ISSN : 1410-5217
Acrredited : 83/Kep/Dikti/2009

Original Paper

BOTTOM WALL CONSTRUCTION OF "JODANG" TRAP APPLIED SELECTIVELY TO BABYLON TIGER (*Babylonia spirata*) SNAIL SIZE

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Received ; September, 12, 211 ; Accepted : December, 29, 2011

ABSTRACT

The objective of this research was to obtain net mesh bottom wall construction of "jodang" trap that selective to babylon tiger snails size, i.e. only shell length of $l < 4.27$ *cm approximately could pass through. There were 3 designs shapes of bottom wall construction tested, i.e. rectangular shape of 2.4* × *2.8 (cm) and 2 diamond shapes with net mesh size of 5,6 cm and primary hanging ratio of* $E_1 = 0.7$ *and 0.5. The results showed that rectangular shape bottom wall trap construction was better than those two other constructions. Only 6.78% of snails with* $l \geq 4.27$ *cm could escape the rectangular shape bottom wall trap construction. Whereas 41.90% and 17.46% of snail shells with* $l \geq 4.27$ *cm could escape from both the diamond mesh bottom wall trap construction. According to selectivity curve, the rectangular shape bottom wall trap construction could retained snails with shells length of* $l \geq 4.33$ *cm. The two others retained shells length of* $l \geq 4.14$ *cm and* $l \geq 4.60$ *cm.*

Key words: Construction ; bottom wall; "jodang" trap; selective; babylon tiger snail

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INTRODUCTION

Pelabuhanratu West Java is one of the centre of babylon tiger snail fishing by using a *"*jodang*"* trap. The babylon tiger snail is mostly for export commodity. The increase demand of the babylon tiger snail in the international market resulted in the uncontrolled exploitation of this organism in Palabuhanratu water.

Lately the babylon tiger snail fishing activity in Pelabuhanratu decreased. According to the babylon tiger snail fishermen, the number of catching reduced, and the size being caught was smaller due to over fishing of this organism. One of the reason was uncontrolled net mesh size of *"*jodang*"*, used by the fishermen, therefore almost all sizes of the snails were trapped/catched.

Up to now, there is no limitation of the allowable catching size of babylon tiger snail. According to the fishermen, the marketable size of babylon tiger snail is at the shell length of $l \geq 1.80$ cm. The higher the size the more expensive the price. Therefore, to protect the babylon tiger snail resources, there should be a legislation on its allowable catching size, i.e. after spawning. Firdaus (2002) mentioned that babylon tiger snail will spawn at the shell length of $l \geq 2.47$ cm. For this reason, therefore, the net mesh size of bottom wall construction of *"*jodang*"* trap should be adjusted with the allowable catching size of shell length of $l = 4.27$ cm, so that it can only catch babylon tiger snail with shell length of $l \geq 4.27$ cm.

Three (3) different net mesh sizes of *"*jodang*"* bottom wall construction were used in this investigation. One was rectangular shape construction (2.4×2.8 cm), while the other two were diamond shapes with net mesh size of 5.6

ISSN : 1410-5217
Acrredited : 83/Kep/Dikti/2009

cm and primary hanging ratio of E_1 = 0.7 and 0.5.

Publication of "jodang" trap supporting this experiment is dificult to find. Similar research was only done by Puspito (2007 and 2009), but the results were unsatisfied since the construction only trapped babylon tiger snails with shell length of $l \geq 3.7$ cm and $l \geq 4.16$ cm, respectively. Two other publications discussed on selectivity of "jodang" trap based on slope and material of trap wall (Puspito 2010a and 2010b). Ram, *et al.*, (1993) and Nashimoto, *et al.* (1995) have actually conducted research on selectivity of snail trap. Although their researches were about snail trap selectivity, but they used the different trap and different snail species as well.

MATERIALS AND METHODS

Materials

Some materials used in this experiment were 27 unit "jodang" traps, 27 pockets made of 210D/6 polyamide net with mesh size of 1.25 cm, 1 unit small fishing boat and 1 calipers to measure the babylon tiger snail shell dimension. "Jodang" trap is the only gear to catch babylon tiger snail in Pelabuhanratu waters. The trap has the shape of truncated pyramid. All walls are covered by net having small mesh size of 0.7 cm. Dimension and construction of the trap can be seen in **Fig. 1**. The pocket was equipped on the lower part of trap in order to collect the escaped snails. Sardine (*Sardinella* spp.) was used as a bait fish.

