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Original Article

DISTRIBUTION AND CHARACTERISTIC OF DEPOSIT-FEEDER CRABS (CRUSTACEA: BRACHYURA) IN SOME MANGROVE ECOSYSTEM TYPES IN LOMBOK ISLAND

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ABSTRACT

Lombok Island consists of five different mangrove forest types with various pattern of fauna distribution. These pattern variations were constructed by different type of substrates. Deposit feeder crabs play an important role in determination of substrate pattern. The objective of this study was to investigate the distribution pattern of some crabs which their characteristics are correlated to the mangroves substrate. Crabs were collected from eight locations in Mangrove area of Lombok Island. Ten species of the deposit feeder crab were identified, their distribution pattern was illustrated based on the result of field observation on their morphological characteristics. The highest species diversity found in Teluk Rasu and Tanjung Luar. Both cheliped and maxilliped characteristics represent to habitat preference. *Uca annulipes*, *U. perplexa*, *U. vocans*, and *Dotilla myctiroides* inhabited sandy substrate, while *U. bellator*, *U. demani*, *U. dussumieri*, *U. forcipata*, *U. triangularis*, and *Tmethypocoelis ceratophora* inhabit muddy substrate.

Keywords: *Deposit feeder, mangrove, Lombok Island, distribution, cheliped, maxilliped*

INTRODUCTION

Lombok island is known with its large varied forest area. There are some kind of forest in this island, *wet forest* (*paramo*), *moist forest*, *rain forest*, *rain* paramo, and *wet forest. Rain paramo* and *wet forest* dominate the forest area in Lombok Island (Nandini & Narendra, 2011). The distribution pattern of those forest types also found in mangrove ecosystem. Mangrove ecosystem is highly susceptible to damage caused by climate change and human disturbance. The damage of one component will affect the other components either directly or indirectly. Destruction parameters can be observed easily on the substrate.

Mangrove ecosystem has variation of water logging, salinity, and substrate. Substrate determines the composition of vegetation and fauna that form pattern (Nirarita *et al*., 1996). One of fauna group that are highly dependent on substrate condition is deposit-feeder crab. Feeder crabs are small in sized but have large population. Their activities are influenced by the tide (Qureshi & Saher, 2012; Saher & Qureshi, 2010; Takagi *et al*., 2010). The presence of deposit-feeder crab was favorable for substrate, it has an important role on organic materials circulation in substrate upper and lower layers (Kochl & Wolff, 2002). Good substrate condition will support the growth of mangrove vegetation in a better way. Beside of that, carbon cycles in substrate are also dependent on the presence of deposit-feeder crab.

Generally, mangrove substrate condition in Lombok Island is damage but intoxicated. The damage caused by large decreasing area (BPDAS Dodokan; Muslim, 2012). However, decreasing of mangrove area can cause habitat loss of deposit-feeder crab that lead to its extinction. Crabs in Lombok Island have been explored in some studies, such as study about crabcomposition in estuary ecosystem (Matsuura *et al*., 2000; Moosa & Aswandy, 1995). Most of studies are concentrated on sea water without any consent on the mangrove crab, because of the lack of study that consent on the species composition, distribution, and characteristics of deposit-feeder crab in mangrove of Lombok Island.

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METHODS

Sampling process was conducted in three districts, there are North Lombok, West Lombok, and East Lombok (Figure 1). Sampling sites were chosen randomly because most of mangrove forest areas in Lombok have been degraded. The chosen sites were mangrove areas with good condition. Deposit feeder crabs were collected by digging the burrow with small shovel. After being catch crabs were preserved gradually in 40% and 70% alcohol. Some specimens from Museum Zoologicum Bogorinese (MZB) also used as sampling product (Appendix 1).

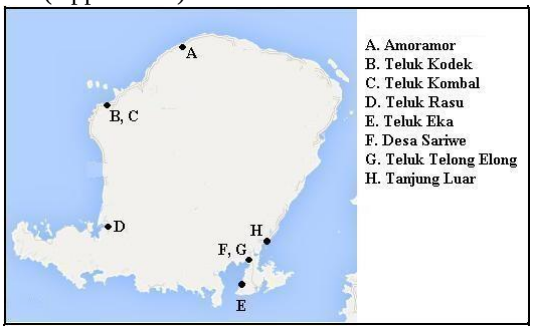

Figure 1. Crab Sampling Location

All samples were identified according to the identification keys from Allen (2010), Crane (1975), and Davie and Kasuge (1995). The distribution pattern of the crabs was determined based on forest types then made compared to the map of the forest type by Nandini *et al*. (2011). Substrate types were identified then compiled with crab composition in order to determine the distribution pattern of mangrove area both seashore and land. The correlation of substrate and crabs characteristic were determined by observing the cutlery, chelipeds, and the second maxillipeds. The observation was conducted using microscope which equipped with a drawing tube that can obtain detail images.

