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The Influence of Different Baits and Funnel Elevations of Collapsible Pot to the Catch of Mangrove Crab

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Abstract

A box-shaped collapsible pot still requires improvement in thebait and the funnel elevation for capturing mangrove crab. The study aimed to determine the most attractive bait quality for the crab and the easiest funnel elevation to cross by the crab. The research was conducted in both laboratory and field experiments. The laboratory experimentsexamined different quality of bait from yellow stripe trevally fish (*Selaroidesleptolepis*). The bait quality consisted of fresh fish, 12 hours soaked fish, and 12 hours decomposed fish. The laboratory experiment also observed movement pattern of the crab to funnel of the pot with elevations 20^o, $40^{o,}$ and 60^o. Furthermore, the field experiments examined actual pot (experiment pot) with funnel elevations of 20^o, $40^{o,}$ and 60^o.The results showed that the crabs selected fresh fish in 58.54%, 12 hours soaked fish in 24.39%, and 12 hours decomposed fish in 17.07%. In the field experiment, the pot 40^o captured more crabs than pot 60^o and pot 20^o, where pot 40^o captured 25 crabs followed with pot 20^o (19 crabs) and pot 60^o.(17 crabs); however, in the field experiment, pot 20^o captured 16 young crabs, followed by pot 60^o (13 crabs)and pot 40^o (8 crabs).

Keywords: influence; bait; funnel elevation; mangrove crab.

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1. Introduction

Mangrove crab (*Scylla* spp.) has a high economic value. *Scylla* consist of *Scylla serrata* ,*S.paramamosain*, *S.tranquebarica* and *S.olivacea* [1]. The distribution of mangrove crab can be found in various places in the world, including Indonesia from the western of Sumatera to the eastern of Papua Island [2]. The vast spreading of the organism indicates that Indonesia has very abundant resources in which the utilization was done more with capturing activities in the habitat [3].

Capturing activity uses some gears such as gill net, lift nets, hook, and traps [4]. One of the traps used in the activity was a box-shaped collapsible pot[5]. Some researchers also provided the reason why fishermen prefer to use the collapsible pot. [6] informed that the pot was most effective trap to capture mangrove crabs if it was compared with other gear types for catching the crab, while [7] stated that the trapping power of the pot was very good so the crab cannot escape from the pot.

The visual observations showed the deficiencies in the construction of funnel elevation. Based on laboratory tests, the crab was difficult to enter the funnel. The legs of the crabs sometimes mire and stuck in the mesh, so the crabs' movement is hampered. Therefore, the construction must be repaired to make the funnel elevation easy to cross by the crabs. Other problems of the collapsible pot are the type and the quality of the baits. Fishermen still use different types of baits in very various qualities. One type of bait used in the crab capturing is yellow stripe trevally fish which is more durable in the waters [8]. In addition, silvery color on the fish body is considered to be more attractive for the crab. However, there is a little information that explains the effect of the bait quality to the crab.

The study was started by examining the types of bait preferred by the crab. Subsequently, the most attractive bait was used in testing the appropriate funnel elevation. The bait was used to attract the crabs approaching actively to the funnel elevation. The study objectives are to determine (1) the quality of bait which is preferred by the mangrove crabs and (2)the funnel elevation of the experiment pot which is more easily passed by the mangrove crabs.

Some previous researches related and disseminated to this study such as the study of the funnel construction that examined the effect of the funnel construction toward *Portunuspelagicus* and *Charybdis japonica* in Japan [9, 7]. Meanwhile, [10]who tried to find alternative types of bait using eel, minced fish, goat leather, and burned coconut did a review of the crab bait. [11] conducted a similar study using bait stingrays, chicken intestine, and eel. This study were performed in laboratory experiment scale. Furthermore, the study have been conducted in the field experiment scale to get more satisfactory results.

