Jurnal Riset Biologi dan Aplikasinya, Volume 4, Issue 2, September 2022

Jurnal Riset Biologi dan Aplikasinya

https://journal.unesa.ac.id/index.php/risetbiologi

On the abundance and occurrence of the mangrove crabs, *Scylla* spp. (Crustacea: Portunidae) from Munjang mangrove, Bangka Belitung Island

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Article History

Received : 5 May 2022
Revised : 12 August 2022
Approved : 19 September 2022
Published : 30 September 2022

Keywords

Decapoda, estuary, muddy substrate, Munjang mangrove Portunidae

ABSTRACT

The mangrove ecosystem is one of the most productive ecosystems on earth. This ecosystem provides a lot of functions for the living organism inhabiting here, such as fishes, mollusks, echinoderms, crustaceans, ect. The mangrove crab is one of the common crustaceans that can be found in the mangrove. This Purtunidae crab is very popular due to their role in the food chain as well as for the economic income that has a high value in the market. However, overexploitation may decrease the crab population. This study aimed to investigate the abundance and occurrence of the mangrove crabs from Munjang mangrove, Bangka Belitung Island from August 2020 to June 2021 using baited traps with the line transect method at four zones. A total of four species of mangrove crabs, *Scylla olivacea*, *S. paramamosain*, *S. serrata* and *S. tranquebarica*, were found in this location and dominated by *S. serrata*. Shannon diversity index (H') was a in low category (<1), evenness index range (J) from 0.35 to 0.89, and there was dominant species in this study. The bed sediment iswas dominated by the muddy clay substratum except in zone 4 with sandy. Overall, this location is a suitable habitat for the *Scylla* spp. And better management is urgently needed before these crabs are exploited by humans.

How to cite: Raniah, N., Henri & Kurniawan. (2022). On the abundance and occurrence of the mangrove crabs, Scylla spp. (Crustacea: Portunidae) from Munjang mangrove, Bangka Belitung Island. *Jurnal Riset Biologi dan Aplikasinya*, 4(2): 75-82. DOI: 10.26740/jrba. v4n2.p.75-82.

INTRODUCTION

Crustaceans exhibit great the disparity in basic body plans, but disparity of crustaceans is different from crustacean biodiversity, that is, the number of species we have within any group. No one knows for certain the exact number of species within any group organism, although the situation might improve with the appearance of online catalogs for groups. The people who set up these databases and maintain them as new species are added and old species are placed in synonymy provide a much-needed service toward adequately cataloging the tree of life. Nevertheless, as humans, we like number-they are easily understood (Schram, 2013).

One groups of the crustaceans that have high diversity is Malacostraca, which includes crabs, shrimps, and their kin (Brusca & Martin, 2016). This class has a wide distribution in their habitat, from inland/terrestrial, freshwater to seawater and their occurrence in the habitat plays an important role, especially in food chain (Brusca & Brusca, 2003). The mangrove ecosystem is one of the most productive ecosystems on earth where the organics and non-organic material accumulate. A lot of living organisms can be found here and most of them have high value in the economic sector/market, from the mangrove trees, fishes, mollusks, crustaceans, and other organisms (Alongi, 2009). The mangrove crabs from the group of *Scylla* spp. Are very popular among the other crabs due to their large size and are valued as a source of food, even farmed commercially on a large scale in Southeast Asia (Naylor & Drew, 1998; Trino et al., 1999; Marichamy & Rajapackiam, 2001; Murniati et al., 2022).