RESULTS

Deposit-feeder crabs distribution in Lombok Island

There were ten species of deposit-feeder crab found in Lombok Island (Table 1 and Figure 2). Each sampling location shows different species composition. The highest species diversity found in Teluk Rasu with 8 species from genus *Uca*. The second highest density found in mangrove of Tanjung Luar with 6 species from genus *Uca* and 1 species from genus *Dotilla*. The lowest diversity found in Amoramor with 1 species of crab, *Tmethypocoelis ceratophora*.

Table 1. Deposit-feeders crab composition on Mangrove area in Lombok Island

Species	Location							
	Amoramor	Teluk Kodek	Teluk Kombal	Teluk Rasu	Teluk Eka	Desa Sariwe	Teluk Telong Elong	Tanjung Luar
Uca annulipes	-	+	+	-	-	-	-	-
U. bellator	-	-	-	+	-	-	-	+
U. demani	-	-	+	+	-	-	-	-
U. dussumieri	-	-	-	+	-	+	-	+
U. forcipata	-	-	-	+	-	-	-	+
U. perplexa	-	+	+	+	+	+	+	+
U. vocans	-	+	+	+	+	+	+	+
U. triangularis	-	-		+	-	+	-	-
Dotilla myctiroides	-	-	-	-	-	-	-	+
Tmethypocoelis ceratophora	+	-	-	-	-	-	-	-

Distribution pattern of the crab population in mangrove ecosystem

The highest density of deposit-feeders crab found at two sampling sites, Teluk Rasu and Tanjung Luar. Whole species were found in these two areas, they live and d their activity on substrate surface with specific characteristic. The characteristic differences became the border between populations (Figure 3). *Dotilla myctiroides* (soldier crab) also found in Tanjung Luar.

There were seven species of deposit-feeders crab in Tanjung Luar mangrove that form layered distribution pattern. The closest layers to the riverbank were inhabited by *D. myctiroides* population. The first layer was sandy-mud substrate. The second layer was dominated by mud and inhabited by *Uca vocans.* The third layer inhabited by *U. perplexa*. Beside of *U. vocans* and *U. perplexa* there was *U. dussumieri* that inhabited these layers but not in large number of population. In the bottom of *U. perplexa* population there was vegetation area with mud substrate that inhabited by *U. bellator* at the front and *U. forcipata* at the back.

Characteristic of the crab cutlery

The observation indicates that there was clear distinction of the cutting edge of the cheliped. There were two specific characteristic of *Uca* genus, which smooth and serrated (Figure 4.)

Uca annulipes, *U. perplexa*, and *U. vocans* have same characteristics which smooth, while other *Uca* species have serrated cutting edge. *Tmethypocoelis* and *Dotilla* have curved claws characteristic, but *Tmethypocoelis* there was blunt serrations on its cutting edge.

Maxilliped characteristic distinction of deposit feeder crab was in the second maxilliped. Second maxilliped characteristics presented in setae structure and composition (Figure 5).

U. annulipes and *U. perplexa* have similar characteristics. *Uca bellator*, *U. demani*, *U. dussumieri*, *U. forcipata*, and *U. triangularis* have similar characteristic, while *U. vocans* characteristic was different from all other species. Maxilliped morphology and characteristics of *Tmethypocoelis* genus were similar to *Uca*, while *Dotilla* was different from both of those genera. The maxilliped structure in both of *Uca* and *Tmethypocoelis* were hard as carapace structure. While the second maxilliped of *Dotilla* was as soft as foam and covered with short setae.

