Grow-out of mud crab crablets, *Scylla paramamosain* in brackishwater pond with different feeding pond strategy

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**ABSTRACT.** This research aimed to know the crablet growth and survival rate after cultured in brackishwater pond with different feeding strategy. Nine ponds fenced by black plastic net, each size of 100 m² and pond water level at 60-80 cm. Crablets (weight size of 1.51±0.15 g/ind) from hatchery stocked at the density of 1 ind./m². Chopped trash fish at biomas 3-5% was given to the crablets as feed at every day (A), at every two days (B) and at every three days (C). Each treatment in three replications. At the three months of culture the highest final weight (128.23±21.19 g/ind.) in treatment A, then treatment C (107.04±25.24 g/ind.) and treatment B (95.60±5.79 g/ind.). Treatment A with the highest daily growth rate (1.41±0.1 g/day) and significantly different (P<0.05) with the daily growth rate in treatment B (1.04 ±0.06 g/day) and treatment C (1.17±0.09 g/day). The highest survival rate (39.7%) after four months cultured was obtained in treatment B. High salinity attained to 54 ppt in the end of third month of culture was caused the high numbers of mud crab mortality in all treatments.

1. Introduction

High economical value of mud crab, *Scylla* spp in Asian region has been causing high exploitation of mud crab in the wild. Now days mud crab culture in brackish water pond still rare due to limiting of seed supply. An effort to produce mud crab *Scylla* spp seed in hatchery has been initiated in some countries of South East Asia including Malaysia [1], Philippina [2], Indonesia [3,4,5] and Vietnam [6].

Mud crab growout in pond has been developed in some area of mud crab resources in Indonesia. One of that area is located in brackish water pond near Cenranae mouth rivers, Bone Regency, South Sulawesi and also in Kuala Lupak, Barito Kuala Regency, South Kalimantan. In these ponds area the wild mud crab seed with size approximately 50-100 g/pieces were stocked in pond at the density of 1000-2000 ind./Ha and the crab without given feeding, the pond also without fenced to prevent of mud crab escape from the pond. However, after two-three months of culture, the mud crab was attained size about 200-300 g/pieces and it can be selected to harvest. Some farmers reported that the mud crab survival rate was approximate at the ranged of 20-25%.

The grow out information of mud crab produced from hatchery is still rare, it could be due to the limited of mud crab seed supply from hatchery. Trash fish, molluscs and crustacean are the feed for mud crab cultured in brackishwater pond, that utilization would made a competition with human life. Knowing the effectiveness and efficiency of feed given to the mud crab cultured in ponds is very important as the effort to minimizing of feed and other ways to reduced feed competition with human life. Feed given to the mud crab in brackishwater pond could be one to two time a day to minimize canibalisms [7]. However, it would be sound an expensive due to almost difficult to find out uneconomical trash fish.

The present study was to evaluate the effectiveness of feeding strategy (every day, every two days, every three days) on crablet *S. paramamosain* and its impact to their growth and survival rate after those crablets cultured in brackishwater pond during a certain period.
2. Materials and Methods
Research was conducted in nine pond compartments with the each size of 100 m² located at Maranak brackishwater pond research station of Research Institute for Brackishwater Aquaculture and Fisheries Extension in Maros, South Sulawesi, Indonesia. Pond preparation including drying to eliminate fish predator, then saponin was also applied in pond to kill all undied fish after drying soil pond. The pond compartments were fenced with black plastic net and mud crab *S. paramamosain* crablet with the mean weight of 1.51±0.15 g/ind obtained from mud crab hatchery of RICA Maros were stocked at the density of 1 ind./m². Three treatments of feeding strategy were tested, namely; A = Crablet was fed with chopped trash fish at 3-5% of total biomass/day, B = Crablet was fed with chopped trashfish at 3-5% of total biomass/2 days, C = Crablet was fed with chopped trashfish at 3-5% of total biomass/3 days. Each treatment with three replications. Pond water was changed following the tidal ritmic and the high water level in pond was approximately 60-80 cm. The mud crab growth was monitored monthly by catching of 20-30 pieces of mud crab in each pond compartment. The crabs were then weighted by using electrical balance with the accuracy of 0.1 g. The biological parameter was monitored on the daily growth rate were calculated by the following equation:

\[
\text{Mean daily growth rate (g)} = \frac{(W_t - W_o)}{t}. 
\]

where: 
\(W_t = \) final weight (g)  
\(W_o = \) initial weight (g)  
\(t = \) Period of rearing (day)

Water quality monitored on Total Ammonia Nitogen (TAN), nitrite, nitrate in the pond are also monitored as supporting data to analyzing relationship among mud crab growth and production.