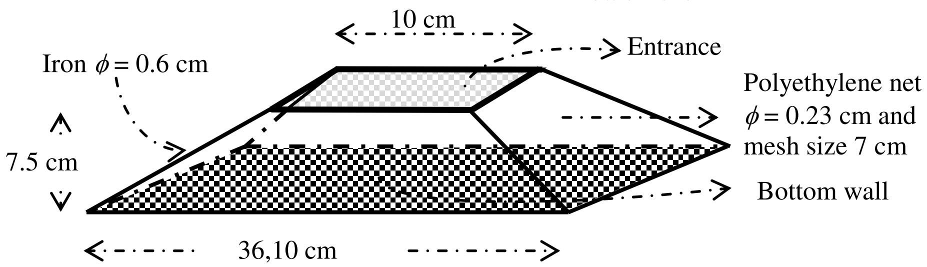


Fig. 1. Construction and dimension of *"jodang"* trap

Methods

This research applied a fishing trial method. "Jodang" traps construction was done at Laboratory of Fishing Gear Technology, Faculty of Fisheries and Marine Science, Bogor Institute of Agriculture. While, the field research was carried out in Pelabuhanratu waters on September 2008.

The net mesh size of bottom construction of trap was adjusted with the height (h) and width (w) of the babylon tiger snail shell at the length of 4.27 cm (**Fig. 2**). The results of 10 shell samples measurement showed the average width of w = 2.8 cm and average height of h = 2.4 cm.

Fig. 3a shows the cross section of the largest shell. Three (3) constructions of net mesh were made based on that shape, i.e.:

1. Rectangular shape of $w \times h$ = 2.4 × 2.8 (cm) (**Fig. 3b**);2. Diamond shape at the net mesh size of 2 × w = 5.6 cm and E_1 = 0.7 (**Fig. 3c**); and
3. Diamond shape at the net mesh size of 2 × w = 5.6 cm and E_1 = 0.5). At the angle of α = 60^{o} which was obtained from direct measurement (**Fig. 3d**).

E_1 is the distance ratio between 2 knots on a net mesh which was set fully stretch horizontally. The materials used for the third construction, i.e. a polyethylene (PE) No. 380 D/9 yarn shows in **Fig. 4.**

The traps were arranged alternately on sea bottom. Therefore each trap could get the same probability to catch snail. Fishing operations were done at night for 3 hours soaking time. The trap was operated 10 times simultaneously as replication (**Fig. 5**).

The waters organisms caught by the traps were identified. Furthermore, height h, width w and length l of each babylon tiger snail entered, either in trap or in pocket, were measured (**Fig. 2**). In field research, it was operated 9 kinds of trap based on 3 bottom wall constructions (**Fig. 4**).

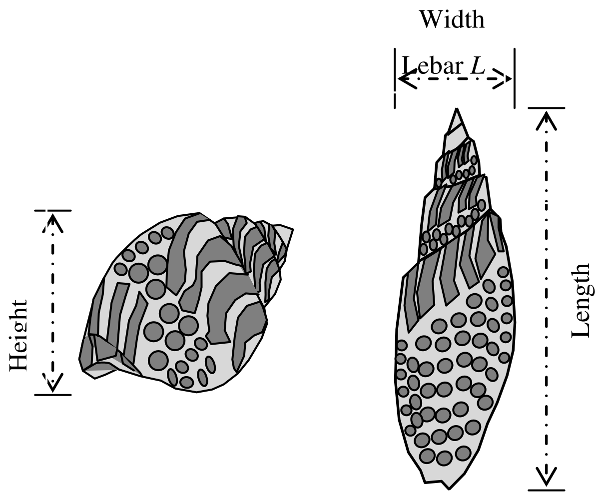


Fig. 2. Measurement position of height, width and length of the shell lebar dan tinggi cangkang.