2. Materials and Methods

The experiment was divided into two phases, namely the laboratory and field experiment. A laboratory experiment was conducted between July 2011 to May 2012 at Laboratory of Fishing Equipment and Materials Technology, Department of Fisheries Resource Utilization, Faculty of Fisheries and Marine Science, Bogor

Agricultural University and at Integrated Laboratory of the university. While, the field experiment was conducted between June 12 to November 2012 in Mutiara Bay waters, Alor District, Province of East Nusa Tenggara (NTT), Indonesia. The selection of field experimental sites refers to information from[12] that the province was known as one of the mangrove crab producers in Indonesia.Map of the field study is shown in Fig.1.

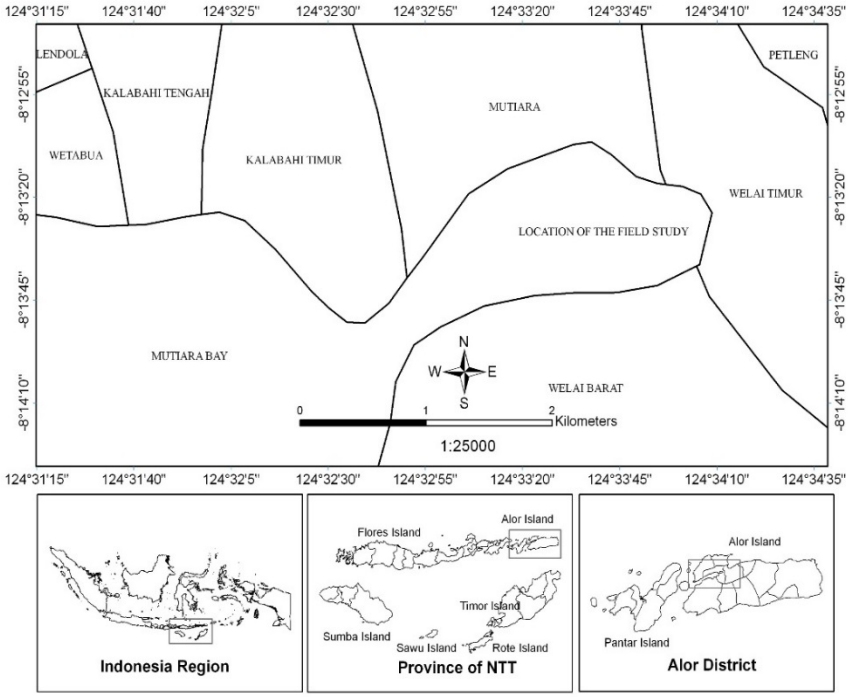

Fig.1:Map of the field study

The Laboratory experiment used four species of crabs, namely *S.serrata, S.paramamosain, S.olivacea, and S.tranquebarica*. Two individuals of each crab spesies were used in the experiment. Fig. 2 shows one species of experiment crab.

