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Design and Effect of Escape Vent in a Trap on the Catch of Blue Swimming Crab (*Portunus Pelagicus*): A Preliminary Study

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KEYWORDS

Crustacea;
Escape gap;
Passive gears;
Size;
WPP 712

Abstract Blue Swimming Crab (*Portunus pelagicus*, BSC) is one of the Indonesian important fisheries commodities often captured by traps. Under Decree No. 56/2016, the Ministry of Marine Affairs and Fisheries managed the BSC, with the standard size of BSC is >10cm of Carapace Width (CW) or >60 g of Weight (W), and non-berried or carried eggs for female. This study aims to determine BSC's crawling pattern toward the trap, design an escape vent on the trap, and assess catch of BSC using vented trap and non-vented trap. The video footage was used to examine crawling pattern of 30 BSCs on the laboratory. The study also includes field experiment by deploying twenty traps (10 vented traps and 10 non-vented traps) on the sea. The study obtained two crawling patterns of BSC, crawling forward and sideways with the most BSC crawled sideways. Design of escape vent was 4.6 cm length x 2.6 cm height. The BSCs captured in the vented traps have >10cm of CW, while 14% of BSCs in the non-vented traps have <10 cm of CW. The use of escape vent did not affect the catch (weight) of BSC in the trap.

Introduction

Blue Swimming Crab (*Portunus pelagicus*, BSC) is one of the most importance crustacean species in Indonesia and, together with crabs, accounted for 9.11% of total export value of fisheries product in 2017 (MMAF, 2018). Java Sea, South Sulawesi, East Sumatera, and Malaka strait are the importance areas for BSC's fishery (IMACS, 2015). The BSC was exported to various country in the form of frozen meat or canned meat. The biggest market for Indonesian BSC was the United State of America, followed by Japan, Malaysia, Singapore, France, England, and Thailand (APRI, 2019). In addition, increase in market demand and high economic viability were likely to increase fishing pressure of BCS (Nugraheni *et al.*, 2015) and therefore, decreased Catch per Unit Effort (CpUE) and caused over fishing state of BSC fishery in some area of fisheries management (*Wilayah Pengelolaan Perikanan*, WPP) in Indonesia, such as WPP 712 (i.e. Java Sea) (Muhsoni *et al.*, 2009; Budiarto *et al.*, 2015; Tama *et al.*, 2017).Since 2015, the Ministry of Marine Affairs and Fisheries (MMAF) (2018) has implemented the Ministerial Decree of Marine Affairs and Fisheries number 1/2015, which then been revised in 2016 by decree number 56/2016, to regulate and ensure the sustainability of lobster (*Panulirus spp.*) and crabs (*Portunus spp.* and *Scylla spp.*). The decree stated that legal size of BSC is >10 cm of carapace width (CW) or >60 g of weight (W), and also the BSC sould not carrying eggs. However, several studies stated that BSCs were captured in the various size of CW, ranged from 4.02 to 17.12 cm, in several Indonesian waters (Apriliyanto *et al.,* 2014; Nugraheni *et al.,* 2015; Kurniasih *et al.,* 2016; Murni *et al.*, 2018; Rahman *et al.,* 2019).

Collapsible trap or pot is one of the fishing gears that is used to catch the BSC in Indonesia (IMACS, 2015). Trap is categorised as passive

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fishing gear, and work on the basic principle to attract the targeted species to come voluntarily into the gear by providing an easy entrance, combined with a difficult exit (Gabriel and Brandt, 2005; Sainsbury, 1996). The trap and the collapsible traps used by Indonesian fishermen to catch the BSC would likely capture all BSC size and potentially break the size limitation rules stated in the decree. Therefore, it is important to modify collapsible traps to increase its selectivity and sustain the BSC resources in Indonesia.

