Molting mud crab (Scylla serrata) in the mangrove ecosystem service

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Abstract. Mud crabs (Scylla serrata) are one of the coastal fisheries commodities, especially in mangrove forests. This study was proposed to determine mangrove ecosystems service to produce molting of mud crab (S. serrata). This research on mangrove crab molting using a completely randomized design with four levels of treatment, namely ablation, autotomy, ablation + autotomy and control with three replications. The highest growth rate was ablation (molting percentage 80.95%, and 100% survival, growth 12.51% per day) and lowest ablation + autotomy (growth 4.95%/day, molting percentage 19.05%, growth 4.95% of the day). The differences in molting stimulation affect the percentage of molting.

1. Introduction
Mangrove forests are natural resources that have unique characteristics in the ecological and economic functions [1]. Ecologically, the mangrove forest functions as a spawning area and nursery ground of various commercial species both fish and shrimp, crabs and the habitat of various types of faunas. Economically, mangrove potential was obtained from three primary sources, namely forest products, fisheries, and beaches (shallow waters), and ecotourism [2].

Mud crabs (Scylla serrata) are one of the coastal fisheries commodities, especially in mangrove forests [3]. Mangrove crabs are one of the fisheries commodities that have significant economic value and are one of the leading fisheries products of the Ministry of Maritime Affairs and Fisheries [4]. The enormous market potential provides an opportunity for the development of mangrove crab cultivation more severely and commercially available [5]. One export demand that continues to increase is soft shell crabs or often called Soka crabs. Softshell crabs production activities have bright prospects to be used as an alternative to fishing business activities [6]. This fishery commodity is an export product that has a relatively high price compared to hard-skinned crabs.
Large-scale use of mangrove land for intensive and super-intensive ponds has led to environmental degradation, disease attacks, low seed quality, in addition to inadequate service and extension are some of the many factors causing crop failure and conditions of the collapse of the aquaculture industry [7]. This condition provides a lesson that with the availability of limited natural resources, the flow of goods and services generated from natural resources cannot be done continuously as an effort to reduce dependency or at least giving time to nature for recovery.

One of the fisheries resources that has the potential to be developed in mangrove forests and has high economic value and is an export commodity is mud crabs (S. serrata). Mud crab market opportunities are wide open and prospective, both domestic and foreign markets with the demand of more than 450 tons every month [8]. This work aimed to study the effect of various methods of stimulation molting, survival, and growth as well as to determine the factors of production levels in the cultivation of soft-shelled crabs.

2. Materials and method

2.1. Implementation of research stages

The mud crab (Scylla serrata) used comes from the coastal waters of the village of Lubuk Kertang, West Brandan District, Langkat Regency. Dark crab indicator traits as molting. The initial weight of the crab used ranged from ± 7 g, length ± 7 cm, and width ± 5 cm. The study used a completely randomized experimental design. Spreading mud crabs carried out by placing in cages step on bamboo slats with a size of 1 x 2 x 1 meter is placed in ponds with a depth of ± 1 m. The density of crabs in the shelves is 2 1 heads, the placement of the treatment in the cage was done, namely autotomy, ablation, autotomy + ablation, and control [9].

2.2. Growth

Growth observation is based on the specific growth rate obtained through gravimetric bodyweight weighing calculations. The daily specific growth rate on crabs, as previously reported [9].

2.3. Per molting sentiment

Observing molting is done every week by counting how many crabs that replace the skin (molting). Observation of the survival rate can be determined by counting how many initial/total crabs in each rearing tank are still alive and how many crabs died at the time of observation.

2.4. Environmental parameters

Measured environmental parameters included several water quality parameters, including temperature, pH (acidity), salinity, and DO, as previously described [7]. The measurement of water quality parameters is carried out with the observation time interval of 2 times, namely when spreading crab seeds and post-harvest.

3. Results and discussions

3.1. Growth rate

The daily specific growth rate of mangrove crabs (S. serrata) from the highest sequentially is in the ablation treatment that is 12.51%/day. Then in the control that is 9.5%/ day, the autotomy treatment results show 8.82%/day and the lowest in the ablation + autotomy treatment reached 4.95%/day. The results on the daily specific growth rate, as displayed in Table 1.

Table 1 showed the daily specific growth rate of mangrove crabs (S. serrata) on the ablation method showed the highest results compared to the autotomy and ablation + autotomy methods. This data is consistent with the results of research [4], which showed that the crab treated with ablation had a growth rate and gonad maturation rate higher than the crab without ablation.
Table 1. The daily specific growth rate of mangrove crabs (S. serrata)

| Treatment                  | Average initial weight (g) | Average end weight (g) | Growth (%/day<sup>-1</sup>) |
|----------------------------|----------------------------|------------------------|-----------------------------|
| Control                    | 7.05                       | 52.38                  | 9.55                        |
| Autotomy                   | 6.05                       | 38.57                  | 8.82                        |
| Ablation                   | 5.58                       | 77.14                  | 12.51                       |
| Ablation and autotomy      | 5.05                       | 14.28                  | 4.95                        |

The ablation method is a method with a higher growth rate because it has more molting than other methods. While at the time of molting, there was a significant increase in growth both in size, weight, and length. According to [10], crustacean growth is influenced by hormonal control, namely molting hormone, the influence of stimulation from outside and age.