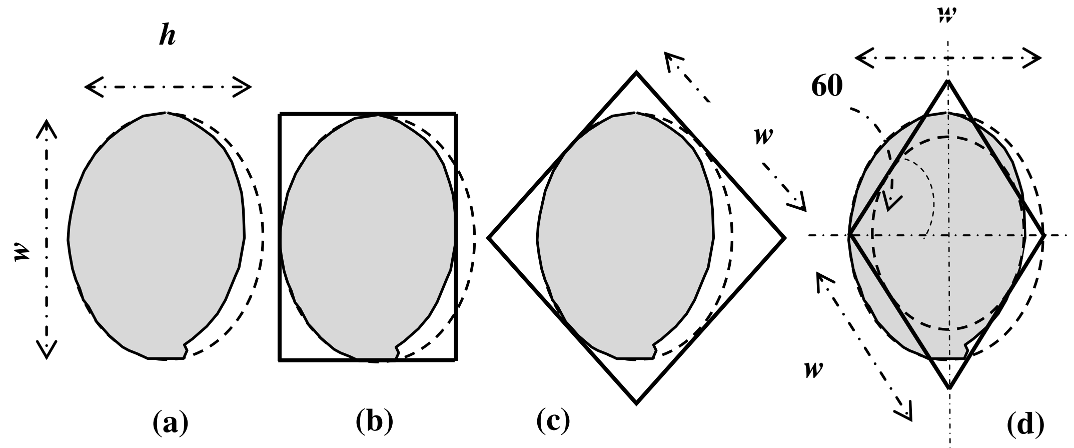
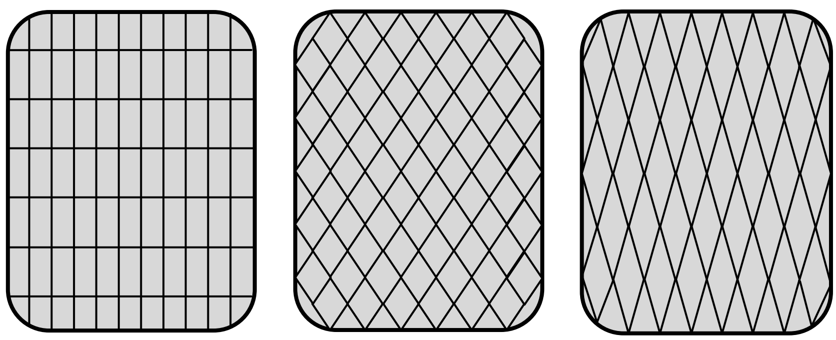


Fig. 3. The construction adjustment of wall mesh size of the trap



(a) Rectangular shape 2.4×2.8 (cm)

