

**Original Research Article**  
**Effect of amphipods (*Grandierellamegnae*) density  
on the growth and survival rate of mangrove crab  
(*Scylla tranquebarica*)**

**Abstract**

This study aims to determine the effect of amphipod density on the growth, survival and molting of mangrove crabs (*Scylla tranquebarica*). Experimental research. The research was carried out at the Tiger Shrimp Hatchery Installation (IPUW) Lawallu Village, Soppeng Riaja District, Barru Regency, South Sulawesi, from May to June 2022. There was 45 mangrove crabs, with an average weight of  $0.04 \pm 0.005$  g and a carapace width of  $5.4 \pm 0.1$  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, the frequency of feeding once a day for the first 10 days and twice a day. day (morning and evening) for the 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 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**

Mud 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]. According to [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 artemiasalina [2]. However, the use of artemiasalina 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,

**Comment [A1]:** Should be revised: The research was conducted experimentally and carried out at the Tiger Shrimp Hatchery Installation .... 2022

**Comment [A2]:** Need to be considered: why is it written 45 crabs while research uses 9 crabs

**Comment [A3]:** Should be revised: frequency of feeding once a day for the first 10 days and twice a day (morning and evening) for the next 20 days.

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 (*Grandierellamegnae*) on growth, survival and molting of mud crabs.

## 2. MATERIAL AND METHODS

The research was conducted at the Tiger Shrimp hatchery located in Lawallu Village, SoppengRiaja District, Barru Regency, South Sulawesi, Indonesia, from May to June 2022. The crabs used in this study measured a weight of  $0.04 \pm 0.005$  g and a carapace width of  $5.4 \pm 0.1$  mm, obtained from local hatcheries. Amphipods were obtained from outdoor culture using a tank with a water capacity of 10 tons. 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  $\mu$ m. 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.

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 is done every day as much as 100%.

The dose/amount of amphipods administration as a 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 [12]:  

$$GW = (\text{final weight} - \text{initial weight})$$

$$GL = (\text{final carapace width} - \text{initial carapace width})$$
2. Specific Growth Rate (SGR), using the formula according to [12]:  

$$SGR-W = \frac{\ln \text{ final weight} - \ln \text{ initial weight}}{\text{time of culture}} \times 100\%$$
 and  

$$SGR-C = \frac{\ln \text{ final carapace width} - \ln \text{ initial carapace width}}{\text{time of culture}} \times 100\%$$
3. Survival Rate (SR), calculated using the formula [13]:  

$$SR = \frac{\text{number of live}}{\text{number of reared}} \times 100\%$$
4. The number of molting crabs is calculated using the formula [14]:  

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

**Comment [A4]:** Suggested: the number of individual amphipods given was adjusted to the treatment, there were three treatments and each treatment was repeated three times, while the treatments were as follows:

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 observed parameters. Because the treatment affected the parameters, it was continued with further testing by Duncan [15] using SPSS software. Water quality is analyzed descriptively, namely comparing the data obtained with the optimal water quality value according to the literature.

**Comment [A5]:** suggested: if the treatment affects the parameters then it is continued with further testing by Duncan...software.

### 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).

**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 <sup>a</sup>	0.69 ± 0.12 <sup>b</sup>	0.85 ± 0.25 <sup>b</sup>
Growth carapace width (GL) (mm)	10.58 ± 0.25 <sup>a</sup>	12.29 ± 1.14 <sup>b</sup>	13.00 ± 1.83 <sup>b</sup>
Specific Growth Rate-Weight (SGR-W) (%)	8.77 ± 0.46 <sup>a</sup>	9.68 ± 0.51 <sup>b</sup>	10.23 ± 0.96 <sup>b</sup>
Specific Growth carapace-width (SGR-L) (%)	3.61 ± 0.15 <sup>a</sup>	3.94 ± 0.21 <sup>b</sup>	4.07 ± 0.33 <sup>b</sup>
Survival Rate (%)	100 <sup>a</sup>	100 <sup>a</sup>	100 <sup>a</sup>
Number of Molting (NM) (n)	3.87 ± 0.12 <sup>a</sup>	4.00 ± 0.35 <sup>a</sup>	4.27 ± 0.23 <sup>a</sup>

