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Sex Ratio, Size Distribution and Length-Weight Relationship of *Portunus pelagicus* Linnaeus, 1758 (Malacostraca : Portunidae) in Betahwalang, Demak, Central Java

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Abstract

Blue Swimming Crab (*P. pelagicus*, Linnaeus, 1758) is the main fisheries product from Betahwalang peoples. Fishing activity of Blue Swimming Crab by the fisherman almost every day in Betahwalang waters. Distribution and body size data of Blue Swimming Crab can be used for sustain management reference. The purpose of this study was to determine distribution pattern and body size of Blue Swimming Crab, started from July to November 2018 in Betahwalang waters, Demak. The data analyze consist of sex ratio, carapace width distribution and relationship between carapace width and body weight. 11790 samples Blue Swimming crab from Betahwalang waters consist of 7070 female crabs and 4720 male crabs. The result showed that sex-ratio between male and female crabs are balanced (1.0:1.37), with the most female crabs found at July and August. Body size distribution of male and female crabs are dominated in class 103-111 mm carapace width. Male and female crabs have a positive allometric on growth parameters, that means growth of the body weight is faster than carapace width. The result showed that Blue Swimming Crab in Betahwalang waters are support for sustainable fisheries.

Keywords: Blue Swimming Crab, Distribution and Body Size, Betahwalang

INTRODUCTION

Portunus pelagicus is one of commodities for the marine crab with high economic value. The distribution of crab (*P. pelagicus*) are at tropical coastal waters along the western Indian Ocean, eastern Pacific Ocean and western Indo-Pacific (Kailola *et al.*, 1993; Ng, 1998). Blue swimming crab are well known in the wide area which is from the intertidal zone (tidal) to the depth zone over 50 meters (Edgar, 1990; Kangas, 2000). On the coast, young crabs are found in shallow waters while adult crabs are found in deeper waters (Williams, 1982).

Data from the Central Bureau of Statistics in 2018, shows that the volume of crab exports in Indonesia for 2012-2017 was growing

up to 0.67% per year, with the export value growing up to 6.06% per year. According to data from APRI (Indonesian Crab Management Association) in 2019, the volume of 2017 crab production increased from (15,800 tons) to 2018 (16,300 tons) by 3.06%. The dominant market share of crab exports is formed as canned meat with USA that becomes main target. The high commodity prices and clear market factors prouced the increased exploitation of illegal crab fishing in the waters of the North Coast of Java, including Betahwalang waters.

One of the indonesia waters which is potential to produce blue swimming crab is Betahwalang village, Demak. The coastal area of Demak Regency is located at coordinates 6°43'26"-7°09'43" LS and 110°27'58"

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- 110°48'47" East Longitude. Demak Regency has sea waters about 2,455.2 km² and has coastal line about 57.58 km. Most of people of Betahwalang work as blue swimming crab catchers (Pamuji *et al.*, 2015). Betahwalang is known as a blue swimming crab enlargement area, because there are crab conservation area.

The income of blue swimming crab fishermen in Betahwalang village is unstable or changes every month, this change is due to the distribution pattern of the crab. According to Effendy *et al.* (2006), changes in the distribution pattern of crabs are caused by several factors such as food availability, physical and chemical conditions of the waters, and hydrooceanographic factors. The pattern of distribution of small crab sizes in nature affects the catch. Based on this, it is necessary to study the distribution pattern and size of the crabs so that information can be used to optimize the management of the crabs that are caught by fishermen. It is hoped that the data on the distribution of the crab in the coastal waters of Betahwalang can be used as input for sustainable crab resource management.

MATERIALS AND METHOD

The research was conducted from July to November 2018 in Betahwalang Village (6°43'26" - 7°09'43" LS and 110°27'58" - 110°48'47" BT). The material in this research is the crab from fishermen in the small crab collectors in Betahwalang Village. The number of crab samples was 11790, divided into 4720 males and 7070 females.

21 The samples were measured on carapace width and body weight. The carapace width of the crabs was measured using a ruler with an accuracy of 0.5 mm, while the body weight of the crabs was measured using analytical scales with an accuracy of 1 g. Male and female crabs are differentiated by observing the shape of their abdomen (Zairion *et al.*, 2014).

The data analysis included sex ratio, frequency distribution of carapace width, and the relationship between carapace width and body weight. The purpose of this study was to

determine distribution pattern and body size of Blue Swimming Crab, started from July to November 2018 in Betahwalang waters, Demak.

Sex Ratio

The sex ratio is determined by comparing the number of male and female crabs. According to Ningrum *et al.* (2015), the existence of sex ratio between the number of male and female crabs is caused by behavior changes of each individual, the effect of fishing activities, mortality and recruitment.