(b) Mesh size = 5.6 cm; $E_1 = 0.7$

(c) Mesh size = 5.6 cm; $E_1 = 0.5$

Fig. 4. Construction of bottom wall of the trap

ISSN : 1410-5217
Acrredited : 83/Kep/Dikti/2009

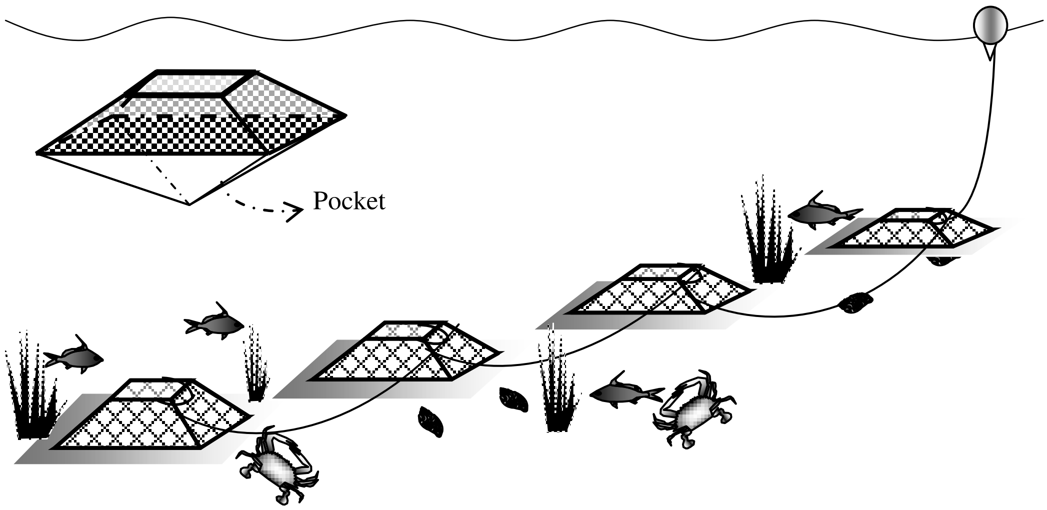


Fig. 5. The setting of *"jodang"* trap on the bottom of the fishing ground

Data Analysis

Shell size reliability

The shell size reliability was meant to find out if the size of the sample shell was in a reliable condition. The shell size reliability was done by looking at the relation of shell length l and width w with height h which were plot in a graph. The reliability will be known by the strong coefficient determination R^2 of the linear regression.

The effect of bottom wall construction on the shell length

Analysis of variance (ANOVA) was used to find out the effects of different bottom wall construction on the trapped shell length. Further analysis of least significance difference (*LSD*) was applied to find out the different between mean value of the treatments statistically. The different mean value of treatment was compared to the smallest different value using formula $LSD_{\alpha} = t_{\alpha}\ (2S^2\ /\ r)^{1/2}$ (Steel *et. al*, 1997).

The bottom wall selectivity

The selectivity of the bottom wall was analyzed by cover net method. The calculation was based on the proportion of the snail caught with average length, i.e. $\phi_i = N_{il}\ /\ (N_{sl} + N_{il})$ (ICES, 1996). Constanta ϕ_i is the proportion of the snail caught by bottom wall construction no-*i*, N_{il} the number of snail trapped by bottom wall construction no-*i* at l length group, and N_{sl} the number of escaped snails no-*s* at l length group.

Selectivity curve was based on $r_i(l) = \exp(a_i + b_i l)\ /\ [1 + \exp(a_i + b_i l)]$. Constanta $r_i(l)$ is the function of net selectivity on the shell length, l shell length, a and b the selectivity curve parameter will be assumed. Parameter a and b were obtained by maximizing the function of *log likelihood* using *add-in solver* on *MS Excell software* with formula $\log L_i = \Sigma [N_{il} \ln \phi_i(l) + N_{sl} \ln(1-\phi_i(l))]$. The *selection length* L_{50}, or shell average length when half of the shell was trapped by the net mesh was found using formula $L_{50} = -a\ /\ b$.

RESULTS AND DISCUSSION

The Catch Composition

The *"jodang"* trap caught 5 species of snails and 4 species of swimming crabs. The snails consisted of *Buccinum* spp., *Collumella testudine*, *Rappana* spp., *Murex califera*, and babylon tiger snail (*Babylonia spirata*). The swimming crabs consisted of *Beuroisia manqueni*, *Tanaoa distinctus*, *Myra grandis*,

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and *Laterallidae* spp. The number of babylon tiger snails caught was 1,224 or 35.27% of the total catch, other snails 1,039 (29.95%) and swimming crabs 1,207 (34.78%)

The number of babylon tiger snail caught was quite a lot because the trap was set on the mud substrate bottom sediment waters (Edward, *et al.,* 2006). Furthermore, the operational of the trap was on the babylon tiger snails fishing season between July-October (Naja, 2004).

The swimming crabs live in the same habitat as babylon tiger snail. Smell of bait invited them to enter the trap. The present of babylon tiger snail and the crabs in the trap indicated that the babylon tiger snails enter the trap earlier than the swimming crab. The babylon tiger snail will not enter the trap if the swimming crabs are already there. The swimming crabs movement are very aggressive (Hill, 1982), whereas the babylon tiger snail is very sensitive to the movement (Rupert and Barnes, 1991). The operation of the trap must use the fresh bait to reduce the number of swimming crabs which enter the trap. According to Ruppert and Barnes (1991), tiger snail is eater 's very selective and only eat fresh bait. While swimming crab like bait which is getting rot (Shelton and Hall, 1988). Another way is to operate the traps at the time of the month of bright, since at that time swimming crab do migration vertical to the sea surface (Fish, 2000).