The occurrence of these crabs also is influenced by the environmental conditions that always fluctuate every single second, such as temperature, salinity, pH, substratum compositions, hydrological conditions, and even the structure of flora. High temperature and salinity can be tolerated by the Scylla spp. (Alberts-Hubatsch., 2016), however, the absorption of atmospheric CO_2 lowers pH in seawater (ocean acidification) and brings negative effects or calcification rates of marine organisms' variety, including crabs (Ries et al., 2009; Byne, 2011). Even though crustaceans with a relatively thick epicuticle seem to be less affected (Ries et al., 2009; Small et al., 2010), however, early life stage (such as the larvae stage) may get affected. For most of the benthic species, such as crabs, soil sediment proprieties always determine the habitat choice (Mokhtari et al., 2015); Checon & Costa, 2017), especially for burrowing activity (Lie et al., 2015) because soil consistency impacts the ability of crabs to dig and maintain the structure of burrows (Riberio et al., 2005; Mokhtari et al., 2015). At the low tide, intertidal areas are mostly dominated by juveniles and sub-adult crabs that are found under mangrove leaves or in shallow burrows (Mirera, 2007), while the large one prefers to live in sub-tidal areas (Walton et al., 2006). For the flora, the species Scylla olivacea is more abundant on the *Xylocarpus* sp., *Rhizophora mucronata* and *Bruguiera* sp., whereas, *S. serrata* prefer to *Sonneratia alba*, *Rhizophora mucronata* and *Bruguiera* sp. (Yunus & Siahainenia, 2019).

Kurau Barat Village is in the Central Bangka Regency that covers area of 651,952 hectares including mangrove zone. One of the mangrove zones in this location is also known as Munjang mangrove with coverage of about 213 Ha, where a lot of important commercial fisheries resources occur. However, a year ago, a total of 30 Ha of this mangrove zone has been exploited and converted for tourism which may affect the living organisms, especially the Scylla spp. that has a high value in the economic income. Unfortunately, the information about some biological notes on the mangrove crabs, *Scylla* spp., in this location is still limited. -Hence, this study was carried out to investigate the abundance and occurrence of the mangrove crabs, *Scylla* spp., from Munjang mangrove, Bangka Belitung Island.

MATERIALS AND METHODS

Study Sites

The Munjang mangrove forest is situated at the 2°19'21" S and 106°13'27" E on the east coast of Bangka Belitung Island and covers about 213 Ha (see Figure 1). The mangrove species in this location consist of *Sonneratia alba*, *Rhizophora apiculata* and *Bruguiera sexangula*. The present study was carried out at 4 sites (zones) of the Munjang mangrove which was planted by *Sonneratia alba*, *Rhizophora apiculata*, *Bruguiera sexangula*, *Exoecaria agallocha*, *Nypa fruticans*, *Xylocarpus granatum*, *Acrostichum speciosum*, *Ceriops tagal*, and *Heritiera littoralis*. The condition of these zones is a muddy clay substratum, with a depth water condition (approximately 0.5 to 2 meter). The salinity condition in this area is fluctuated due to the mixing of the freshwater from the inland with the seawater from the east coast of Bangka Belitung Island.

Sampling Methods

Sampling was carried out at 4 zones of Munjang mangrove, Bangka Belitung Island from August 2020 to June 2021. The mangrove crabs, *Scylla* spp. were collected using rattan fish traps (mud crab traps) which were equipped with eels as abit (*Monopterus albus*). The samples were collected using line transect methods with 3 lines and a 50-meter distance of each line. In each transect line, 5 x 5 meter plot was made with five replicates 5 meters apart from each other (Figure 2). The traps were installed at each zone from 01.00 to 10.00 AM considering the active time of the mud crabs. Ng (2017) has explained that the best time to catch crabs is at night because many species are nocturnal. Burrowing species come out mainly at night. The best time at night varies, from just one to two hours after sunset for some species to well into the early morning hours for others. Different species also respond differently to the lunar cycle. Crabs are generally less fearful of humans, come out earlier at night, and are generally easier to catch in