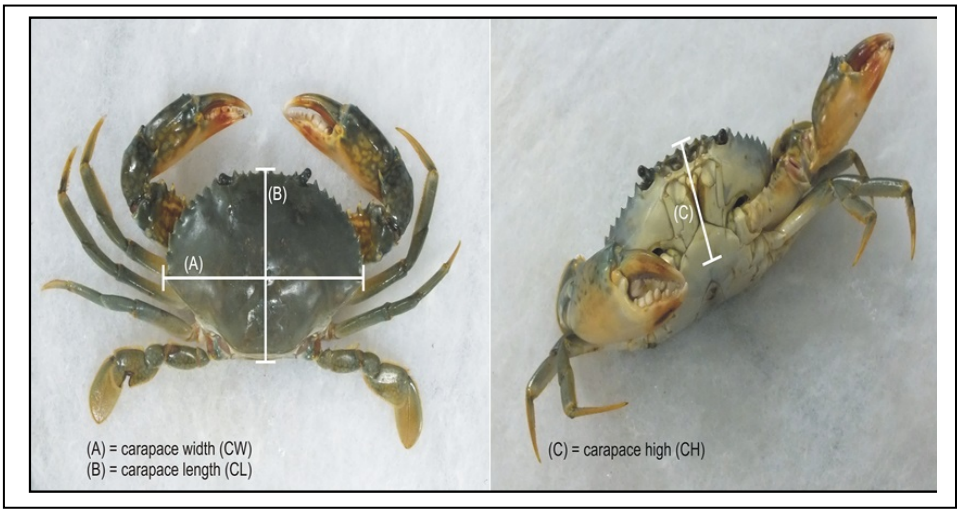

Fig.2: An experiment crab (*Scylla paramamosain*) with its parameter measurements.

The bait tested was the whole of yellow stripe trevally fish (*Selaroidesleptolepis*) in fresh condition (fresh fish), 12 hours soaked in seawater (soaked fish) and 12 hours decomposed (decomposed fish). The experiments referred to information from[13]that the soaking time affected to fish odour and the meal strength. The sequence of the study was started with entering one crab *S.serrata* that was hungry in 12 hours in the aquarium and it was allowed to enter the shelter. The shelter was made from black colour plastic with size of 10 x 20 x 10 (cm). Two types of baits namely fresh fish and decomposed fish were placed in the same aquarium with distance 50 cm from the shelter. The presence of crab bait quality and the pattern of movement of approaching crab were observed with a submersible video camera. Similar experiments were conducted on three kinds of the other crab with the same type of bait. The testing was done with a variety of different baits, namely fresh fish – soaked fish, soaked fish – decomposed fish. Test of one variation bait was repeated in 4 times with the same crab species. The most preferred bait of the crab was used to select the funnel elevation (model of funnel elevation). The illustrations of bait testsare shown in Fig.3.

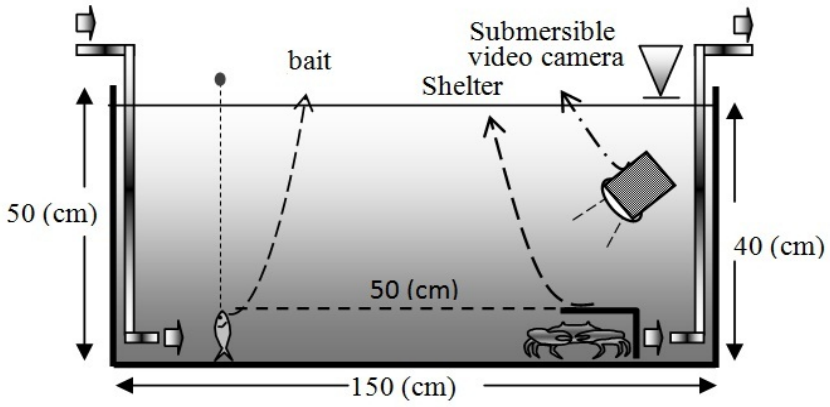

Fig.3: The illustration of bait test in the aquarium

The testing was also focused on the pot funnel elevation which has three elevations withα =20^o, 40^o and 60^o. The pot construction referred to the general funnel elevation of the commercially collapsible pot (20^o) and the crossing ability of the test crab at an elevation of funnel between 20^o to 90^o where crabs passed relatively more only on the three elevations namely 20^o, 40^o and 60^o. This experiment used the same kind of the crab. The experiment used four individuals of each crab species.

One crab of *S.serrata* was positioned in front of the funnel with elevation of 20^o. The distance between crab and the funnel was 30 cm. The crab was attracted using bait that was placed on the other side of the funnel. The movement patterns of crab crawling toward the funnel were observed with a video camera. The same experiment was conducted on three types of crabs with the same construction. Then, tests were conducted to funnel with elevation of 40^o and 60^o.The testing of each funnel was performed four repetition times with the same type of crab. Fig.4 shows Illustration of the funnel elevation tests.

