Population studies of *Cerithidea obtusa* (Lamarck 1822) in mangrove forest Pangkal Babu, Tanjung Jabung Barat, Jambi

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Abstract. Snail *Cerithidea obtusa* has an important role in the mangrove ecosystem as a decomposer and this species generally serve as food in some Southeast Asian countries, especially in Indonesia. The research of the population studies the snail in the mangrove forest of Pangkal Babu was conducted in January to February 2012. In conducting the research, we divided the sites into 3 stations by using the Purposive Random Sampling. The average of density population ranges between 3.87–7.87 ind/m². The highest of average density population was founded in station 3, which was located in the back of the mangrove forest. It was dominated by plants of *Avicennia* sp. and *Rhizophora* sp. The snail has cluster spreading pattern. The shell length was measured between 1.8–4.4 cm, the weight was between 0.38–1.8 grams, and biomass ranges from 0.3–1.8 grams. The Spearman correlation test results indicated there was no correlation between the density of *C. obtusa* and abiotic parameters.

Keywords: *Cerithidea obtusa*, population, density, distribution, mangrove forest

1. Introduction

The mangrove forest ecosystem of Pangkal Babu located in Tungkal Ilir sub-district, Tanjung Jabung Barat district is a conservation area based on the Decree of the Minister of Forestry Number: 14 / Kpts-II / 2003 dated January 7, 2003. One species of Gastropoda species that has high abundance in Pangkal Babu mangrove forest is snail *Cerithidea obtusa*. The snail has an important role in the mangrove ecosystem as a decomposer [1].

*Cerithidea obtusa* is one of the original mangrove gastropods of the Potamididae tribe. The snail is found generally at the root and branches of mangrove trees, above the substrate, or on the mudbank in the tidal area. These animals are often found in the wettest places at the lowest ebb [1]. This species generally serve as food in some Southeast Asian countries, especially in Indonesia. *Cerithidea obtusa* has a thick and conical shell, with some whorl, sculpture with spiral and axial ribs and consists of 6-7 spirals above between whorl and 4–5 axial ribs in the second part of the back of the whorl (sometimes more). The shell colour is dark brown or purplish brown, at the bottom of the suture the color is brighter. Whorl 7–8 is always broken. The whole whorl is convex, the suture is rather deep. The edge is rounded but when the young is angular. The base is rounded with the number of 12–15 fine spiral ridges. Size up to 50 mm, width 27 mm, aperture height without peristome 12 mm [2].
Cerithidea obtusa spread in the Indo-Western Pacific region, Madagascar, India, Malay Peninsula, Siam, Indo-China and Malaya Islands, Indonesia, Philippines and Queensland [2-4]. The population density of snail in Matang Mangrove (Malaysia) was recorded at 0.48 individuals per m² [5] while the population density in the Mahakam Delta (East Kalimantan) was recorded at 0.05 individuals per m² [6].

As one species of Gastropoda in the mangrove ecosystem, C. obtusa has an important role, with respect to the food chain in the region as a detritivor [1, 7]. In addition to the detritus eaters, C. obtusa also plays a role in tearing and shrinking the newly fallen litter. It is very important to accelerate the decomposition process of litter by microorganisms [5, 8, 9].

Cerithidea obtusa also has a role as a source of food containing protein [9]. Fisherman in the Pangkal Babu region collects and trade the snail even exported to Malaysia and Singapore. Continuous harvesting will decrease in the abundance of the snail.

The purpose of this study was to determine the density, distribution and growth patterns of C. obtusa. The benefit of this research was to inform the structure of snail population in the Pangkal Babu mangrove ecosystem.

2. Methodology

2.1. Location and time of study

The research was conducted in the mangrove forest of Pangkal Babu, Tungkal Ilir, Tanjung Jabung Barat, Jambi, Indonesia. The Tanjung Jabung Barat is located between S 0°53’– 01°41’ and E 103°23’– 104°21’ (figure 1). Data were collected from January 2012 to February 2012.

We divided the research location into 3 stations, namely:

1. Station 1, was located on the front of the mangrove forest. Its location was somewhat open with rare mangrove vegetation with a density of species 0.09 ind/m² and generally was Sonneratia sp. and Avicennia sp.
2. Station 2, was located in the middle of mangrove forest with denser vegetation with species density of 0.15 ind/m² and generally was Rhizophora sp. and Avicennia sp.
3. Station 3, was located at the back of mangrove forest near a residential area. The density of the vegetation species was 0.15 ind/m² and the substrate was drier than the Station 2, commonly Rhizophora sp.