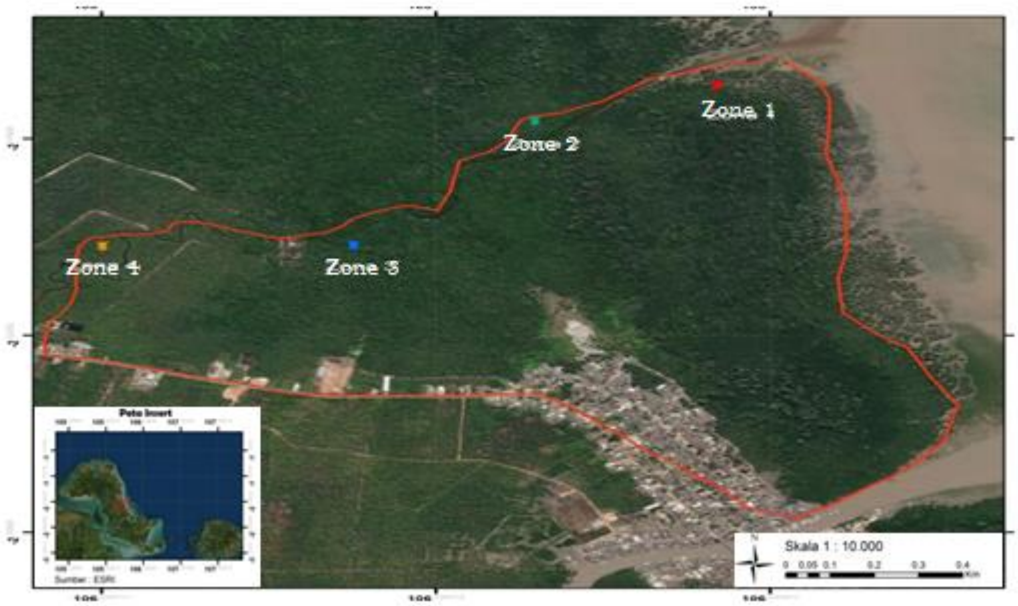

Figure 1. The map showing the study sites at the 4 zones of Munjang mangrove, Bangka Belitung Island

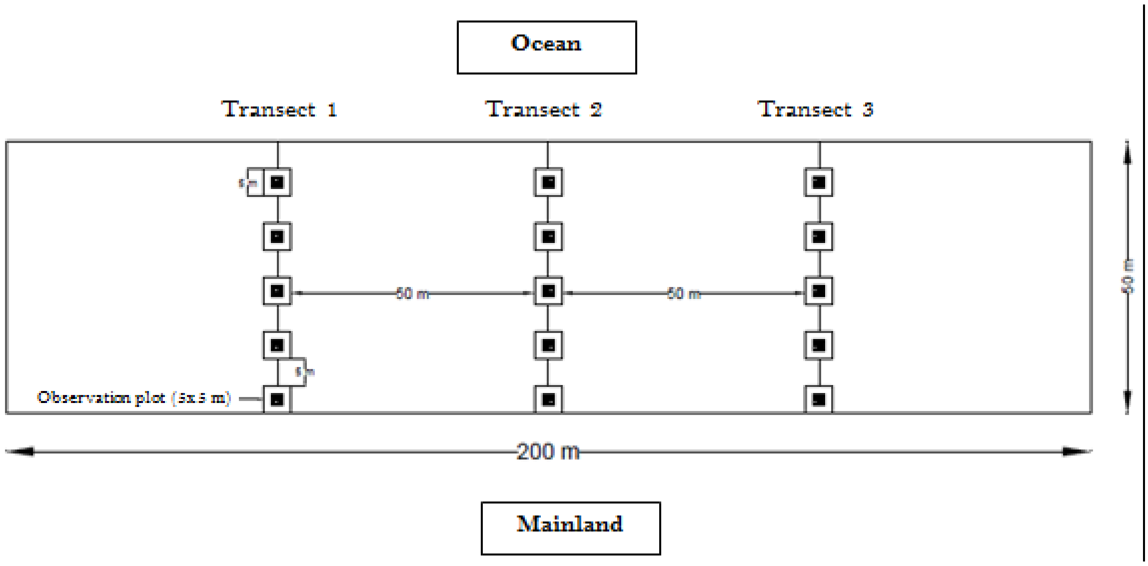

Figure 2. The sample collection technique used 3 line transect with 5 plots (25 m² each) at each zone in the Munjang mangrove, Bangka Belitung Island from August 2020 to June 2021.

areas with few human inhabitants. In this study, the maximum number for each species per catch was limited to 3 individuals only with a carapace width >15 centimeters, and the rest were released to their habitat again, based on the Decree of Ministry Number 1 of 2015. All the collected samples from the field were then cleaned from the mud, trash and other materials and stored in a cool box filled with ice temporary before transported to the laboratory.

