POPULATION DYNAMICS OF THE THREE-SPOT SWIMMING CRAB (*Portunus Sanguinolentus*) IN PATI WATERS, CENTRAL JAVA

DINAMIKA POPULASI KEPITING BINTIK TIGA (*Portunus Sanguinolentus*) DI PERAIRAN PATI, JAWA TENGAH

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ABSTRACT

Currently, *Portunus sanguinolentus* is one of the fishery commodities that has experienced a decline in population due to exploitation pressures and habitat or environmental damage. This has an impact on changes in the population structure and reproductive strategy of *P. sanguinolentus*, with parameters that can change, among others, the size of the first gonad becoming smaller, changes in spawning areas and seasons, and changes in the balance of the sex ratio. This study aims to determine the population dynamics of *P. sanguinolentus* in Pati Regency, Central Java, and whether it is useful for the processing industry to make a new product. Data and information were obtained through observation, interviews, and enumeration, which were carried out at each fish landing site. Collecting data from catches in fishing areas below 12 miles with a maximum depth of 15 m for 5 months. The FISAT II software was used to analyze the growth parameters, mortality rate, and exploitation rate. Obtained weight data of 7.72 kg with a total sample of 107 ind. Detailed data were obtained for 46 females with an average width of 106.24 mm and 61 males with a width of 103.95 mm, and the average weight of the entire sample was 74.26 g.

Keywords: exploitation rate, growth, mortality, population dynamic, Portunus sanguinolentus

ABSTRAK

Saat ini Portunus sanguinolentus merupakan salah satu komoditas perikanan yang mengalami penurunan populasi akibat tekanan eksploitasi dan kerusakan habitat atau lingkungan. Hal ini berdampak pada perubahan struktur populasi dan strategi reproduksi P. sanguinolentus, dengan parameter yang dapat berubah antara lain ukuran gonad pertama yang mengecil, perubahan daerah dan musim pemijahan, serta perubahan keseimbangan rasio jenis kelamin. Penelitian ini bertujuan untuk mengetahui dinamika populasi P. sanguinolentus di Kabupaten Pati Jawa Tengah dan bermanfaat bagi industri pengolahan untuk menghasilkan suatu produk baru. Data dan informasi diperoleh melalui observasi, wawancara, dan pencacahan yang dilakukan di setiap tempat pendaratan ikan. Pengumpulan data hasil tangkapan dilakukan di daerah penangkapan ikan kurang dari 12 mil dengan kedalaman maksimal 15 m selama 5 bulan. Perangkat lunak FISAT II digunakan untuk menganalisis parameter pertumbuhan, tingkat kematian, dan tingkat eksploitasi. Diperoleh data berat badan sebesar 7,72 kg dengan jumlah sampel sebanyak 107 ind yang terdiri dari 46 ekor betina dengan rata-rata lebar 106,24 mm dan 61 ekor jantan dengan lebar 103,95 mm, serta rata-rata berat seluruh sampel 74,26 g.

Kata Kunci: laju eksploitasi, pertumbuhan, kematian, dinamika populasi, Portunus sanguinolentus

I.   INTRODUCTION

Portunus sanguinolentus or three-spotted crab is a group of crustaceans. The difference from this crab was that it had black spots or three dots on the carapace, brown color all over the body, and red claws covered with white. *P. sanguinolentus* (Herbst, 1783) was widespread in marine waters from East Africa, through the Indo-Pacific region, to the Hawaiian Islands. Seeds and adult males usually inhabited sandy and muddy bottoms in nearshore waters, around 10–30 m. In contrast, females were abundant at 40–80 m depth (Wenner, 1972; Campbell & Fielder, 1986).

Both *P. pelagicus* and *P. sanguinolentus* were distributed from the intertidal zone of approximately 50 m depth along the coastline (Klinbunga *et al.,* 2010). These swimming crabs also provided an excellent source of nutrition because of their high protein content. *Portunid* crabs were further supported by recreational fishing as an important component of the food web and were the principal source of food for numerous fish, birds, and carnivorous animals.

The three-spotted crab is one of the thousands of marine animals in Indonesian waters. This species can be found by crab fishermen using traps and gill nets. Three-spotted crab can be found in certain seasons, for example during the rainy season or the west monsoon that occurs in Indonesia, namely between January and March. And also found in the dry season between July and November. Currently, the three-spotted crab is one of the fishery commodities that is estimated to experience a decline in population due to exploitation pressures and habitat or environment degradation (Johnston *et al.*, 2011). This has an impact on changes in population structure and crab reproduction strategies with parameters that can change, including the size of the first maturity of the gonads becoming smaller, changes in spawning areas and seasons, and changes in the balance of the crab sex ratio (Arfah *et al.,* 2005).