Shell Size Reliability

The correlation between length l, width w and height h from 438 shells of babylon tiger snail is shown in **Fig. 6.** The regression was $w = 0{,}664\ l - 0{,}185$ and $h = 0{,}647\ l - 0{,}264$. Value $R^2 > 0{,}6$ on both regressions mention a very strong relation among variables (Wicaksono, 2006). It means that the ratio between l, w and h in every shells were reliable. Thus, the research will give satisfactory results, because every snail which caught having a normal body size.

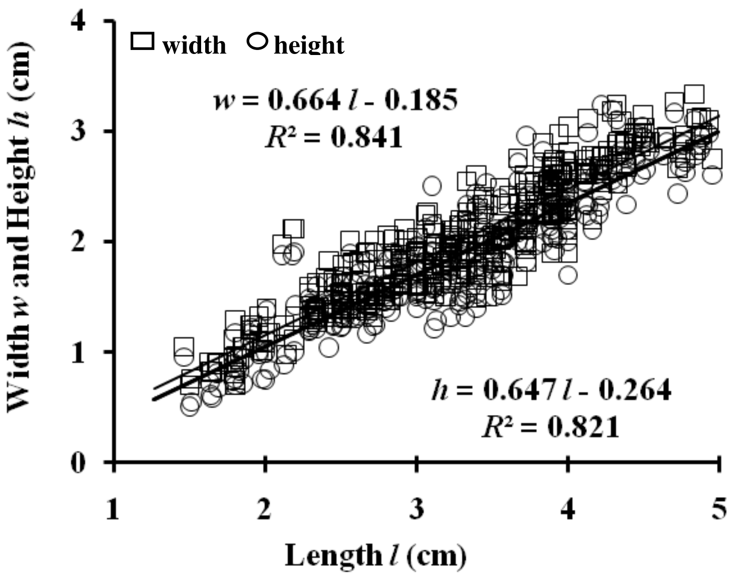

Fig. 6. Linear relation between width w and height h with length l of babylon tiger snail shell

The Babylon Tiger Snails Escape

The number of babylon tiger snails catch was 1.224 with average shell length between 0.00-6.09 cm were grouped in 10 groups class with the interval of 0.61 cm. The 887 numbers of babylon tiger snails (72.41%) were at $2.44 < l < 4.27$ cm (**Fig. 7**).

The number of babylon snails trapped by three different bottom walls (**Fig. 7**) was proven by ANOVA analysis which shows a significant different between treatment $F_{calculation(=64.68)} > F_{table(=3.35)}$. There was also a

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significant different of the mean values of each net construction.

Rectangular shape net mesh construction

The babylon tiger snails entered the rectangular shape net mesh construction were 413 snails. The number of 354 snails (85.71%) were at the range of shell length of $2.44 < l < 4.27$ (cm). The number of reasonable size being caught was 57 snails (13,80%) (Fig. 7a-1). Fig. 7a-2 mentions that 2 snails with l between 3.66 – 4.27 cm and 55 snails with $l > 4{,}27$ cm were trapped. There were 4 snails escaped from the trap.

Diamond shape with net mesh size of 5.6 cm and E_1= 0.7

According to Fridman (1986), the net with primary hanging ratio of E_1=0.7 has higher mesh strength compared with mesh with primary hanging ratio of E_1=0.5 although their mesh size are the same (5.6 cm). In theory, this bottom wall would release more snails. It was proven by the catch of 393 (**Fig. 7b-1**), but only 63 snails were trapped (**Fig. 7b-2**). The bottom wall net was still retained 3 uncatchable snails and released 45 catchable size snails.

Diamond shape with net mesh size of 5.6 cm and E_1= 0.5

The trap with diamond shape bottom wall construction with net mesh size of 5.6 cm and primary hanging ratio of E_1= 0.5 caught 418 snails at the range of shell length of l = 1.22-5.49 cm (**Fig. 7c-1**). There were 99 (23.68%) snail retained (**Fig. 7c-2**). The trap was able to retain 47 snails at the shell length of l = 3.05-4.27 cm, and 52 snails with $l \geq 4{,}27$ cm.

