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Biological Aspects of Jerbung Shrimp (*P. merguiensis*) in Cilacap Waters, Central Java

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A B S T R A C T

Cilacap waters have very high biodiversity, among the diverse aquatic species found in Cilacap waters, Jerbung shrimp (Penaeus merguiensis) stands out as one of the key resources. This study aimed to explore various biological characteristics of P. merguiensis, including size distribution, the relationship between length and weight, sex ratio, stages of gonadal maturity (TKG), the size at first capture, size at first gonadal maturity, and condition factor. Additionally, the study sought to develop a management strategy for P. merguiensis in the Cilacap region. A survey method was employed for sampling, which took place between July and August 2024. Each month, four sample sets—representing approximately 10% of a single boat's total catch at one landing site—were collected, covering a range of shrimp sizes. This sampling approach aimed to ensure the data was representative of the broader population. The findings revealed that the mode of carapace length was 44 mm, with Lc_{50}% measured at 45 mm and Lm_{50}% at 43.5 mm. The growth pattern of the shrimp was identified as negative allometric, indicated by a b value of 2.322. The condition factor for male P. merguiensis shrimp is 1.01 while for females it is 1.00.

Keywords: Penaeus Merguiensis, Biological Aspects, Cilacap Waters.

Introduction

Capture fisheries in Cilacap have grown rapidly with various main commodities and one of them is shrimp. The fishing gear used is a three-layer net or trammel net [1]. Shrimp capture fisheries in the waters of Cilacap Regency are predominantly dominated by penaeid shrimp. The long-standing exploitation of these shrimp resources has raised concerns regarding a possible decline in stock abundance. This condition also reflects the overall utilization status of shrimp resources in Cilacap waters, which appears to be experiencing increasing pressure. The tendency of shrimp catches to surpass sustainable harvest limits has negatively affected the sustainability of the resource. According to data from the Cilacap Regency Fisheries Service in 2020, this overexploitation poses a significant risk to the long-term viability of shrimp populations in the region, where the development of the value of marine capture fisheries production for crustaceans (shrimp, crabs, and crabs) has decreased every year. Where according to research by Patria et al., 2014 that, the average utilization of shrimp stocks in the waters of the Cilacap Regency coastal area in 2011 and 2012 has passed the level of resource sustainability (MSY). As for 2009-2010 the level of utilization is far below MSY. In general, the condition of shrimp fishing by small-scale fishermen in Cilacap Regency can be said to be potentially unsustainable.

Jerbung shrimp in Cilacap spawn throughout the year and peak in April, August, and November. The lowest spawning occurs in February and October. The size of jerbung shrimp first matured gonads in Cilacap at 31.64 mm and 39.9 mm carapace length. The spatial and temporal distribution patterns of shrimp are thought to be related to the life cycle patterns of shrimp. The harvesting of shrimp before they have the opportunity to spawn is a contributing factor to overfishing [2]. The Segara Anakan estuary functions as a critical nursery habitat for Jerbung shrimp larvae, playing a vital role in supporting the continuity of their life cycle and sustaining shrimp stocks in the adjacent waters [3]. The shrimp fishing grounds in Cilacap waters are categorized into two main areas: the Nusakambangan Island zone, located along the southern coast of the island, and the Penyu Bay area, situated near the estuaries of the Serayu and Tipar Rivers [1]. Given this spatial distribution and the ecological importance of the region, studying *Penaeus merguiensis* in Cilacap waters is considered essential. This research aims to evaluate the biological potential and utilization status of *P. merguiensis* populations in the area. The findings are expected to contribute to the formulation of a sustainable management strategy for this species. Specifically, the study investigates several biological parameters of *P. merguiensis*, including size structure, length-weight relationship, size at first capture, size at first gonadal maturity, sex ratio, gonad maturity stages (TKG), and condition factors. The objectives of this research are as follows: Knowing some aspects of the biology of P. merguiensis shrimp which includes size structure, length-weight relationship, first size caught, first size of gonad maturity, sex ratio, level of gonad maturity (TKG) and condition factors in Cilacap waters.

Methods

The method used in this research is the survey method. The survey method is used to provide a description or description systematically, factually, and accurately about the facts, characteristics and relationships between the phenomena being investigated [4]. The material used in this study was P. merguiensis shrimp taken from one of the fishermen who landed their catch in basket (pier 3) Cilacap Regency, Central Java. The tools used in the field are sterofoam boxes for shrimp sample containers that come from baskets. Scales (accuracy 0.1 g) to weigh the body weight of shrimp, ruler (accuracy 1 mm) to measure the length of the body and carapace of shrimp, magnifying glass to see the shape of the rostrum.