Pati is a district in the north of the island of Java with a well-known motto, namely Pati Bumi Mina Tani. Most of the Pati Regency area is lowland, with an area of 1,503.68 km^2. In Pati Regency, three-spotted crabs were caught by fishermen using traps as a by-catch. The total catch that landed over six months was recorded at 8 kg. These results indicate that the stock of three-spotted crabs in nature has decreased in population. For the details, the aims of this research were to determine the population dynamics of three-spotted crabs, including growth, mortality, and exploitation rates in Pati Regency and provide manufacture of new products for the industry with pure meat three-spotted crabs.

II.   RESEARCH METHODS

2.1.   Time and Place of Research

The research was conducted in Pati, Central Java, in July–November 2021, by means of observation and interviews to obtain data on species composition, gonadal maturity level, equipment specifications, area, and fishing trips.

2.2.   Material and Data

Whereas, enumeration was carried out to obtain data on the carapace width of the three-spotted crabs, sex, and gonad maturity. The width of the carapace was measured using a caliper and then tabulated in a carapace width frequency distribution table with 5mm intervals using the Microsoft Excel program. The carapace width frequency data were used to estimate the population parameters of the three-spotted crab.

2.3.   Data Analysis

The estimation of the size of the first sexual maturity was carried out using the Spearman-Karber method (Udupe, 1986):

$$m = X_k + \frac{x}{2} - (X \sum_{i=1}^{n} p_i) \quad \text{...................(1)}$$

Description: m = Log size when the ovary first matures; X_k = Log size where 100% of the sample fish are cooked; X = Hose log size (*log size increment*); pi = Proportion of ripe in group i.

The average size of the three-spotted crab, when the gonads ripen for the first time, is obtained from the antilog value (m). The sex ratio test was carried out with a chi-square test (Steel & Torrie, 1993):

$$\chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i} \quad \text{.................(2)}$$

Description: o_i = the number of male and female frequencies; e_i = Expected number of spotted crabs of three males and females; k = Number of groups observed.

The growth of the three spotted crab was analyzed using the *Von Bertalanffy* growth model (Sparre & Veneme, 1992) :

$$Lt = L^\infty (1 - e^{-k(t-t0)}) \quad \text{..............(3)}$$

Determination of asymptotic or infinitive carapace width (CW) and growth coefficient (K) was estimated using the ELEFAN program packaged in FISAT II software (Gayanilo *et al.,* 2005). Theoretical age (t_0) with Pauly (1983) empirical equation:

$$\text{Log} - (t_0) = -0.3922 - 0.2752 \log CW - 1.038 \log K \quad \text{..................(4)}$$

Determination of age group is done by distribution separationnormal frequency data for carapace width with the forward motion method. Analyzed using the FISAT II program (King, 1995; Gayanilo *et al.*, 2005). The natural mortality rate (M) is estimated by Pauly (1983) empirical equation using the annual average surface temperature (T):

$$\text{Log (M)} = -0.0066 - 0.279 \log CW + 0.6543 \log K + 0.4634 \log T \quad \text{.................(5)}$$

Estimation of total mortality (Z) was carried out using the yield conversion curve method of catch with length (*length converted catch curve*) with FISAT II (Gayanilo *et al.,* 2005; Pauly, 1983):

$$Z = F + M \text{ and } E = F/Z \quad \text{.................(6)}$$

Description: F = Exploitation mortality; E = Exploitation rate.

III. RESULT AND DISCUSSION

3.1. Catch Area

The catchment area is divided into 4 zones. Zone I is a catchment area with a distance of 0-2 miles, Zone II is 2-4 miles, Zone III is 4-12 miles, and Zone IV is over 12 miles from the berth area. The depth of each zone varies, with the seabed area from 0-12 miles being a mud area while above 12 miles being a sandy seabed area.

3.2. Catching Tools

The main fishing gear used by fishermen in Pati Regency is nets (gillnet) and bubu (collapsible trap). Each fisherman has a different number of fishing gear. Fishermen who use nets have a total of 5-8 pis per fisherman. While the fishing gear is 200 to 700 pieces of fishing gear per fishing boat. The size of the boat used has a tonnage of 1 GT with a 16 PK engine. 75% of catching tools in Pati were collapsible traps rather than gillnets (25%), as shown in Figure 3.
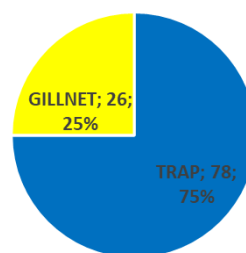

Figure 3. Pie chart of often used fishing gear in Pati waters.

Figure 1. Fishing area of three-spotted crabs in Pati Waters.

| (a) | (b) |

Figure 2. (a) Boats and (b) fishing gear fishermen used in Pati Waters.