A trap is considered good ideal if it can retain snail with shell length of $l \geq 4.27$ cm of a catchable snail biologically. That size of snails are already spawned, therefore the catching of that size will not disturb its natural resources sustainability. The Babylon tiger snails with shell length of $l < 4.27$ cm should be remained in its habitat to promote their spawning and reproduction, therefore their population in nature is sustained.

Under allowable catch size of snails was still trapped by those three different net mesh sizes of bottom wall construction of "jodang" trap. The reasons could be : 1) the snails were sandwiched between side wall and bottom wall of the trap, 2) the snails were on the top of the other bigger size trapped snails, 3) the snails were obstructed by the trapped crabs. The other possibility, the catch were only at one side of the "jodang" trap, so that small size snails could not escape when the trap was hauled. The solution is to shake the traps before being hauled to the water surface. It is intended to make the small size snails pass through the net mesh.

During hauling process of the traps, the bottom wall would get hydrodynamic pressure and pressure from the catch. The weight of the pressures depend on the number, weight and size of the catch as well as the speed of hauling. The combination of both forces would increase the mesh size of the net due to the stretch of the yarn. Klust (1982) mentioned that polyamide yarn had the highest stretch in wet condition. The hauling speed and the number of the catch resulted in the firmed bottom wall and evasion of the allowable catching size snails.

The Construction of Bottom Wall Selectivity

Fig. 8 shows the value of L_{50} of the rectangular shape is 4.33. It means that the trap retained the snails with the shell length of $l \geq 4.33$ cm. Under allowable catch size of snails would pass through that net mesh size. The diamond shape bottom wall with the net mesh size of 5.6 cm and E_1=0.7 has L_{50} value of 4.60. It means that this bottom wall construction could only keep the snails with the shell length of $l \geq 4.60$ cm. Allowable catch size of snails at the size of 4.27 cm $\leq l < 4.60$ cm were still able to escape through the net mesh. While the diamond shape bottom wall construction with the net mesh size of 5.6 cm and E_1=0.5 has L_{50} value of 4.14. It indicated that the trap was not able to release the snails under allowable catch size (4.14 cm $\leq l < 4.27$ cm). From those above explanation, it seemed that the rectangular shape bottom wall construction was more selective compare to those both diamond shape bottom wall construction.

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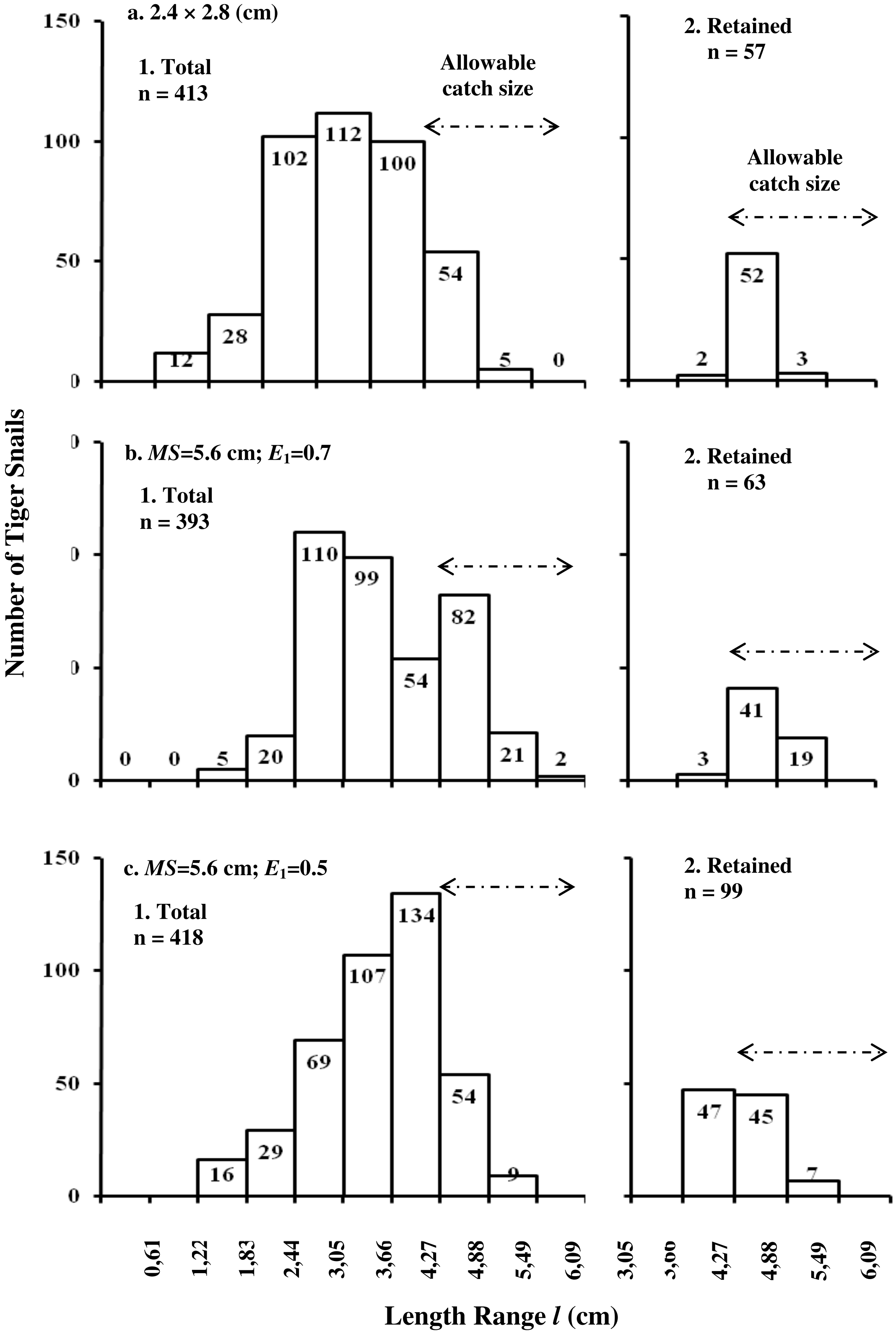