The survival and feed conversion ratio (FCR) were calculated after the crab in pond were harvested totally. The mud crab means weight and survival rate among the treatments were compared and tested using varians analysis and the Duncan’s multiple range test at 5 % level of significance after obtained any significant different among those treatments.

3. Result and Discussion

3.1. Growth, survival and feed conversion ratio
In order to grow larger, mud crab must periodically shed its smaller carapace through a process known as molting. The expanding of crab size after molting was caused by water absorption to the body tissue. The growth of mud crabs reared during 90 days in pond fed with chopped trash fish with different strategy was shown in Figure 1.

![Figure 1](image-url)

*Figure 1. The growth of crablet mud crab, *S. paramamosain* cultured in pond at 90 days of rearing.
Crablet in treatment A with the highest growth since August to September 2014, then followed by crablet in treatment C is also showing the crab growth higher that the crab in treatment B. Absolute growth after three months (middle of June to middle of September 2014) cultured in treatment A reaching 128.23 ± 21.19 g/ind., treatment B (94.09 ± 7.85 g/ind) and treatment C (107.04 ± 25.24 g/ind.). The mud crabs in the treatment A had a higher daily growth rate and significant different (P<0.05) with mud crab daily growth rate in treatment B (1.04 ± 0.04 g/day) and treatment C 1.17 ± 0.05 g/day). Mud crab in treatment A received feed in every day, while mud crab in treatment B received feed at every two days and mud crab in treatment C received feed at every three days, thereby mud crab in treatment A fasted growth compared than that mud crab in treatment B and C. In this research trash fish was chosen as the feed given to the mud crab in all treatments at the different strategy, since trash fish from by catch was reported to be the best feed compared than formulated diet with or without vitamin for mud crab in pond culture [8]. Mud crab in treatment A with lowest survival rate (Table 1). It due to high salinity attained to 54 ppt in the end of September was caused high mud crab mortality in all treatments. It seemed that mud crab with higher size (>130g/ind) is more sensitive to die compared than mud crab with small size (<130g/ind.) when subjected to the high salinity (>40 ppt). In fourth months (middle of October 2020) of mud crab cultured in pond, the daily growth rate was decrease to 1.05 ± 0.1 g/day (treatment A), 0.91 ± 0.06 g/day (treatment B) and 1.0 ± 0.09 g/day (treatment C). The statistical analysis exhibited not significant different (P>0.05) among those treatments.

Table 1. Growth, survival and feed conversion rate of crablet cultured in brackish water pond with different feeding strategy.

| Parameter                             | A (+ SD)        | B (+ SD)        | C (+ SD)        |
|---------------------------------------|----------------|----------------|----------------|
| Wide compartment (m²)                 | 100            | 100            | 100            |
| Stocking density (ind./m²)            | 1              | 1              | 1              |
| Initial weight (g/ind.)               | 1.51 ± 0.15    | 1.51 ± 0.15    | 1.51 ± 0.15    |
| Final weight after three months (g/ind.) | 128.23 ± 21.19 | 94.09 ± 7.85  | 107.04 ± 25.24 |
| Daily growth rate after three months (g/day) | 1.41 ± 0.1  | 1.04 ± 0.04    | 1.17 ± 0.05    |
| Daily growth rate after four months (g/day) | 1.05 ± 0.1  | 0.91 ± 0.06    | 1.0 ± 0.09     |
| Survival rate after four month (%)    | 15.66 ± 11.59  | 39.66 ± 8.02   | 29.00 ± 10.14  |
| Production after four month (kg/100 m²) | 1.85 ± 1.19   | 4.27 ± 0.86    | 3.35 ± 0.96    |
| Feed conversion                       | 11.02 ± 5.405a | 1.87 ± 0.347b | 1.65 ± 0.426b |

