Population dynamics of cat shrimp (*Mierspenaeopsis sculptilis*) in the morning caught on the Samboja Kuala, Kutai Kartanegara Regency

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ABSTRACT

Samboja Kuala has a vast sea and abundant natural resources. East Kalimantan Province. The increase in capture fisheries certainly has a positive effect on fishermen, but it is necessary to know that an increase is always followed to carry out more intensive exploitation. Overfishing conditions allow for the catch of a number of stocks that exceed the amount needed in a waters. Various fishing gear used. The fishing gear used by fishermen to catch shrimp includes trawls. So far there are no specific catches that refer to the cat shrimp species (*M. sculptilis*) in Samboja Kuala waters, so studies or research are needed to provide information about the cat shrimp species population in these waters. The purpose of this study was to determine the estimated biomass and distribution of cat shrimp caught during the day in the Samboja Kuala sea and abundant natural resources, Kutai Kartanegara Regency. This research was carried out in November-December 2023, by conducting identification in the laboratory and taking samples of shrimp operating in Samboja Kuala Waters. The average stock density of cat shrimp (*M. sculptilis*) obtained during the day was 17.98 kg/km² and an estimated value of 442.28 kg with an area surveyed of 30.75 km². Based on research caught during the day cat shrimp were evenly distributed to all stations, the highest number of shrimp caught was obtained at station 5 and station 13.

INTRODUCTION

Samboja is one of the regions in Kutai Kartanegara Regency, East Kalimantan Province. The area of Samboja District covers 1,045.90 km², located between 116°50' E - 117°14' E longitude and 0°52' S - 1°08' S latitude (BPS, 2022). Samboja Kuala Subdistrict is predominantly inhabited by fishermen and serves as a base for fishing activities. The coastal waters in this area boast abundant natural resources, particularly in capture fisheries. Due to the potential of these resources, stock estimation of fish is essential. Stock estimation involves statistical and mathematical analysis of data to quantitatively assess the status of fish stocks (Leonart, 2002). Samboja Kuala significantly contributes to the capture fisheries sector, thereby boosting the economy of Samboja District and Kutai Kartanegara Regency. Fishing activities in Samboja Kuala amounted to 8,482.90 tons in 2019, increasing to 10,246.50 tons in 2020, indicating a yearly rise (BPS Kutai Kartanegara, 2022).

While increased fishing yields benefit fishermen, it's crucial to manage exploitation carefully to prevent overfishing, where the catch exceeds sustainable levels. Shrimp, particularly the cat shrimp (*M. sculptilis*), is a key catch in Samboja Kuala's daytime fisheries. Shrimp play a vital role in the aquatic ecosystem as a component of the food chain (Heller, 1862). Currently, there is no specific catch data

available for cat shrimp (*M. sculptilis*) in Samboja Kuala's coastal waters. Therefore, there is a need for studies or research to estimate the cat shrimp (M. sculptilis) population in daytime coastal fisheries in Kutai Kartanegara's Samboja Kuala area.

METHODOLOGY

Research Location and Time

The research was conducted from November to December 2022 in the Coastal Waters of Samboja Kuala, Samboja District, Kutai Kartanegara Regency, following shrimp catching activities using trawl nets during daytime. Data collection locations during the study were in the Northern Zone of Samboja Kuala Coastal Waters.

Research Procedure

Sampling for this research was carried out by collecting samples from fishermen's shrimp catches. The fishermen used trawl nets for catching shrimp, and this was done during nighttime. Samples were collected once a week to facilitate measurement and prevent sample damage. Subsequently, the body parts of the shrimp were measured at the Conservation Laboratory, Faculty of Fisheries and Marine Sciences, Mulawarman University.

Data Analysis

The collected data underwent analysis using the following methods:

1. Sex Ratio

The sex ratio of the white shrimp was determined using the equation:

X = M : F

Where:

X = sex ratio

M = number of male shrimp (individuals)

F = number of female shrimp (individuals)

2. Age Estimation

Age estimation was conducted using the Von Bertalanffy growth formula (Sparre et al., 1999) as follows:

$$Lt = L\infty (1 - e^{-K(t-t0)})$$

Where:

Lt = Length of white shrimp at age t (mm)

L∞ = Asymptotic length of shrimp (mm)

K = Coefficient of growth rate

t0 = Theoretical age of shrimp when length is zero (months)

t = Age (months)

To determine t0, the Pauly formula (1980) will be used:

$\text{Log}(-t0) = -0.3922 - 0.2752\ (\text{Log}\ L\infty) - 1.038\ (\text{Log}\ K)$

Where:

$L\infty$ = Asymptotic length of shrimp (mm)

K = Coefficient of growth rate

t0 = Theoretical age of shrimp when length is zero (months)

3. Mortality

Natural mortality estimation is assumed using the Pauly empirical formula (1980):

$\text{Log}\ M = -0.0066 - 0.279\ \text{Log}\ L\infty + 0.543\ \text{Log}\ K + 0.4634\ \text{Log}\ T$