Several environmental variables were also measured directly during the sampling session, such as temperature, water depth, and current velocity, meanwhile, DO, pH, salinity, and sediment fractions were measured in the laboratory. The temperature was measured using a thermometer, water depth using bathymetry, and velocity using a velocity meter. Bed sediment representing recent deposits was collected by scooping the upper 5 cm of the sediment with a plastic spade at 50-150 cm water depth. The sediment was packed and sealed in plastic containers. The collected crabs including the environmental data then transported to the Biological Laboratory, Faculty of Agriculture, Fisheries, and Biology, Universitas Bangka Belitung for further investigation.

In the laboratory, each crab was sorted and identified to the lowest taxonomic unit by observing the morphological characteristics. Identification of the species level was performed following Ng (1998). After that, the number was counted for analysis and stored in 70% ethanol. For the unfinished environmental data, further examination was conducted to obtain the data. Dissolved oxygen was measured using a DO meter, pH using a thermometer, and salinity using a refractometer. Sediments were air-dried in an oven at 500°C and the samples were passed through standart mesh sieve to separate the grant size or type of the sediment, such as clay, silt, or sand using the Shepard triangle method.

Data Analysis

For the crabs, all of the data were analyzed descriptively. Due to the limited data, the abundance and their relative abundance value were omitted. Several indices were used to calculate the data, as follows:

***Shannon-Wiener's diversity index* (H')**

$$H' = \sum\left(\frac{ni}{N}\, ln \frac{ni}{N}\right)$$

Where *ni* is the number of individuals in the abundance of species-*i* and *N* is the total number of individuals in the community (Magurran, 1988), with the criteria: High (H'>3.22), Moderate (1.00≤H'≤3.22) and Low (H'<1.00).

***Simpson's evenness index* (J)**

$$J = \frac{H'}{ln(S)}$$

Where H' is the value of the *Shannon-Weiner* diversity index and *S* is the number of species that occur in the area.

Simpson's dominance index (D)

$$D = \frac{\sum ni}{C}$$

Where this formula is the result of *ni* (the number of individuals in the abundance of species-*i*) which is divided by *N* (the total number of individuals in the community) and 2 squared (Magurran, 1998). The minimum value is 0 and the maximum value is 1.

RESULTS AND DISCUSSION

Environmental Variables

In this study, the measurement on the variables showed a minor variation from all of 4 zones, except for the water depth. The temperature ranged from 27.1 to 28.1°C with an average of 27.5±0.19°C; water depth ranged from 37 to 90.73 cm with an average of 62.11±2.70 cm; the velocity ranged from 0.34 to 0.55 with an average of 0.46±0.07 m/s; water acidity (pH) ranged from 5.87 to 6.32 with an average of 6.06±0.07; dissolved oxygen ranged from 5.45 to 8.35 mg/l with an average of 6.26±0.70 mg/l; and salinity ranged from 23 to 25 ppt with an average of 24.00±0.07 ppt. Detailed information is showed in Table 1.

Shepard triangle examination showed that the bed sediment in this mangrove forest are constructed by sand, silt and clay. The majority of the sediment here was dominated by the clay, followed by silt and sandy substrates; except for the zone 4 that was observed from zone 2, meanwhile lowest in zone 4. The highest percentage of the silt substrates occurred in zone 1 and lowest in zone 3, and the highest percentage of the sandy substrate was observed in zone 4, meanwhile lowest in zone 2. Detailed information is provided in Figure 3.

Mangrove crabs species composition with the biological indices

A total of species of the mangrove crabs belonging to 52 individual were identified from Munjang mangrove, namely *Scylla olivacea*, *S. paramamosain*, *S. serrata* and *S. tranquebarica* (see Figure 4). Among them, *S. serrata* was the most abundant with 50% from total of all species and distributed at all 4 zones, meanwhile *S. paramamosain* was the lowest one with 5 individuals. On the first to the third zone, the crabs consisted of 3 species, meanwhile only 2 species in the last zone. Of the biological indices, the diversity value (H') was ranged from 0.67 to 1 with the highest value was on the first zone and lowest in last zone; the evenness value (J) was ranged from 0.35 to 0.89 with the highest in the second zone and lowest in the first zone; and the dominance value (D) was ranged from 0.39 to 0.52 with the highest in the last zone and lowest in the first zone (Table 2).

