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Analysis of Carapas Width and Weight on Maturity Level of Swimming Crab (Portunus pelagicus) as Basis for Sustainable Resource Management in the Eastern Waters of Surabaya

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Abstract

Swimming crab (Portunus pelagicus) is one of the fishery commodities that has important economic value and has become an export product from Indonesia with high value. Swimming crab catching is done by using gillnet fishing gear by fishermen, especially in East Surabaya waters. The purpose of the study was to analyze the effect of carapace width and weight on the age of swimming crab as a basis for sustainable management of swimming crab resources in Eastern Surabaya waters. The research method used was a descriptive quantitative method, with a survey data collection method, namely by measuring the carapace width and weight of swimming crabs from the catch of fishermen in East Surabaya waters. Data analysis to determine the effect of carapace width and weight on swimming crab maturity level was a correlation test, significance analysis using the F test to determine the effect of independent variables on the dependent variable simultaneously, partial analysis using the t-student test, and determining the regression model. The results of the study stated that carapace width and weight influenced the age of swimming crabs caught in Eastern Surabaya waters. Carapace width and weight can be used as important parameters in determining the maturity level of a swimming crab. The weight of the swimming crab influenced the maturity level of the swimming crab although not as much as the carapace width parameter. The average carapace width was 89.07 mm, the weight of the swimming crab was 101.93 g and the stadia of the swimming crab in adulthood was 89%. The results of the study can be used as an insight into the sustainable management of swimming crab fisheries in the eastern waters of Surabaya.

Keywords: Gillnet (G), Carapace width(CW), Weight (W), Maturity level (ML), Sustainability (S)

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Introduction

Swimming crab (Portunus pelagicus) is one of the fishery commodities that has important economic value and has become an export product from Indonesia with high value. Swimming crab catching is done using bubu and gillnet fishing gear by fishermen, especially in the eastern waters of Surabaya. This fishing activity certainly has a significant impact on the sustainability of the aquatic ecosystem as a place of life for swimming crabs, so it is necessary to study the morphological factors that affect the balance of swimming crab resources in Eastern Surabaya waters (Zapelini et al., 2016).

Carapace width, weight, and maturity level of the caught swimming crab are some of the parameters that affect the carrying capacity of the environment, where there is a reproduction process and the running of the food chain process so that the overall ecosystem balance occurs. The purpose of the study was to analyze the effect of carapace width and weight on the maturity level of swimming crab as a basis for sustainable management of swimming crab resources in Eastern Surabaya waters. In an unexploited population, there is no mortality caused by capture, the number of deaths that exist is only due to natural mortality, caused by the

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process of predation, disease, and death due to drastic changes in environmental parameters (Cochrane, 2002).

Research Methodology

The research method used was a descriptive quantitative method, collecting data through surveys, namely by measuring the carapace width and weight of swimming crabs from the catch of fishermen in Eastern Surabaya waters. Sampling was conducted in August with a total of 189 samples using 6 replicates. Data measured were the carapace width and weight of each swimming crab, then identified its age based on morphological characteristics. Data analysis used to determine the effect of carapace width and weight of captured swimming crabs on the maturity level of swimming crabs is a correlation test, significance analysis using the F test to determine the effect of variable X on variable Y simultaneously, partial analysis using the t-student test and determining the regression model. The independent variables determined were carapace width as variable X_1, swimming crab weight as variable X_2, and the dependent variable (Y) was swimming crab maturity level.

Observations using the parameters of sex, carapace width, weight, and maturity level are biological factors that can be used as a reference (Wardiatno, Boer, & Fahrudin, 2015; Xiao & Kumar, 2004; Zainal, 2017). Male and female swimming crab sex is distinguished by secondary sex characteristics, namely through the shape of the abdomen (Damora A & Nurdin E, 2016). The hypothesis set is the initial hypothesis (H_0) that there is no effect of carapace width and weight on the maturity level of swimming crabs (Portunus pelagicus) caught in the Eastern waters of Surabaya; The counter-hypothesis (H_1) is that there is an effect of carapace width and weight on the maturity level of swimming crabs (Portunus pelagicus) caught in the eastern waters of Surabaya(Barbosa et al., 2016).