The trap's selectivity could be increased using a specific mesh size or installing an escape vent to allow unwanted catch (e.g., small crabs) to exit the trap (FAO, 2001; Jirapunpipat *et al.*, 2008). This study aims to determine the crawling pattern of BSC toward the trap, design escape vent's dimension on trap, and assess catch of BSC using vented traps and non-vented traps.

Materials and methods

The dimension of the escape vent

The escape vent's design was assessed at Balai Besar Perikanan Budidaya Air Payau (BBPBAP) Jepara, Central Java. Initially, a camera was mounted inside the baited trap. The trap then was set in the pond for around 1 hour to let BSC passed through the entrance and recorded by the camera. The trap was set on five pond locations over 10 days to represent all sides of the pond. The behavior observed was BSC's crawling pattern toward the trap, whether it crawled forward, sideways, or others. The dimension and the shape of the escape vent designed based on the information of BSC's crawling pattern and the information of Carapace Length (CL) – Carapace Width (CW) – Body Height (BH) relationship from Rahman *et al.* (2019). The escape vent should allow BSCs with CW less than 10cm to escape from the trap.

Experimental fishing of vented trap

A field experiment was conducted on the fishing grounds at the Java Sea between Gresik and Madura, East Java (Figure 1). The traps used in the experiment were similar to traps used by fishermen (40 cm length x 27 cm width x 15 cm height) with the entrance on both short sides of traps. The escape vent was installed at the bottom side of the traps, as this was the most effective location to freed crabs (Jirapunpipat *et al.*, 2008; Boutson *et al.*, 2009; Sturdivant and Clark, 2011). A small rectangular chamber (40 cm length x 13.5 cm width x 15 cm height), named escape chamber, was installed close to the escape vent (Figure 2) to allow small BSCs to escape through the vent. This method was modified from Jirapunpipat *et al.* (2008). To block the small BSC swam back to the retention chamber, 10 cable ties were attached around the vent.

Twenty collapsible traps (10 vented traps and 10 non-vented traps) were used in the experiment. The vented traps were alternately set ten non-vented traps to separate similar types of traps. The traps were set 10 meters apart in the morning with a soaking time of around 18 hours, similar to fishermen's regular catching method. All the crabs in the retention chamber, as well as in the escape chamber, were measured individually for CW using a vernier caliper (precision of 0.01 mm) and weighed using a digital scale (precision of 0.1 g).

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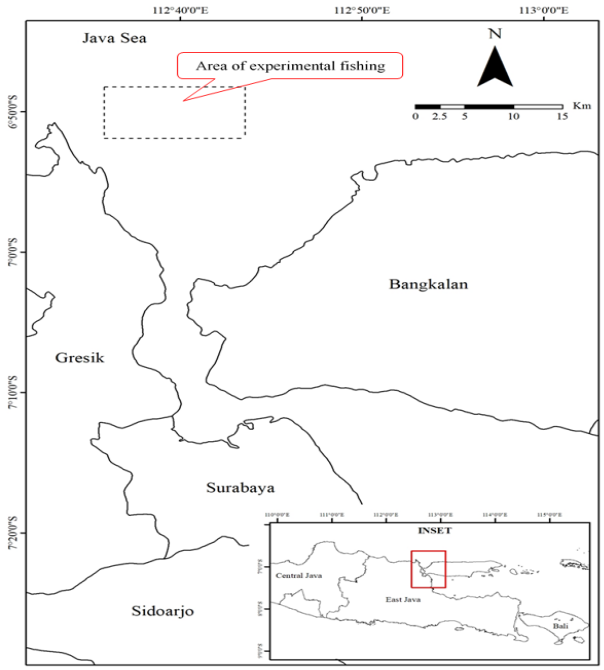