2.2. Tools and materials

We used GPS, meter, quadrant of raffia rope, plastic bag, thermometer, hand refraktometer, soil tester, caliper vernier, electric scales, O’Hauss balance sheet, oven, crus cup, Olympus digital camera, Luxmeter, bucket, and alcohol 70 %.

Figure 1. Research location (black arrow) in the mangrove forest of Pangkal Babu, Tungkal Ilir, Tanjung Jabung Barat, Jambi.
The research location is divided into 3 stations using Purposive Random Sampling method, with the distance between station 500 m. At each station 3 transect lines are made with the distance between transects 20 m. Each transect consists of 5 plots with a size of 1 m x 1 m and the distance between plots is 10 m. In each plot, we collected *C. obtusa* and took 100 gr of the substrate and measured temperature, salinity and pH substrate. The amount of samples which have already obtained will be recorded and put into plastic bags and labeled from each square as data to calculate population density and distribution.

Subsequently, the collected snail was measured in the height of the shell using a vernier caliper and weighed by using an electric scales. Animals removed from their shells and then weighed wet weight with O’Hauss scales. Then dried by the oven and weighed again to get the dry weight.

2.3. Data analysis

From the data, we calculated density, distribution of the snail also correlation between density and C-organic content in substrate. The relationship of length and weight *C. obtusa* data were analyzed by the regression.

3. Results and discussion

3.1. Density

Based on the analysis, the average density of *C. obtusa* at Station 1 was 3.87 ind/m$^2$, Station 2 was 7.80 ind/m$^2$, and Station 3 was 7.87 ind/m$^2$. The high average density of *C. obtusa* at Station 2 and Station 3 was presumably because both stations have sufficiently dense vegetation compared to Station 1, so the resultant litter was also abundant. *Cerithidea obtusa* is one of the original gastropods of mangrove which is a detritus or litter gut. This is in line with Budiman’s [10] opinion, which states that the presence of native littropods of litter-eating mangroves is largely determined by the presence of vegetation in mangrove forests [6].

The low average density of *C. obtusa* at Station 1 was presumably because the vegetation of Station 1 is more open than Station 2 and Station 3. This causes high ambient temperature, low humidity which inhibits litter decomposition process. This results in a lack of food for the snail resulting in low density [6].

The average density of *C. obtusa* in the Pangkal Babu mangrove forest was relatively high when compared to other areas such as Matang, Malaysia, which recorded 0.48 individuals per m$^2$ [5] and in the Mahakam Delta, East Kalimantan 0.05 individuals per m$^2$ [6]. This was alleged because of environmental conditions in the Pangkal Babu mangrove forest with a dense vegetation structure more dense than in Matang, Malaysia and in the Mahakam Delta. These conditions caused high environmental temperatures, low humidity to inhibit litter decomposition processes and lead to a lack of food for *C. obtusa* [5, 6].

Based on results of the Morisita dispersion index analysis, the distribution pattern of *C. obtusa* at each station was clustered, with values ranging from 1.5–4.7. The highest dispersion index is in Station 1 with a dispersion index value of 4.7. The snail is the original gastropod of mangroves, whose life associate with mangrove vegetation that tends to approach mangrove trees [11].

In addition to spreading horizontally, *C. obtusa* also spreads rapidly to overcome the tidal changes of sea water because the snail can also live at the roots and stems of mangrove vegetation. Gastropod species belonging to the family of Cerithidea are known to feed on the substrate surface and climb trees to rest when the tide occurs and will descend back to the forest floor at low tide [12]. The distribution pattern of *C. obtusa* in Pangkal Babu mangrove forest was clustered, while *C. californica* on Sipora Island was uniform [11]. The uniform distribution pattern of *C. californica* on Sipora Island was thought to be due to its high adaptability to the environment [11].
3.2. Abiotic parameters

Overall abiotic parameter conditions such as temperature, pH, substrate salinity and light intensity in the mangrove forest ecosystem of Pangkal Babu were still within the normal range and were still tolerable by *C. obtusa*. The temperature in Pangkal Babu mangrove forest ranged from 29–34 °C still in tolerance Gastropoda temperature range that is between 25–32 °C [13]. The highest temperature was at Station 1, which is 29–34 °C, because the Station 1 was located adjacent to the beach and more open area than other station.