3.3. Carapace Width, Size, and Structure

The number of samples of three-spotted crabs collected during the study was 108 individuals, consisting of 61 males and 47 females. The average width of the female carapace is 106.24 mm and the average width of the male carapace is 103.95 mm, with the average weight of the entire sample being 74.26 g.

3.4. Growth Parameters

The results of the estimation of the three-spotted crab growth parameters in Pati waters are presented in Table 1. The value of the infinitive carapace width (CW_∞) and the

growth rate (K) of the female three- spotted crab is greater than those of the male.

3.5. Total Mortality Rate (Z), Natural (M), Fishing Mortality Rate (F)

The estimation of the total mortality rate was carried out using the catch conversion curve method with carapace width which was analyzed using the FISAT II program by entering the CW^∞, K, and each gender into the program and the analysis results are obtained as shown in Figure 5. Based on the results of the analysis, the total mortality rate (Z) of spotted crabs in three-spotted crabs was 1.42/year and that of females was 1.41/year. Natural mortality (M) obtained the analysis results of 0.81 males and 0.79 females. The fishing mortality rate (F) is obtained by the formula F = Z–M, so that the result is 0.61/year for males and 0.62/year for females.

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Table 1. Growth Parameters of Three-spotted Crabs in Pati waters.

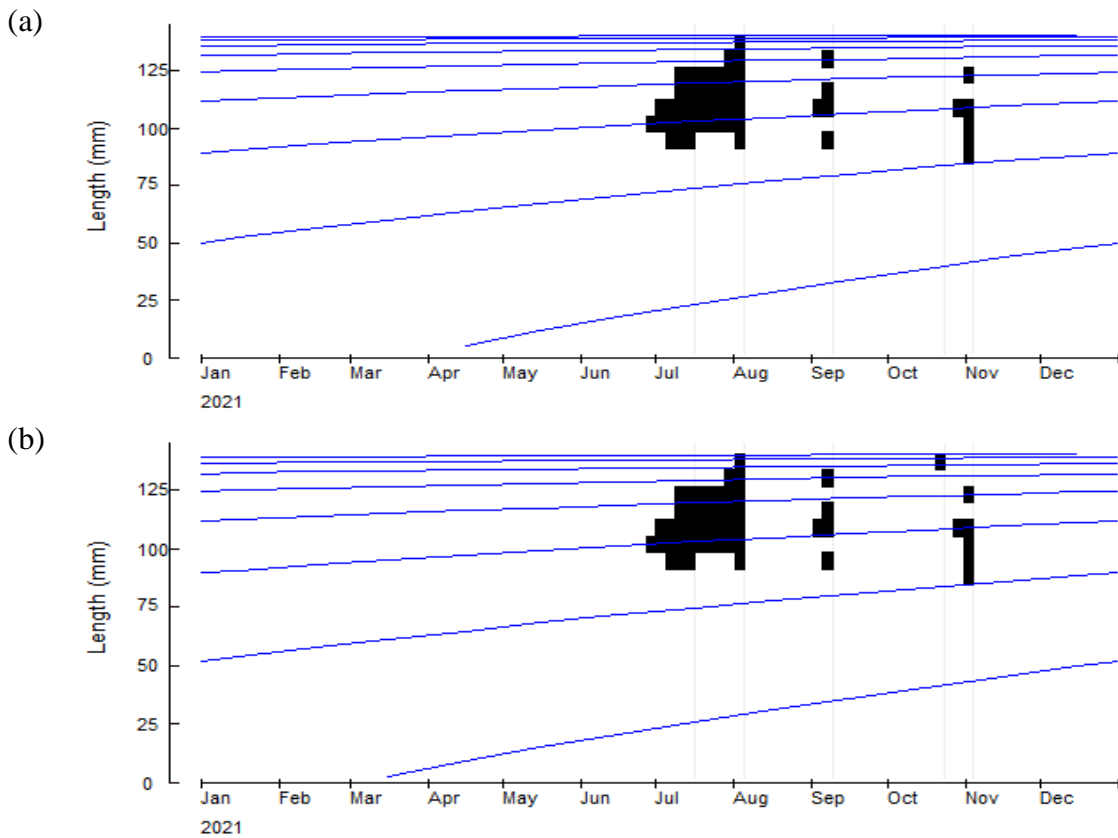| Gender	CW∞ (mm)	K (year^{-1})	t_0 (year)	Growth Equation
Male	141.54	0.56	-0.72	CWt=141.54(1 - e$^{-0.56(t+0.72)}$)
Female	142.61	0.54	-0.71	CWt=142.61(1 - e$^{-0.54(t+0.71)}$)