Data of sex ratio were as data in determining the sex ratio. Determination of the sex ratio of male and female crabs can use the formula based on Jazayeri *et al.* (2011). To determine the balance of male and female sex, statistical analysis was carried out with Chi-square test by Kamrani *et al.* (2010).

Distribution on width of carapas

The calculation on width of the crab carapace is carried out to determine the maximum and minimum value of the carapace width. The difference between the maximum and minimum carapace width measurement are to determine the carapace width interval in each size class (mm).

To find the number of width of crab carapace classes was carried out using the equation according to Kembaren *et al.* (2012). The number of classes is for finding the size of the class width to determine the class interval (class width).

5 The Relationship between Carapace Width and Body Weight

The method used for determining the growth characteristics of small crabs in Betahwalang waters is to analyze the relationship between carapace width and total weight. Analysis of the relationship between carapace width and body weight according to Rickter (1973).

2 The values a and b are constants from analysis of carapace regression width and total weight using Microsoft Excel. According

to Effendie (2002), the b value has 2 categories if: Value $b < 3$ or $b > 3$, is called allometric growth, with criteria: Value $b < 3$ is called negative allometric, where the growth of karapas width, slower than weight growth. Value $b > 3$ is called positive allometric, where weight growth is faster than the growth of karapas width. Value $b = 3$ is called isometric growth. The value b in the growth pattern was analyzed for the significance level using the T test according to Fauzi *et al.* (2018) with a hypothesis, if: $H_0: b = 3$ (isometric); $H_1: b \neq 3$ (allometric)

RESULT AND DISCUSSION

The sex ratio of the crab from January to November shows different conditions each

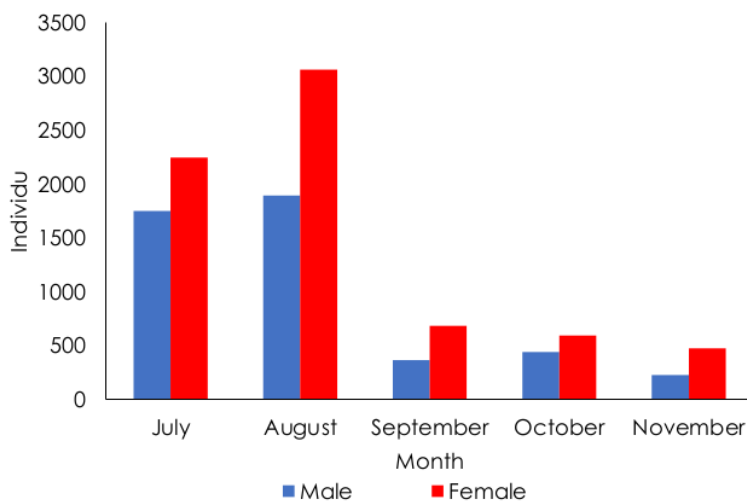
month. The results of the crab sex ratio during the study showed a relatively balanced condition. There were 4720 male crabs, lower than 7070 female crabs. Male and female crabs mostly found in August, with total crabs are 1896 male crabs and 3066 female crabs. The sex ratio data can be seen in Table 1.

12 The ratio between male and female crabs in the study was 1.0: 1.37, with female crabs that are dominating and the sex ratio is in balanced condition. Based on these results, it can be interpreted that there is no significant difference between the number of male and female crabs. The graphic of the number of male and female crabs caught by fishermen in Betahwalang can be seen in Figure 1.

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Table 1. Sex ratio of male and female crabs from Betahwalang, Demak

Observation Months	Sex		Percentage (%)		Comparison		Value		Description	
	M	F	M	F	M	F	χ^2 Calc	χ table	B	IB
July	1752	2249	43.79	56.21	1.0	1.3	61.74	100	✓	
August	1896	3066	38.21	61.79	1.0	1.6	275.85	124.03		✓
September	365	685	34.76	65.24	1.0	1.9	97.52	26.23		✓
October	441	594	42.61	57.39	1.0	1.3	22.62	25.85	✓	
November	228	476	33.43	66.57	1.0	2.1	74.89	17.03		✓
Total	4720	7070	42.18	57.82	1.00	1.37	390.99	405.38	Balanced	

Descriptions: B: Balanced; IB: Imbalanced.



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Figure 1. Comparison in the number of male and female crabs from Betahwalang, Demak

The difference in the composition of male and female crabs in waters is thought to be due to differences in individual crab behavior, mortality, and recruitment in nature. Sumpton *et al.* (1994) in his research in Moreton Bay, stated that the composition of the crab sex ratio at a certain location will follow changes in the spawning season, in the sense that the composition pattern can change before and during the spawning season. According to Murni *et al.* (2018), differences in catch composition are also influenced by the habitat preferences of male crabs that prefer brackish waters and female crabs prefer deep waters with high salinity during spawning. Percent of catch the female crabs will decline during the spawning period associated with the migration of adult female crabs to sandy areas to extract eggs.

