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Effect of Amphipods (*Grandierella megnae*) Density on the Growth and Survival Rate of Mangrove Crab (*Scylla tranquebarica*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

This study aims to determine the effect of amphipod density on the growth, survival and molting of mangrove crabs (*Scylla tranquebarica*).The research was conducted in the Installation of Tiger Shrimp Hatchery (ITSH), located Lawallu Village, Soppeng Riaja District, Barru Regency, South Sulawesi, from May to June 2022. There was 45 mangrove crabs, with an average weight of 0.04 ± 0.005 g and a carapace width of 5.4 ± 0.1 mm which were obtained from local hatcheries. The maintenance container is a glass jar containing 0.5 liters of water, each jar is filled with one crablet. The treatments tested were differences in amphipods density, namely: A) 20 ind/0.5 L, B) 30 ind/0.5 L, C) 40 ind/0.5 L, feeding frequency is once a day for first 10 days and twice a day at 8:00 AM and 5:00 PM for next 20 days. Parameters observed were growth weight (GW) and growth carapace width (GC), specific growth rate-weight (SGR-W) and specific growth carapace- width (SGR-C), survival rate (SR) and number of molting (NM). Using a completely randomized design with three treatments and three replications, each replication consisted of 5 crabs. Data were

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analyzed for variance and Duncan's further test, physical and chemical parameters of water were analyzed descriptively. The results showed that amphipod density had an effect on GW, GC, SGR-W and SGR-C, but had no effect on SR and NM. Amphipod densities of 20 - 40 ind/0.5 L produced good survival and a large number of molting, but amphipod densities of 30 ind/0.5 L were more efficient for the growth of mangrove crabs.

Keywords: Mud crab crablet; amphipod; growth; survival rate; molting.

1. INTRODUCTION

Mangrove crab (*S. tranquebarica*) have high economic value, especially in Southeast Asia, such as Indonesia, Malaysia, Singapore, Thailand and Vietnam [1]. Mud crab production in Indonesia is still dominated by catches in nature because their cultivation activities have not yet developed, such as tiger prawns, vaname shrimp, milkfish and several other types of cultivated fish [2]. The increasing demand for mangrove crabs has an impact on the availability of seeds [3]. One of the problems in seed supply is the cannibalism of crabs, especially during the megalopa-crablet phase, which causes a high mortality [1]. Budi et al [4], explained that the high mortality in this phase is referred to as the 'molting death syndrome', the inability of the larva to shed its exoskeleton completely during the molting process. Cannibalism is triggered by differences in size, density and feed that do not match both the quantity and quality [5,6].

Efforts to reduce crab cannibalism include the use of shelters [7], setting density and type of feed [5], optimal feed dosage [8], improving feed quality by using natural food *Artemia salina* [2]. However, the use of *Artemia salina* as natural feed causes production costs to increase, because the price of natural feed is increasingly expensive.

Amphipods are one of the natural food that can be developed. Amphipods are benthic fauna that inhabit marine, fresh and brackish environments which are a central part of the mangrove ecosystem [9]. Amphipods have several advantages, including being able to tolerate various environmental parameters, reproduce quickly, and have a short life cycle which makes it possible to be developed as natural food in hatcheries and grow-out aquaculture [10]. Amphipods as natural food have been tried on keeping cuttlefish (*Sepia officinalis*) [10], tiger prawns (*Penaeus monodon*) [11]. This study aims to determine the effect of amphipods (*Grandierella megnae*) on growth, survival and molting of mud crabs.

