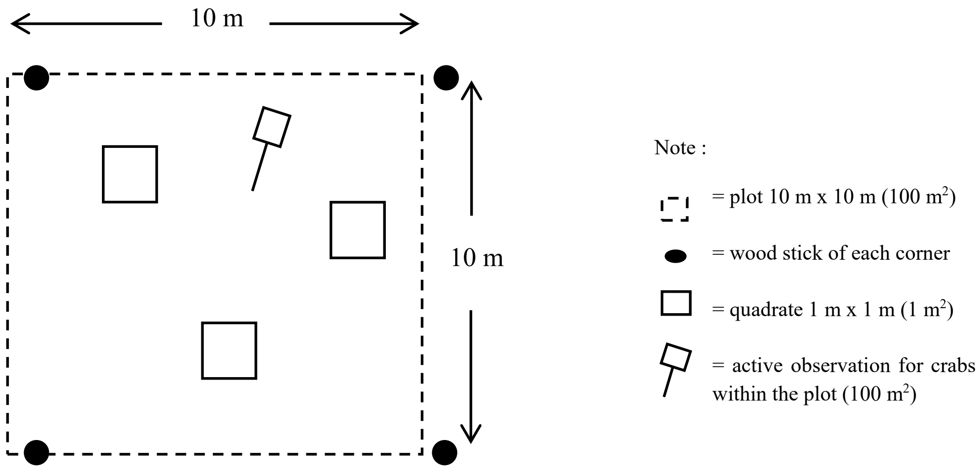

Figure 2. Transect and Plot Location in One Research Station (Chapman 1998)

