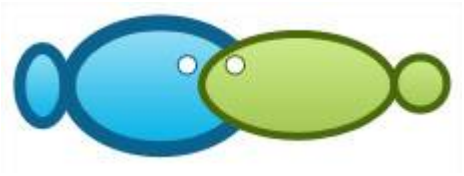

Biological aspects of shrimp *Penaeus merguiensis* De Man (1888) in the Arafura Sea, Merauke, South Papua Province, Indonesia

[1,4]Edy H. P. Melmambessy, [2]Suradi W. Saputra, [2]Agus Hartoko, [3]Abdul K. Mudzakir

[1] Doctoral Program - Aquatic Resources Management, Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia; [2] Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia; [3] Department of Capture Fisheries, Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia; [4] Aquatic Resources Management Study Program, Faculty of Agriculture, Musamus University, Merauke, Indonesia. Corresponding author: E. H. P. Melmambessy: melmambessy@unmus.ac.id

Abstract. The potency of Penaeid shrimp in FMA 718 of the Arafura Sea is approximately 62,842 tonnes year^{-1}. Utilization rate has the value of 0.84 with fully-exploited status. Shrimp fishing efforts need to be closely monitored, because excessive shrimp fishing can result in shortages and imbalances in fisheries resources. The aim of the research was to analyze the biological aspects of the *Penaeus merguiensis* shrimp in the coastal waters of the Arafura Sea, Merauke, South Papua Province. The research method was a survey method, with a systematic random sampling technique. Primary data were collected from August 2022 to July 2023, at three research stations. The structure of the carapace length (CL) was dominated by 14-32 mm CL size. The relationship between CL and weight was classified as negative allometric. The length-weight equations for male and female shrimp were $W = 0.0066\ L^{2.4042}$ and $W = 0.0111\ L^{2.2265}$ respectively. The male to female sex ratio was 1.00:1.81. The condition factors for male and female shrimp were 1.2143 and 1.3132 respectively. First size of shrimp caught (Lc_{50}) for males at the station: A = 32 mm CL, B = 17.8 mm CL, C = 21.5 mm CL. For female: A = 32.5 mm CL, B = 21 mm CL, C = 24 mm CL. The shrimp caught were dominated by 94.01% immature gonads, and 5.99% mature gonads. Female carapace length at the time of gonad maturation (Lm): station A = 42.2 mm CL, station B = 40.2 mm CL, and station C = 42 mm CL. The size of Lm was larger than the size of Lc at all three stations. This difference indicates that the shrimp caught were still small and had immature gonads. The discovery of *P. merguiensis* in the waters off Merauke, South Papua Province's Arafura Sea coast demonstrates the persistence of the biota's delicate balance, which is sustained by the aquatic environment. This research contributes to the management aspect of the penaeid shrimp fishery.
Key Words: allometric, Arafura, carapace, condition factors, gonads.

Introduction. Capture fisheries in the world, including Indonesia, are currently facing the problem of overfishing or over-exploited (excessive exploitation). Among the world's fish stocks, 35% have been over-exploited, and 57% of fish stocks are in a condition of maximally fished (maximum exploitation) or fully exploited (FAO 2023; Pham et al 2023; Wijayanto 2023). When excessive fishing/shrimp fishing activities increase, it will lead to significant shortages and imbalances in fisheries resources, which directly affect fish biomass, biodiversity, fisheries sustainability, and exacerbate fishing practices which damage the marine environment (Pham et al 2023).

The production of marine capture fisheries based on main commodities, particularly shrimp, showed an average negative increase in 2019-2020, i.e. -14.56% (Ministry of Marine Affairs and Fisheries (MMAF) 2022b). Utilization of Penaeid shrimp resources in Fisheries Management Area (FMA) 718 of the Arafura Sea and its surroundings according to Decree of the Ministry of Maritime Affairs and Fisheries of the Republic of Indonesia Number 19 of 2022 (MMAF 2022a), is 0.86 per year, with fully-exploited status. Research reports from various sources regarding the exploitation rate of

P. merguiensis shrimp generally exceed its sustainable potential (Sumiono 2012; Purwanto 2013; Suman & Satria 2014; Hargiyatno et al 2015; Kembaren & Ernawati 2015; Chodrijah & Suman 2017; Saputra et al 2018; Wagiyo et al 2018; Suman et al 2020; Tirtadanu & Chodrijah 2020; Suman et al 2022).