Where:

$L\infty$ = Asymptotic length of shrimp (mm)

K = Coefficient of growth rate

T = Average surface water temperature (°C)

Total mortality is estimated using the equation proposed by Beverton and Holt (1956) in Sparre et al. (1992):

Fishing mortality is estimated with the equation:

$Z = F + M$

Where:

F = Fishing mortality

Z = Total mortality

Exploitation rate (E) is obtained using the Beverton and Holt formula:

Where:

Z = Total mortality (per month)

K = Coefficient of growth rate

$L\infty$ = Asymptotic length of shrimp (mm)

L = Average length of captured shrimp (mm)

L' = Lower limit of length class of captured shrimp (mm)

4. Recruitment Pattern

Recruitment pattern in the data is analyzed with the assistance of FiSAT II software, specifically using the recruitment pattern sub-program. This aims to determine the recruitment pattern over time from length frequency data to ascertain the annual peak count. Data are transformed into a lfq format (grouped frequencies), inputting previously calculated values of $L\infty$ and K. The results of the recruitment pattern analysis are presented as a histogram.

The research was conducted from November to December 2022 in the waters of Kuala Samboja, Samboja District, Kutai Kartanegara Regency. This location represents the primary catch site for fishermen. The fishing gear used includes Gillnets, Purse seines, Trammel nets, and Trawls. Fishing activities were conducted both during daytime and nighttime.

RESULT AND DISCUSSION

A. Sex Ratio

The sex ratio values of male and female cat shrimp (*M. sculptilis*) during the study are presented in Table 1 below:

Table 1. Sex Ratio

Month	Number of Individuals	Ratio
Nov-Dec	Male: 71, Female: 429	Male: 14.2%, Female: 85.8%

Based on Table 1, the sex ratio of cat shrimp (*M. sculptilis*) shows a higher number of females compared to males, with a ratio of 14.2% males to 85.8% females. Calculating the sex ratio gives a male-to-female ratio of 1:35.8. This ratio indicates that the number of females is three times greater than that of males, which suggests an imbalance in the Samboja Kuala waters. Saputra (2009) states that environmental factors are among the reasons for more females or males in shrimp populations, as each species has its own ability to live in certain depths of water.

B. Age Estimation

Age estimation analysis was conducted using the Length Frequency Analysis program (ELEFAN-1), resulting in growth values for males and females. Based on total length frequency data of male and female cat shrimp (M. sculptilis), the growth rate (K) for males is 0.83 and for females is 0.64. The asymptotic length (L∞) values are 128.53 mm for males and 100.69 mm for females.

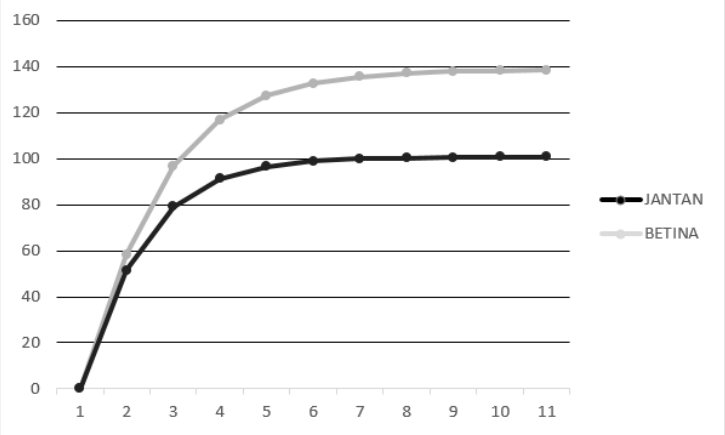

Figure 1. Age estimation of cat shrimp

Based on the growth chart in Figure 1, the growth of male and female cat shrimp (*M. sculptilis*) differs, showing that the growth rate of female cat shrimp is faster compared to males. Rapid growth in length for both male and female shrimp occurs at a young age, while growth slows down as they approach asymptotic length with increasing age.