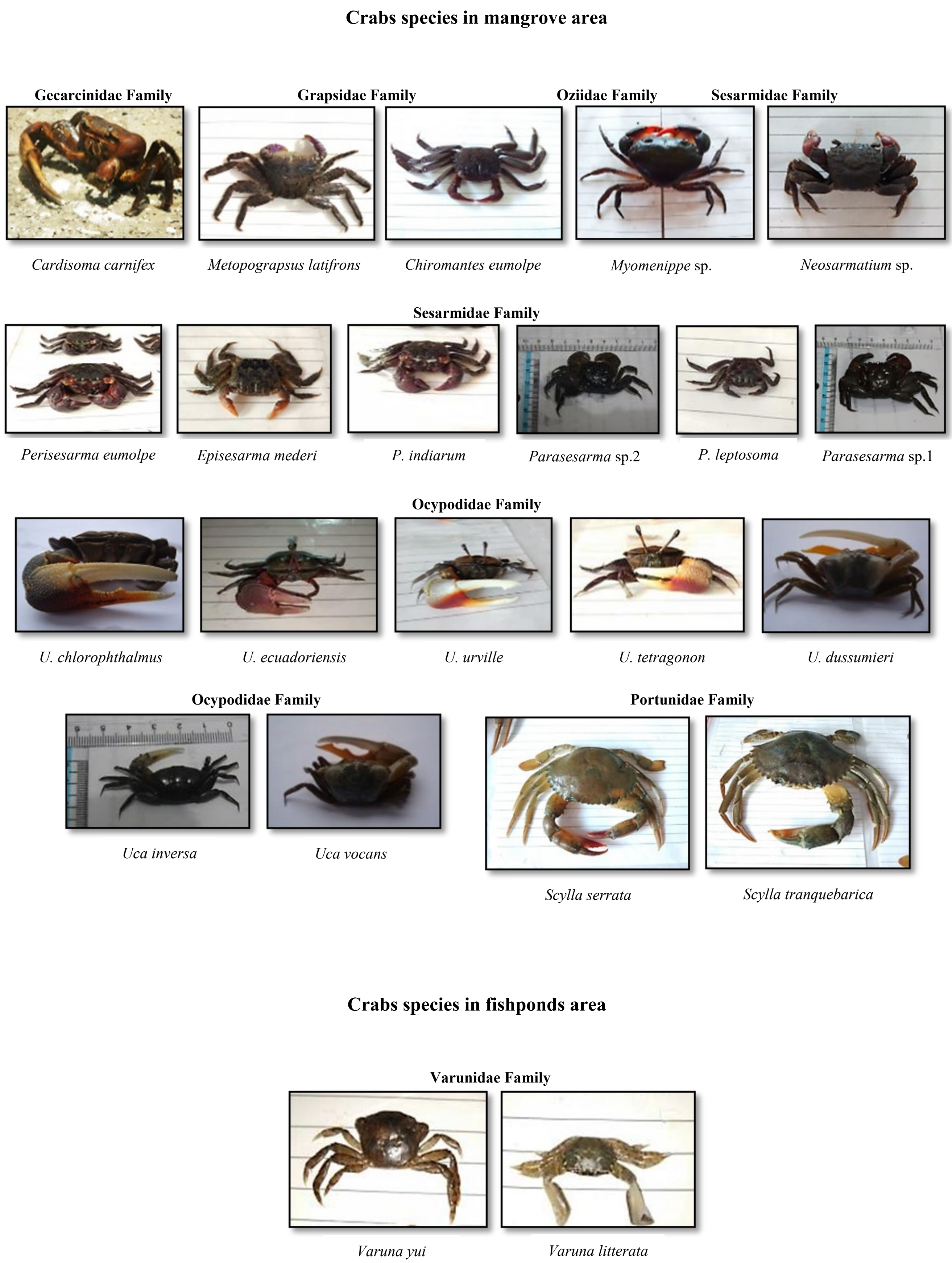

Figure 3. Crabs species in the research site of Tanjung Panjang Natural Reserve of Pohuwato District, Gorontalo Province, Indonesia

Table 2. The composition of number of species and number of individuals found in the research site

Family	Mangrove area	Fishponds area	Total
Gecarcinidae	1 (30)	1 (2)	32
Grapsidae	2 (291)	0	291
Oziidae	1 (13)	0	13
Sesarmidae	7 (5160)	3 (200)	5360
Portunidae	2 (7)	0	7
Ocypodidae	7 (1248)	5 (127)	1375
Varunidae	0	2 (473)	473
Total	20 (6749)	11 (802)	7551

Note: Number outside the bracket indicates the number of species and number within the parenthesis indicates the number of observed individuals

Crabs samples were taken within the 1 m x 1 m quadrate (1 m^2), which was randomly placed under the mangrove tree and within the fishpond area. The quadrates are placed in a representative area (the visible crab holes). For 15 minutes, all crabs were gathered from the surface of the substrate and were dug from the sediments to the depth of about 20 cm. The crabs living under the tree area (trunks and branches) were observed up to 1.5-2.00 m from the mud surface for arboreal species., The other location such as the remaining trees (the decomposed tree) were also observed to look for other crab species. The crabs that could be identified on the spot were released after the type and number of crab's individuals were recorded on the data sheet.

The calculation of species and number of individual was done using the crab's holes with the size of the holes (0-1 cm, 1-3 cm, and > 3 cm) and the length of the 1 m x 1 m (1m^2) quadrate. Each crab hole represents the number of crabs residing within one plot (Kathiresan et al. 2016). To count the number of crab holes, the quadrate was then divided into four quadrants of 50 cm x 50 cm. For unidentified types of crabs, the samples were collected for further analysis using the identification guideline book by Irawan (2013), Chapman (1998) and other supporting journals.

The collected specimens were stored in samples bags, labeled, and stored in the freezer to be further identified. The big size crabs were not collected within the quadrate, but they were observed in each plot of 10 m x 10 m (100 m^2) for 5 minutes, including the tree bark habitat, holes, and puddle. The crab collection was conducted during the low tide to make the collection easier (Katili et al. 2017). In addition, the soil samples were also taken during the low tide using the core panel which was modified from PVC pipe with the depth of 0-30 cm (Sara et al. 2014) to check the level of soil nutrition (N, P, K).