Figure 4. *Von Bertalanffy* Growth Curve of (a) male and (b) female three-spotted crab in Pati waters.
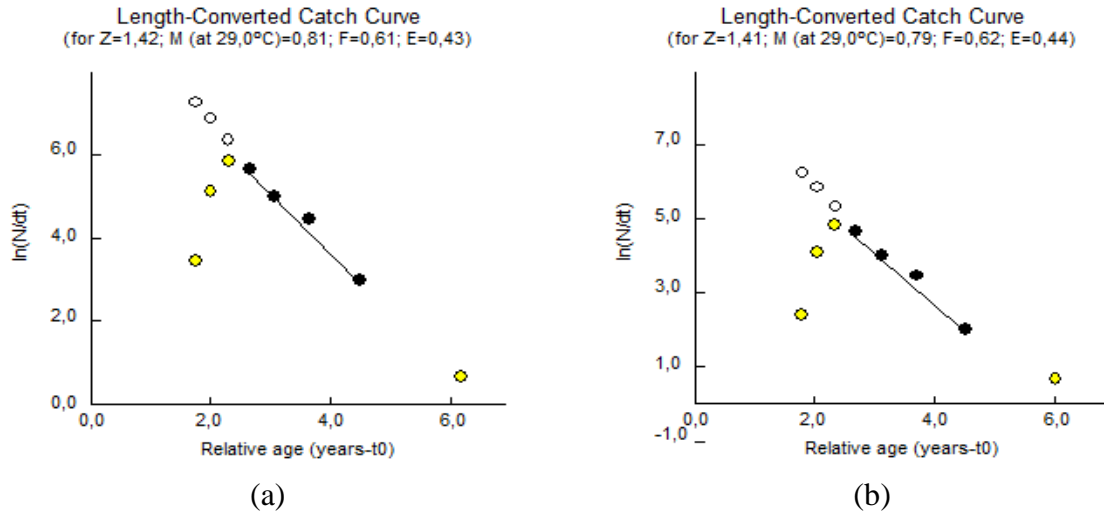
Figure 5. Length converted catch curve of three-spotted of (a) male and (b) female crabs in Pati waters.

3.6. Exploitation Rate

The exploitation rate (E) is obtained from the values of Z and F with the formula E = F/Z. According to (Pauly, 1984), the value of the rate of rational and sustainable exploitation of a water body is at the value of E <0.5 or the highest value of E = 0.5. The results obtained from Pati waters showed that the value of E for males was 0.43 and for females it was 0.44. The growth parameters within one species vary, shows that the growth parameter is dynamic The infinite carapace width value (CW∞) and the growth rate (K) of female three-spotted crabs were greater than those of males. This difference was obtained based on the carapace width of the female three-spotted crabs, which has a maximum of 142.61 mm, while the male is 141.54 mm. While the male three-spotted crabs' growth rate (K) is greater than the female growth rate. The value of the male three-spotted crabs is 0.56/year and the female is 0.54/year. The growth rate of the three-spotted crabs in this study is still below one, which indicates that the three-spotted crabs have a slow growth rate (Kembaren *et al.*, 2016).

The availability of sufficient natural food in their habitat will cause the growth of the three-spotted crabs to be relatively faster.

The total death rate, natural and accidental, and the capture of three-spotted crabs in Pati waters are smaller than those of crabs in Bone. According to (Kembaren *et al.*, 2016), male crabs had a Z value of 9.21 years and female crabs had a Z value of 6.90 years; male crabs had an M value of 1.33/year and female crabs had an M value of 1.21/year; and male and female crabs had F values of 7.88 years and 5.69 years, respectively. The total death rate (Z) varies from year to year because it is influenced by the capture mortality rate, while the natural death rate varies very little. The exploitation rate of the three-spotted crabs in Pati waters is still quite rational and sustainable, and the utilization value of the three-spotted crabs is still small. For this reason, more conservation efforts are needed in order to increase the value of the three-spotted crabs themselves.

IV. CONCLUSION

In Pati waters, the growth value of three-spotted crabs varies according to the width of the carapace. The female three-spotted crabs have a larger carapace width with a value of 142.61 mm compared to males at 141.54 mm. Males have a K value greater than 0.56 per year, while females

have a K value of 0.54 per year.It can be concluded that the three-spotted crabs have slow growth.

The total mortality rate (Z) of male three-spotted crabs is 1.42/year and for females it is 1.41/year. The exploitation rate of three-spotted crabs in Pati waters is still below the rational or sustainable value, namely 0.43 and 0.44 for males and females, respectively. This shows that the utilization of the three-spotted crabs is not yet intensive, because it's still below 0,5. However, because this value is close to the maximum threshold for the rate of exploitation, further attention is needed regarding efforts to przeserve three-spotted crabs, separate use by the industry, and efforts to stop exploitation in certain seasons.

ACKNOWLEDGMENT

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