DISCUSSION

Forest areas that preferred as sampling location were influenced by human activities, but the substrate condition still appropriate to inhabited by crab. Based on Nandini *et al.* (2011), mangrove points are classified as three forest types. They are wet forest (paramo), rain forest (rain paramo), and rain forest (Figure 2.). Rain paramo can be found from low to high plateau, such as mountain, while rain forest found only on specific height plateau. Thus, these classification are based on Holdridge Life Zone system classify forest based on the annual rainfall, temperature, and evapotranspiration potential (Villers-Ruiz & Trejo-Vázquez, 1997). Mangrove at Amoramor classified as rain paramo, while Teluk Kodek, Teluk Kombal, Teluk Rasu, Teluk Eka, Desa Sariwe, and Teluk Telong Elong were classifies as wet forest. Tanjung Luar that consisted of two deposit-feeders crab genera

was classified into wet forest (paramo) type. This ecosystem has higher habitat variation. This sampling location was surrounded by settlements with traditional sewage system that end in the river. The waste enriches mangrove substrate with organic matter. This condition makes the substrate became more suitable to be inhabited by some species deposit-feeders crabs. It was proved by six species of the deposit feeder crabs that can be found inhabit the substrate. With similar condition, there were seven species of deposit-feeders crab found in Teluk Rasu, they were from genus *Uca*. Substrate type that inhabited by genus *Uca* and *Dotilla* generally dominated by mud and sandy-mud with weak water river stream. On the contrary, there was only one crab species found in Amoramor. *Tmethypocoelis ceratophora* that found in this location was not associated with other deposit-feeders. Substrate type inhabited by *Tmethypocoelis ceratophora* consisted of dense mud as hard as clay with gravel with high water river stream. This substrate characteristic was not relevant with behavior of crabs from *Uca* genus which make burrows in soft substrate (Crane, 1975; Lim *et al*., 2004) and crabs from genus *Dotilla* that cover their body with layer above their substrate when the tide (Gherardi *et al*., 2002).