The field experiment used the same test material, but the different test location and actual pot or experiment pot. The experiment potused funnel elevation with α = 20o (pot 20o), 40o (pot 40o) and 60o (pot 60o). Each experiment pot has six units.

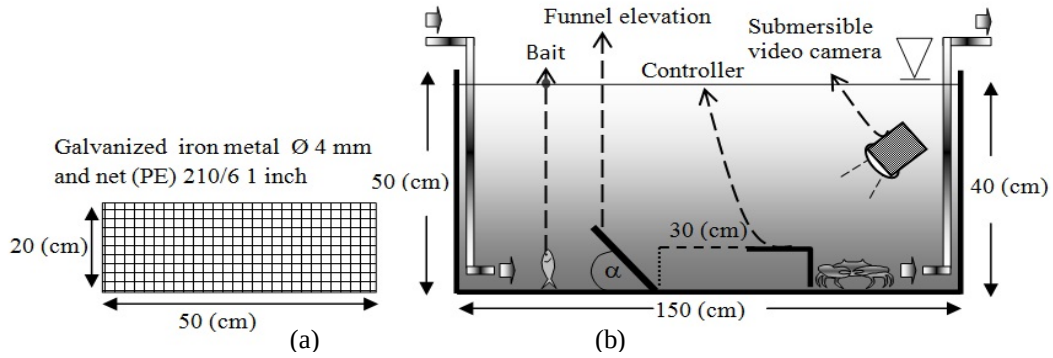

Fig.4: The illustration of funnel elevation test, construction of the funnel(a) and funnel position toward the crab (b)

The procedure was begun by placing bait (the same with a laboratory experiment) in each trap. Each pot was placed in mangrove forest of which distance between the pots was 5 m. The soaking time was 06:00 am to 06:00pm and 06:00 pm to 06:00 am. The catches of crab were identified by measuring the carapace dimensions with a calliper scale of 0.1 mm, and the weight with digital scale of 1g. The crabs were grouped into categories of young crabs and adult crabs based on carapace width size (CW) following the categorization of [5] who stated that the crabs with CW more than 8.5 cm were categorized as adult crabs and they were sold as live crab. The crabs with CW less than 8.5 cm were categorized as young crabs and they were used in soft-sell mud crab culture.[14] also stated that mean CW at sexual maturity of the crabs for female crabs was approximately 8.6 cm. The operation of experiment pot was performed with 60 repetitions. The illustration of the experimental pot is shown in Fig.5.

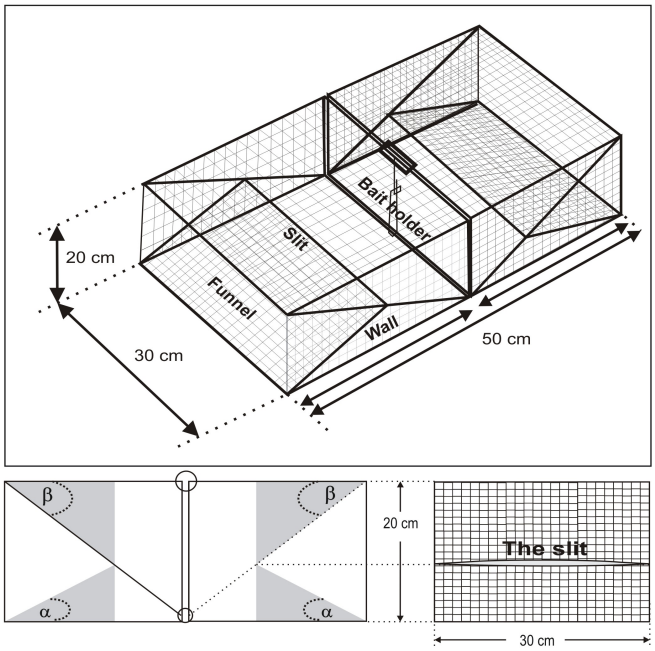

Fig.5: The illlustration of experiment pot

The data of laboratory and field experiments were analysed using several statistic tests. The data of laboratory experiments such as a movement pattern of crab approaching to the bait and movement patterns of crab crawling