Figure 1. Location of experimental fishing

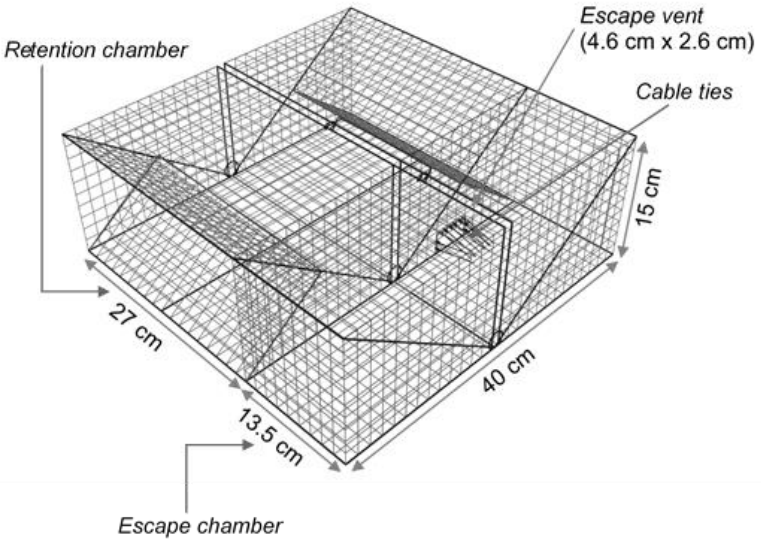

Figure 2. Trap used in the study; Modified by adding an escape vent with cable ties and an escape chamber

Data analysis

The experimental fishing was analyzed using a parametric independent t-test as there is no relation (independent) between each group (i.e., catch from vented and non-vented traps). The test was used to compare the means of two quantitative data with a formula (Sugiyono, 2007):

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - n_2)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

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where:

$\bar{x}_1$ = mean of sample 1
$\bar{x}_2$ = mean of sample 2
s_1^2 = variants of sample 1
s_2^2 = variants of sample 2
n_1 = total number of sample 1
n_2 = total number of sample 2

The SPSS (Statistical Package for the Social Sciences) version 16.0 was used to help the analysis.

Results and Discussion

The dimension of the Escape Vent

While entering the traps, BSCs shown two type of crawling pattern (crawling forward and sideways). From 30 BSCs observed, 83% crawled sideways, while 17% of samples crawled forward. Sideways crawling behavior has also been observed when BSCs escaped from the escape vent of the collapsible crab pots (Boutson *et al.*, 2009). Based on this behavior, the body part's size used to design an escape vent was BSC's CL rather than CW.

In addition, Rahman *et al.* (2019) stated that the relationship between BSC's CW and CL was linear with the formula CL = 0.0583 + 0.4501*CW, while the linear formula of CW and BH relationship was BH = 0.0614 + 0.2543*CW. Using the formula and referring to the legal size stated in the Ministerial Decree of Marine Affairs and Fisheries number 56/2016 (CW should be more than 10cm), it could be estimated that when BSC's CW is 10.01 cm, the BSC's CL and BH is 4.56 cm ≈ 4.6 cm and 2.61 cm ≈ 2.6 cm, respectively (Figure 3). Therefore, the dimension of escape vent used was 4.6 cm x 2.6 cm, rectangle shape.