RESULTS AND DISCUSSION

Crabs species within the research site

Twenty-two species of crabs were found in this study, which was classified into seven families, i.e., Gecarcinid, Garside, Ocypodid, Oziidae, Portunidae, Sesarmidae, and Varunidae. Sesarmidae and Ocypodidae families were the largest species with each family consisted of seven species. For other families, i.e., Portunidae, Grapsidae, and Varunidae, each had two species followed by Gecarcinidae and Oziidae with each of them one species (Figure 3). Overall, Sesarmidae and Ocypodidae were found abundantly in the research site.

Crab diversity and density in research site

Crab diversity value index is presented in Figure 3. It shows that crab species in station II has the value which categorized in zone 3: 1.72, zone 1: 1.68, and zone 2: 1.08. While in station I, the diversity value index in the sequence have belonged to zone 2: 1.68, zone 3: 1.47, and zone 1: 1.28.

The fishpond area had the lower diversity index than the mangrove area. In the station, I, the diversity index in the sequence were zone 2 with 1.25, zone 3 with 1.21, and zone 1 with 1.14. Whereas in station II, the crab diversity index value in the sequence was zone 3 with 1.38, zone 1 with 1.31, and zone 2 with 1.08. Of all the crab diversity index, both within the mangrove area and fishponds ranged between 1.08-1.72. This means that the crabs diversity in this research site was classified as moderate.

The density value of crabs of the mangrove area in Station I were as follows; zone 1 with 4.52 ind/300m^2, zone 3 with 3.47 ind/300m^2, and zone 2 with 3.23 ind/300m^2. Whereas, in Station II, the density of crabs in the sequence was Zone 1 with 4.17 ind/300m^2, zone 2 with 3.79 ind/300 m^2, and zone 3 with 3.58 ind/300m^2. The density value of crabs in research site is presented in Figure 4.