Table 1. The result from the measurement of several environmental variables in the Munjang mangrove, Bangka Belitung Island from August 2020 to June 2021

Zone	Environmental variables					
	Temp. (°C ± SD)	Depth (cm ± SD)	Current velocity (m/s ± SD)	pH (value ± SD)	DO (mg/l ± SD)	Salinity (ppt ± SD)
I	27.9 ± 0.37	37.00 ± 1.05	0.34 ± 0.10	6.09 ± 0.02	5.72 ± 1.51	25.0 ± 0.02
II	28.1 ± 0.06	62.73 ± 2.26	0.55 ± 0.05	5.94 ± 0.11	5.51 ± 0.60	24,0 ± 0.03
III	27.2 ± 0.06	90.73 ± 5.18	0.45 ± 0.02	5.87 ± 0.11	8.35 ± 0.20	25.0 ± 0.10
IV	27.1 ± 0.26	58.00 ± 2.32	0.51 ± 0.12	6.32 ± 0.02	5.45 ± 0.48	23.0 ± 0.11
X ± SD	**27.5 ± 0.19**	**62.12 ± 2.70**	**0.46 ± 0.07**	**6.06 ± 0.07**	**6.26 ± 0.70**	**24.00 ± 0.07**

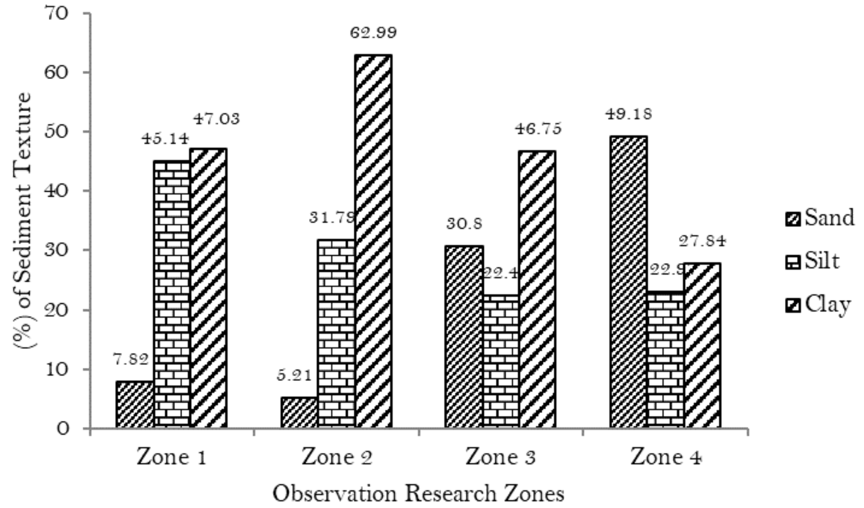

Figure 3. The composition and percentage of bed sediments in the Munjang mangrove, Bangka Belitung Island after examined using the Shepard triangle method