on the funnel elevation of experimental pot were descriptively analysed. Preferences of crab to the baits were analyzed using Kruskal-Wallis test. Subsequently, the data were tested using Mann-Whitney U test to determine the differences among the baits. The field data in the form of number and size of the carapace width (CW) were analysed using analysis of variance then followed by Duncan's test. All tests used 95% of the confident level. Previously, the normal data on crab caught were tested using Kolmogorov-Smirnovtest, the data were transformed with the formulation of arc sin transformation. All data were processed using SPSS software for Windows.

3. Results

Laboratory observation showed that the crabs detected the presence of bait with a pair of antennae. Furthermore, the crabs' mouth was twitching when crabs crawled towards the bait. The crab crawled towards the bait with sideways body position. This body position was maintained during the crab approaching the bait. When approaching the bait, crab stopped its movement. The crab body was rotated so that the front of the body faced directly toward the bait. The crab's claw was moved in the direction of the bait. The bait was clamped by both of crab claws and the crab started to do feeding activity. The movement pattern of the crab to position of the bait is shown in Fig.6.

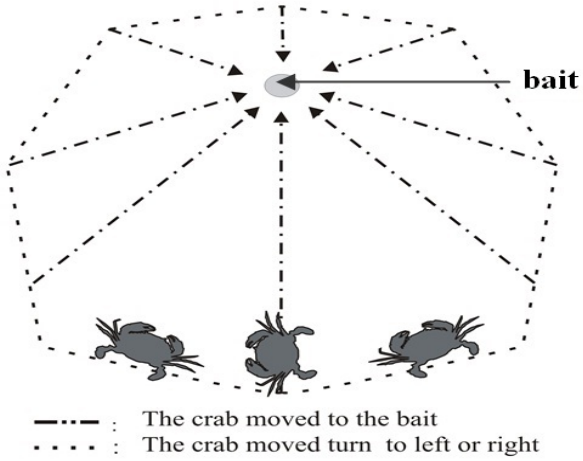

Fig.6: Movement patterns of the crab to the bait.

Figure 6 shows some crab movement patterns moving to direction of the bait. The crab positioned its body sideways and immediately moved straight toward the bait. The other pattern of the crab movement was movement by turning to the left or right. Figure 6 shows the percentage of bait selection where the fresh fish was selected more highly than soaked fish or decomposed fish by the crabs.

The statistics tests on crab's preference of bait in the laboratory experiments had some differences. The Kruskal-Wallis test showed that the fresh fish was the first rank, soaked fish in the second rank and followed by decomposed fish at third rank with the value of $\chi 2_{0.05, 2, table} = 5.99$ and the value of $\chi 2count = 23.37$. The value

of $\chi\ 2_{count}$ was greater than the value of $\chi\ 2_{table}$. It means that preference of the crabs to the bait were significantly different. Whereas, Mann-Whitney U test showed that the value of $Z_{0.025}$tables was 1.96, and the value of Z_{count} between fresh fish and soaked fish; fresh fish and decomposed fish; and soaked fish and decomposed fish were -3.74; - 4.46; and -0.84 respectively. These values prove that the choice between fresh fish and soaked fish were significantly different. The choice between fresh fish and decomposed fish was also significantly different, but the choice between soaked fish and decomposed fish was not significantly different.