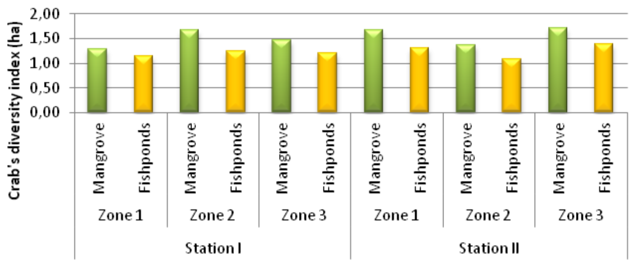

Figure 3. Crab diversity in both mangrove and fishpond area

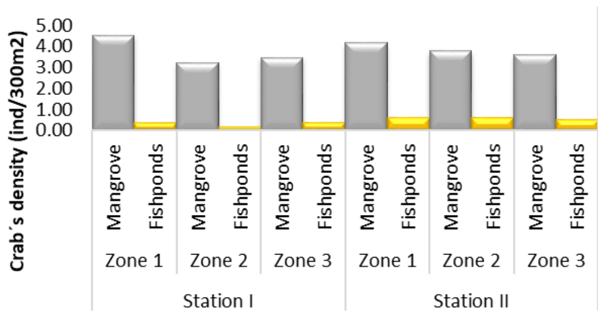

Figure 4. Crabs density in both mangrove and fishpond area

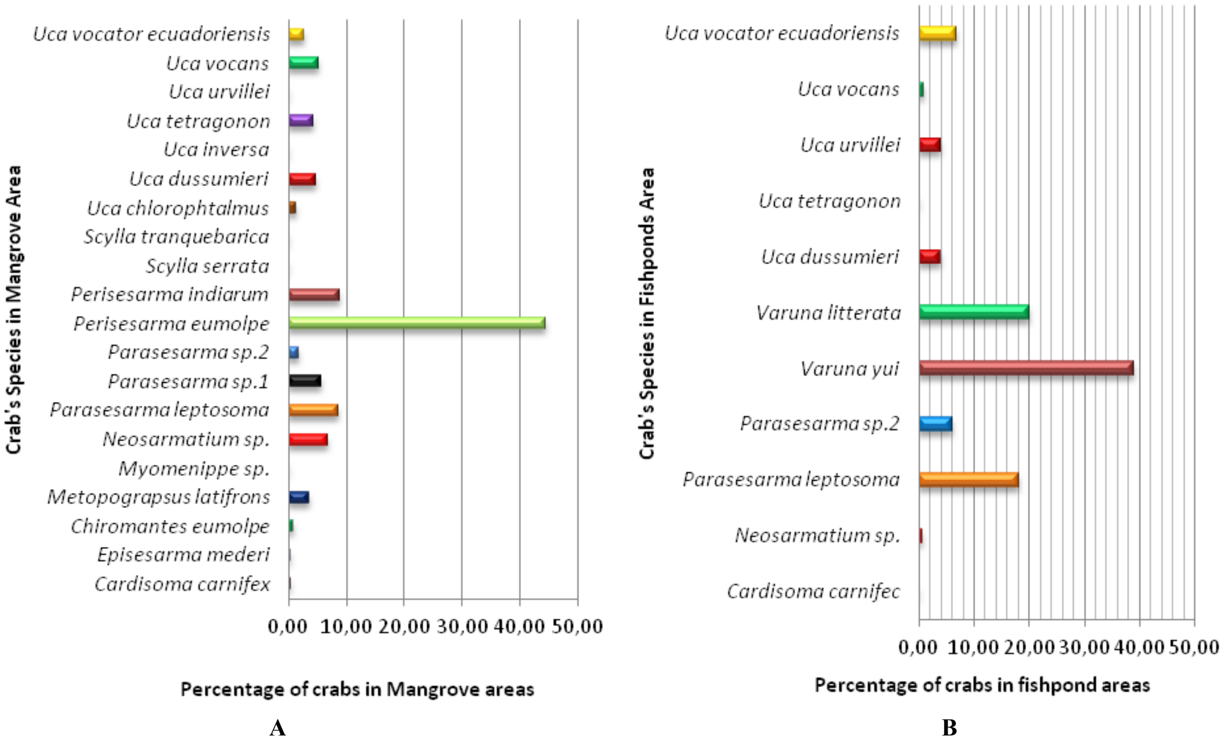

Figure 5. Crabs RDi percentage in (A) Mangrove Area, and (B) Fishpond Area

The fishponds area has lower crabs density index than the mangrove area. The crabs density index in fishponds area in Station II in sequence are: zone 1 0.63 ind/300m^2, zone 2: 0.60 ind/300m^2, and zone 3: 0.53 ind/300m^2. Whereas in station I, the crabs density index in sequence are: zone 3: 0.39 ind/300m^2, zone 1: 0.36 ind/300m^2, and zone 2: 0.16 ind/300m^2.

Discussion

The degradation of the crab habitat in both mangrove area and fishponds is an evidence that the density of the crabs in those areas was small. Most of them were dominated by Sesarmidae and Ocypodidae families. Ravichandran et al. (2011) study showed that Uca spp were often abundantly found in disturbed mangrove forests, and becomes the dominant species compared to other aquatic creatures. Several observed species such as, *Uca urvillei* which are often found in the holes with stable temperatures, are able to adapt to the extreme environment. Uca spp is generally found in the open area and plays an important role in the mangrove forest.

Other species of crabs, such as Gecarcinidae and Oziidae families are also found in the research site. However, their number is not as many as the Sesarmidae and Ocypodidae families. It is suspected that the existence of this species in mangrove area is for feeding ground and protection ground only. This is different with the Portunidae family that could be abundantly found in the mangrove area. Regardless, the Portunidae *(Scylla* spp.) were rarely found within the research site. This indicates that the loss of mangrove vegetation in research site has caused a disturbance on the ecological balance and has impacted on the decrease of crab species in this area.