Sampling Method

The shrimp sampling method was carried out by *systematic random sampling*. This method is used by researchers to take samples systematically (samples are taken at the same place and in the same time interval) in a homogeneous population [4]. The number of samples of jerbung shrimp for measurement of carapace length and weight is 1 kg from the catch once a week for 3 months on 1 random boat that landed its catch at TPI PPS Cilacap or at collectors.

Data Analysis

Size Structure

This size structure is obtained by determining the class interval, the class center value and the frequency distribution of the predetermined length within the same class interval plotted on a graph.

Length-Weight Relationship

The study of length-weight relationships has practical value in that it allows converting length values into weight or vice versa [5]. Shrimp weight can be considered as a function of length, and this length-weight relationship follows the cubic law.

$W = a L^b$

Where:

W = body weight (g)

L = Carapace length (mm)

or in the linear form of the equation:

$\log W = \log a + b \log L$

The coefficient *b* in the length-weight relationship equation serves as an indicator of the shrimp's growth pattern. When $b = 3$, the shrimp exhibits isometric growth, meaning its body shape remains proportional as it grows. If $b<3$, the growth is classified as negative allometric, indicating that the shrimp's length increases more rapidly than its weight. Conversely, if $b>3$, the growth is considered positive allometric, suggesting that the shrimp's weight increases at a faster rate than its length.

Level of Gonadal Maturity (TKG)

Analysis of the level of gonad maturity (TKG) can be done by making observations of shrimp gonads include the shape, color, and development of gonads that can be seen [6]. Development of TKG penaeid shrimp can be classified in 5 levels [8], namely:

TKG 0 : Colorless ovaries, intestines and muscles visible at the junction between the cephalothorax and abdomen.

TKG 1 : Milky white ovaries, ovaries do not appear translucent carapace, intestines and muscles visible.

TKG 2 : Ovaries are pale yellow in color, ovaries do not show through the carapace, shrimp and muscles are visible.

TKG 3 : Ovaries yellow, red chromatophores obvious, ovaries visible through carapace, some muscles not obvious.

TKG 4 : Orange colored ovary, striking red chromatophores, partial ovary lobe has a large size.

Condition Factor

The calculation of the condition factor for $b \neq 3$ fulfills the equation below [8]:

$K = W/aL^{(b)}$

Description:

K = Condition factor

W = Weight (grams)

L = Total length (mm)

Sex ratio

To determine the sex ratio of male and female shrimp, the Chi-square test was conducted [7]:

$X^2 = \frac{\sum (fo-fh)}{fh}$

where :

