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Distance of fishing ground against blue swimming crab (*Portunus pelagicus*) catches using a gillnet in Gresik, East Java, Indonesia

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Abstract. Information on fishing grounds is crucial in efforts to manage blue swimming crab capture fisheries. The further away the fishing location, the higher cost risk. The purpose of this study is to determine differences in catches and biological characteristics of crabs caught by the crab fishermen using gillnets on 0–2 miles and 5-7 miles from November 2022 to January 2023 in the waters of Mengare Island, Bungah District, Gresik Regency, East Java Province. Descriptive analysis and multivariate analysis of variance (MANOVA) were used to explain the biological characteristics of the blue swimming crabs and differences in the effect of fishing ground distance on crab catches. The results showed that the total yield of 2478 female crabs and 4360 male crabs with details at a distance of 0–2 miles was 1701 males and 925 females, while at a distance of 5-7 miles, there were 2659 males and 1553 females. Most crabs with mature level were found at 0–2 miles and 5-7 miles. The distance to the fishing ground affects the average width, average weight, and number of male crabs. Distance and fishing ground differences can affect the diversity of crab biological characteristics.

Keywords: blue swimming crab; biological characteristics; fishing ground; gillnet

1. Introduction

The blue swimming crab or BSC (*Portunus pelagicus*), often referred to as Rajungan, has the habit of hunting or catching small biota swimming near the surface or at depths of 56 meters [1]. One of Indonesia's most valuable seafood resources is the blue swimming crab, which ranks fourth among the total export value of Indonesian fishery products [2].

Seasonal and fishing area information is a crucial management tool for capture fisheries [3]. Accurate prediction of BSC fishing zones is made possible by the integration of various vital resource information [4]. Essentially, fishermen look for fishing locations with high yields, respectable revenue, and minimal operating expenses. However, there are situation where fishing in distant locations incur high costs [5]. This poses a challenge in the sustainable management of blue swimming crab fisheries, requiring appropriate management, one of which involves understanding the internal and external factors affecting the blue swimming crab resource through the dynamics of fishing areas. Sustainability is expected to improve resource conditions and the welfare of the fishing community [6]. There are several methods of capturing blue swimming crab, one of which is using gill net. According to Permen KP No. 2 of 2015,



gill net is classified as allowed fishing gear, while trawl nets, purse seines, and drift nets are considered banned bottom trawls. Fishermen must adopt environmentally sustainable technology or fishing gear, such as gill net selectivity [7].

In the fishing activities on Mengare Island, Gresik Regency, fishermen mainly use gill net for capturing blue swimming crab. The difference in fishing ground distance in the blue swimming crab capture activities by fishermen on Mengare Island, Gresik Regency, becomes the background of this research, as it serves as a determinant of catch results. Therefore, the purpose of this research is to determine the differences in catch results and the biological characteristics of blue swimming crab caught by fishermen using gill net in different fishing grounds, namely 0–2 and 5–7 miles.

2. Methods

2.1. Study Area

This research was conducted from November 2022 to January 2023 in the waters around Mengare Island, Bungah District, Gresik Regency, East Java Province. Geographically, the research locations are situated at $6^{\circ}58'44''$ $112^{\circ}42'43''$ (point 1) with a fishing ground distance of 0–2 nautical miles and $6^{\circ}56'40''$ $112^{\circ}43'51''$ (point 2) with a fishing ground distance of 5–7 nautical miles (Figure 1). That location was determined by Mengare fishermen's experiences over 20 years of engaging in blue swimming crab fishing activities. The fishing ground locations represent the distance of the fishermen's blue swimming crab fishing activities, as indicated by points 1 and 2 in Figure 1. The gill net used by each fishing boat has a length of 2000 meters, a mesh size of 3.5 inches, and a quantity of 80–100 units per trip. The boats used by the fishermen were classified as 1 Gross Ton (GT) with a 10-horsepower (HP) engine.