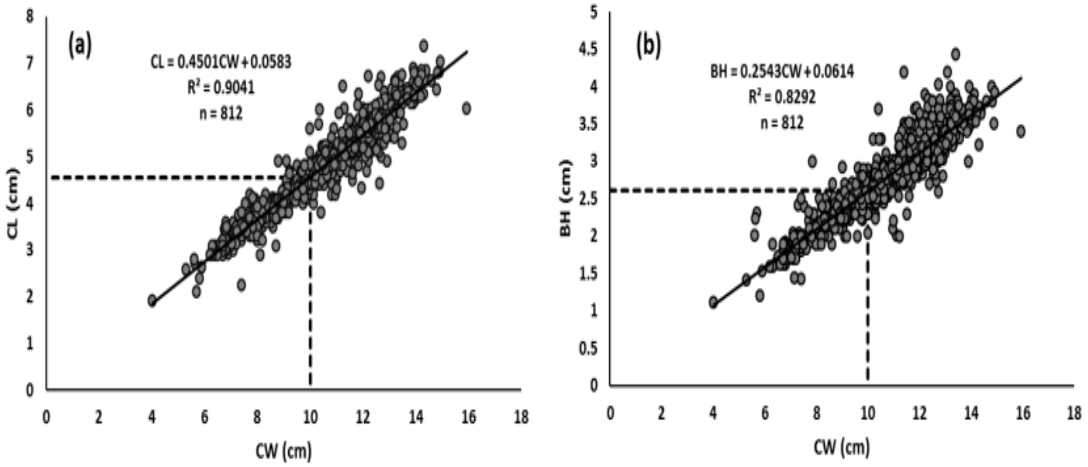

Figure 3. The relationship between (a) carapace width (CW) and carapace length (CL) of BSC; (b) CW and body height (BH) of BSC (modified from Rahman *et al.*, 2019)

Experimental fishing of vented trap

There were 14 replicates applied in the experiment with a total of 37 BSCs were captured in the vented (42.3%) and non-vented (56.8%) traps (Table 1). The lack of catch was possibly due to

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the low season of BSC's trap fishery in the location. Local fishermen said that the peak season of BSC's trap fishery is around February to May. Besides, the competition with other fishing gear, such as gill nets, also decreased the number of BSC captured by traps.

Moreover, the catches were dominated by females, with 25% were in berried egg condition (Table 1). This condition was suggested due to the experiment's depth, where traps were set in the depth of ±20 m. Around 24% of BSC's catch in >10 m of depth was carrying eggs in East Lampung's coastal waters (Zairion *et al.*, 2014). After mating, the female crabs migrate out to sea to hatch the eggs, which need an area with high water salinity (King, 2007). Additionally, Adam *et al.* (2006) stated that the male BSC was dominantly captured around the coastal area (up to 1.4 nautical miles), while the female was dominantly captured offshore.

Table 1. The biological condition of BSCs caught by vented and non-vented traps

Type of traps	Number of BSC (individual)	Sex		Female condition	
		Male	Female	Berried eggs	Non-berried eggs
Vented traps	16	1	15	5	10
Non-vented traps	21	4	17	3	14
Total	**37**	**5**	**32**	**8**	**24**

All BSCs captured by vented traps were >10 cm of CW (11.17 ± 0.19; average ± standard error), with the minimum and maximum size of CW were 10.02 cm and 12.45 cm, respectively. Meanwhile, there were 3 small BSCs (≤10 cm of CW) captured in the non-vented traps (Figure 4). Based on this information, it can be identified that the traps, were commonly used by fishermen (non-vented traps), had a chance to capture BSCs below the legal size regulated in decree no. 56/2016. Without an escape opening, the small BSC's could not escape due to the trap's basic design that makes the trapped species difficult to exit (Sainsbury, 1996).