Results of laboratory observations show a different movement pattern of crabs when it crawled on the funnel. The crab climbed the funnel path using the walking legs and swimming legs. The crab used sideways body position when climbing the each funnel. The walking legs at the front pulled the crab body upward, while the walking legs at the backward pushed it. The walking legs reached each net mesh to pull up the crab body. Other walking legs were used as the foundation for moving on experiment pot. The crab claws were also used to hold the nets, so that the body could climb on funnel. The way of crab movement over the funnel was also directed by its swimming legs. When crabs moved sideways, the swimming leg was moved forward to pedal and direct crab movement, while swimming leg at backward was used to push the crab body to cross the funnel. The crab was going to stop or leave the funnel if its swimming legs were difficult to get a foothold. Crab movement of the funnel showed the different patterns. There were crabs that moved directly from the center of the pot funnel and there were crabs that started from the edge of the wall the pot funnel. From the both of ways, the most dominant movement patterns were started from the edge of the wall of pot funnel then followed with from the center of pot funnel. This indicated that the presence of the wall of the pot was needed. The wall serves as a steering movement of crabs to the entrance of the pot funnel. Fig. 7 shows the bait selection percentages by the crab.

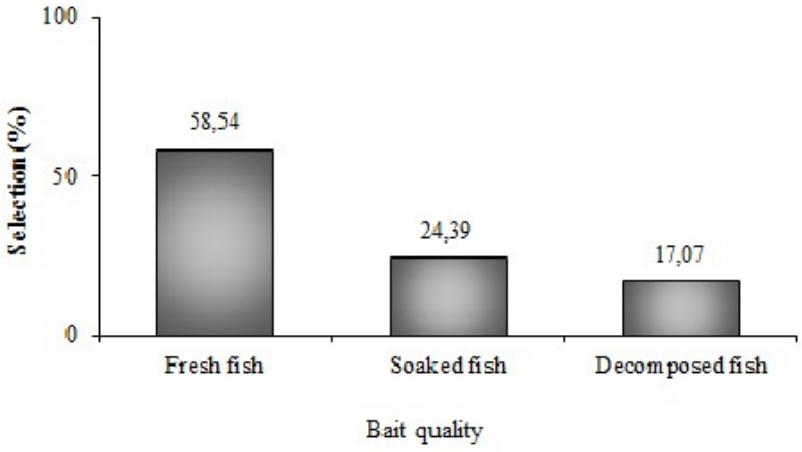

Fig. 7: Persentage of the bait selection by the crab

Crabs could pass through all funnels with various difficulties. Crab passed more easily through the experiment pot with funnel elevation of20^o, followed by 40^o and 60^o.The funnel elevation of 20^o was passed as many as 47 times or 97.91% of the 48 repetitions, followed by 40^o with 43 times (89.58%) and 60^o with 39 times (81.25%).

Crab movement passed through funnelelevation of 20^o, and 40^o was done by using its walking legs. The swimming legs were used to steer and push its body when it passed the funnel with elevation 60^o. From the observations, it appears that if the crabs have a hard time to pass through the funnel 60^o, then the crab will leave the funnel. Movement patterns of the crab the crab are shown in Fig.8.

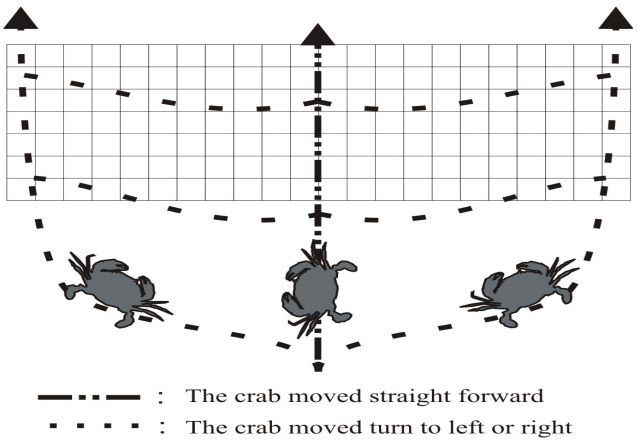

Fig. 8: Crab movement patternswhen pass through the funnel

The operation of the experiment pots in the field produced four kinds of crabs, namely *S. serrata, S.paramamosain, S.olivacea, and S.tranquebarica. S.serrata* were captured as many as 53 crabs or 86.9% of the total catch, *S.paramamosain* 4 crabs (6.6%), *S.olivacea* 2 crabs (3.3%) and *S.tranquebarica* 2 crabs (3.3%).