The high and low tide of the seawater also has contributed to the existence of the crabs, where crabs can be harvested during the lowest tide. In addition, the crabs within the mangrove area are more adaptive to the environmental changes in their habitat, and they will migrate when their habitat is disturbed. The dominant crabs species in the research site is the *Perisesarma eumolpe.* However, this species cannot be consumed. Salgado and Keith (2010), *Perisesarma* sp. most abundantly found in mangrove forests in intertidal areas with a total of 554 individuals and a total of 11 species was found. This species is able to adapt to the surrounding environment even in damaged or extreme conditions. In addition, this species has a habit of eating litter and even leaves on propagule (mangrove seeds).

Human activities, such as illegal cutting of the mangrove tree have also caused the crab density to be low as the environment is experiencing pressure and physical changes. This was backed up by Chairunnisa (2004) who found that the substrate was changed although the components and the content of the substrate did not change drastically. Furthermore, Nadia (2002) insisted that on a similar situation, where mangrove density is high, the population of existed biota is limited due to the logging activity in the area. Hence, the biota residing within the substrate is disturbed.

From informal interview with the community from the research site surrounding area reveals that they generally caught *Scylla* spp. crabs because this type of crabs is edible, and that the crabs collection are still traditionally done using the booby trap (crabs trap), however the captured crabs are only suitable for local consumption and not for commercial trading. Land degradation in this area due to the conversion of mangrove forest into fishponds triggers the decrease of crab population in this area. Hence, a strategy to reverse and revive the degraded habitat and create an appropriate ecosystem for crabs *Scylla* spp. and other aquatic creatures can be done by restoring the function of the area through mangrove rehabilitation. Sara et al. (2014) state that the need for calculation and regulation of crab fishing in nature through the management of habitats and populations. For example, the ban of catching crabs, which in still teenagers and female is done to maintain the population, as well as to maintain crab habitat.

Water pH also influences the crabs existence. Interestingly, the average water pH in fishponds area is 6.5, this is higher than the mangrove area around 5.6. Informal interview with the fish farmers reveals that most of fishponds are treated with fertilizer of N (nitrogen), P (phosphate), and K (potassium) as a nutrient for the fish. However, the administration of these fertilizers is harmful to certain species such as Gastropods that can no longer be found in fishpond area. In reverse, crabs from Varunidae family, *Varuna yui,* and *Varuna litterata* species are abundantly found in fishpond area. This indicates that the abundant nutrient found in fishpond area, not only increased the fishpond production, but also support the existence of the crabs from Varunidae family.

Humaidy (2010) stated that the N (nitrogen) compound could increase the pH of the water in the fishpond area to become higher than those of the mangrove area. The existence of nitrogen can increase the nitrogen cycle, hence, is able to maintain the stability of the water pH. In contrast, the existence of toxin and heavy metals can lower the pH. In addition, Humaidy (2010) described that the soil pH and water pH values are not significantly different from 6 to 7.

It is concluded that the crab species in mangrove area found in this study was 20 species, whereas, in fishponds area, 11 species were founded. There were two crab species that were only founded in fishponds area, i.e., *Varuna yui,* and *Varuna litterata*. The diversity index of the crabs ranged between 1.08 to 1.72, which means that the diversity is moderate. Also, the density of crabs in mangrove area ranged from 3.23 ind/300m^2 to 4.52 ind/300m^{2,} while the density in fishponds area ranged from 0.16 ind/300m^2 to 0.63 ind/300m^2. However, the influence of mangrove tree characteristics and age toward the macro-zoobenthic biota (Gastropods, Bivalvia, Mud Lobster, Polychaeta, and shrimps) and fish, associated with mangrove in Tanjung Panjang Natural Reserve should be further researched. It is also recommended that sustainable restoration and the restocking of the mangrove habitat should be done.

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