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 results of table 1 show that the GW, GL, SGR-W and SGR-L, treatments with an amphipod density of 20 ind/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 [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 a ~~cophopod~~ 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 the treatment with a density of 40 ind/0.5 L. According to [19], that 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 [20], high survival is an illustration of the results of mutually supportive interactions between the environment and the feed given. According to [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 [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 – 31°C, 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*).

### CONSENT (WHEREEVER APPLICABLE)

Authors may use the following wordings for this section: "All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal."

### ETHICAL APPROVAL (WHEREEVER APPLICABLE)

"All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee"

### REFERENCES

- [1] Gunarto, Herlinah, Syafaat MN, and Sulaeman. Grow-out of mud crab crablets, *Scylla paramamosain* in brackishwater pond with different feeding strategy. *IOP Conf. Ser. Earth Environ. Sci.* 2021; 777(1):1–8. doi: 10.1088/1755-1315/777/1/012020.
- [2] Usman U, Kamaruddin K, Laining A. Pengaruh kadar triptopan pakan terhadap pertumbuhan dan sintasan krablet kepiting bakau, *Scylla serrata* selama pendederan. *J. Ris. Akuakultur.* 2016;11(3):259–269. doi: 10.15578/jra.11.3.2016.259-269.
- [3] Qunitio E, Parado-Esteva FD, Rodriguez E. Seed Production of Mud Crab *Scylla* spp. *Asian Fish. Sci.* 2001;7(3):29–31. doi: 10.33997/j.afs.2001.14.2.006.
- [4] Budi S, Karim MY, Trijuno DD, Nessa MN. Effect of ecdyson hormone on mortality and moult death syndrome of larvae mud crab *Scylla olivacea*. *Int. J. ChemTech Res.* 2017;10(6):158–164.
- [5] Mirera OD, Moksnes PO. Cannibalistic interactions of juvenile mud crabs *Scylla serrata*: the effect of shelter and crab size. *African J. Mar. Sci.* 2013;35(4):1–9. doi: 10.2989/1814232X.2013.865677.
- [6] Ariyati RW, Rejeki S, Bosma RH. The effect of different feed and stocking densities on growth and survival rate of blue swimming crablets (*Portunus pelagicus*). *IOP Conf. Ser. Earth Environ. Sci.* 2018;116(1):1–7. doi: 10.1088/1755-1315/116/1/012071.
- [7] Ravi R, Manisseri MK. Efficiency of shelters in reducing cannibalism among juveniles of the marine blue swimmer crab, *Portunus pelagicus*," *Isr. J. Aquac.* 2012; 64(704):1–6.
- [8] Qomariyah L, Samidjan I, Rahmawati D. Pengaruh persentase jumlah pakan buatan yang berbeda terhadap pertumbuhan dan kelulushidupan kepiting bakau (*Scylla paramamosain*). *J. Aquac. Manag. Technol.* 2014;3(4):18–25.
- [9] Rattanama K, Pattaratumrong MS, Towatana P, Wongkamhaeng K. Three new records of gammarid amphipod in songkhla lake, Thailand. *Trop. Life Sci. Res.* 2016;27(1):53–61. doi: 10.21315/tlsr2016.27.3.8.
- [10] Baeza-Rojano E, et al. Marine gammarids (crustacea: Afmhipoda): A new live prey to culture Octopus maya hatchlings. *Aquac. Res.* 2012;44(10):1–11. doi: 10.1111/j.1365-2109.2012.03169.x.
- [11] Sulaeman, Herlinah, and A. Parenrengi, "The consumption rate of tiger prawns (*Penaeus monodon*) on alive Amphipod-Crustacean," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 564, no. 1, pp. 1–6, 2020, doi: 10.1088/1755-1315/564/1/012087.
- [12] Panase P, MengumphanK. Growth performance, length-weight relationship and condition factor of backcross and reciprocal hybrid catfish reared in net cages. *Int. J. Zool. Res.* 2015;11(2):57–64. doi: 10.3923/ijzr.2015.57.64.
- [13] Cruz-Suárez LE, Nieto-López M, Guajardo-Barbosa C, Tapia-Salazar M, Scholz U, Ricque-Marie D. Replacement of fish meal with poultry by-product meal in practical