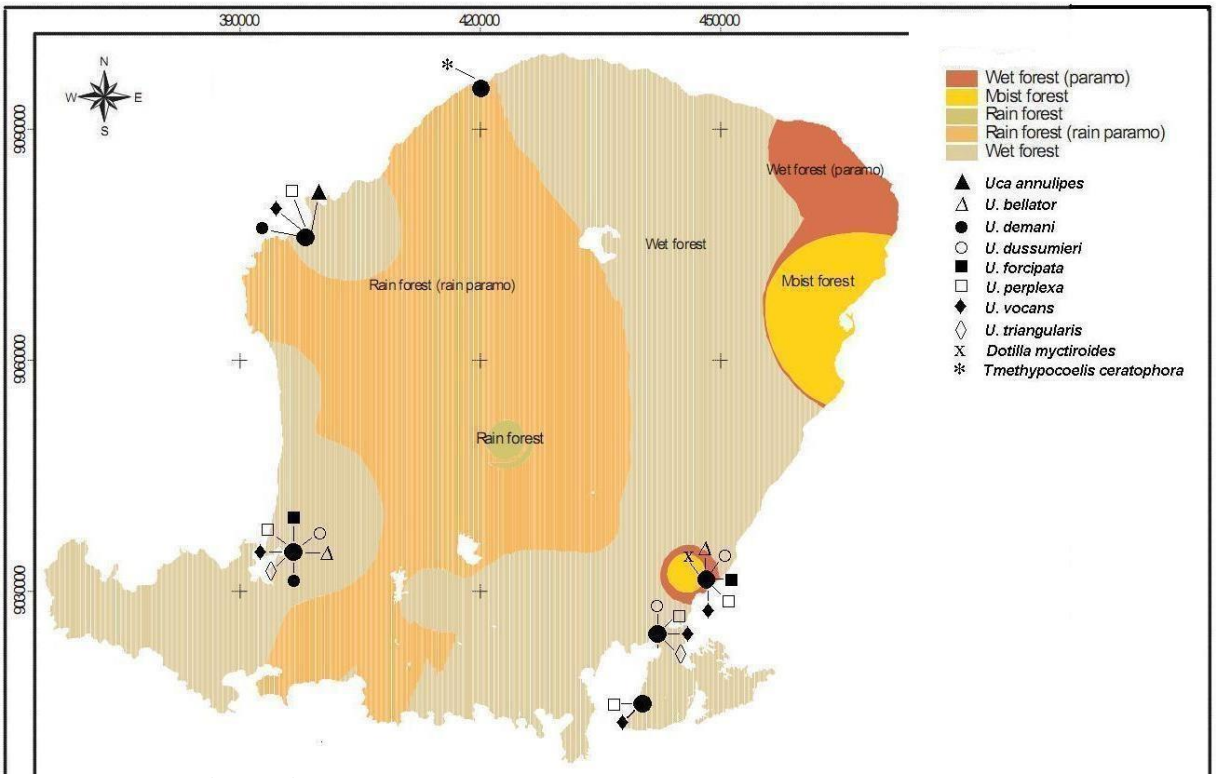

Figure 2. The distribution of deposit-feeders crab in Mangrove area in Lombok island (Source: Forest type Map by Nandini *et al*., 2011).

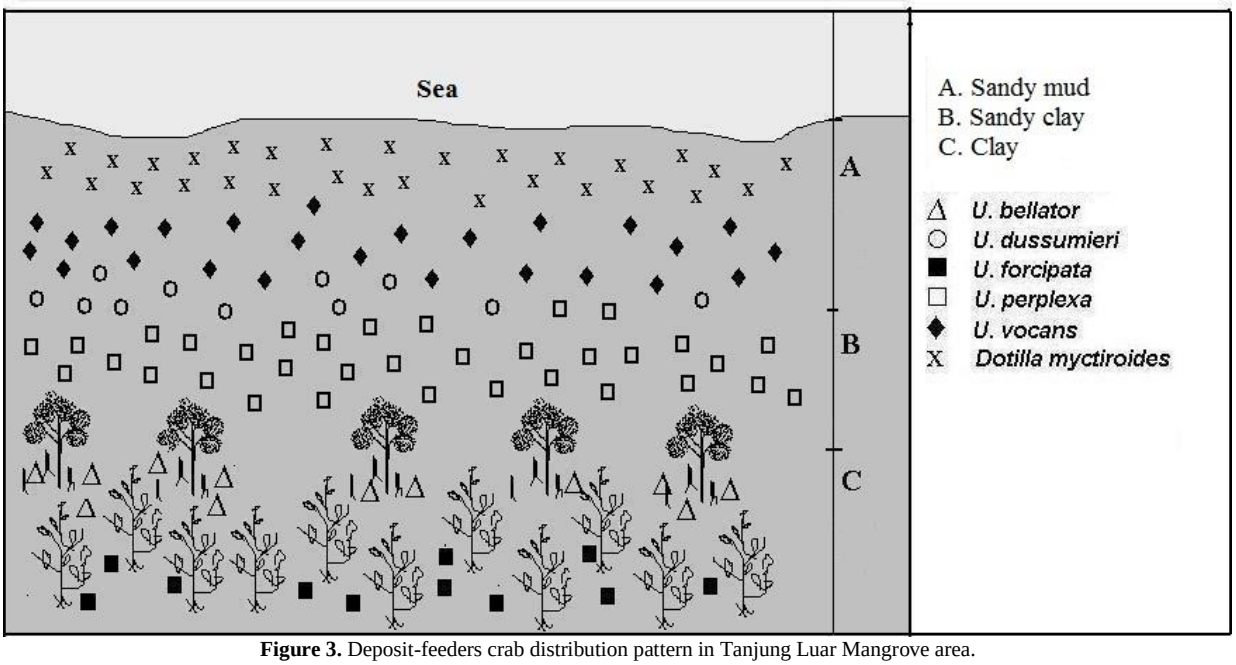

Figure 3. Deposit-feeders crab distribution pattern in Tanjung Luar Mangrove area.

Uca vocans that found in Tanjung Luar mangrove was associated with *D. myctiroides*. Study in Bali Island found that high population density of*D. myctiroides* in Kalong Island that has sandy substrate (Murniati, 2010). Habitat conditions in this island was clean and pristine, while in Tanjung Luar was exposed by domestic sewage. Allen (2010) found that genus *Dotilla* possess physiological and behavioral adaptation by adopting isospatial strategy. *Dotilla* has ability to inhabit area with high content of organic matter as long the surface of organic material regularly renewed when covered by the tide that can be found in Tanjung Luar.