X^2 = Chi squared

fh = expected percentage

fo = percentage of observation results

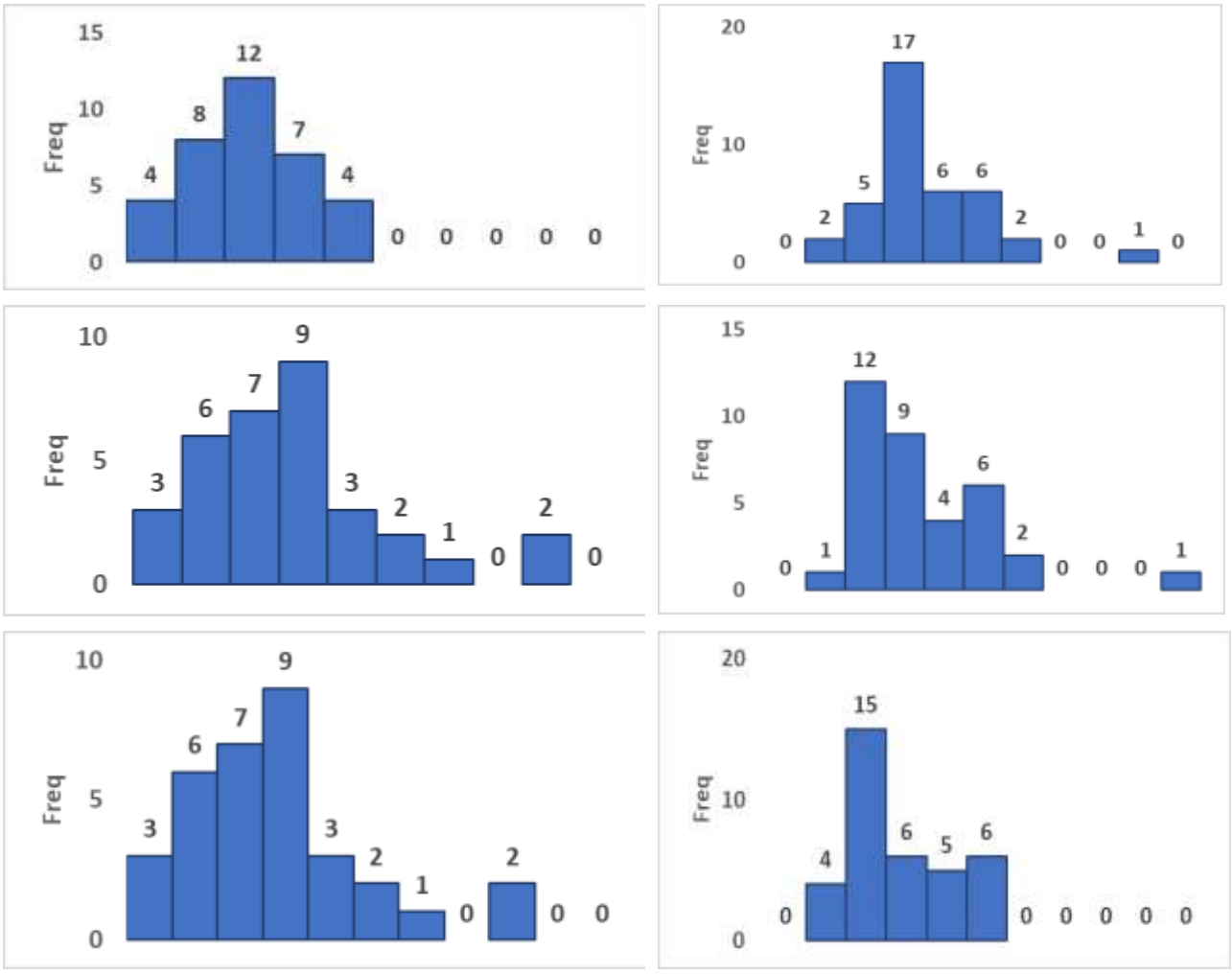
First Size Caught ($L_{c50\%}$)

The average size of shrimp caught was obtained by plotting the cumulative frequency with each shrimp length, resulting in a standardized logistic curve, where the point of intersection between the curve and 50% cumulative frequency is the length at which 50% of the shrimp are caught.

Result and Discussion

Size Structure of *P. merguiensis* Shrimp

The length structure of P. merguiensis shrimp at each sampling is presented in graphical form in Figure 1.



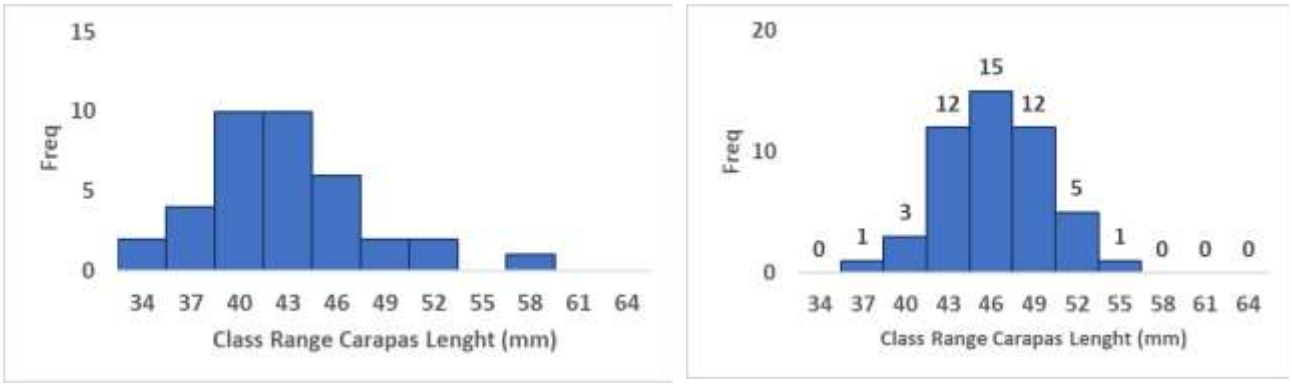


Figure .1. Size Structure of Jerbung Shrimp (*P. merguiensis*)