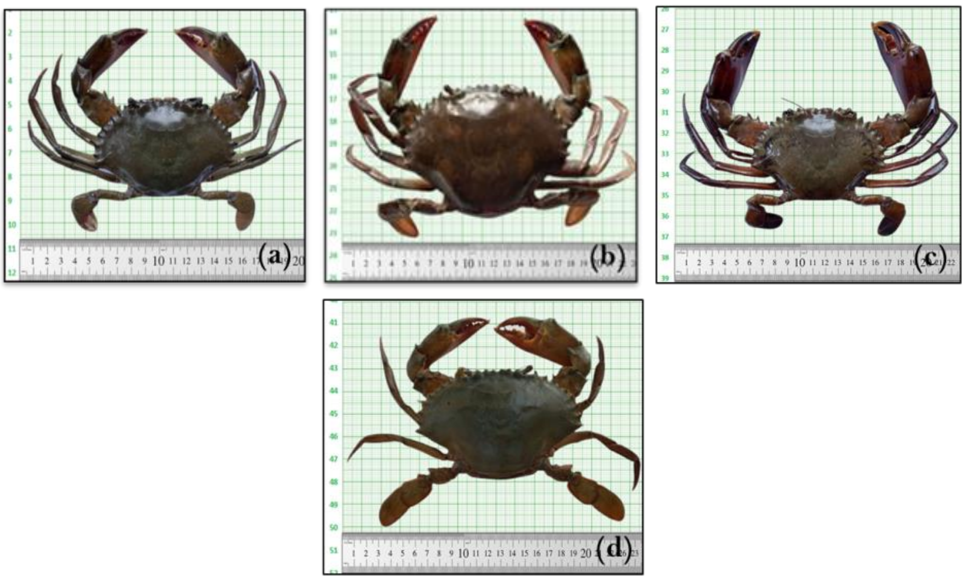

Figure 4. The species of mangrove crabs from Munjang mangrove, Bangka Belitung Island. (a) *Scylla serrata* (b) *S. olivacea* (c) *S. tranquebarica*, and (d) *S. paramamosain*

Table 2. Species composition, individual number and the biological indices of the mangrove crabs from Munjang mangrove, Bangka Belitung Island from August 2020 to June 2021

The *Scylla* spp. and biological indices value	Zone			
	1	2	3	4
Scylla olivacea	3	4	2	0
S. paramamosain	5	0	0	0
S. serrata	9	7	8	2
S. tranquebarica	0	2	7	3
Shannon-Wiener's diversity index (H')	1	0.98	0.97	0.67
Evenness index (J)	0.35	0.89	0.88	0.61
Dominance index (D)	0.39	0.40	0.40	0.52

Our findings showed that the *S.serrata* is the predominant species among the mangrove crabs in this location, followed by *S. tranquebarica*, *S. olivaceae* and *S. paramamosain*; although this species is not the dominant one based on dominance index calculation. This result may be affected due to the habitat condition in Munjang estuary, such as zonation, the species of mangrove, sediment character and also environmental variables. Avianto et al. (2013) reported that the species *S.serrata* had a wide distribution in the Cibako mangrove forest, Garut District, West Java and was very abundant in the opening/fringing zone, however, its abundant gradually decreased from the intermediate to the landward zone. Meanwhile, *S. tranquebarica* was very abundant in the intermediate zone and *S. paramamosain* in the landward zone. The abundance of *S.serrata* was also reported being correlated with the mangrove density and the species of mangrove, mostly from *Rhizophora* spp. (La Sara et al., 2014; Tahmid et al., 2015). The characteristics of the sediment also influence the presence of the mud crab. The opening/fringing zone is always in contact with the water from inland and also the seawater, hence, the sediment in this area always muddy. The muddy sediment is very rich with organic materials and other living fauna (such as fishes, gastropods, and bivalves) that can be used as food resources for the mud crabs (Alberts-Hubatsch et al., 2016).

The environmental variables also determine the occurrence of the mud crabs in the habitat. The *Scylla* spp., mostly has a wide tolerance to the condition of temperature and salinity. Tropical and subtropical condition is very suitable for their lives (Avianto et al., 2013; La sara et al., 2014; Alberts-Hubatsch et al., 2016; Karniati et al., 2021). However, temperatures below 16°C causes them in active (Hill, 1980). They also can tolerate the salinity from low conditions to the higher condition (Davenport & Wong, 1987; Hill, 1979; La Sara et al., 2014; Karniati et al., 2021), however, extreme salinity (more than 64) is lethal for their life (Hill, 1979). Water and mud depth including the dissolved oxygen also cause an impact on the living of the mud crabs (Karniati et al., 2021). Overall, our findings in the Munjang mangrove forest showed that the condition and characteristics of the mangrove in this area were suitable and supported the occurrence and living of the mud crabs.

CONCLUSION

Four species of the mud crabs (*Scylla olivacea*, *S. paramamosain*, *S. serrata* and *S. tranquebarica*) were live in the Munjang mangrove. *S. serrata* was the predominant species and occured in all study sites. Its highest abundance was found in the opening/fringing zone, while *S. tranquebarica* in the intermediate zone. The diversity of the mud crabs in this study was low (H'<1.00) and no dominant species based on dominance index (D). The condition of environmental variables, such as temperature, salinity, water depth, water velocity, pH and DO was very suitable for the mud crabs that live in this mangrove. Future management in this mangrove zone is needed due to the potential of the these crabs in economic value or commercial before overexploited.

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