Results and Discussion

Composition of Carapace Width and Weight of Swimming Crab Catches

The composition of the carapace width of swimming crab catches was analyzed based on the category of swimming crab maturity level, namely: (a) baby, with a width range < 60 mm, (b) juvenile, with a width range of 61-80 mm and (c) adult, with a width range > 81-157 mm (Mardhan, Sara, & Asriyana, 2019). According to the data on the number of swimming crab catches during the study, the carapace width was obtained as the basis for determining the stadia of swimming crabs in East Surabaya waters including 168 adults (89%) and 21 juveniles (11%) (Figure 1). The location of catching swimming crabs in the East Surabaya waters is dominated by sand substrates mixed with mud and minimal freshwater input, so it is possible to support the growth of swimming crabs to adulthood even to spawning (La Sara & Astuti, 2015).

In this study, swimming crabs were caught using gillnets, which are selective for catching swimming crabs (Subhan & Ahsan, 2015). The swimming crabs used as samples were caught using gill nets at depths of up to 5 m, this is by the results of research which states that the average swimming crab is caught in shallow waters of less than 5 m (Mardhan et al., 2019). The measurement results of the width of the swimming crab carapace (Figure 2) in the first replication amounted to 90.73 mm, the second replication amounted to 89.70 mm, the third replication amounted to 89.60 mm, the fourth replication amounted to 89.40 mm, the fifth replication amounted to 88.43 mm and the sixth replication amounted to 86.53 mm, so the total average was 89.07 mm (Veliz-Cuba, Voss, & Murrugarra, 2022). The measurement results of swimming crab weight (Figure 3) in the first replication amounted to 109.93 gr, the second replication amounted to 105.76 gr, the third replication amounted to 104.24 gr, the fourth replication amounted to 100.93 gr, the fifth replication amounted to 96.09 gr and the sixth replication amounted to 94.63 gr, so the total average amounted to 101.93 gr. The Regulation of the Minister of Marine Affairs and Fisheries states that the capture, traffic, and or release of swimming crab (Portunus Spp) for

consumption purposes is carried out with the following provisions: not in egg-laying condition, a minimum weight of 60 grams or a carapace width of 10 cm, fishing is carried out with passive fishing gear and environmentally friendly and carapace width size above 10 cm (Sugiarto, 2021). When viewed from the aspect of swimming crab mortality due to fishing activities in Surabaya waters, in terms of body weight is dominated by swimming crabs that are above the legal size allowed. This indicates one of the characteristics of the resource is not overfished (Aulia et al., 2023). However, in the future, swimming crab catches must still be controlled by the authorities to maintain the sustainability of the population. In fish populations, total mortality is natural mortality plus fishing mortality. Fishing mortality ideally does not cause loss or damage to the sustainability and productivity of the population, where the age structure of the biota is maintained and the population can maintain reproduction rates so that recruitment can maintain its existence from pressure due to mortality, both natural and due to fishing (Gandhi, Robert, Palacios, & Chan, 2022).