Penaeid shrimp fishing in the Arafura Sea coastal waters of Merauke, South Papua Province is classified as active; thus, there are concerns that production will decrease due to excessive fishing. Studies carried out in the Arafura Sea include: Naamin (1984), Bailey et al (1987), Wijopriono et al (2008), Sumiono (2012), Purwanto (2013), Suman & Satria (2014), Hargiyatno et al (2015), Carter et al (2018), Wagiyo et al (2018), Suman at al (2020), and Tirtadanu & Chodrijah (2020). However, it can be stated that most of them were conducted in the IV Dolak fishing area which is the main target for national shrimp fishing which is under the authority of the Ministry of Maritime Affairs and Fisheries of the Republic of Indonesia, which is more than 12 nautical miles, as studies by Wijopriono et al (2008) and Sumiono et al (2011). Meanwhile, studies in the coastal waters of the Arafura Sea in the Merauke Regency area are rarely carried out. For this reason, it is significant to conduct an analysis of the biological aspects of the *Penaeus merguiensis* De Man, 1888 shrimp in the coastal waters of the Arafura Sea in Merauke Regency, South Papua Province.

This study aims to analyze the biological aspects of *P. merguiensis* in coastal waters in the Arafura Sea, Merauke, South Papua Province. The importance of this research is to develop a shrimp fisheries management plan in the Papua region, which is based on the spirit of Law Number 22 of 1999 concerning Regional Autonomy and Law Number 2 of 2021 concerning the Second Amendment to Law Number 21 of 2001 concerning Special Autonomy for Papua Province.

Material and Method. This study was carried out in the Arafura Sea coastal waters of Merauke, South Papua, at three observation stations which actively catch shrimp, with different substrate characteristics and fishing ground areas. The three stations covered: (A) Naukenjerai District; (B) Merauke District; and (C) Semangga District, as illustrated in Figure 1.