Based on the size structure histogram of P. merguiensis shrimp (Figure 4), it can be seen that during the sampling period (July-August), the carapace length pattern of P. merguiensis shrimp ranged from 41-45 mm. This size structure is different from the research of Melmambisi et al. (2023) in the coastal waters of Arafura where the carapace length ranged from 14-32 mm and also different from the research of Saputra et al. (2018) in the north coast waters of Central Java where the carapace length ranged from 20-27.5 mm, as well as previous research in Cilacap waters where the carapace length of P. merguiensis shrimp ranged from 34-40 mm (Figure 2). Differences in size structure of P. merguiensis shrimp are caused by differences in fishing gear, fishing line, and gear operation (manual, semi-modern, and modern). Differences in size structure due to oceanographic conditions and fishing gear [9]. Differences in shrimp size structure due to the characteristics of each species [10]. Based on the discussion of the size structure of P. merguiensis shrimp in Cilacap waters, Central Java Province is classified as medium to large size.

Length-Weight Relationship

The length-weight relationship between male and female Jerbung shrimp during the study is presented in Figure 2.

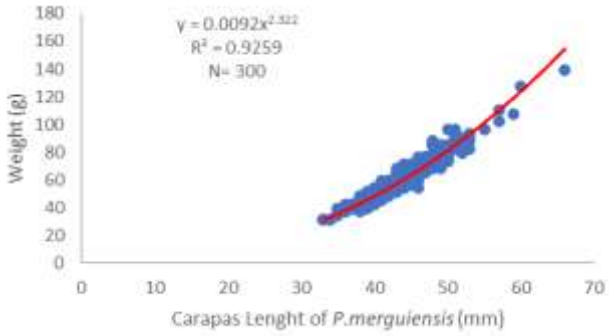


Figure. 2. Length-Weight Relationship of *P. merguiensis* Shrimp.

Based on the results of the analysis of the carapace length of P. merguiensis obtained a value of b = 2.3 so that it can be known that P. merguiensis in Selakap waters experienced negative allometric growth (b < 3). This growth indicates that the growth of shrimp length is faster than the growth of shrimp weight. Variations in shrimp growth (negative chimeric growth, positive chimeric growth, and isometric growth) are influenced by several factors including: Stress levels, diet, growth, and reproductive activity. Differences generally occur in different regions and sampling times [11]. The difference in weight gain of male and female shrimp is related to the age of shrimp [12]. At the beginning of its growth, the increase in length is faster than the increase in weight and vice versa, after the size increases the weight gain is faster than the increase in length. As the age of shrimp increases, weight gain is greater than length gain. In young shrimp, length gain is greater than weight gain. Based on the discussion of shrimp carapace length-weight relationship above, it can be concluded that P. merguiensis shrimp in Cilacap waters are classified as juvenile shrimp (post larvae and juveniles), and the growth pattern is negative sympatric.

Gonadal Maturity Level

The results of observations of the level of gonad maturity of female and male P. merguiensis shrimp are presented in Figure 3.