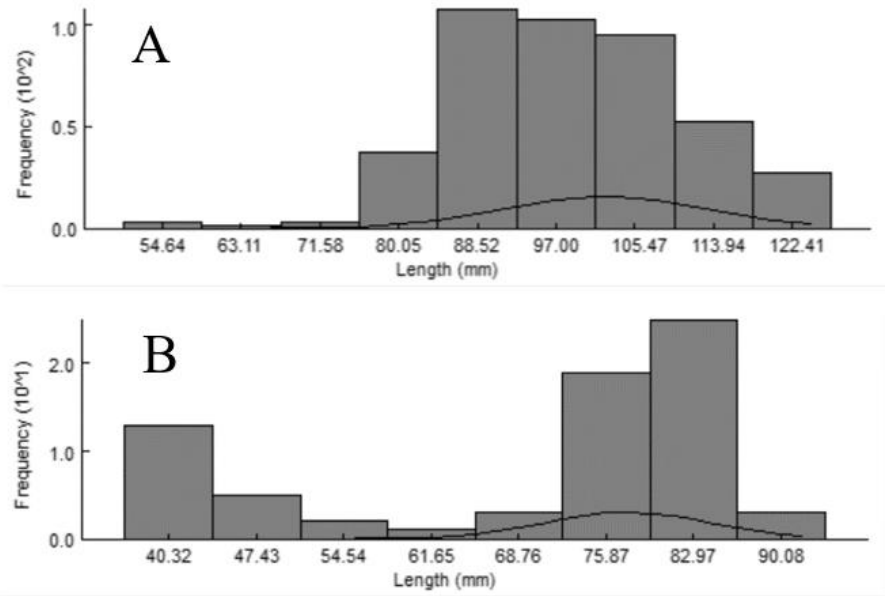

Figure 2. Age group of cat shrimp by sex: female (A) and male (B)

Based on the mapping results between frequency values and class midpoints, significant differences were found in the age groups of male and female cat shrimp (*M. sculptilis*). The age group of male cat shrimp (M. sculptilis) ranges from 75.87 mm to 82.97 mm, while the age group of female cat shrimp (M. sculptilis) ranges from 88.52 mm to 105.47 mm.

C. Mortality

Based on the parameters of brown spotted shrimp length values, calculations have been performed to estimate the catch results, processed using FiSAT II software, as shown below:

Table 2. Mortality

Parameter	Estimated Value
Male	Female
Natural Mortality (M)	1.16488
Total Mortality (Z)	2.2
Fishing Mortality (F)	1.04
Exploitation Rate (E)	0.84

According to the table above, with maximum length and growth rate, the water temperature is 29°C, which is normal for the water. The total mortality coefficient (Z) for male cat shrimp (M. sculptilis) is 2.2 per year, while for female cat shrimp it is 1.27 per year. The natural mortality coefficient (M) for male cat shrimp (*M. sculptilis*) is 1.16488 per year and for female cat shrimp it is 0.90211 per year. The mortality coefficient due to fishing (F) for male cat shrimp (M. sculptilis) is 1.04 per year and for female cat shrimp it is 0.37 per year. The utilization rate of cat shrimp (M. sculptilis) for males and females is 0.84 and 0.29, respectively.

D. New Growth Pattern (Recruitment Pattern)

Based on the monthly percentage of new additions or the new growth pattern of cat shrimp (M. sculptilis) for males and females, presented in Figures 3.

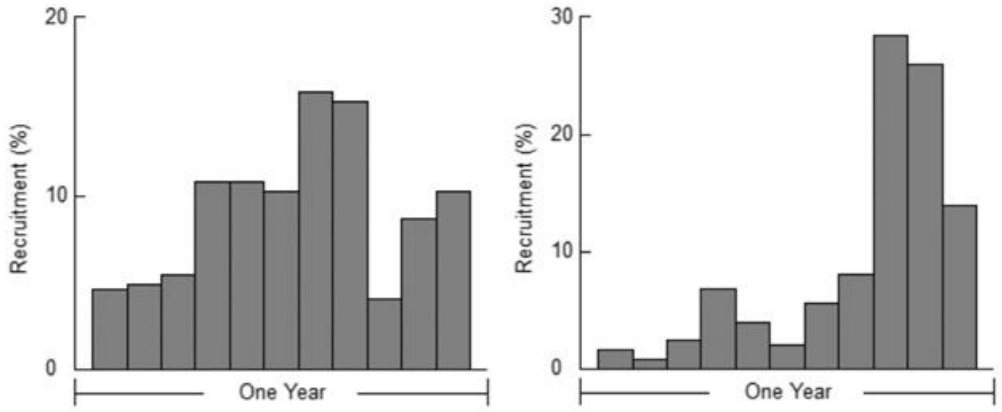

Figure 3. Growth Pattern Graph of female (left side) and male (right side) cat shrimp (*M. sculptilis*)

The new growth pattern of male and female cat shrimp (*M. sculptilis*) in Samboja Kuala waters. Based on length frequency data obtained through the ELEFAN I program, the analysis shows that new additions for male cat shrimp occur in July at 15.72%. Meanwhile, for female brown spotted shrimp, new additions occur in September at 28.55%. According to Naami (1984) cited in Nurdin and Kembaren (2015), rainfall levels are related to the peak spawning season of shrimp, which usually occurs at the beginning and end of the rainy season. Therefore, it is recommended to reduce or avoid fishing efforts during these times.

CONCLUSION

Cat shrimp (*M. sculptilis*) caught during daytime in Samboja Kuala waters exhibit faster growth rates in females compared to males. These shrimp display distinct growth patterns, mortality rates, and recruitment patterns between males and females. Generally, males tend to have higher mortality rates than females, likely influenced by environmental factors. The obtained mortality values differ between males and females, including natural mortality (M), total mortality (Z), fishing mortality (F), and exploitation rate (E).

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