- diets for *Litopenaeus vannamei*, and digestibility of the tested ingredients and diets,” *Aquaculture*. 2007;272(1):466–476. doi: 10.1016/j.aquaculture.2007.04.084.
- [14] Hasnidar H, Tamsil A, Wamnebo MI. The effects of the amaranth extract (*Amaranthus* spp.) on the molting of orange mud crab (*scylla olivacea*). *AACL Bioflux*. 2021;14(2):1036–1045.
- [15] Piepho HP, Edmondson RN. A tutorial on the statistical analysis of factorial experiments with qualitative and quantitative treatment factor levels. *J. Agron. Crop Sci*. 2018;204(5):429–455. 2018, doi: 10.1111/jac.12267.
- [16] Lestari D, Saade E, Achmad M. The biological evaluation of mud crabs (*Scylla olivacea*) in fattening activities using seaweed *kappaphycus alvarezii* in ponds. *AACL Bioflux*. 2020;13(6):3322–3329.
- [17] Syafaat MN, et al. A review of the nursery culture of mud crabs, genus *scylla*: Current progress and future directions. *Animals*. 2021;11(7):1–15. doi: 10.3390/ani11072034.
- [18] Ikhwanuddin M, Amin-Safwan A, Hasyima-Ismail N, Azra MN. Dataset on body weight, carapace width increment and growth band count of mud crabs, *Scylla olivacea*. *Data Br*. 2019;26(2):1–8. doi: 10.1016/j.dib.2019.104477.
- [19] Craig S, Kuhn DD. Understanding fish nutrition, feeds, and feeding. in *Virginia Cooperative Extension*. 2017;420–256:1–6.
- [20] Ikhwanuddin M, Azra MN, Sung YY, Bolong AMA, Long SM. Growth and survival of blue swimming crab (*Portunus pelagicus*) reared on frozen and artificial foods. *Agric. Sci*. 2013;04(06):76–82. doi: 10.4236/as.2013.46a012.
- [21] Aslamyah S, Fujaya Y, Rukminasari N. Utilization of Feed and Growth Performance of Mud Crabs: The Effect of Herbal Extracts as Functional Feed Additives. *Isr. J. Aquac. - Bamidgeh*. 2022;74. doi: 10.46989/001C.32548.
- [22] Hastuti YP, Affandi R, Millaty R, Tridesianti S, Nurussalam W. The best temperature assessment to enhance growth and survival of mud crab *Scylla serrata* in recirculating system. *J. Ilmu dan Teknol. Kelaut. Trop*. 2019;11(2):311–322.
- [23] Hastuti YP, Affandi R, Safrina MD, Faturrohman K, Nurussalam W. Optimum salinity for growth of mangrove crab *Scylla serrata* seed in recirculation systems. *J. Akuakultur Indones*. 2015;14(1):50-56. doi: 10.19027/jai.14.50-57.
- [24] Faturrohman K, Nirmala K, Djokosetiyanto D, Hastuti YP. The concentration of optimum dissolved oxygen levels for growth of mangrove crab *Scylla serrata* seed in recirculation system. *J. Akuakultur Indones*. 2017;16(1):107–115. doi: 10.19027/jai.16.1.109-117.
- [25] Paterson BD, Mann DL. *Mud Crab Aquaculture*. 2011.