Note: The different letter in the same row showed significantly different among the treatments (P<0.05)

The mud crab growth was influenced by their feed nutrition and their environmental parameters including water temperature, salinity and stocking density. In this research, the salinity was 20 ppt in June 2014 when crablet stocked in the pond. The salinity then increased up to 30 ppt in the beginning of August 2020 then salinity continuous increased until 54 ppt in the middle of September 2014 to beginning of October 2014. In the earlier research, the highest growth rate of crablet S. olivacea with initial size of 0.04-0.09 g/ind. and reared individually in plastic glass was obtained at the salinity 5 ppt, while the highest of survival rate (100%) was obtained at the salinity 20 ppt [5]. Furthermore another researcher [9] was found that S. serrata with the initial weight 1.1-1.95 g/ind. showing the specific growth rate 4.46 % at the salinity of 25 ppt, while S. paramamosain in this research was obtained to have a lower specific growth rate in the all treatments (3.84-3.96 %/day equal to 1.04-1.41 g/day) after reared during three months in pond at the salinity 20-54 ppt. In addition, in the other research for this
species was also cultured in Marana pond Station, of RICA Maros at the salinity of 30-40 ppt and obtained specific growth rate of 2.53 %/day [10]. In India [11] mud crab S. transquebarica cultured at the salinity 29.6 ppt with survival rate 87%, while when salinity drop to 10.4 ppt, the survival rate decreased to 45%.

The high range salinity during this research was influenced to the growth of the mud crab. The increasing of salinity started from the beginning of August 2014 (>30 ppt) affected to the osmoregulation process, which it high energy requirement on the metabolic process in the mud crab. Salinity will also influenced to the internal ionic management, which it directly requiring energy used for ion active transportation. This physiological process would impact to the growth and mortality of the mud crab.

In tropical water, the water temperature is relatively stable at the range 25-31°C, and the salinity fluctuated at the range 0-70 ppt mainly in estuary and mouth rivers. The mud crab, S. paramamosain in this research which size less than 130g are still more adapted and alive (Figure 3), eventhough salinity was increased to 54 ppt during cultured in pond in September 2014, therefore mud crab alive in pond is dominated by size <130g in all treatments (Figure 2).

The mud crab in all treatments are fed with chopped trash fish at 3-5% of total biomass/day, two days and three days. It meaning that mud crab could fasting caused of limited feed supply in the treatment B and C. This could be caused to the low oxygen consumption of mud crab. Based on the data that the dissolved oxygen in the pond used for mud crab culture also low concentration mainly in the morning (<1 mg/L) (Table 2). That reason was proved that mud crab in treatment B and C, eventhough, dissolved oxygen concentration in pond water was low < 1 mg/L and high salinity level (54 ppt) in pond, however, many mud crab still alive and resulted the higher survival rate in treatment B and C compared to the treatment A. The mud crab cultured in the pond at the treatment B showed the highest survival rate namely 39.66±8.02%, followed by the treatment C and A with the percentage value of 29±10.14% and 15.66 ±11.59% respectively. Statistically there was not any significant difference among those treatments (P>0.05). The low survival rate of mud crab in all treatments was influenzed by extreme salinity increasing to 54 ppt, occurred in pond during September to the beginning of October 2014. The increasing of salinity disturbed osmoregulation process of mud crab and futhermore resulted unsuccess of molting process, furthermore, resulted the mortality of mud crab. Mud crab naturally die due to the extended of life span also caused low quality of environmental parameters to support their live [12]. Low survival rate of mud crab growout also was obtained by other researcher, [13] cultured S.olivacea in mangrove pond at salinity 16-30 ppt for 90 days with the stocking density of 1 ind/m² obtained the lower survival rate attaining to 33%. Therefore, [10] also reared S. tanquebarica and S. olivacea in pond
of Marana Pond Station of RICAFE Maros for 60 days at the salinity of 44-45 ppt and was obtained the survival rate of 60.64% for *S. olivacea* and 67.20% for *S. tranquibarica*. The high mortality was not only caused by the high salinity but also due to the cannibalisms among crabs. Seagrass, *Gracilaria* sp cultured in polyculture systems with mud crab, *Scylla* spp was effective to reduced high canibalism among mud crab cultured in brackiswater pond [14].