Research by Damora dan Nurdin (2016) in Labuhan Maringai waters, East Lampung, it was found that the composition of female crabs was known to increase (January, April, and August), which indicates that in this period the migratory season of crabs after spawning begins, so it is estimated that the spawning

season for female crabs occurs in months. previous month. Hermanto *et al.* (2019) in Subang Waters, mentions that the crab spawning season occurs in May, June, August and after September. The crabs are thought to be swaying with the currents and big waves towards the sea for spawning.

The comparison between male and female crabs in the study was 1.0: 1.37, where the overall number of female crabs dominated the fishing. Based on these results, it can be interpreted that there is no significant difference between male and female sex ratios in crabs caught during the study or the number of crab population is still included in balanced condition. The same results were also obtained in previous studies by Ningrum *et al.* (2015) in Betahwalang waters, where the ratio of male and female crabs is 1.0: 1.1.

The composition of female crabs in this study increases in July and August, which is thought to be migrating female crabs after spawning in the previous period. Kangas (2000) states that the comparison of male and

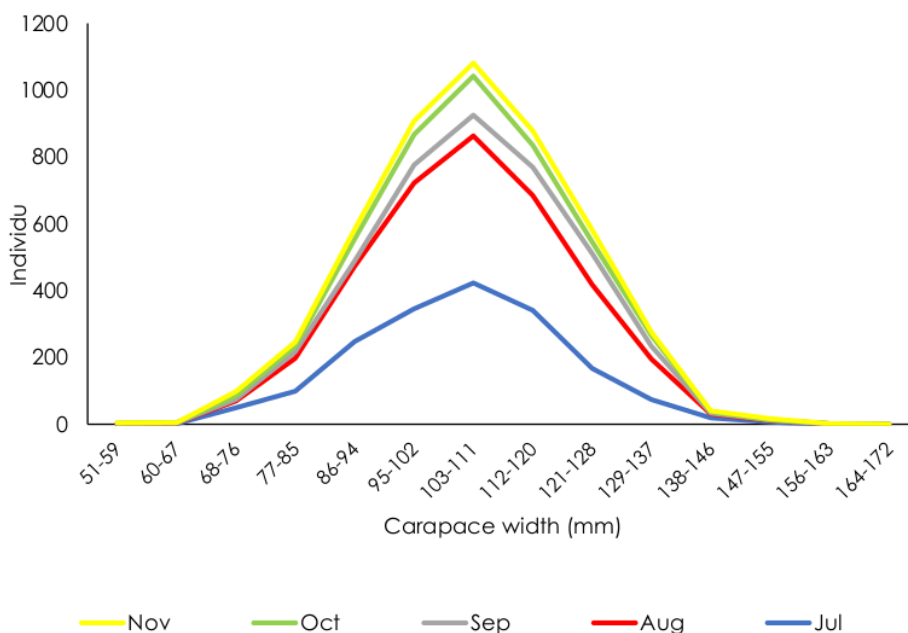


Figure 2. Carapace Width Distribution of Male Crab from Betahwalang Waters, Demak

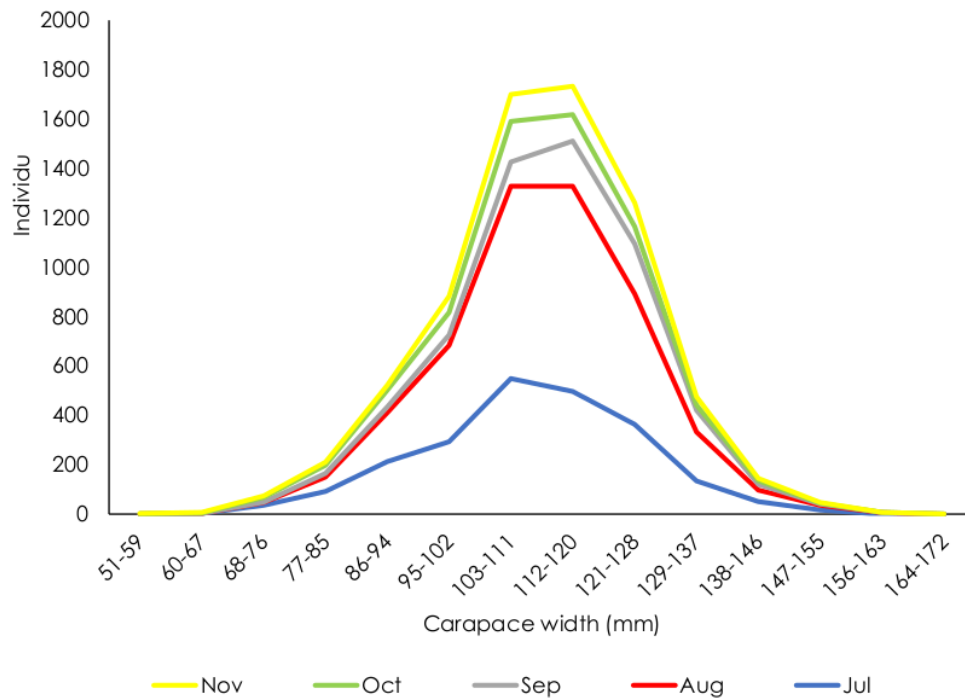


Figure 3. Carapace Width Distribution of Female Crab from Betahwalang Waters, Demak