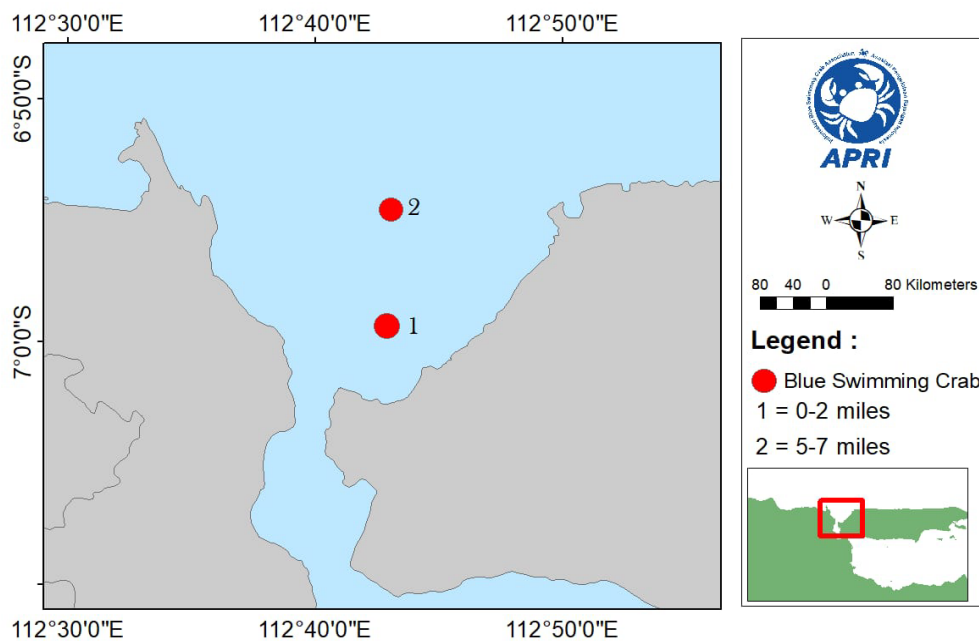


Figure 1. Map of blue swimming crab fishing location in Mengare, Gresik Regency.

2.2. Data collection

Samples were obtained from the data collected at the crab collectors who received supplies of catches from fishermen at different fishing grounds. Then identified the biological characteristics including the number of crabs, crab weight, carapace width, sex, and gonadal maturity level. Measurements of carapace width were used with a ruler, while crab weight used a digital scale with a precision of 0.01 grams. Whilst, the number of caught, sex, and gonadal maturity level of the crabs were counted and directly observed during the data collection.

2.3. Data analysis

Data analysis used descriptive analysis to visually explain and tabulate the biological characteristics of the crabs. The influence of different fishing grounds was analyzed using multivariate analysis of variance (MANOVA). Field explained that MANOVA is an extension of the analysis of variance (ANOVA) that involves more than one independent variable tested simultaneously or together [8]. In MANOVA, the independent variables consist of several categories, while the dependent variables are metric (interval or ratio) in nature. Both analysis methods utilized Microsoft Excel and IBM SPSS Statistics 25.0 software.

3. Results and discussion

3.1. Profile of Blue Swimming Crab Catches Based on Fishing Ground in Mengare, Gresik Regency

The crab catches obtained during the research based on the fishing ground were 2626 ind. with a total weight of 229.12 kg for the 0–2 miles, while for the 5–7 miles were 4212 ind. with a total weight of 396.22 kg. The quantity and weight of captured crabs based on fishing ground as shown in Figure 2.

The data sample of crabs over three months from November 2022 to January 2023 in the waters of Mengare Island, Gresik Regency was calculated the total of individuals and weight according to different fishing grounds, namely 0–2 miles and 5–7 miles. The total number of crabs based on sex was captured in the waters of Mengare Island, Gresik Regency, with the difference in fishing ground, as shown in Figure 3.

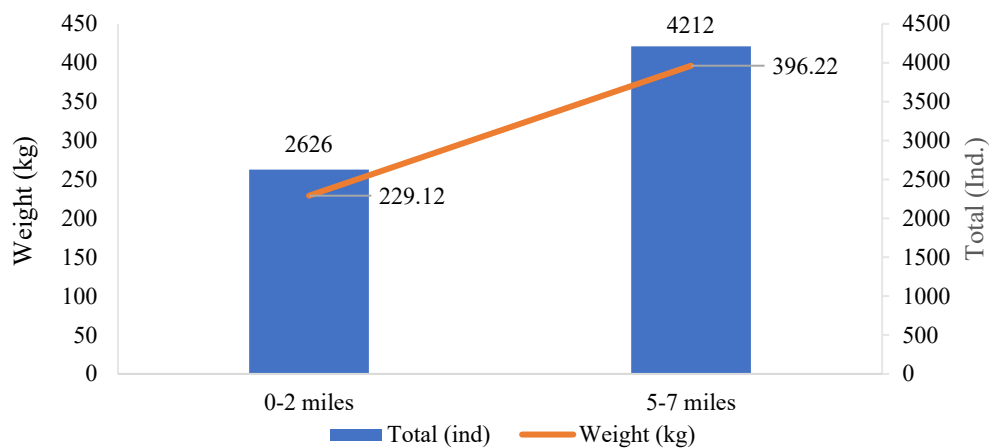


Figure 2. Total and weight of blue swimming crab catches based on fishing ground.

