Growth and survival rate of blue swimming crab enlargement in the south coast of Pamekasan, Madura Island

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F Ramadhan[1], **R Z Wicaksono**[1], **D Darmawan**[1*]

[1] Indonesian Blue Swimming Blue swimming crab Association (Asosiasi Pengelolaan Rajungan Indonesia-APRI), Surabaya, Indonesia

*E-mail: rajunganindonesia@gmail.com

Abstract. Indonesia has fishery commodities favoured by the world market, especially blue swimming crab fisheries. Fishing activities that continue to increase have caused the blue swimming crab population in nature tend to decrease. Therefore, it is necessary to develop aquaculture in ponds and coastal waters. However, blue swimming crab enlargement has technological constraints that have yet to be widely known by the wider community. The study aimed to determine the survival rate of blue swimming crabs in coastal waters using ponds conducted in Pamekasan, East Java. The parameters measured were the width of the blue swimming crab's carapace using a ruler and the growth of the blue swimming crab's weight using a digital scale. The experimental results on blue swimming crabs obtained an absolute growth of 9.8 cm and a survival rate of 3.96%. The high rate of cannibalism in blue swimming crabs can indicate the cause of the low survival rate of blue swimming crabs. This research is expected to increase the choice of blue swimming crab enlargement to reduce the pressure of catches and be another alternative to reduce the level of blue swimming crab fishing in nature.

Keywords: blue swimming crab, enlargement, growth, *Portunus pelagicus*, survival rate

1. Introduction

Indonesia has fishery commodities that are favoured by the world market. One of these commodities is the crab fishery. Crab is one of the leading export commodities and is widely offered in restaurants [1]. Therefore, Indonesia has a high production of crab fisheries exports. However, the increase in crab production, which increases yearly, causes the yields to decrease. This is due to intensive fishing activities in marine waters [2]. This can be seen in the number of catches and the crabs' size.

According to [1], fishing activities that continue to increase cause the crab population in nature to be felt to decrease. So to reduce the exploitation of crabs caused by fishing, it is necessary to develop aquaculture in ponds and coastal waters. Crabs able live in coastal waters with good seawater input and fish ponds. They also able to live in different substrates, such as sand, mud, and clay [3].

Determining the location of crab enlargement is a challenge in itself to find a more effective location. However, the enlargement of crabs has technology constraints that still need to be discovered by the wider community. Based on this, further research on crab enlargement is expected to be another alternative to reduce fishing rates in nature. This study aimed to determine the survival rate of crabs in coastal waters based on mortality and crab size.

2. Research methodology

The study was conducted in Pamekasan, East Java, from January to May 2022. The study used ponds in coastal waters bordered by bamboo buildings with a size of 80 m^2 (8 m x 10 m). Sampling was carried out every month for 125 days. Parameters observed included carapace width measured using a ruler and weight growth using a digital scale.

Figure 1. The process of measuring the width of the carapace and weighing the crab's weight using a ruler and digital scale.

Data analysis was carried out on the growth of carapace width and body weight. The growth rate is calculated based on the following formula [4]:

$$G = (Wt\text{-}Wo)/(t) \quad (1)$$

Description: *G* = growth rate (g/day); *Wt* = weight at the end of the experiment (g); *Wo* = weight at the start of the experiment (g); *t* = trial length (days).

Absolute length growth is calculated based on the following formula [5]:

$$\Delta L = Lt - L0 \quad (2)$$

Description: ΔL = absolute length growth (cm); *Lt* = average length on day t (cm); *L0* = average length at the start of stocking crab seeds (cm).

Survival Rate is calculated based on the following formula [6]:

$$SR = Nt/N0 \times 100 \quad (3)$$

Description: *SR* = survival rate (%); *Nt* = number of live crabs at the end of rearing (ind); *N0* = number of crabs at the beginning of maintenance (ind).