Genus *Uca* was distributed in muddy and sandy substrate. An ecosystem possibly inhabited by seven species of *Uca*, but each species has ability to adapat in different microhabitat. This condition was demonstrated by the characteristic differences of cheliped and maxilliped (Figure 4 and 5). The characters of both cutlery were fixed which have been established since crabs entering to the juvenile phase and did not change until they reach the adult stage. Therefore, the characteristics of cutlery can be used as supporting character in species identification.

Unlike the other genus that use both cheliped as cutlery, genus *Uca* only use their minor cheliped. The function of minor cheliped is to scoop the substrate particles toward maxilliped. Cheliped characteristic was correlated with the substrate. Species that inhabited sandy-mud substrate or sandy substrate have entire cutting edge on its chelipeds. On the contrary, crabs that inhabited mud substrate have serrated cutting edge. The presence of serration was expected having two functions, separate large particle from small particle before processed by mouthpart and hold the sediment from the first intake until reach maxilliped. The cheliped characteristic of *Dotilla* and *Tmethypocoelis* were curved, that have same function with *Uca*'s serrations.

Maxilliped consists of three layers from the inside to outside. The outer layer called as third maxilliped, the middle as the second maxilliped, and the inner is the first maxilliped. The third maxilliped structure of *Uca* and *Tmethypocoelis* were as hard as carapace. Unlike *Dotilla* that has third maxilliped with hard structure, while their second and first maxilliped were soft. This structure correlated with two feeding behaviors of *Dotilla*, deposit-feeders and filter feeder (*planktonic algae-feeders*) (Allan, 2010).

On feeding process, sediment that scooped by cheliped was accepted by the third maxilliped. Setae on the third maxilliped will continue to deliver it to the second maxilliped. Setae of the second maxilliped will dredged the organic material from sediment and swept it onto the first maxilliped. The first maxilliped not only dredged and incorporate organic matter, but also pushed back the remains of sediment particles (Rosenberg, 2000; Allen, 2010). The process of sediment intake and drop through these three maxilliped layers were using floatation mechanism.