Catch of the crabs are shown in Fig.9. The number of crabs caught with pot 40^o was more than the pot 20^o and 60^o. The pot 40^o captured as many as 25 crabs or (40.98%) of the total catch, it was followed by pot 60^o with 19 crabs (31.15%) and pot 20^o with 17 crabs (27.87%). The catch was dominated with 60.65% of young crabs and the remains (39.35%) were adult crabs. The young crabs were captured more at pot 20^o and pot 60^o. The pot 60^o captured 16 young crabs or (94.11%) of the total catch, while pot 60^o captured 13 young crabs or (68.42%) of the total catch. The pot 40^o only caught 8 crabs (32%) of the total catch.

Analysis of variance also showed that the funnel elevation of experiment pot has significantly affected to the number and size of crab catch. The influence of funnel elevation on the number of crabs was indicated by the F calculated value = 3.29 which was higher than the value of F_{table} = 2.99. This means that the number of crabs caught by each trap was significantly different. Further testing with the test results of two-way Duncan was known that the number of crabs in the traps catches significantly different from pot 40^o, toward pot 60^o and pot 20^o, while the number of crabs was captured by pot 60^o statistically equal to the pot 20^o. As for its effect on crab size indicated by the value of F_{count} = 3.34, or higher than the F_{table} = 2.99. The size of the carapace width of crabs of each pot was significantly different. Further two-way Duncan test also proved that the size of the crab of pot 40^o significantly different with pot 60^{o}and pot 20^o, while the size of the crab of pot 60^o also statistically as same as the pot 20^o.

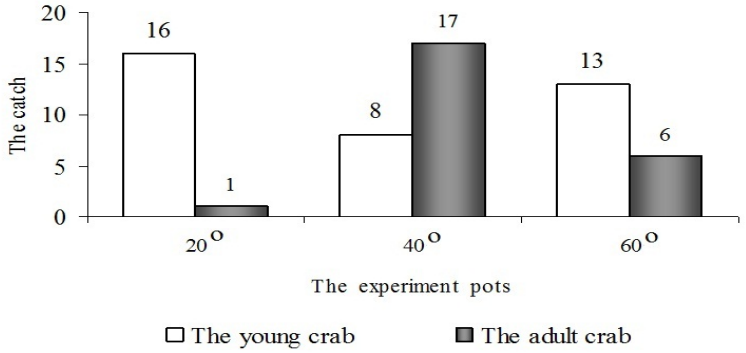

Fig. 9: Catch of the crab in each pot

Based on Fig. 9, the young crabs were trapped by all pots. This indicates that the young crab can get into every pot and it was not too affected by the funnel elevation. The ability to move of the young crab easier and faster than adult crabs, so the young crab more easily passed through the funnel elevation than the adult crabs. The presence of young crab was inhibited by the presence of adult crabs. The adults often attack the young crab. Therefore, the young crab tends to move away when the adult crabs were at a nearby location. It was occurred in 40^o pot. The young crabs were more caught by pot 20^o and pot 60^o that were difficult entered by the adult crabs.

4. Discussion

The crab detected any bait with a pair of antennae; besides, the movement of the crab's mouth as the crab moved towards the bait with the same lateral position. Observation of [15] indicating that antenna and mouth movement always worked when the crab crawled towards the bait, then the crab moved sideways body position to the direction of bait stink.[16, 17] informed that the crab found the bait by following the odour of the bait that was scattered in the water. The crabs tended to follow the odour of the bait to find the bait as feeding behaviour of crabs. As the organisms that inhabited in mangrove areas with turbid water conditions and low light levels, the crabs could smell to find the food. [18] stated that the aquatic organism in areas with low light levels used their smelling sense to find the presence of food, so the organisms will more easily find the odour of the bait.

