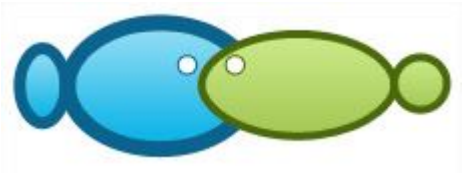

# Physiological response: survival, growth, and nutrient content of the mud crabs (*Scylla olivacea*) which cultivated in mangrove area with different types of feed

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**Abstract**. Cultivation of mangrove crabs for fattening can be carried out in mangrove area or known as a silvofishery system. This study aimed to determine the best types of feed for mangrove crab (*Scylla olivacea*) fattening which cultivated in the mangrove area. The research was conducted in the mangrove area of Pangkep Regency, South Sulawesi Province, Indonesia. The experimental animal used was male mangrove crabs (*S. olivacea*) with a weight of 250±10 g. The container used was a confinement that made from bamboo with length, width, and height of 1.0 x 1.0 x 1.0 m respectively, and placed in the mangrove area. Four types of feed used referred to treatment with a dose of 10% of crab's body weight. The frequency of feeding was twice per day namely in the morning by 30% and in the afternoon 70%. The study used a complete randomized design (CRD) consisting of 4 treatments and 3 replications. The different types of feed used were: (A) trash fish, (B) mujair fish, (C) oysters, and (D) rice field snails. The data were analyzed using variance analysis (ANOVA) and the further test was performed using W-Tuckey test. The result showed that different type of feed had no significant effect ($p > 0.05$) on the survival, but very significant ($p < 0.01$) on the growth and the nutrient content in the crab body. The best growth and highest nutrient content were produced on crabs that fed with mujair fish and oysters, while the lowest was produced on the crabs that fed with trash fish and rice field snails.
**Key Words**: aquaculture, coastal ecosystem, crabs, growth, mangrove.

**Introduction**. Mangrove is a typical coastal ecosystem that has high productivity as well as has the physical, ecological and economic role. The interaction between the components in mangrove ecosystem makes the ecosystem as a good habitat for different types of biota (Ong & Gong 2013; Lee et al 2014). As an ecosystem that has a high fertility, mangrove has the potential to be developed as a cultivation area for mud crab fattening using a silvofishery system.

Mud crab fattening is an attempt to increase the weight of crabs that were still thin to be a fat crab (Mahato 2008). Crab fattening business has the potential to be developed because it only requires a small capital, short cultivation time, and simple technology. Mud crabs are known as commercial organism, and studies are required for aquaculture of mud crabs in Indonesia (Karim et al 2016). Recent research of RNA in mandibular organ will be a valuable knowledge to crab aquaculture (Tahya et al 2016; Sunarti et al 2016). In the cultivation, various factors need to be considered, one of which is the type of feed. Commonly, the type of feed used is trash fish that are often found around cultivation area, even though the trash fish itself has different types and nutritional content.

*Scylla olivacea* is one of four species of mangrove or mud crab which can commonly be found in Indonesian waters. This crab has the advantage compared to the other three species in which the reproduction process is shorter and can survive in extreme conditions (Karim et al 2016). In order to produce mangrove crabs with good

survival and growth as well as the high nutrient content, it is required the proper type of feed.

This study aimed to determine the proper type of feed on the fattening of mangrove crabs which cultivated in the mangrove area. The result of the research is expected to be one of information about the application of cultivation of mangrove crabs which are cultivated in the mangrove area.

**Material and Method**. The research was conducted in March until August 2017 in mangrove area of Pangkep District, South Sulawesi Province, Indonesia.

***Experimental animals***. The experimental animal used was skinny male mangrove crabs (*S. olivacea*) with a weight of 250±10 g that were stocked with a density of 10 tails/confinement. The crabs were bought from crab collectors in Pallime Village, Cenrana Subdistrict, Bone District, South Sulawesi, Indonesia.

The container used was confinement that made from bamboo with length, width, and height of 1.0 x 1.0 x 1.0 respectively. The confinements were placed in the mangrove area. The outside of the confinements were coated with webbing, in order to protect the confinements against the garbage that is carried by the waves.

The 4 types of feed referred to the treatment with 10% dose of crab biomass per day. The frequency of feeding was carried out twice a day in the morning and afternoon as much as 30% and 70% of the total feed given.