3.2. Percentage of molting

Molting percentage average rat a mud crab (S. serrata) in control indicated the first week until the third week the percentage of molting 0% because there is no occurrence of skin turnover process on the crab. Furthermore, the ablation method shortly percentage of molting did not occur in the first week, molting occurred in week two, namely 52.38% and Sunday to three, namely 28.57% so we can conclude the ablation method has several molting percentage of 80.95%. In the autotomy, the method shows the percentage of molting 0% there is no percentage of molting in the first week. Furthermore, in the Ablation + Autotomy method, there is no percentage of molting in the first week and the third week, the percentage of molting occurs during the second week that is equal to 19.05%.

The results showed that molting occurred after the second week. The highest percentage of individual molting is achieved by the ablation method. According to [11], in crustacean eye stalks, some hormones can inhibit molting and gonad development. Therefore, the elimination of producing organs that inhibit molting hormone in the eyestalk through the process of ablation can further increase the number of molting occurrences in cultivated crabs. The process of ablation works directly to the target organ, namely by removing the eyestalk as an organ that produces molting inhibiting hormones so that the molting process works quickly.

Table 2. The number of crabs that replace the skin (molting)

| Time      | Control | Ablation | Autotomy | Ablation and Autotomy |
|-----------|---------|----------|----------|-----------------------|
| 1st week  | 0       | 0        | 0        | 0                     |
| 2nd week  | 0       | 52.38    | 0        | 19.05                 |
| 3rd week  | 0       | 28.57    | 0        | 0                     |
| Total     | 0       | 80.95    | 0        | 19.05                 |

Furthermore, the autotomy method was performed by injuring the claws and cutting the foot of the road, but the eyestalk is still intact so that the molting inhibiting hormone is still formed. The autotomy method also causes stress because the pain due to treatment is higher than the treatment of other methods, namely clamping of the legs and legs. This condition requires the crab to heal again in the formation of new individuals.

From the results of the study showed that the highest survival rate was achieved by ablation treatment in the amount of 100%. This is thought to be due to the wound caused by the ablation method, which is smaller than the wound in the treatment method autotomy so that the Ablation +
Autotomy method has the lowest survival rate. The difference in survival rate is caused by several factors, including the level of stress caused by the injury received by crabs. Wounds obtained in the autotomy method make crabs need more time to recover from their condition. This injury can also cause infection due to bacteria present in the media of seawater and bacteria originating from the rest of the feed, causing death. According to [12] argues that crabs that are already stressed, the body's physiological balance is disturbed, so that their endurance decreases, giving opportunities to parasites, viruses, and water quality fluctuations to enter and damage the physiological function of crabs so they can cause death. Biologically breaking the claws and legs can stimulate crab organs to grow back. This condition because after the claws and legs walk off the crab, the crab will be stimulated to improve the morphological function of the body employing changing the skin so that it will become a soft shell crab [13].

3.3. Environmental conditions
In the following Table can be seen that the shoot when measurements waters in ponds that range 28-30°C so it can be said that the temperature in the ponds observation has been proper, it is in line with the report [3], namely Shoot best at growth and life of crab mangrove is 25 °C - 35 °C. Further observations of salinity in the ponds have been excellent, and it ranged between 18-20, it is appropriate m according to [12] salinity which is suitable for per mud crab namely the range of 15-30 ppt. On the observation, the pond has a pH ranging from 6.6 to 6.9, so it can be clarified that the pH on the observation pond is not proper because it is acidic [14]. This study is according to which states that a suitable pH for crab growth is 6.8-8.2 [15]. Next pond DO contain in the observations already neither the number 6.8-7.2 ppm. It fits which states that the oxygen is best for the cultivation of mangrove crab is > 4 ppm.

| Parameter | Unit | Value | Quality standards |
|-----------|------|-------|-------------------|
| Temperature | °C   | 28-30 | 25-35 |
| Salinity | %   | 18-20 | 15-30 |
| pH | -   | 6.6-6.9 | 6.8-8.2 |
| DO | ppm | 6.8-7.2 | > 4 |

4. Conclusions
Differences in the method of stimulation of molting affect the percentage of molting, survival, and growth of mangrove crabs (S. serrata). The highest percentage of molting, survival, and daily specific growth rate were achieved in the ablation method (percentage of molting 80.95 %, and survival 100 %, growth 12.51 %/day). Daily specific growth rate, lowest molting rate achieved by ablation + autotomy method (growth 4.95 %/day, molting percentage 13.33 ± 5.78%).

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