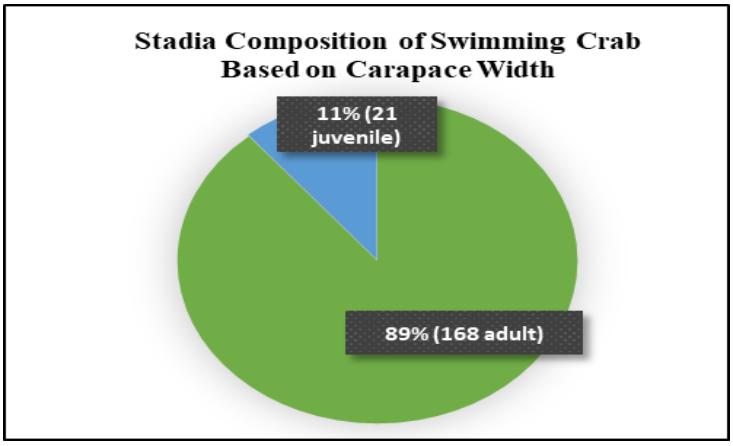

Figure 1: Maturity level composition of swimming crab based on carapace width

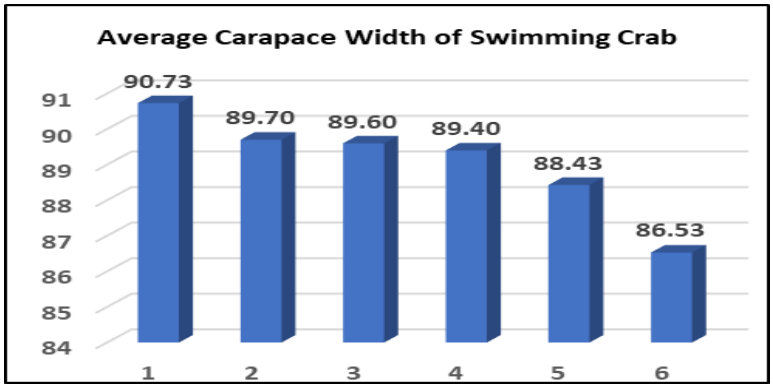

Figure 2: Average Carapace Width of Swimming Crab

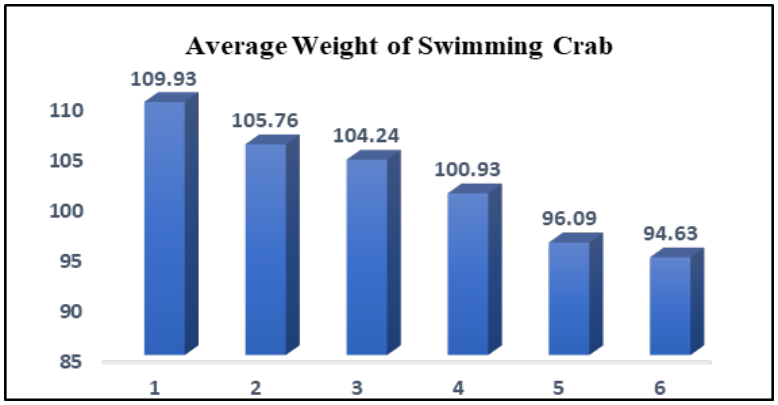

Figure 3: Average weight of swimming crab

Sex Ratio Distribution

The total number of swimming crabs caught during the study was 189, of which 19 were female swimming crabs (10.05%) and 170 male swimming crabs (89.95%) (Figure 3), so it can be said that the sex ratio distribution of swimming crabs is not balanced. Female swimming crabs were found in the spawning phase totaling 13 (68%) and not spawning 6 (32%) (Figure 4), while the composition of adult female swimming crabs totaled 12 (63%) and juvenile females totaled 7 (37%) (Figure 5).

Based on Marine and Fisheries Ministerial Regulation, swimming crabs in the spawning phase are not allowed to be caught, so it is necessary to consider this condition as a basis for consideration of sustainable management of swimming crab resources in the waters of East Surabaya. It is necessary to conduct socialization efforts to fishermen related to regulations that have been set by the government and its implementation in the field, to maintain the sustainability of swimming crab resources.