***Treatment and research design***. The study was designed using a complete randomized design (CRD) with 4 treatments and each treatment had 3 replications. Thus, the study consisted of 12 experimental units. The four treatments used were: (A) trash fish (mixed species of fish); (B) tilapia fish (*Oreochromis mossambicus*); (C) oysters (*Anadara granosa*); and (D) rice field snails (*Pomacea* sp.).

The parameters observed in this study were the survival and growth of mangrove crabs. The survival was calculated using the formula: SR = (Nt / No) x 100, where SR is survival of crab (%), No is the number of crabs at the beginning of the study (tail), Nt is the number of live crabs at the end of the study (%) (Sang & Fotedar 2004). The absolute growth of crab is calculated using the formula PM = Bt - Bo, where PM is absolute growth (g), Bo is the average weight of crab at the beginning of the study (initial weight) (g), Bt is the average weight of crab at the end of the study (final weight).

The daily growth rate of crab was calculated using the formula SGR = 100 x (ln Wt - ln Wo)/t, where: SGR is the daily growth rate (% $day^{-1}$), Wo is the average weight of crab at the beginning of the study (initial weight) (g), Wt is the average weight of crab at the end of the study (final weight) (g), t is the length of cultivation (days) (Zhu et al 2004).

As the supporting data, the measurement of several physical and chemical parameters of cultivation environment was performed including temperature, salinity, pH, dissolved oxygen, ammonia, and nitrite. Measurements of temperature (thermometers), salinity (Atago hand-held refractometer), pH (HANNA instrument), and dissolved oxygen (YSI 500A) were performed twice in the morning and evening. The ammonia and nitrite levels were measured 3 times during the study namely beginning, middle, and end of the study.

The data obtained were analyzed using variance analysis (ANOVA). The W-Tuckey test was used to compare differences between treatments (Steel & Torrie 1960). As a tool for the statistical analysis, it was used SPSS program version 22.0. The data of water quality obtained were analyzed descriptively based on live feasibility of mangrove crab.

## Results and Discussion

***Survival of the fittest***. The average survival of mangrove crabs cultivated in mangrove area with various types of feed is presented in Table 1.

The result of variance analysis shows that the different types of feed had no significant effect ($p > 0.05$) on the survival of mangrove crab for the fattening which

cultivated in the mangrove area. This illustrates that the different types of feed on the fattening of mangrove crab produce the same survival. The survival value was quite high which ranged from 86.67-93.33%. The high survival is due to the type of feed given can be consumed and the feed adequacy rate may support the maximum survival of mangrove crabs. The value obtained is close to the findings of Sagala et al (2013) that obtained mangrove crab survival by using the basic method of 80-100%.

Table 1

Average survival of mud crabs (*S. olivacea*) cultivated mangrove area with various types of feed

| *Type of feed* | *Survival (%)* |
|---|---|
| Trash fish | 86.67±5.77 |
| Mujair fish | 93.33±5.77 |
| Oyster | 93.33±11.55 |
| Rice field snails | 90.00±10.00 |

Not significantly different between treatments at the level of 5% ($p > 0.05$).

***Growth***. The average growth of mangrove crabs cultivated in mangrove area with various types of feed is presented in Table 2.

The result of variance analysis shows that different type of feed had a very significant effect ($p < 0.01$) on the absolute growth and daily growth rate of mangrove crabs which cultivated for fattening in the mangrove area. Table 2 shows that the highest absolute growth and daily growth rate in the cultivation of mangrove crab fattening in the mangrove area were produced on crabs that fed with mujair fish and oyster, while the lowest was produced on crabs that fed with trash fish and rice field snails. This illustrates that for the cultivation of mangrove crab fattening which cultivated in the mangrove area should be given the feed in the form of oysters or mujair fish. The high absolute growth rate and daily growth rate of mangrove crabs which cultivated in the mangrove area indicate that the best feed for crabs are oysters and mujair fish. The nutrient content of mujair fish and oyster, particularly protein and lipid were higher than trash fish and rice field snails. Crabs require feed as a source of energy for preparation of both molting (growth) and reproduction. Physiologically, the presence of methyl farnesoate (MF) (Sunarti et al 2016; Tahya et al 2016) and ecdysteroid (Tahya 2016) are internal stimulation for molting. Growth only occurs when there is remained energy after the energy consumed for various activities, which means that the physiological conditions are in the ideal state. Cholik (1999) states that the differences in the growth of cultured mangrove crab are caused by feed, age, initial weight, space, and other factors. Report of Karim et al (2016) found the best growth and highest nutrient content on crabs which were obtained at the cultivation density of 5-10 crabs/confinement. The growth of crabs which cultivated in confinement experienced different growths. The daily growth rate obtained in the present study ranged from 0.67 to 1.20% day$^{-1}$. Mirera & Mtile (2009) obtained the growth rate of mangrove crabs by 1.29% day$^{-1}$. Meanwhile, Trino et al (2001) obtained a high growth rate on the fattening of mangrove crab that was 1.8-1.9 % day-1 with 156 days cultivation period.