3.2. Size distribution
The size distribution of mud crab obtained after mud crab totally harvested and it was conducted at four months crab cultured in brackishwater pond. That mean after salinity in pond reaching 54 ppt at the end of September 2014 and the bigger size of mud crab in all treatments were die. Therefore, the data showed that mud crab in all treatments were more dominant at the smaller size at range of 81-130 g. Mud crab in treatment B and C with total number is around 35 individual each, while in treatment A is only 22 individual. The biggest crab size (>231 g) obtained in the treatment C, while treatment A and B the biggest crab size at 230 g. The total number of mud crab with smallest size is dominant in treatment B, then followed by treatment C and the lowest numbers of crab with smallest size was obtained in treatment A. That mean mud crab in treatment B with highest survival rate. It data was proven that the crabs with bigger size in all treatments, especially in treatment A, when at the third month of culture with highest of daily growth rate (Table 1), it should be with the biggest crab size. Unfortunately, high salinity reaching to 54 ppt affected mortality of mud crab with big size, mostly in treatment A with crab feeding was given in every day.

![Figure 3](image-url) Mud crab weight distribution in each treatment after cultured during 107 days in brackish water pond with high salinity under different feeding strategy.

In this paper, we reported on mud crab growth only until 90 days of culture, when the growth data reported until four months, it will saw the crab growth decreased. It due to high mortality on bigger size of mud crab in all treatments when salinity reaching 54-55 ppt in the end of September 2014 to the beginning of October 2014. However, total harvest of mud crab in ponds was conducted after four months crabs cultured.

The worse or highest feed conversion was obtained in treatment A (11.02 :1.00), followed by treatment B and C with the feed conversion value of 1.87:1.00 and 1.65:1.00, respectively. The highest feed conversion value in treatment A was due to the lowest of crab survival rate. In Queensland, Australia, *S. serrata* stocked in pond at the density of 0,5-0,6 ind./m² in 1.6 Ha pond size was obtained feed conversion 3 : 1, with the mud crab survival rate of 20-47% [15]. Another research, [13] using wild mud crab juvenile with the initial mean weight of 50 g, the stocking density of 3 ind./m² and feed was
given every day at 5% of total biomass, after mud crab harvested was obtained the production of 7 kg/100 m² after 90 days cultured in pond with feed conversion value was 8:1.

Feed conversion value of mud crab cultured were influenced by feed nutrition and the right of prediction to the mud crab population in pond. The exceeding of population prediction will affect to the exceed of feed given to the organisms cultured. This phenomena presumably was occured in treatment A in this research, where the feed conversion value was 11:1. By feeding every two days to the mud crab resulted the higher survival rate (39%) and production than those of mud crab given feed at every days (15%) when the crab were reared at salinity 20-55 ppt. It was concluded that mud crab have capability to make a slower digest of feed after the crab cultured in the higher salinity level attained >40 ppt. It means that the feed given to the crablet at every two days was enough and able to stimulate normal growth as well as resulted lower feed conversion value or efficient and resulted highest survival rate in B treatment.

3.3. Water quality

Data on water quality parameters showed in Table 2. Water temperature is very important in the respiration process, metabolisms and feed consumption. The lowest temperature (26.3°C) in the pond in this study was occurred in the end of August 2014. The highest water temperature (30.3°C) was obtained in June 2014. Survival rate of juvenile mud crab, Scylla serrata was higher (96-98%) at the water temperature 25-30°C, compared than 36% at the water temperature 20°C [16]. When crablet were just stocked in the pond in June 2014, the salinity was found 20 ppt. The salinity then increased to 29 ppt in the end of July 2014 and continued to increase reach 36-37 ppt in all pond treatments at the middle of August 2014. At the beginning of September 2014, the salinity was attained to 54-55 ppt in all pond treatments. Salinity 15-25 ppt resulted the constant mud crab, S. tranquebarica survival rate, when salinity drop to 10.5 ppt, the survival rate and daily growth rate were also dropped from 87 to 45% and from 2.68 g to 0.97 g/day [12].