3. Results and discussion

3.1. Enlargement location

The location of crab enlargement is in the village of Pagagan, specifically in the coastal area adjacent to the mangrove plant, at the coordinates 7.22929 south latitude and 113.49912 east longitude. The location of crab rearing is in protected shallow sea waters, especially in shallow (about 1-3 meters at high tide) and flat (mud flats or reef flats) areas with a not-too-wide tidal range (1-2 m). The depth of water at the enlargement location is about 80 to 100 cm, so at low tide, there is still water in the location, with the bottom of the water being muddy sand, while the water source at this location is quite dependent on the tides. This causes the water in the location to change continuously.

Figure 2. Preparation of Sak Sak (Woven Bamboo) by fishermen in Pagagan Village, Pamekasan.

Protection against current shocks is carried out by placing several sacks (woven bamboo) arranged and layered twice to make them stronger and planting used car tires near wooden stakes to protect the location from further wave impact. The size of the enlargement trial location in Pagagan Village is eight by 10 meters, which is relatively small, so it is recommended by the Jepara BBPAP technician to fill 5000 crablets. This is based on the consideration that if the crab seeds are filled with more numbers, the location will be narrow for the crabs that move actively and to avoid the effects of the nature of the crabs that eat each other (cannibals).

The provision of shelters in the form of dried coconut leaves has been carried out to reduce the risk of crab cannibalism and provide a shelter for the seeds that have been stocked. This aligns with the research results by [7], which state that certain habitats can protect crabs from predators, especially during the early crab stage. According to [8], it is emphasized that cannibalism can directly accelerate growth, and usually, larger crabs occupy a higher trophic level than smaller crabs. So that it is possible that cannibalism can occur if the size of the kept crab is not uniform anymore, especially after the tenth day during the rearing period. This shows that providing shelter other than in the form of the basic substrate (sand) cannot function as a protector, especially when the crab is molting. This indicates the need to improve the method of maintaining crablets by providing shelter not as a basic substrate but in other materials with different sizes and shapes.

3.2. Water quality at the enlargement site

The water quality at the location during the 125 days of stocking the crab seeds was measured, and salinity and pH levels were measured to determine the feasibility of the condition. The average water

salinity at the crab enlargement sites ranges from 23 to 30 ppt (Figure 3). While Figure 4 shows the development of water quality in terms of pH value during the 125 enlargement periods.

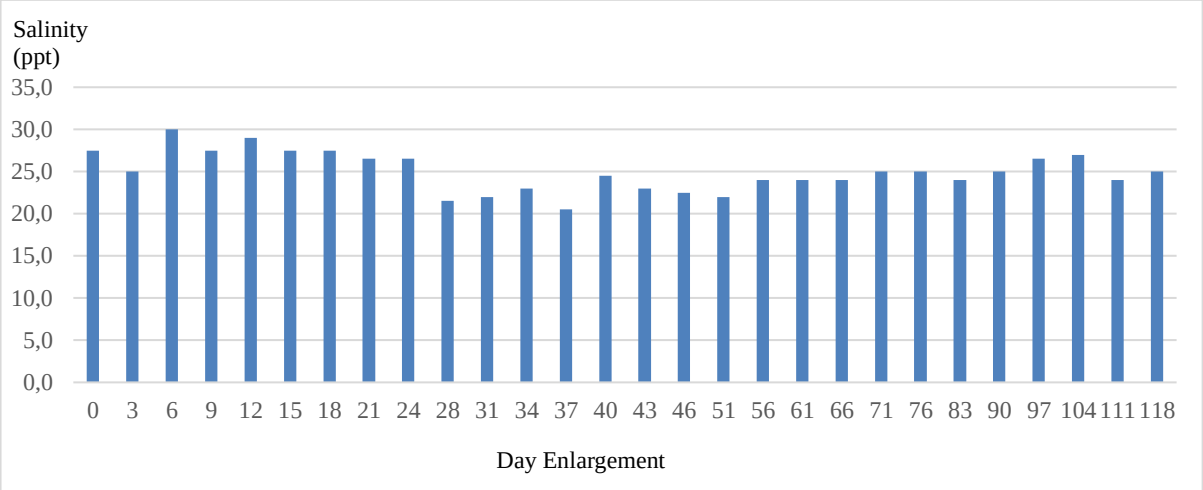

Figure 3. Water salinity conditions in crab enlargement pond.