Crab choice on the type of bait may also be influenced by the chemical content of the bait.[19] informed that the chemical compounds that affect the crab bait were the content of protein and amino acids. [20]revealed that amino acid content in the bait decreased when it was soaked in 1.5 hours, whereas if it was soaked for 24 hours, the content of amino acids in the bait would be static or constant. The reduction of soluble amino acid levels made the bait difficult to detect by the crab. [19] stated that crab family Portunidae, *Portunuspelagicus* and *Charybdisferiata* showed a positive response to the concentration of amino acids $2x10^{-7}$ to 2×10^{-4}moll l^{-1}. [21] informed that amino acid of bait was the trigger cravings for crustacean and fish. The desire to eat of the crustaceans would be reduced by decreasing amino acids of the bait. [22]stated that artificial bait composed of the amino acids such as arginine and leucineattracted grouper to approach and then they were entrapped into the basket trap. The content of amino acids (arginine and lysine) from unpublished data of this study in percentage for the fresh bait was 1.16 and 1.15; soaked bait (1.03 and 1.11); and decomposed bait (1.04 and 1.10). This

information indicated that the fresh bait had higher levels of the amino acid such as arginine and leucine, so that fresh bait was preferred by crabs more than soaked bait and decomposed bait.[23] also informed that the rate of release of amino acids of natural bait which was soaked in 1 hour about 36%, 4 hours (20%) and 24 hours (4%). So, the crabs more preferred fresh bait than other bait such as soaked bait and decomposed bait.

The catch was dominated by *S.serrata* of which number of distribution in the nature was more than other kinds of Scylla. [3] informed that the four crabs were more discovered in the waters of Indonesia however, the number of *S.serrata* crab in this area was more than the other kinds of Scylla.

The difference of the catches among pots indicated different results between the laboratory and field studies. The laboratory study found that the crab more easily passed through the experiment pot with funnel elevation 20^o, while the results of the field study showed that the experiment pot with funnel elevation of 40^o had more catches of the crabs. This was due to the number of crabs per repetition test on laboratory only one individual, so that there was no disturbance to the movement of the crab. In the field study, all crabs competed for entering the pot. Adult or large-sized crabs tended to enter the trap in advance, while the young crab would avoid from the adult crabs. Visual observation showed that crabs attacked each other in the experiment. This is same with the observations of [24] which reported that The adult crabs either males or females usually attacked other crab. The young crabs were preyed by the adult.

The adult crabs were very difficult to enter the experiment pot with funnel elevation of 20^o and 60^o. [9] informed that the pot with a low of funnel elevation made the adult crabs difficult to enter the pot. The spines on the body of the crab were caught in the mesh. The crab was going to leave the pot if the crab was difficult to pass through the funnel. [25] referred to a similar case that the crab would leave the pot if the crab was difficult to enter the pot. This happened similarly at the pot 60^o when the adult crab crawled the funnel elevation in upright position. The large hydrodynamic pressure, the gravity force and the formation of a narrow angle between the end of the funnel and the top wall of the pot will hind the movement of the crabs.

5. Conclusions

The research raised important and accurate information about determination of the most attractive bait quality for the crab and the easiest funnel elevation crossed by the crab. The fresh yellow stripe trevally fish was most preferred bait by mangrove crabs if compared with the soaked fish in sea water for 12 hours or decomposed fish for 12 hours. In field experiment, the pot with 40^o funnel elevation captured the most number of crabs namely 25 crabs, followed by the pot 60^o with 19 crabs and the pot 20^o with 17 crabs.

Some recommendations can be given for the completion of the study in determining the most attractive bait quality for the crab and the easiest funnel elevation crossed by the crab. The bait can be placed into a protected container as a box or bag so the bait will not run out quickly, and the height of box-shaped collapsible pot can be adapted to funnel elevation of 40^o.

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