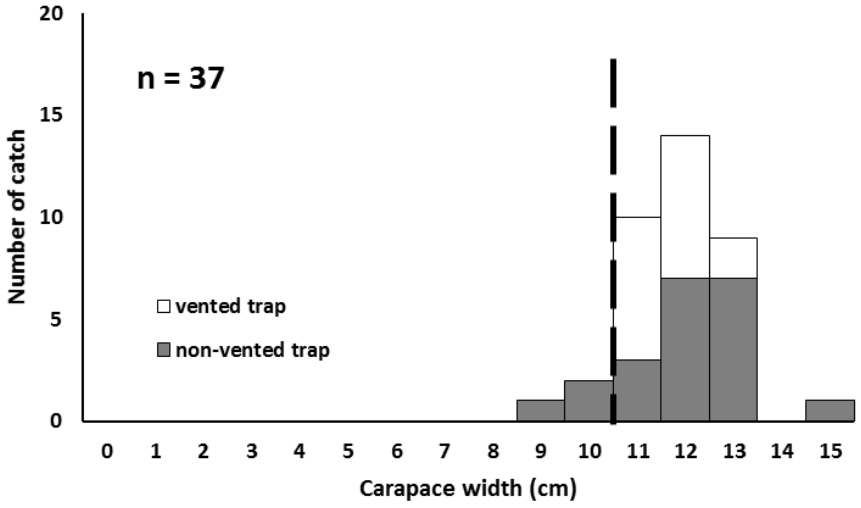

Figure 4. Carapace width frequency distribution of BSCs captured by vented and non-vented traps; long dash line indicates the minimum legal size (CW) of BSC according to Ministerial Decree 56/2016

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Although this study could not determine the effectiveness of the escape vent toward small BSCs since no small BSCs were entering the vented trap (indicated by there was no BSC inside the escape chamber), the escape vent was effective to prevent the big BSCs (>10 cm of CW) to escape from the traps. In addition, there was no differences of catch (weight) between vented and non-vented trap ($t = 1.598$; $df = 35$; $p = 0.119$). Several studies concluded that the use of vented traps was effective to decrease the number of small crabs captured inside the traps as well as reduce immature catch, while maintaining the catch of mature size crabs (Boutson *et al.*, 2008; Jirapunpipat *et al.*, 2009; Kurniasih *et al.*, 2016).

The use of escape vent on collapsible traps may be one of the options to maintain BSC's resources. Since the vent did not affect catch, means would not be decreasing fisher's income, hopefully the acceptance of vented traps by Indonesian fishers would be high. Further study with more collapsible traps (vented and non-vented) is needed to obtain a more promising result.

Conclusions and Suggestion

The study determined that the use of escape vent in the traps would not affect the catch of BSCs. It might be needed to compare different designs, dimensions, or locations of escape vent in the future. Moreover, as there were 25% of mature berried females captured in both types of traps, it was suggested to provide temporary shelters for berried females. The shelters will give the berried females sufficient time to breed and contribute to the fishery before being sold by fishermen.

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References

Adam, I. Jaya, and M. F. Sondita. (2006). Model numerik difusi populasi rajungan di perairan selat Makassar. Jurnal ilmu-ilmu perairan dan perikanan Indonesia, 13(2), 83–88

[APRI] Asosiasi Pengelolaan Rajungan Indonesia. (2019). 2018 Annual report (online). Indonesian Blue Swimming Crab Association, Surabaya. Available on https://www.apri.or.id/full-width-page-layout/downloads/download-info/apri-annual-report-2018 [Accessed on 2nd April 2019]

Apriliyanto, H., Pramonowibowo, and T. Yulianto. (2014). Analisis daerah penangkapan rajungan dengan jaring insang dasar (bottom gillnet) di perairan Betahwalang, Demak. Journal of Fiseheries Resources Utilization Management and Technology, 3(3), 71–79

Boutson, A., C. Mahasawasde, S. Mahasawasde, S. Tunkijjanukij, and T. Arimoto. (2009). Use of escape vents to improve size and species selectivity of collapsible pot for blue swimming crab Portunus pelagicus in Thailand. Fisheries Science, 75(1), 25–33

Budiarto, A., L. Adriarto, and M. Kamal. (2015). Status pengelolaan perikanan rajungan (Portunus pelagicus) di Laut Jawa (WPPNRI 712). Jurnal Kebijakan Perikanan Indonesia, 7(1), 9–18

E-ISSN 2355-9926

[FAO] Food and Agriculture Organization. (2001). Fishing Gear types, Pots, Technology Fact Sheets (online). Food and Agriculture Organisation of the United Nations, Rome. Available on http://www.fao.org/fishery/geartype/225/en [Accessed on 29th August 2019]