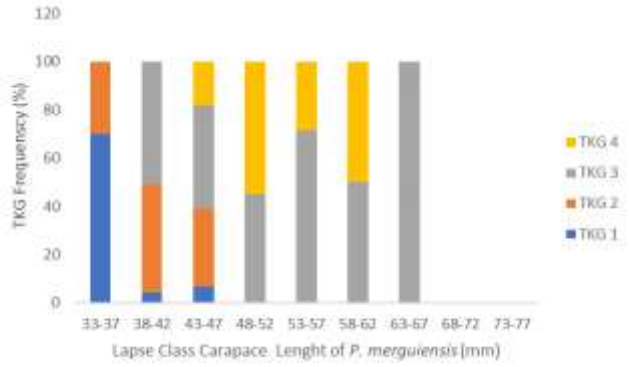


Figure. 3 - Gonad maturity stage of P. merguiensis

The composition of the level of gonadal maturity (TKG) of P. merguiensis shrimp in Cilacap waters as shown in Table 4. The percentage of immature shrimp (TKG I and TKG II) was 40% and 60% of the shrimp were mature (TKG III and TKG IV). This indicates that more than half of the shrimp caught have reached reproductive maturity, which is a positive indicator in terms of population regeneration potential. The dominance of TKG III and IV indicates that most of the shrimp were either ready to reproduce or in the final stages of gonadal maturity when captured. Healthy and potentially sustainable shrimp populations usually have a balanced distribution of gonad maturity or are dominated by reproductively mature individuals [13]. Based on the results of this study, it can be hypothesized that trammel-net shrimp caught in the Cilacap PPS area are shrimp breeding areas, while the detection of many gonadally mature shrimp indicates that the shrimp are in the process of breeding. This is in line with the research of Suman and Presantoso (2013) and Rutiangsay et al. (2013), that the spawning season of spotted shrimp in Cilacap waters lasts almost all year round, but the peak occurs in January and August.

Condition Factor

The results of the calculation of the condition factor value of P. merguiensis shrimp are presented in Table 1.

Condition Factor Value of *P. merguiensis* Shrimp in Cilacap Waters

Gender	Average L (mm)	Average (W)	Condition Factor (Kn)
Females	46,216	65,796	1
Male	40,024	46,206	1,01

Based on the data above, the condition factor values for female and male P. merguiensis shrimp are 1.00 and 1.10, respectively. This indicates that the maturity level of female and male shrimp is not much different. When compared to the research of Tirtadano and Ernawati (2016) which obtained a condition factor value of 0.09-0.11, the P. merguiensis shrimp in Cilacap waters are currently fatter than the same shrimp in the northern waters of Central Java. However, this value is different from the research of Saputra, et al (2013) conducted at the same location in Cilacap waters and obtained a condition factor value of 2051 females and 1152 males where these results indicate that P. merguiensis shrimp are fatter than the results of research conducted in July-August 2024. Variations in shrimp maturity are caused by differences in gonad maturity, food availability, biotic and abiotic factors. The range of condition factor values based on the combination of males and females is in the range of one value (average - 0.81 - 1.19). The value range of one reflects that relative time does not affect the speed and balance of shrimp growth [12]. This indicates that fish with a condition factor of 1-3 are categorized as less planar or fusiform fish [8]. If the condition factor value is more than one, it means that the individual or group is in better condition, and if it is less than one, it means that the individual or group is in better condition. Based on the description above, it can be concluded that the condition factor of *P. merguiensis* shrimp in Cilacap waters shows that water conditions are still good to support shrimp growth.

Sex Ratio

The results showing the comparison of P. merguiensis shrimp are presented in Table 2.

Comparison of sex ratio of male and female P. merguiensis shrimp in Cilacap Waters, Central Java.

Gender	Quantity (ind)	Sex Ratio	Percentage (%)
Male	82	1	27,33%
Females	218	2.7	72,67%

Based on Table 2, the number of female shrimp is more than male shrimp, with a ratio of females and males of 2.7: 1. The percentage of male shrimp was 27.33%, while the percentage of female shrimp was 72.67%. When compared with previous research in Appendix 12. that female shrimp are more than males, but in contrast to the research of Sari, et al (2017) in North Kendal, Mulinda, et al (2022) in Kendal, Central Java and Momeni, et al (2018)

in Arabian Gulf Waters where the ratio of males is more than females. If the ratio of males and females is balanced or more males than females, it can be interpreted that the shrimp is still ideal for maintaining sustainability. Based on the explanation above, the P. merguiensis shrimp in Cilacap waters at this time is still ideal to be preserved.

First Time Captured Size ($Lc_{50\%}$)

The calculation of the average size of Jerbung shrimp caught during the study in Cilacap waters is presented in Figure 4.

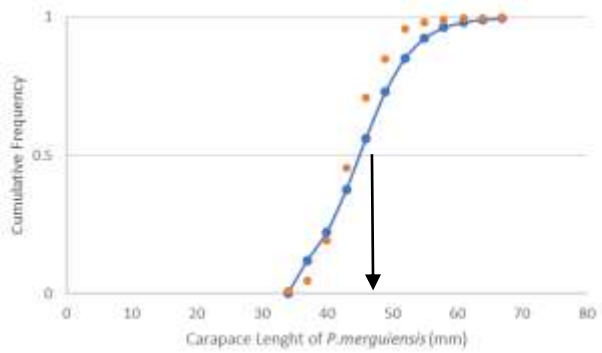


Image. 4- Size of First Time Caught Flathead Shrimp (*P. merguiensis*)

The first size caught (Lc_{500}) of Penaeus merguiensis shrimp in Selakap waters was recorded to have a carapace length of 45 mm. This result is not much different from the pattern of shrimp carapace length during the study which is 44 mm. When compared with the results of Saputra, et al. (2013) who reported a carapace length of 43 mm for the first catch in the same waters, there is an indication of an increase in the size of the catch. The higher Lc value at the time of the study compared to previous studies indicates a decrease in fishing pressure on gerbil shrimp resources in these waters [3]. This is also reflected in SEAFDEC's Selakap fisheries statistics where there has been a decrease in the number of trawl trips since 2021.