2. MATERIALS AND METHODS

The research was conducted at the Tiger Shrimp hatchery located in Lawallu Village, Soppeng Riaja District, Barru Regency, South Sulawesi, Indonesia, from May to June 2022. The crabs used in this study measured a weight of 0.04±0.005 g and a carapace width of 5.4±0.1 mm, obtained from local hatcheries. Amphipods were obtained from outdoor culture using a tank with a water capacity of 10 tons. The morphology of mud crabs and amphipods is shown in Figs. 1 and 2. The research container was a glass jar, measuring 23 cm high and 15 cm in diameter. Each container is filled with seawater that has been sterilized and filtered with a filter with a mesh size of 100 µm. The glass jar is filled with 0.5 L of water and one crablet, aerated at medium speed, and placed in an incubator tub so that uniformity of water temperature can be maintained for study.

Fig. 1. Mangrove crab (*Scylla tranquebarica*)

Fig. 2. Amphipod (*Grandidierella megnae*)

Mangrove crab weight was measured using a digital scale with an accuracy of 0.01 g and carapace width was measured using a digital clipper with an accuracy of 0.1 mm. The crabs were fasted for four hours before being given the first amphipod feed. Dosage of amphipod administration (according to treatment), frequency of administration once in the first 10 days and twice a day (morning and evening) on the next day. Water change was done every day as much as 100%.

The number of individual amphipods given to the crabs is adjusted to the treatment, there were three treatments and each treatment was repeated three times, while the treatments were as follows:

Treatment A = Amphipods 20 ind/0.5 L
Treatment B = Amphipods 30 ind/0.5 L
Treatment C = Amphipods 40 ind/0.5 L

The study was designed using a completely randomized design.

Parameters measured include:

1. Growth in weight and carapace width, using the equation according to Panase and Mengumphan [12]:

   GW= $(final\ weight - initial\ weight)$

   GL = $(final\ carapace\ width - initial\ carapace\ width)$

2. Specific Growth Rate (SGR), using the formula according to Panase and Mengumphan [12]:

   SGR-W = $\frac{Ln\ final\ weight\ - Ln\ initial\ weight}{time\ of\ culture}\ x\ 100\%$ and

   SGR-C = (Ln final carapace width-Ln initial carapace width)/(time of culture) x 100%

3. Survival Rate (SR), calculated using the formula [13]:

   SR = $\frac{number\ of\ live}{number\ of\ reared}\ x\ 100\%$

4. The number of molting crabs is calculated using the formula [14]:

   NM = $\frac{number\ of\ molting}{number\ of\ reared}$ x 100%

5. Water quality parameters that are measured are temperature, salinity, dissolved oxygen, and ammonia; The tools used are as follows: thermometer, refractometer, DO meter and test kit (Tetra), temperature and salinity are measured daily; oxygen and ammonia were measured every ten days.

Analysis of variance (ANOVA) was used to determine the effect of treatment on the parameters observed. If the treatments influenced the observed parameters, it was continued with further testing by Duncan's [15] using SPSS 18.0 software for windows (IBM Corp., Armonk, NY, USA). Water quality is analyzed descriptively, namely comparing the data obtained with the optimal water quality value according to the literature.

3. RESULTS AND DISCUSSION

The results showed that the density of amphipods had a significant effect on the growth weight, growth carapace width, the specific growth rate-weight and specific growth carapace-width, however amphipod density has no effect on survival rate and number of molting (Table 1).

The results of Table 1 show that the GW, GL, SGR-W and SGR-L, treatments with an amphipod density of 20 indi/0.5 L were lower than the treatments with 30 and 40 ind/0.5 L. The low growth in this treatment is thought to be due to the inadequate number of amphipods given to support more optimal growth. Growth can occur if the energy obtained and stored is greater than the energy used for body activities. This is in accordance with the statement of Lestari et al. [16] that mud crabs will grow well if feed is available in sufficient quantities and contains all the nutrients needed at optimal levels. The growth of carapace weight and width, the growth rate of carapace weight and width of the 30 and 40 ind/0.5 L treatments was higher, this was allegedly because the amount of feed given was able to meet the nutritional needs for crab growth, where the stored energy was greater than the energy used for body activity. Proper feeding both in terms of quantity and quality is an effort to reduce the level of cannibalism and trigger the growth of mangrove crabs [2,17]