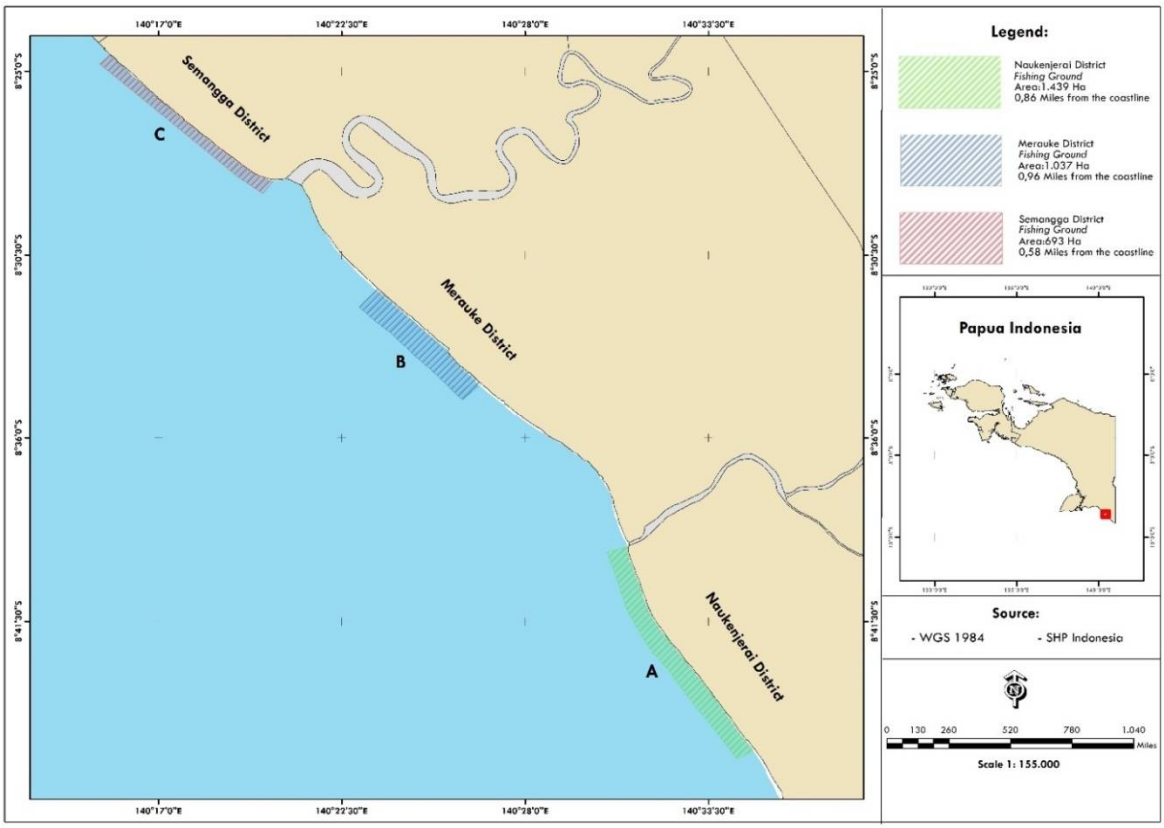

Figure 1. Research location.

The research method applied in this study was a survey method (Nazir 2003). The shrimp sampling method uses a systematic random sampling method (Rutiyaningsih et al 2013). A total of 3153 individual *P. merguiensis* samples were obtained from three collecting traders representing each observation station, based on the results of previous surveys. Shrimp samples were taken proportionally following the following criteria:

1) if the number of shrimps landed at the collecting trader was 1-3 kg, the number of samples taken was 100% of the production landed;
2) if the amount of shrimp production landed at the collecting trader was less than 50 kg (4-49 kg), then the number of samples taken randomly was 6.12-80% of the production landed;
3) if the amount of shrimp production landed at the collecting trader was 50 kg, the number of samples taken randomly was 6% of the production;
4) if the amount of shrimp production landed by collecting traders was 51-100 kg, the number of samples taken randomly was 2-5.9% of the production.

Primary data on *P. merguiensis* were collected during twelve (12) months of research, starting from August 2022 to July 2023. Primary data included data of: carapace length, total length, weight, sex, and gonad maturity level (FAO 1998; Treece 2000; Saputra 2008; Dineshbabu et al 2014; Kembaren & Risnawati 2015; Vance & Rothlisberg 2020). Measurement, weighing and observing shrimp samples were conducted at the Aquatic Resources Management Laboratory, Faculty of Agriculture, Musamus University, Merauke, South Papua.

Size structure. The size structure reflects the size composition of the shrimp and was presented in the form of a histogram graph. In addition, descriptive statistical calculations were carried out to get an idea of the minimum, maximum and mode sizes (Saputra et al 2021).

Carapace length-weight relationship. The increase in shrimp body weight (W) at each life stage is a function of the increase in length (L). Therefore, to calculate the relationship between carapace length and shrimp weight, the general formulae proposed by Effendie (2002) and Saputra et al (2021) used in this study are as follows:

$$W = a_x L^b$$

where: W = weight of fish (grams);
L = carapace length of fish (mm);
a and b = constants.

This equation can be transformed into a linear equation by taking the logarithm of both sides of the equation as followss:

$$\text{Log } W = \log a + b \log L$$

This equation is used to determine relative growth. If the value of b = 3 indicates that the pattern of relative growth is isometric, i.e. the increase in weight is proportional to the increase in length. If the b value ≠ 3, it indicates an allometric relative growth pattern, i.e. the increase in weight is not proportional to the increase in length.