Conclusion

The conclusion that can be drawn from the research of Biological Aspects of Jerbung Shrimp (*Penaeus Merguiensis*) in Cilacap Waters, Central Java is the mode of carapace length of *P. merguiensis* shrimp is 44 mm, the size of the first time caught $Lc_{(50\%)}$which has a carapace length of ± 45 mm, the size of the first time mature gonad ($Lm_{50\%}$)has a carapace length of 43.5 mm, *P. merguiensis* shrimp has negative allometric growth properties, the condition factor of this shrimp is 1.1 for males and 1.00 for females. Strategies in the management of jerbung shrimp (*P. merguiensis*) in Cilacap Waters can be developed and increased back capture of jerbung shrimp but should not reach the maximum limit. It is intended that the stock of jerbung shrimp can still develop more and regenerate. Fishermen should do fishing after the spawning season.

References

1. Pangessti, T.B. 2017. Shrimp Fisheries Management Strategy in Cilacap Regency, Central Java.
2. Hargiyatno, I., A. A. Widodo, and S. Nurhakim. 2015. *Stock Status of Fish Resources in the State Fisheries Management Area of the Republic of Indonesia (WPP-NRI)*. Jakarta: Ministry of Marine Affairs and Fisheries.Wagiyo et al, 2018
3. Sugiyono. 2016. *Quantitative, Qualitative and R&D Research Methods*. Bandung: Alfabeta.
4. Nazir, M., 1999. Research Methods. Ghalia Indonesia. Jakarta.
5. Saputra, S. W. and Subiyanto. 2007. Dynamics of Jerbung Shrimp (Penaeus merguiensis de Man 1997) in Segara Anakan Lagoon Cilacap, Central Java. J. Marine Science, 12(3):157-166.
6. Suparjo, M.N. 2005. Potential of Dogol Shrimp (Metapenaeus ensis) in Kebumen Regency, Central Java. J. Fisheries, 84 92.
7. Saputra, S.W., Djuwito, and A. Rutiyaningsih. 2013. Some Biological Aspects of Jerbung Shrimp (Penaeus merguensis) in the Coastal Waters of Cilacap, Central Java. Journal of Management of Aquatic Resource. 2(3) : 47-55.
8. Effendie, M. I. 2002. Fisheries Biology. Nusatama Library Foundation, Yogyakarta.
9. Motta, F. S., Gadig, O. B. F., Namora, R. C., & Braga, F. M. S. 2005**.** Size and sex compositions, length-weight relationship, and occurrence of the Brazilian sharpnose shark *Rhizoprionodon lalandii*, caught by artisanal fishery from southeastern Brazil. *Fisheries Research, 74*, 116-126.
10. Nurdin, E., & Kembaren, D. D. 2015.Population parameters of white shrimp (*Penaeus merguiensis*) in Sampit and surrounding waters, Central Kalimantan. *BAWAL Widya Riset Perikanan Tangkap*, *7*(2), 103-109. DOI:10.15578/bawal.7.2.2015.103-109

11. Hargiyatno, I., A. A. Widodo, S. Nurhakim, and D. Prasetyo. 2013. *Prospects for Fish Resources Management in the Republic of Indonesia Fisheries Management Area (WPP-RI)*. Jakarta: Ministry of Marine Affairs and Fisheries).

12. Saputra, S. W., Solichin, A., Taufani, W. T., Rudiyanti, S., & Widyorini, N. (2021). Growth parameters, mortality, recruitment pattern, and exploitation rate of white shrimp *Penaeus indicus* in northern coastal waters of Western Central Java, Indonesia. *Biodiversity: Journal of Biological Diversity*

13. Kanna, I., Amri, K., & Santoso, A. (2014). Distribution of gonad maturity in healthy and sustainable shrimp populations. *Indonesian Journal of Fisheries Biology*, 10(2), 123-134