Similar research results stated that the catch of swimming crabs is dominated by males and caught at a depth of less than 5 m (Prasetyo GD, Fitri ADP, & Yulianto T, 2014). The dominance of male swimming crabs caught in shallow waters, one of which is due to male swimming crabs like waters with low salinity (28 ppt) compared to female swimming crabs who like waters with higher salinity (34 ppt) to conduct spawning in shallow waters (Adam, Jaya I, & Sondita MFA, 2006)

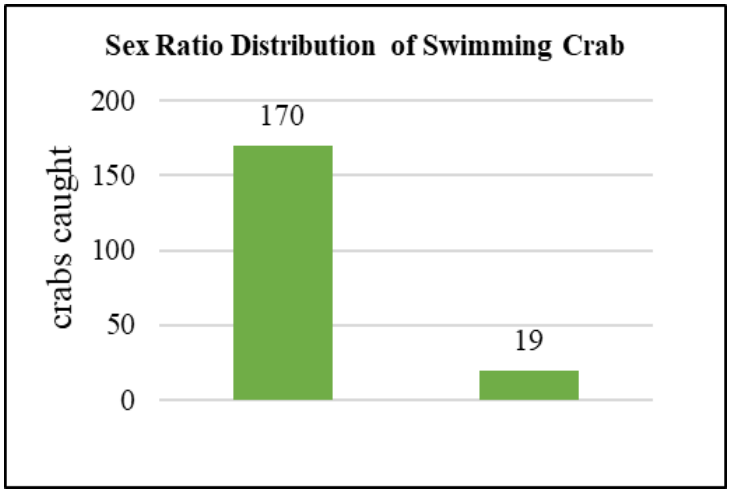

Figure 4: Sex ratio distribution of swimming crab

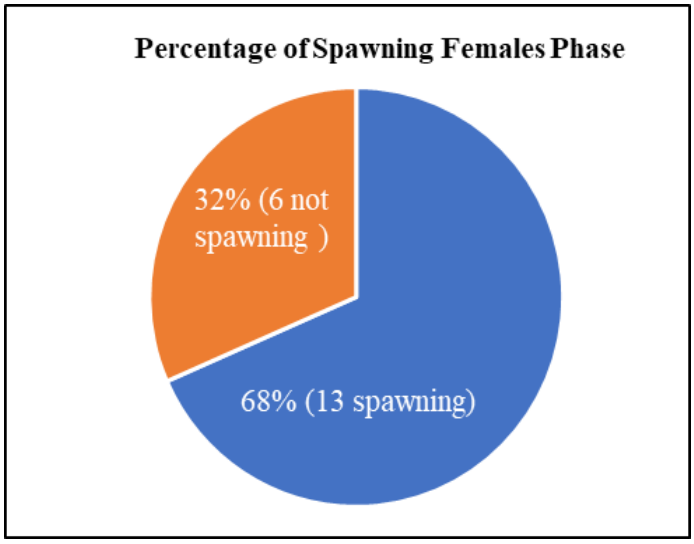

Figure 5. Percentage of spawning females Phase

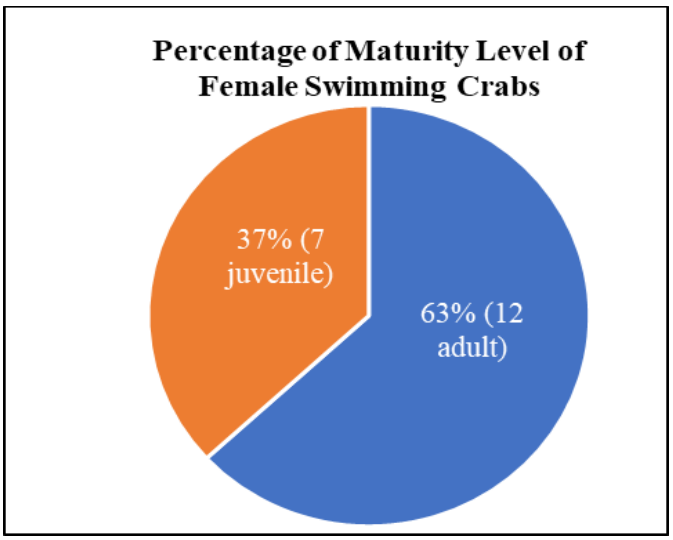

Figure 6: Percentage of maturity level of female swimming crabs

Effect of Carapace Width and Weight on Maturity Level of Swimming Crab

The results of the correlation analysis of carapace width and weight to the maturity level of the swimming crab (Portunus pelagicus) can be seen in Table 1, as follows:

Table 1. Correlation of Carapace Width and Weight to Maturity Level of Swimming Crab

Correlations				
		Width	**Weight**	**Maturity level**
Width	Pearson Correlation	1	.395**	.587**
	Sig. (2-tailed)		.000	.000
	N	189	189	189
Weight	Pearson Correlation	.395**	1	.255**
	Sig. (2-tailed)	.000		.000
	N	189	189	189
Maturity level	Pearson Correlation	.587**	.255**	1
	Sig. (2-tailed)	.000	.000	
	N	189	189	189

**. Correlation is significant at the 0.01 level (2-tailed).

From Table 1, it can be explained that in general the three factors (carapace width, weight, and maturity level) have a correlation and influence each other, where the correlation value between carapace width and swimming crab weight is 0.395 with a significance value of 0.00; the correlation value between swimming crab weight and swimming crab maturity level is 0.255 with a significance value of 0.00 and the significance value between carapace width and maturity level is 0.587 with a significance value of 0.00. Furthermore, to determine the relationship model of carapace width and weight to the maturity level of the swimming crab, a regression model was used, with the results of the determination value (R^2) of 0.339 which can be interpreted that the parameters of carapace width and weight affect the maturity level of swimming crab by 33.9% and the overall correlation value (r) of 0.588 which means that the three parameters have a close relationship (Table 2). The significance test (F test) used to determine the effect of carapace width and weight as a whole on the maturity level of swimming crab obtained a sig. value of 0.00, so it can be concluded accept H_1, namely there is an influence of carapace width and weight as a whole on the maturity level of swimming crab (Table 3).

Partial variable analysis was carried out using the t-test, where the results obtained according to table 4, stated that carapace width partially influenced the maturity level of swimming crab with a sig value. 0.000,

while the weight of the swimming crab partially does not affect the age of the swimming crab. The relationship model of carapace width and weight to the maturity level of the swimming crab is obtained as follows: $Y = 0.755 + 0.024\ X_1 + 0.000019\ X_2$, where X_1 is carapace width, X_2 swimming crab weight and Y is swimming crab maturity level. The model obtained explains that changes in carapace width and weight that are getting bigger indicate that the maturity level of the swimming crab will increase, as well as the weight of the swimming crab which is influential but not as big as the carapace width. Swimming crab fishing operations that until now still use various types of fish bait as an attractant (Sofijanto & Subagio, 2022; Subagio & Rosana, 2020) and use simple tools with the help of light (Arimoto, 2013), need to be developed with other alternatives by considering the size of carapace width, weight, and maturity level, can be used as a basis for managing swimming crab because it can help identify resources that can be released back into the waters so that they can develop to support the sustainability of the swimming crab population in the waters.

Table 2. Determination and Correlation Values of Carapace Width and Weight on Maturity Level of Swimming Crab

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.588[a]	.346	.339	.256
a. Predictors: (Constant), Weight, Width				

Table 3. F-test of Carapace Width and Weight Variables on Swimming Crab Maturity Level

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	6.450	2	3.225	49.103	.000[b]
	Residual	12.216	186	.066		
	Total	18.667	188			
a. Dependent Variable: Maturity level						
Predictors: (Constant), Weight, Width						

Table 4. T-Student Test of Carapace Width and Weight Variables on Maturity Level of Swimming Crab

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	.755	.225		3.359	.001
	Width	.024	.003	.577	8.932	.000
	Weight	1.979E-005	.000	.027	.412	.681
a. Dependent Variable: Maturity level						

Conclusion

The study can conclude that carapace width and weight affect the maturity level of swimming crabs caught in the eastern waters of Surabaya. Carapace width and weight can be used as important parameters in determining the maturity level of a swimming crab. The weight of the swimming crab influences the maturity level of the swimming crab although not as big as the carapace width parameter. The results of the study can be used as an insight into the sustainable management of swimming crab fisheries in the eastern waters of Surabaya.

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