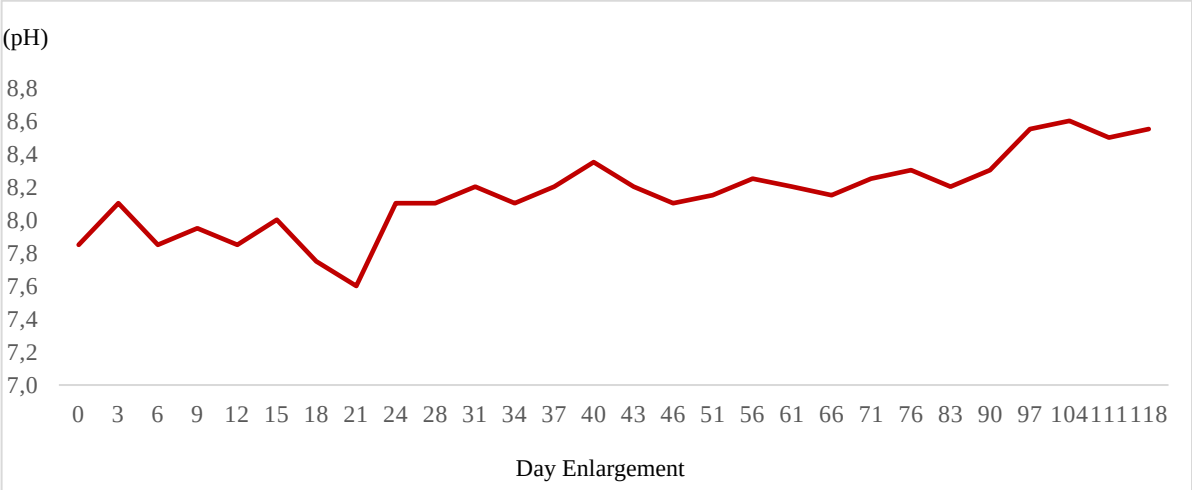

Figure 4. Water pH conditions in crab enlargement pond.

The water quality parameters used as a reference in determining the feasibility of the crab enlargement process are based on the recommendation of [9] with a pH of 7-9 and a salinity of 15-33 ppt (Table 1). Meanwhile, the water quality data at the rearing location is in the range of pH 7.5-8.2 and salinity 23-30 ppt, so it can be concluded that the water quality of the enlargement site is based on pH and salinity parameters that are still classified as normal and optimum conditions in the growth and survival of crabs. Monitoring or sampling activities are carried out every month at the beginning of the month by observing the weight and width of crab seedlings.

Table 1. Value of water quality parameter values for enlargement locations.

Parameter	Enlargement Location	Enlargement feasibility reference
pH	7.5 – 8.2	7 – 9
Salinity (ppt)	23 – 30	15 – 33

3.3. Growth rate

The absolute growth rate of the crab during 125 days of enlargement was monitored based on length (cm) and weight (grams). From the beginning of seeding until 125 days of enlargement, the length of the crab increases to 9.8 cm, where the seed length is 1 cm and grows up to 10.8 cm. Meanwhile, based on weight, there was an increase in the daily growth rate of up to 62.46%, from 0.022 grams; the weight of crab seed increased to 78.1 grams after 125 days of enlargement. These results indicate that the 5000 seeds sown in early February have grown. In more detail, Figure 5 shows the initial process of spreading the crab seeds. The growth rate of crab seeds is based on weight, carapace width, and the increase in pH and water salinity at the crab enlargement location, as shown in Figure 6.

Figure 5. The process of spreading crab seeds at enlargement location.