Table 2

Average growth of mangrove crabs cultivated in mangrove area with various types of feed

| *Type of feed* | *Absolute growth (g)* | *Daily growth rate (% day$^{-1}$)* |
|---|---|---|
| Trash fish | 27.00±1.73$^{b}$ | 0.67±0.04$^{b}$ |
| Mujair fish | 49.50±3.17$^{a}$ | 1.19±0.07$^{a}$ |
| Oyster | 50.17±5.57$^{a}$ | 1.20±1.37$^{a}$ |
| Rice field snails | 35.27±2.89$^{b}$ | 0.88±0.06$^{b}$ |

Different letters in the same column show significant differences between treatments at the level of 5% ($p < 0.05$).

***Nutrient content***. The average nutrient content of mangrove crabs (*S. olivacea*) cultivated in the mangrove area with various types of feed is presented in Table 3.

The result of variance analysis shows that the different type of feed had a significant effect ($p < 0.01$) on protein, lipid, and energy content of crabs. The highest protein, lipid, and energy content were produced on crabs that fed with mujair fish and oyster, while the lowest was produced on crabs that fed with trash fish and rice field snails.

The nutrient content supports growth and survival data obtained in this study, so it is recomended for use in crab cultivation. Table 3 shows the main nutrient role for growth and survival, therefore the feed originating from tilapia and oyster will be utilized by crabs in maintenance. The available energy in the body will be exploited for molting and growing (Tahya 2016).

Table 3

Average nutrient content of mangrove crabs (*S. olivacea*) cultivated in mangrove area with various types of feed

| *Type of feed* | *Nutrient content* | | |
|---|---|---|---|
| | *Protein (%)* | *Lipid (%)* | *Energy (Kkal $g^{-1}$)* |
| Trash fish | $45.26 \pm 0.28^{b}$ | $10.33 \pm 0.18^{b}$ | $3.536 \pm 0.01^{b}$ |
| Mujair fish | $47.53 \pm 0.48^{a}$ | $12.57 \pm 0.29^{a}$ | $3.685 \pm 0.10^{a}$ |
| Oyster | $47.54 \pm 0.52^{a}$ | $12.54 \pm 0.23^{a}$ | $3.657 \pm 0.03^{a}$ |
| Rice field snails | $45.70 \pm 0.33^{b}$ | $10.33 \pm 0.08^{b}$ | $3.572 \pm 0.02^{b}$ |

Different letters in the same column show significant differences between treatments at the level of 5% ($p < 0.05$).

***Physical and chemical parameters of water***. During the research, measurements of several physical and chemical parameters of water in cultivation area of mangrove crabs including temperature, salinity, pH, dissolved oxygen, ammonia, and nitrite are presented in Table 4.

Table 4

Measurement results of several physical and chemical parameters of water in cultivation area of mangrove crabs

| *Parameter* | *Value* |
|---|---|
| Temperature ($^{o}$C) | 25-30 |
| Salinity (ppt) | 23-29 |
| pH | 7.24-7.54 |
| DO (ppm) | 3.67-5.13 |
| Ammonia (ppm) | 0.03-0.09 |
| Nitrite (ppm) | 0.29-0.36 |

During the research, physical and chemical parameters of water were in proper condition for the cultivation of mangrove crab. The range of values is feasible to support the life of mangrove crabs. The optimum temperature for the growth of mangrove crab ranged from 26-32$^{o}$C, a salinity of 15-30 ppt, pH 7.0-8.5, dissolved oxygen of >3 ppm, ammonia of < 0.1 ppm and nitrite of < 0.5 ppm (Christensen et al 2004; Pedapoli & Ramudu 2014).

**Conclusions**. Based on this research, it can be concluded that the fattening of mud crabs which cultivated in mangrove area with different types of feed will produce the same survival, however, the best growth and the highest nutrient content are produced on crabs that fed with trash fish and rice field snails.

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