The range of pH measurements at each station is 5-7 still within the tolerance range of Gastropoda pH ranging from 5 to 9. This condition indicates that Pangkal Babu mangrove forest still supports Gastropoda life which was commonly found in areas whose pH is greater than 7 [13].

The salinity measurements at each station range from 20 ‰ to 26 ‰. The results of these measurements are still within the range of Gastropoda tolerance ranging from 25 ‰ to 40 ‰ [13]. The highest salinity was found in the Station 3 located in the rear mangrove forest adjacent to the mainland, because at the time of data collection just happened high tide so that substrate salinity becomes high. While at the Station 1, the measurement resulted range from 20 ‰ to 24 ‰, because at the time was raining and mixing with the seawater and cause the salinity was lower. Types of substrate at the station 1, 2, and 3 in Pangkal Babu mangrove forest consisted of mud. Abiotic parameter measurement results are presented in table 1.

3.3. Growth pattern

Based on the regression test results, the relationship between length and weight gain on *C. obtusa* showed an allometric growth pattern with b value being 0.647 and R² was 0.962. The length relationship with the weight was shown in figure 2. The result of growth analysis of *C. obtusa* through the relationship between length and weight is known that the increment of snail's shell length will be followed by weight gain. The more calcium carbonate content in the substrate the more weight the shell will accelerate. Marshall [14] states that in addition to the availability of adequate nutrients, other factors that affect the formation of shells are the content of calcium and pH in the substrate. High calcium content in the substrate will accelerate the formation of the shell and high acidity will cause erosion on the shell [15]. As a result, the increase in shell length is faster than weight gain. While the value of R² shows the magnitude of the relationship between the length and weight of *C. Obtusa*, R² value ranges from 0–1, getting closer to 1 means the relationship was getting stronger. The value of R² obtained for the length and weight relationship of *C. obtusa* is 0.962, it means that the length influences the weight of 96.2 % and 3.8 % is influenced by other factors. Based on the regression graph it is assumed that the weight gain of *C. obtusa* will continue to increase as the length increases until it reaches the maximum shell length. According to [1], the maximum shell length of *C. obtusa* 50 mm.

3.4. Spearman correlation test between shell length and *C. obtusa* biomass

The results of Spearman analysis know that between the lengths of the shell with *C. obtusa* biomass there was a positive correlation. This means that the addition of shells will be followed by the increase

| Abiotic Parameters | Station 1 | Location | Station 2 | Station 3 |
|--------------------|-----------|----------|-----------|-----------|
| Temperature (°C)   | 29–34     |          | 30–32     | 29–30     |
| pH                 | 5–7       |          | 5.6–6.4   | 6–6.8     |
| Salinity (‰)       | 20–24     |          | 20–23     | 20–26     |
| Light intensity (Lux)| 50–125  |          | 48–1100   | 19–160    |
| Substrates         | Mud       |          | Mud       | Mud       |
| C organic contains (%)| 2.54–4.94|          | 2.36–4.4 | 2.54–9.8 |
Figure 2. Graph of length versus weight of snail.

of C. obtusa biomass. It is suspected that the mangrove forest ecosystem of Pangkal Babu contains high calcium. According to [14], the factor that affects the formation of the shell is the content of calcium in the substrate. The calculation result obtained by correlation coefficient on Station 1 was 0.849, at Station 2 was 0.914 and at Station 3 was 0.921. The value of the correlation coefficient indicates the correlation between the length of snail's shell and its biomass was very strong.

3.5. Correlation between C. obtusa Density with abiotic parameters
Based on Spearman correlation test results found no correlation between the density of C. obtusa with abiotic parameters. This was alleged because the substrate in Station 1, Station 2, and Station 3 are relatively the same, ie in the form of sludge so as not to affect the density of C. obtusa. Mangrove snail population density is strongly influenced by the type of substrate [16].

4. Conclusion
The density of C. obtusa in the mangrove forest of Pangkal Babu was determined by the vegetation structure present in the ecosystem. Distribution patterns C. obtusa in the mangrove forest Pangkal Babu was clustered. The increase in the length of C. obtusa's shell was followed by the addition of weight. The increase in the shell length of C. obtusa was followed by the addition of its biomass. There was no correlation between the density of C. obtusa and abiotic parameters in Pangkal Babu mangrove forest.

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