Gabriel, O., and A. V. Brandt. (2005). Fish Catching Methods of The World. Blackwell Publishing Oxford United Kingdom. Lowa

[IMACS] Indonesia Marine and Climate Support. (2015). Protokol Pengumpulan Data Perikanan Rajungan (Portunus pelagicus) Indonesia (online). Available on http://ifish.id/e-library/library/protocol/2015_Protokol%20Pengumpulan%20Data_Rajungan_BHS%20FINAL.pdf. [Accessed on 23rd May 2018]

Jirapunpipat, K., P. Phomikong, M. Yokota, and S. Watanabe. (2008). The effect of escape vent in collapsible pots on catch and size of the mud crab Scylla olivacea. Marine Fisheries Research Journal, 94(1), 73–78

King, M. (2007). Fisheries Biology, Assessment and Management 2nd Ed. Blackwell Publishing. Lowa

Kurniasih, A., R. Irnawati, and A. Susanto. (2016). Efektifitas celah pelolosan pada bubu lipat terhadap hasil tangkapan rajungan di Teluk Banten. Jurnal Perikanan dan Kelautan, 6(2), 95–103

[MMAF] Ministry of Marine Affairs and Fisheries. (2018). Materi Paparan Dirjen PDSPKP pada Forum Merdeka Barat 9 (FMB9) (online). Available on https://kkp.go.id/wp-content/uploads/2018/01/KKP-Dirjen-PDSPKP-FMB-Kominfo-19-Januari-2018.pdf. [Accessed on 2nd April 2019]

Muhsoni, F. F., and I. W. Abida. (2009). Analisis potensi rajungan (Portunus pelagicus) di perairan Bangkalan – Madura. EMBRYO, 6(2), 140–147

Murni, L., D. Arfiati, A. Kurniawan, Y. Kilawati, H. U. Subarijanti, Suliswanto, M. N. A. Syams, A. B. Gumelar, and A. R. A. Huda. (2018). Biological analysis of blue swimming crab (Portunus pelagicus) from collectors in Lamongan, Tuban, Pasuruan, and Rembang, Java, Indonesia. Journal of Experimental Life Science, 8(2), 90–96

Nugraheni, D. I., A. Fahrudin, and Yonvitner. (2015). Variasi ukuran lebar karapas dan kelimpahan rajungan (Portunus pelagicus, Linnaeus) di Perairan Kabupaten Pati. Jurnal Ilmu dan Teknologi Kelautan Tropis, 7(2), 493–510

Rahman, M. A., F. Iranawati, E. S. Yulianto, and Sunardi. (2019). Hubungan antar ukuran beberapa bagian tubuh rajungan (Portunus pelagicus) di perairan utara Lamongan Jawa Timur. Journal of Fisheries and Marine Research, 3(1), 111–117

Sainsbury, J. C. (1996). Commercial Fishing Methods: an Introduction to Vessels and Gears. Fishing News Books Oxford Cambridge. United State of America

Sturdivant, S. K., and K. L. Clark. (2011). An Evalution of The Effects of Blue Crab (Callinectes sapidus) Behavior on the Effiecacy of Crab Pots as A Tool for

E-ISSN 2355-9926

Estimating Population Abudance. Fish Bulletin, (109), 48–55

Sugiyono. (2007). Statistik Nonparametris untuk Penelitian. CV Alfabeta. Bandung

Tama, T. A., D. Wijayanto, and T. D. Hapsari. (2017). Analisis Bioekonomi Sumberdaya Rajungan (Portunus pelagicus) di Kabupaten Tuban. Jurnal Perikanan Tangkap, 1(1). 26–34

Zairion, Y. Wardiatno, A. Fahrudin, and M. Boer. (2014). Distribusi Spasio-Temporal Populasi Rajungan (Portunus pelagicus) Betina Mengerami Telur di Perairan Pesisir Lampung Timur. BAWAL, 6(2), 95–102

E-ISSN 2355-9926