Growth is the change/addition of weight or body size of crabs kept in units of time [18]. Treatment with an amphipod density of 30 ind/0.5 L was as good as a density of 40 ind/0.5 L. Based on feed efficiency, the treatment with an amphipod density of 30 ind/0.5 L was more efficient than

Table 1. Growth weight and growth carapace width, specific growth rate-weight and specific growth carapace width, survival rate and number of molting mud crabs based on different amphipod densities

Parameters	Treatment		
	20 ind/0.5 L	30 ind/0.5 L	40 ind/0.5 L
Growth weight (GW) (g)	0.52 ± 0.07^{a}	0.69 ± 0.12^{b}	0.85 ± 0.25^{b}
Growth carapace width (GL) (mm)	10.58 ± 0.25^{a}	12.29 ± 1.14^{b}	13.00 ± 1.83^{b}
Specific Growth Rate-Weight (SGR-W) (%)	8.77 ± 0.46^{a}	9.68 ± 0.51^{b}	10.23 ± 0.96^{b}
Specific Growth carapace-width (SGR-L) (%)	3.61 ± 0.15^{a}	3.94 ± 0.21^{b}	4.07 ± 0.33^{b}
Survival Rate (%)	100^{a}	100^{a}	100^{a}
Number of Molting (NM) (n)	3.87 ± 0.12^{a}	4.00 ± 0.35^{a}	4.27 ± 0.23^{a}

Description: - Treatment; (A) 20 ind/ 0.5 L, (B) 30 ind/ 0.5 L, (C) 40 ind/ 0.5 L
Different letters in the same row indicate significant differences between treatments at the 5% level (p<0.05)

the treatment with a density of 40 ind/0.5 L. According to Craig & Kuhn [19], the feed efficiency will be higher if the amount of feed given is less but the feed can be utilized properly so as to provide maximum growth.

Furthermore, amphipod density has no effect on SR and NM, this is presumably because the amphipod density of 20 - 40 ind/0.5 L has sufficient quantity and quality of feed so that it is able to support SR properly, namely 100%. The results of the feed proximate test showed that the amphipods had a protein content of 45.19%; 0.77% fat, 7.27% crude fiber and 34.60% ash. According to Ikhwanuddin et al [20], high survival is an illustration of the results of mutually supportive interactions between the environment and the feed given. According to Syafaat et al [17], giving amphipods in the zoea – crablet phase does not have a negative effect and provides better survival compared to artificial feeding. Providing natural food such as amphipods in the early phases of the organism's life is the right choice. Similar to survival, the frequency of molting treatment with an amphipod density of 20 – 40 ind/0.5 L has the ability to stimulate crab crablets to molt. According to Hasnider et al [14], molting is a complex physiological process involving internal and external factors. Internal factors include the availability of sufficient molting hormone to stimulate molting, in addition to external factors, the availability of feed both in quantity and quality is fulfilled. In general, crab molting occurs due to an increase in body size and biomass. The available energy is used for growth first, after being fulfilled, the remaining energy is used for molting [21].

The physical and chemical parameters of water during the study were temperature 26 – 310C, salinity 29 – 32 ppt, dissolved oxygen 5.05 – 5.50, ammonia 0.0 – 0.025 ppm. Optimal physical and chemical parameters for mud crab cultivation are as follows: temperature 25 – 35°C [22,14]; salinity 25 ppt [23]; dissolved oxygen > 5 ppm [24]; ammonia <0.1 ppm [25]. Based on these results indicate that the physical and chemical parameters of water are in the range that can be well tolerated by mangrove crabs.

4. CONCLUSION

Amphipod densities of 20 - 40 ind/0.5 L resulted in good survival and number of molting, but amphipod densities of 30 ind/0.5 L were more efficient for the growth of mangrove crab crablets (*Scylla tranquebarica*).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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