female crabs can also be used as a parameter for the abundance of one species at a fishing location. For example, in the estuary area, a balanced sex ratio (1: 1) is obtained, which means that at that location there is a balanced recruitment of new members from the egg hatching process so that the proportion of the number of male and female crabs is equal.

The results of the carapace width distribution of the crab can be used to assess the condition of the crab population in a water. The width of the crab carapace of the collectors of Betahwalang with carapace width ranges from 51-172 mm. The distribution chart of the width of the crab carapace in Figure 2 and Figure 3 shows that the mode of class of male and female crabs at sizes 103-111 mm.

In this study, the carapace width of male and female crabs ranged from 57 to 166 mm. Based on the classification of the carapace

width of the crabs caught in Betahwalang waters, they are dominated by young crabs, according to the research of Prasetyo *et al.* (2014) in Rembang waters dominated by young crabs with carapace widths of 60-120 mm. according to Hosseini *et al.* (2012), younger crabs were found in shallower waters or closer to the shoreline, whereas adult crabs were generally found in deeper waters up to a depth of 50 meters with higher salinity.

The results of the analysis of the relationship between carapace width growth and crab weight in Betahwalang waters during 2018 showed that the growth patterns of crabs tended to be positive allometric. Overall male crab growth patterns were positive, while in female crabs there was a negative growth pattern in November. The growth patterns of male and female crabs can be seen in Table 2.

The results of the analysis of the relationship between carapace width and

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Table 2. The Relationship between Carapace Width and Body Weight of Blue swimming crab from Betahwalang waters, Demak

Months	a		B		n (ekor)		W = aL ^b		Growth Pattern	
	M	F	M	F	M	F	M	F	M	F
July	3,49	4,99	3,14	3,05	1752	2249	3,49L ^{3,14}	4,99L ^{3,05}	Positif	Positif
August	1,21	3,14	3,37	3,15	1896	3066	1,21L ^{3,37}	3,14L ^{3,15}	Positif	Positif
September	5,14	1,91	3,55	3,26	365	685	5,14L ^{3,55}	1,91L ^{3,26}	Positif	Positif
October	6,25	5,50	3,01	3,03	441	594	6,25L ^{3,01}	5,50L ^{3,03}	Positif	Positif
November	2,03	8,14	3,26	2,96	228	476	2,03L ^{3,26}	8,14L ^{2,96}	Positif	Negatif

Description: M: Male; F: Female.

body weight of crabs tended to be positive allometric. The positive allometric growth pattern means that the crab body weight gain is faster than the carapace width (Kamrani *et al.*, 2010). Ernawati *et al.* (2015), stated that the value of the constant b of male crabs is greater than that of female crabs, this indicates that at the same size male crabs are larger than female crabs. The results of the constant b value obtained in this study, it is suspected that male crabs in Betahwalang waters are indicated to have experienced gonad maturation and are ready for the mating process. The difference in the results of the relationship between carapace width and body weight in various waters is thought to be influenced by several factors, namely sex, reproductive process, water temperature, salinity and food availability (quantity, quality and size).

The growth pattern of crabs in this study was the same as the previous study by Ningrum *et al.*, (2015) in Betahwalang waters, with a positive allometric growth pattern (b = 3.16). Different results were obtained in research in Belitung waters (Ernawati *et al.*, 2015), with a negative allometric growth pattern (b = 2.92). The results showed that female crabs in November had a negative growth pattern. It is assumed that during this period the female crabs were in the moulting period. Ernawati *et al.* (2014), stated that female crabs experience moulting before mating so that carapace width growth is faster (negative allometric), then during the gonad maturation period the crab weight increases faster (positive allometric) because female crabs require more nutrients from food.

CONCLUSION

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The results showed that the composition of *P. pelagicus* from Betahwalang Village showed a balanced condition (1,0: 1,37). Many female crabs are found in February, July and August, which are thought to start migrating after the spawning season. The size distribution of male and female crabs is dominated by size class 103-111 mm. The growth pattern of the crab is positive allometric, which means that the body weight gains faster than the carapace width.

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