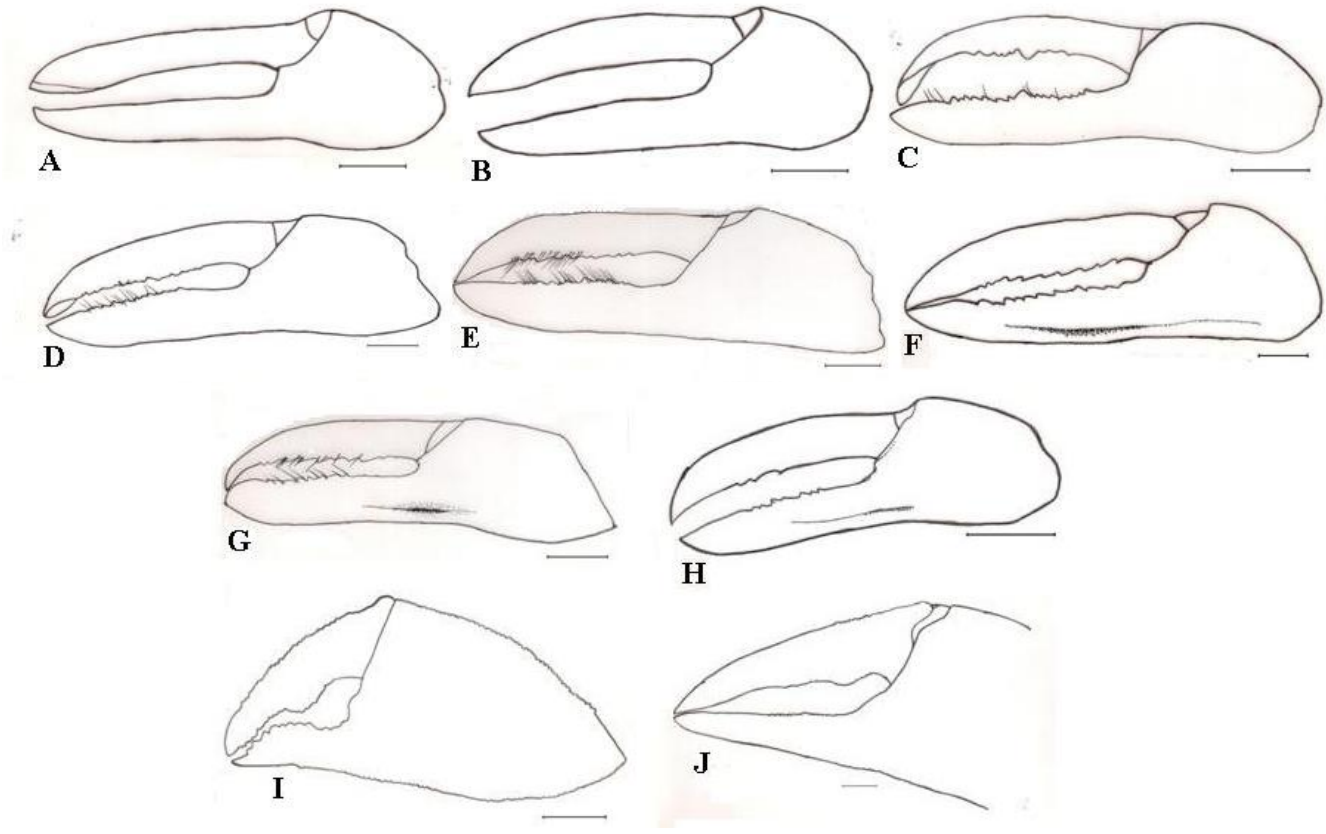

Figure 4. The Characteristic of cheliped Dorsal Surface of the deposit-feeders crab in Lombok island. (A) *Uca annulipes*, (B) *U. perplexa*, (C) *U. vocans*, (D) *U. bellator*, (E) *U. demani*, (F) *U. dussumieri*, (G) *U. forcipata*, (H) *U. triangularis*, (I) *Tmethypocoelis ceratophora*, (J) *Dotilla mictyroides*. Scale: 1 mm.