Fig. 7. The length of tiger snails catch

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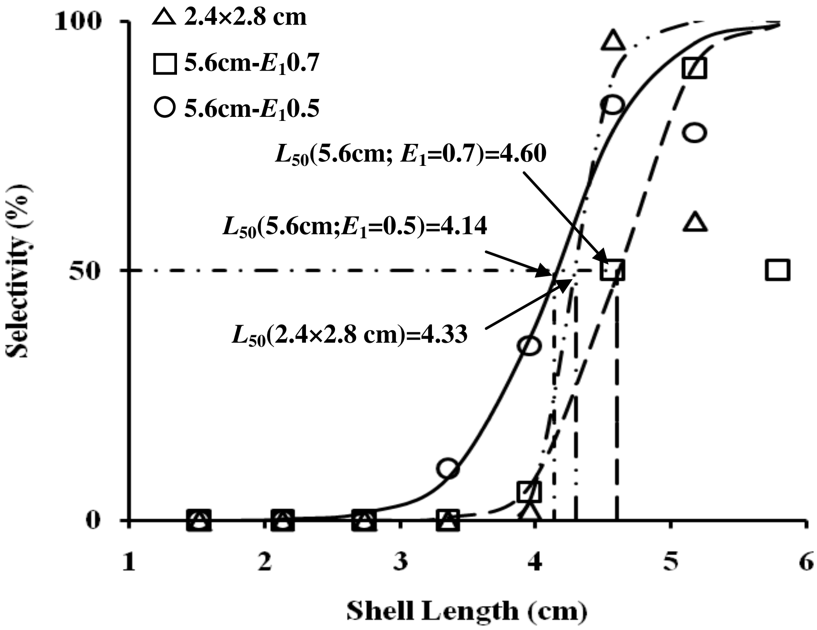

Fig. 8. Selectivity of bottom wall trap curve

CONCLUSION

From those above explanations, it can be concluded that the *"jodang"* trap bottom wall net mesh which is selective on the babylon tiger snail catch is the rectangular shape bottom wall construction at mesh size of 2.4×2.8cm^2, because it could keep the babylon tiger snails at the length size of $l > 4.33$ cm.

ANKNOWLEDGEMENT

This research was one of a self funding continues serial researches with the same topic. A great gratitude was addressed to Ir. M Dahri Iskandar, M.Si., and Ayu Adhita Damayanti, S.Pi. M.Si for supports and help for data collection.

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