In the first month of crab culture, the dissolved oxygen at 08:00 a.m in the treatment A, B and C was 0.88 mg/L, 0.95 mg/L and 0.99 mg/L respectively. The low oxygen concentration obtained in the all ponds due to the growth abundance of Caulerpa sp. However, the increasing oxygen dissolved of 3 mg/L was occured in the afternoon in the all pond treatments. The alkalinity ranged in the treatment A, B and C were 145-164 mg/L, 137-169 mg/L and 156-161 mg/L, respectively. Similar to the dissolved oxygen, the nitrate concentration was low at 0.028 mg/L (A), 0.021 mg/L (B) dan 0.013 mg/L (C) in the initial research. However, it was obtained to increase up to 0.2 mg/L at the end of the research in the all treatment ponds.

Ammonium is a poisonous, in the nature it is produced by fish feces, fertilizer and decomposing nitrogen microbial. when the ammonium concentration in the water was increased, the ammonium excretion in the fish body was found to decrease and caused the increasing of the ammonium concentration in the blood and tissue of organisms. Thus, blood pH will be increased and would give a negative effect to the enzyme and membran stabilization. The high ammonium concentration in the rearing water will also affect to the increasing oxygen consumption of tissue organisms, destruction of gill and decreasing of blood to carry oxygen. In the early of experiment, the ammonium concentration was low (0.2 mg/L) in all treatments and found to be increased to 0.85 mg/L (A), 0.56 mg/L (B) and 0.52 (C) in the end of research. Nitrite concentration was ranged from 1.14-1.94 mg/L (A), 0.43-0.84 mg/L (B) and 0.57-1.16 mg/L (C). The high nitrate concentration (>1.136 mg/L) in the rearing water of mud crab cultured in pond was obtained at the initial research. It was caused by the using of urea at the dosage of 150 kg/Ha and it was suspected to cause the high density of Caulerpa sp.
Table 2. The water quality monitored in brackiswater pond used for mud crab culture with the different feeding strategy.

| Parameters         | Treatments |
|--------------------|------------|
|                    | A          | B          | C          |
| Water temperature (°C) | 26.3-30.3  | 26.3-30.3  | 26.0-30.3  |
| Salinity (ppt)      | 20 – 54    | 20 - 54    | 20 – 55    |
| pH                 | 7.1-8.5    | 7.1-8.5    | 7.1-8.8    |
| DO (mg/L)           | 0.88-3.94  | 0.95-3.61  | 0.99-4.48  |
| Alkalinity (mg/L)   | 145.44 – 164.29 | 137.36 – 169.68 | 156.21 – 161.6 |
| Nitrite (mg/L)      | 0.028 – 0.205 | 0.021 – 0.214 | 0.013 – 0.208 |
| TAN (mg/L)          | 0.205 – 0.849 | 0.202 – 0.562 | 0.2007 – 0.525 |
| Nitrate (mg/L)      | 1.136 – 1.938 | 0.430 – 0.839 | 0.574 – 1.157 |

4. Conclusion
Crablet fed with chopped trash fish at 3-5% of total biomass/day was resulted highest crablet growth rate during three months culture, namely at 128.23±21.19 g/ind (A treatment), 95.60±5.79 g/ind (B treatment) and 107.04±25.24 g/ind (C treatment).

The highest daily growth rate was obtained in A treatment (1.41±0.1 g/day) and significant different (P<0.05) with the daily growth rate of B treatment (1.04±0.06 g/day) and C treatment (1.17±0.09 g/day). The high salinity in September to October 2014 (> 40 ppt) was caused the high numbers of mortality on mud crab with bigger size in all treatments, therefore it affected to the low of mud crab survival rate in all treatments.

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