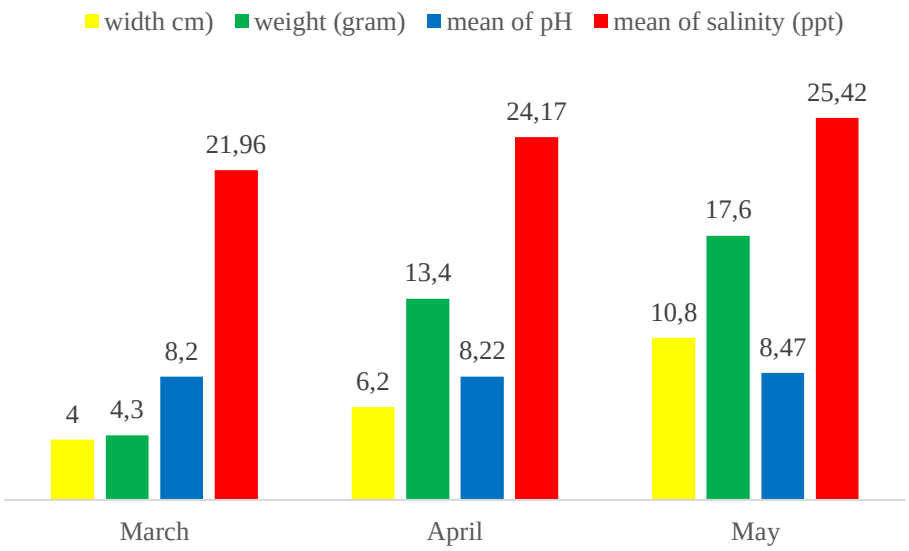

Figure 6. Graph of crab growth rate and increase in pH and salinity values of water.

The weight and width of the crab, as shown in Figure 6, continue to increase per month, and the increase in the growth rate of both weight and carapace width indicates that the crab is in decent condition [10]. The crab, at the beginning of the rearing process, is adapting to the new environment, so it requires more energy and becomes weaker, resulting in more prey for other crabs. This does not happen in the middle or at the end because the crabs have been able to adapt to their environment. It was proven that there was a slight increase in March and April, possibly because the amount of feed given was quite small because the size of the crabs was still very small, so it was feared that the ammonia content in the rearing site would be high.

3.4. Survival rate

The survival rate is one of the important benchmarks in crab enlargement. [11] Stated that the crabs at the crablet stage were more vulnerable than the larger ones. Crabs of this size, especially when the premolars show very high agitation properties, result in high mortality. The greater the opportunity for shelter, the more proportionally it increases the survival rate, and it shows that the quantity of shelter has a greater effect on reducing the rate of cannibalism in crabs.

Of the 5000 stocked crab seeds, 198 were harvested with a total weight of 15.5 kg. The low survival rate (3.96%) obtained from enlargement in the waters of Pagagan village is due to the high cannibalism of the crab. The average salinity from March to May of 24.40 ppt, which is moderate, does not cause the shifting of energy used by crabs for growth into energy for environmental adaptation. This is because the average salinity value is still in the salinity range for crab life, which is 9–39 ppt [12].

4. Conclusion

The absolute length growth rate of the crab from the initial stocking of seeds to 125 days of enlargement was 9.8 cm, which means the crab has experienced an increase in length of up to 9.8 cm from the size of the stocked crab seeds. The daily weight growth rate of crabs is 62.46%, which means an increase in weight of 62.46% from the beginning of seeding until 125 days of enlargement. The survival rate of the crab was 3.96%, in other words, from the 5000 crab seeds that were stocked, 198 crabs were successfully harvested. The low survival rate is indicated by the high rate of crab cannibalism.

Recommendation

Joint awareness, especially among fishermen, is needed on the importance of crab enlargement to reduce exploitation pressure from crab fishing activities in nature. Efforts or other alternatives are needed to suppress the effects of the great influence of crab cannibalism to increase the growth rate and survival rate of crabs in enlargement sites.

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