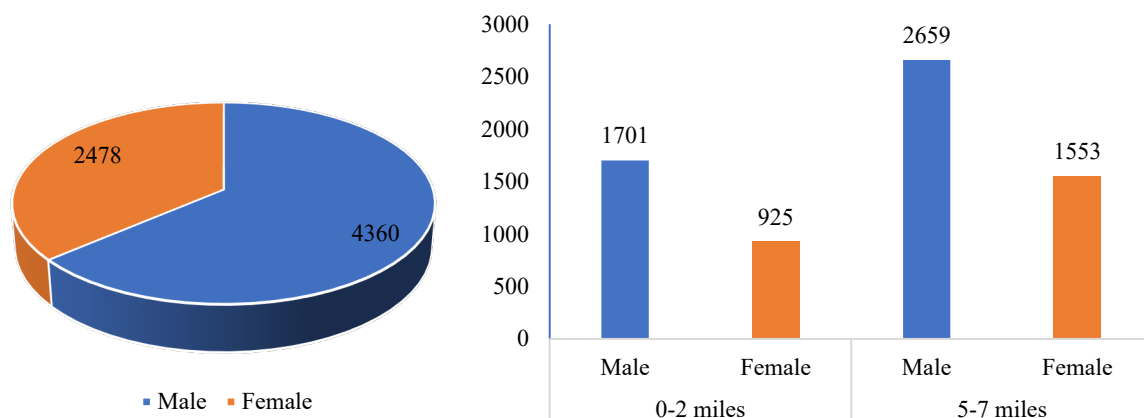


Figure 3. Total catches of blue swimming crab by male-female based on fishing ground.

Figure 3 shows that there were a total of 2478 female crabs, consisting of 925 female crabs at 0–2 miles and 1553 female crabs at 5-7 miles. Meanwhile, the total number of male crabs was 4360, with 1701 male crabs at 0–2 miles and 2659 male crabs at 5-7 miles. Most of the captured female crabs (60%) were mature females that had not yet spawned [9]. Additionally, the data obtained related to the total number of captured crabs in the waters of Mengare Island, Gresik Regency, based on gonadal maturity level as shown in Figure 4.

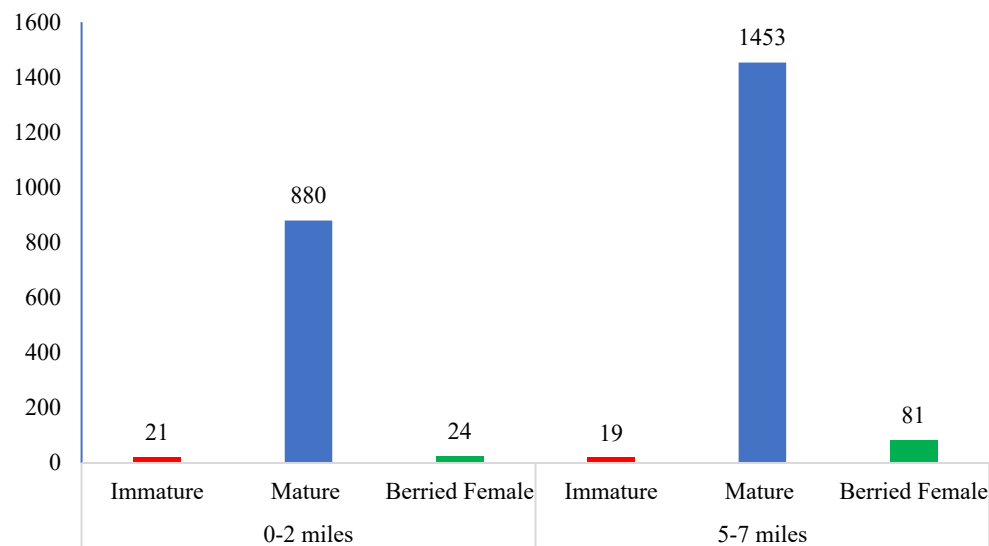


Figure 4. Total catches of blue swimming crab based on gonadal maturity level.

At 0-2 miles, there were 21 individuals of female crab catches with the immature level. Whilst, the mature level dominates with 880 ind. and 24 ind. at the berried female. At 5-7 miles, the lowest total catches of female crabs were found at the immature of gonadal maturity (19 ind.). The mature was the most (1453 ind.) and 81 ind. had the berried female of gonadal maturity. Based on the research data, it was found that the closer the fishing ground distance, the more female crabs with the first level of gonadal maturity were encountered.