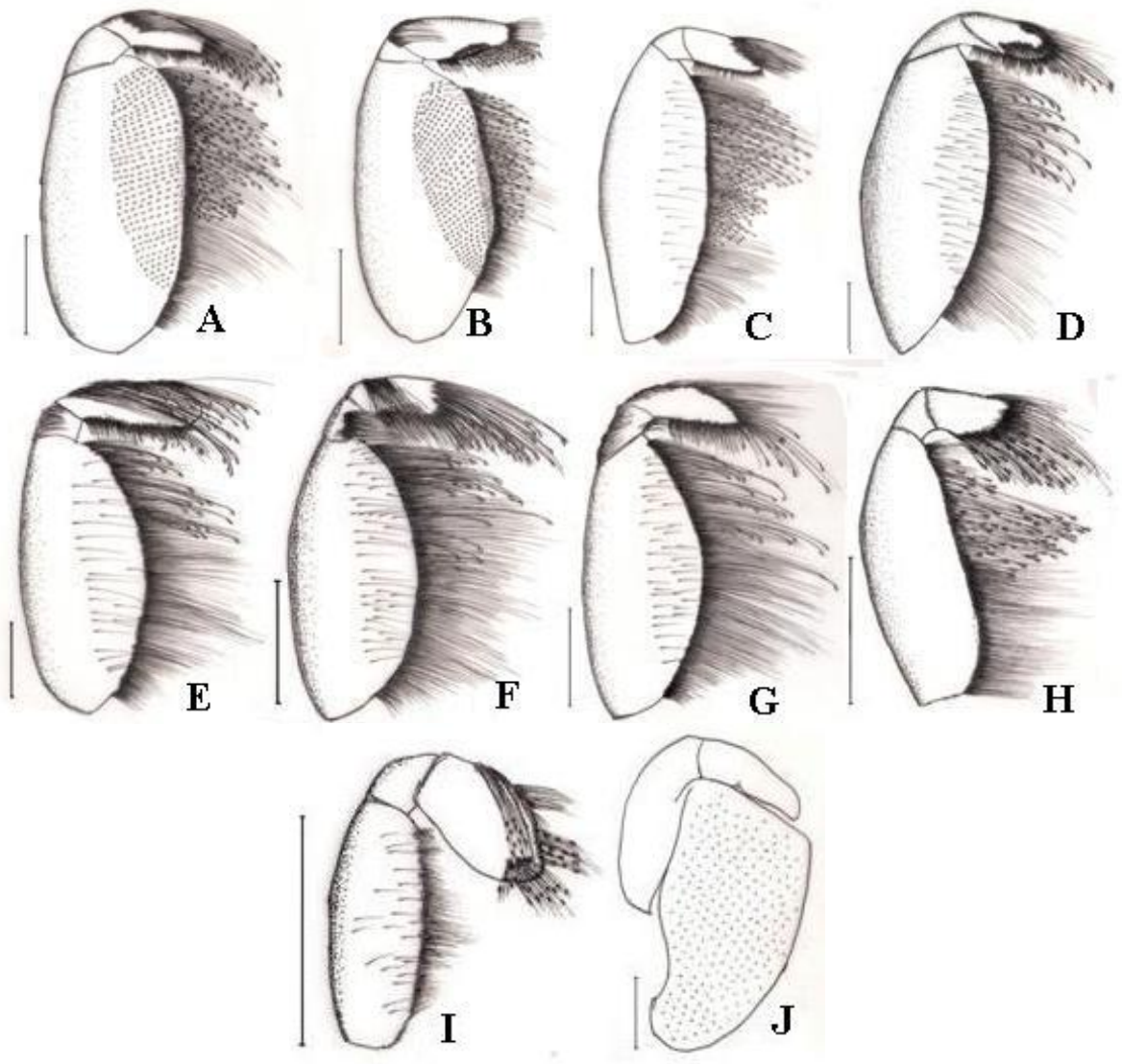

Figure 5. The characteristic of dorsal surface of the second maksilliped. (A) *Uca annulipes*, (B) *U. perplexa*, (C) *U. vocans*, (D) *U. bellator*, (E) *U. demani*, (F) *U. dussumieri*, (G) *U. forcipata*, (H) *U. triangularis*, (I) *Tmethypocoelis ceratophora*, (J) *Dotilla mictyroides*. Scale: 1 mm.

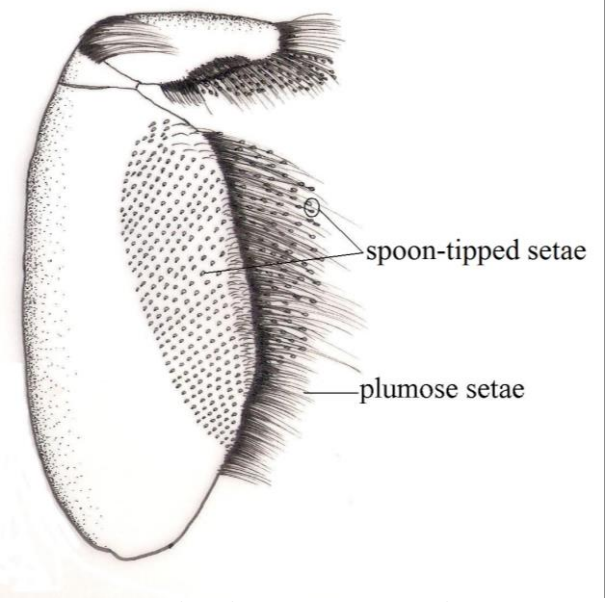

Figure 6. Dorsal Surface of the Third Maksilliped of *Uca annulipes*

Setae on the second maxilliped were highly dense compared to the third maxilliped. Because of that, this part become the most important tools in the eating process and be the specific characteristic that shows correlation with the substrate (Figure 6.). There were two types of setae on *Uca* and *Tmethypocoelis*, spoon-tipped setae and plumose setae. While, *Dotilla* had only spoon tiped setae which covered entirely on maxilliped surface. The tip of spoon-tipped setae were rounded, while plumose setae have pointed tip shape. Maxilliped that dominated by spoon-tipped setae indicate correlation with sandy-mud or sandy substrate. Instead, the maxilliped that have fewer spoon-tipped setae indicate correlation with muddy substrate (Crane, 1975; Lim, 2004).

Maxilliped observation according to the distribution of crabs in ecosystem describes that *U. perplexa*, *U. vocan,s* and *Dotilla myctiroides* inhabited sandy-mud substrate. While, other species that inhabited muddy substrate was *U. perplexa* that has the same characteristic with *U. annulipes* that found abundant in higher plateau

area. *U. vocans* that has many spoon-tipped setae inhabited sandy substrate. . Lim *et al*. (2005) explain that high mud content in the lower area than *U. perplexa* area, the *U. vocans* only moved to the higher area with high mud content.

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REFERENCES

Allen CJ, 2010. Ecology of the intertidal crab Dotilla Intermedia from tsunami-impacted beaches in Thailand. Thesis for the degree of Doctor of Philosophy. University of Southampton.

BPDAS Dodokan. http://sim-lps.dephut.go.id/mangrove/pic/data/bpdas/. Accessed on July 15th 2014 13:00.

Crane J, 1975. Fiddler Crabs of the World, Ocypodidae: Genus Uca. Princeton University Press, New Jersey.

Davie PJF and Kasuge T, 1995. A new species of Tmethypocoelis (Crustacea: Brachyura: Ocypodidae) from Japan. The Raffles Bulletin of Zoology 43(1): 207-215.

Gherardi F, Russo S and Lazarra L, 2002. The function of wandering in the sand-bubler crab, Dotilla fenestrate. Journal of Crustacean Biology 22(3): 521-531.

Kochl R and Wolff M, 2002. Energy budget and ecological role of mangrove epibenthos in the Caete estuary, North Brazil. Marine Ecological Proceeding Series 228(1): 119-130.

Lim SSL, 2004. A comparative study of some mouthpart adaptation of Uca annulipes (H. Milne Edwards, 1837) and U. vocans (Linnaeus, 1758) (Brachyura, Ocypodidae) in relation to their habitats. Crustaceana 77(10): 1245-1251.

Lim SSL, Lee PS and Diong CH. 2005. Influence of biotope characteristics on the distribution of Uca annulipes (H. Milne Edwards, 1837) and U. vocans (Linnaeus, 1758) (Crustacea: Brachyura: Ocypodidae) on Pulau Hantu Besar, Singapore. The Raffles Bulletin of Zoology 53(1): 111-114.

Matsuura K, Sumadiharga OK and Tsukamoto K, 2000. Field Guide to Lombok Island: Identification guide to marine organisms in seagrass beds of Lombok Island, Indonesia. Ocean Research Institute, University of Tokyo. Tokyo.

Moosa K and Aswandy I, 1995. Krustasea dari padang lamun di perairan Lombok Selatan. http://www.coremap.or.id/downloads/1995.pdf. Accessed on July 15th 2014 13:00

Murniati DC, 2010. Komposisi jenis kepiting (Decapoda: Brachyura) dalam ekosistem mangrove dan estuari, Taman Nasional Bali Barat. Berita Biologi 10(2): 259-264.

Muslim, 2012. Kerusakan Ekosistem Mangrove dan Upaya Pelestariannya di Kab. Lombok Barat. http://asia.ifad.org/web/indonesia/ . Accessed on July 15th 2014 13:00.

Nandini R and Narendra BH, 2011. Kajian perubahan curah hujan, suhu dan tipe iklim pada zone ekosistem di Pulau Lombok. Jurnal Analisis Kebijakan Kehutanan 8(3): 228-244.

Nirarita CH, Wibowo P, Susanti S, Padmawinata D, Kusmarini, Syarif M, Hendriyani Y, Kusnianingsih and Sinulingga Lbr, 1992. Ekosistem Lahan Basah Indonesia. Wetlands International-Indonesia Programme. Bandung.

Qureshi NA and Saher NU, 2012. Density, distribution and population biology of Macrophthalmus (Venitus) dentipus Lucas, 1836, from mangrove areas of Pakistan. Pakistan Journal of Zoology 44(3): 615-623.

Rosenberg MS, 2000. The comparative claw morphology, phylogeny, and behavior of fiddler crabs (Genus Uca). Dissertation for the degree of Doctor of Philosophy. State University of New York.

Shaher NU and Qureshi NA, 2010. Zonal distribution and population biology of Ilyoplax frater (Brachyura: Ocypodoidea: Dotillidae) in a coastal in coastal mudflat of Pakistan. Current Zoology 56(2): 244-251.

Takagi KK, Cherdsukjai P, Mimura I, Yano Y, Adulyanukosol K and Tsuchiya M, 2010. Soldier crab (Dotilla myctiroides) distribution, food resources and subsequent role in organic matter fate in Ao Tang Khen, Phuket, Thailand. Estuarine, Coastal and Shelf Science 87: 611-617.

Villers-Ruiz, L. & Trejo-Vázquez I, 1997. Assesment of the vulnerability of forest ecosystems to climate change in Mexico. Climate Research 9 : 87-93.