3.2. The effect of fishing ground on catches in Mengare, Gresik Regency

From November 2022 to January 2023, a total of 75 data crab collections of fishermen's catches were obtained, with 31 of them catching at 0–2 miles and the remaining 44 data at 5-7 miles. The influence of the different fishing ground effects was examined by total crab catch (number of individuals), average carapace width (mm), average weight (grams), and total male-female crab catch. Referring to Field, the statistical value of Pillai's Trace was used in making decisions for the MANOVA test [8] on the differences in the effect of fishing ground on the BSC catch (Table 1).

The results show that the fishing ground distances of 0–2 miles and 5-7 miles have a significant effect and produce significantly different total catch and biological characteristics of blue swimming crabs, with a significance level of 0.018 and a significance level of 0.05. The partial differences in these effects can be explained and described in Table 1, where the fishing ground distances of 0–2 miles and 5-7 miles have different effects on the average carapace width (mm) with a significance level of 0.04. The significance values are 0.016 for the average weight (grams) and 0.044 for the total catch of male crabs (ind.) at a significance level of 0.05. Referring to [10], the growth of blue swimming crabs is divided into three phases based on their carapace width. The first phase is called Juvenile when the crab has a maximum carapace width of 60 mm, then it is considered Young when the carapace width is between 60 mm, young crab has a 60-100 mm [11] and for adult crab has a >100 mm [12]. Different fishing ground distances affect the catch results based on the average carapace width of the crabs caught by the fishermen in Table 2.

Table 1. Simultaneous and partial MANOVA for fishing ground against BSC catches.

MANOVA Category	Variable	Signification value	Critical point	Notes	
Simultaneous	fishing ground	0,018	0,05	The characteristics of the catch at a fishing ground distance of 0–2 miles differ significantly from those at 5-7 miles.	
Partial	fishing ground	total catch	0,086	0,05	The total catch at fishing ground distances of 0–2 miles and 5-7 miles do not differ significantly
		Average of carapace width	.004	0,05	The average carapace width at fishing ground distances of 0–2 miles and 5-7 miles differs significantly .
		Average of weight	.016	0,05	The average weight at fishing ground distances of 0–2 miles and 5-7 miles differs significantly
		total female	.282	0,05	The total catch of female blue swimming crabs at fishing ground distances of 0–2 miles and 5-7 miles does not differ significantly
	total male	.044	0,05	The total catch of male blue swimming crabs at fishing ground distances of 0–2 miles and 5-7 miles differs significantly	

Table 2. Number of blue swimming crab caught based on carapace width

Carapace width	Growth phase	Total (ind.)	
		Fishing ground 0-2 miles	Fishing ground 5-7 miles
< 60 mm	Juvenil	0	0
60 - 100 mm	Young crab	176 (7%)	177 (4%)
> 100 mm	Adult crab	2450 (93%)	4035 (96%)

From November 2022 to January 2023, 93% of the blue swimming crabs caught at the fishing ground within 0–2 miles and 95% at 5-7 miles were in the adult phase, with an average carapace width of >100 mm. Meanwhile, the remaining portion was in the young phase, with a carapace width exceeding 60-100 mm. These findings are consistent with [13], which reported that caught blue swimming crabs had an average carapace width of 121–130 mm, and with [14], which stated the overall average carapace width of blue swimming crabs to be 13.91 cm. The relationship between the distance of the gillnet fishing gear from the coast and the blue swimming crab catch is significant; the farther from the coast, the greater the catch [15]. The fishing ground area for blue swimming crab is influenced by the fleet's capacity to conduct fishing operations; larger vessels can venture into more distant crab-catching areas [16]. Fishing ground distance is a key factor in sustainability and can be approached through a

precautionary approach [17]. The characteristics of the blue swimming crab, particularly the egg-berried female, were influenced by the distance of the fishing site from the coast [18]. The size of the blue swimming crab will get bigger when the water gets deeper and smaller when the water gets shallower [19]. According to Priyambada, the farther and deeper the fishing ground, the smaller the catch and the narrower the carapace width; conversely, the farther from the fishing ground, the larger the prospective catch and the wider the carapace width [20].

4. Conclusion

The blue swimming crab caught in the waters around Mengare Island, Gresik Regency, is more abundant at the fishing ground within 5-7 miles compared to the one within 0–2 miles. The blue swimming crabs caught are predominantly in the young phase, with a male gender, and most of them are caught at mature level. The influence of different fishing ground distances has been proven to affect the diversity of biological characteristics of the blue swimming crabs caught. This condition indicates that fishing ground distance is one of the factors that can achieve the principles of sustainable crab fishing and serves as educational material for fishermen to always apply sustainability principles. A suggestion to the fishermen in Mengare Island, Gresik Regency, is to pay attention to the fishing ground distance when operating gillnet fishing gear in order to obtain larger catch sizes and increase the quantity of blue swimming crabs caught.

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