Condition factor (K). If the b value = 3, the condition factor is calculated using the following formula:

$$K = \frac{10^3 x\, W}{L^3}$$

But if b ≠ 3, the condition factor is calculated using the formula as follows:

$$K = \frac{W}{a\, L^b}$$

where: K = condition factor;
W = weight (grams);
L = carapace length (mm);
a and b = constants obtained from the regression results of the length-weight relationship.

Condition factor shows fish plumpness with numbers (Lagler 1961 in Saputra et al 2021). Effendie (1987) in Saputra et al (2021) created a criterion that the K value is around 2-4, which means the fish's body is somewhat flat; if the K value is around 1-3, it means the fish's body is less flat.

Sex ratio. The sex ratio of *P. merguiensis* was obtained from the Saputra at al (2009) equation:

$$SR = \frac{Nm}{Nf}$$

where: SR = sex ratio;
N_m = number of male shrimp (tails);
N_f = number of female shrimp (tails).

Estimation of the size of the first caught shrimp (Lc_{50}). Estimating the size of first caught shrimp uses a graph of the relationship between the class length distribution (X-axis) and the number of shrimps expressed by estimating the cumulative normal distribution (Y-axis). The first size (Lc_{50}) of white shrimp is obtained from the equation of Sparre & Venema (1992):

$$SLest = 1/(1+Exp(S_1-S_2) \times L)$$
$$L_{C50} = S_1/S_2$$

where: SLest = maximum slope of the logistic curve;
S_1 = intercept value a (intersection between the linear line and the y axis);
S_2 = slope b value (the slope angle of the regression line).

Level of gonad maturity and size of the first mature gonad (Lm). Observation of the level of gonad maturity was carried out using morphological method, referring to Motoh (1981); the gonad maturity level of *P. merguiensis* shrimp takes place in five stages, where the morphological characteristics include:

Stage	*Characteristics*
Stage 1	Immature - ovaries are thin, clear and colorless.
Stage 2	Initial maturity - ovaries enlarge, the middle and front parts develop.
Stage 3	Further maturity - the ovaries are light green and can be seen through the exoskeleton, the middle and front parts are fully developed.
Stage 4	Mature eggs/final maturity - ovaries are dark green, ova are larger than the previous level.
Stage 5	After laying eggs/spent - the ovaries are soft and shriveled, the ova have been released, the shrimp's body usually feels soft and the upper abdominal cavity is empty.

Two methods were carried out to determine the first size of mature gonads of *P. merguiensis*:
(1) Plotting the cumulative percentage of gonad mature fish/shrimp with body/carapace length, then it is calculated using the standard logistic curve model (Saputra et al 2021):

$$Y\ (\%) = (1 + ae^b X_i)^{-1}$$

where: Y(%) = cumulative percentage of fish;
a = constant;
b = slope;
e = exponent;
Xi = carapace length.
(2) The Spearmen-Karber method (Udupa 1986) is as follows:

$$m = X_k + \frac{X}{2} - (X\ \Sigma pi)$$

If $\propto = 0.05$, the 95% confidence limits of m can be calculated by using this equation:

$$\text{antilog}\ [m \pm 1.96 \sqrt{X^2\ \Sigma\ (\frac{pi\ x\ qi}{ni-1})}]$$

where: m = logarithm of the fish length when they were first mature gonads;
X_k = logarithm of the median value of the length class when all fish are 100% or completely mature gonad;
X = difference in the logarithm of the median value;
p_i = proportion of mature gonad in the i-$_{th}$ class ($p_i = r_i/n_i$);
r_i = number of mature gonads in the i-$_{th}$ class;
n_i = number in the i-$_{th}$ class;
$q_i = 1 - p_i$.

Thus, the average carapace length of *P. merguiensis* at the time of reaching first mature gonad is:

M = antilog m

Results and Discussion

Size structure. The size structure of *P. merguiensis* based on carapace length during one-year study is presented in Figure 2.

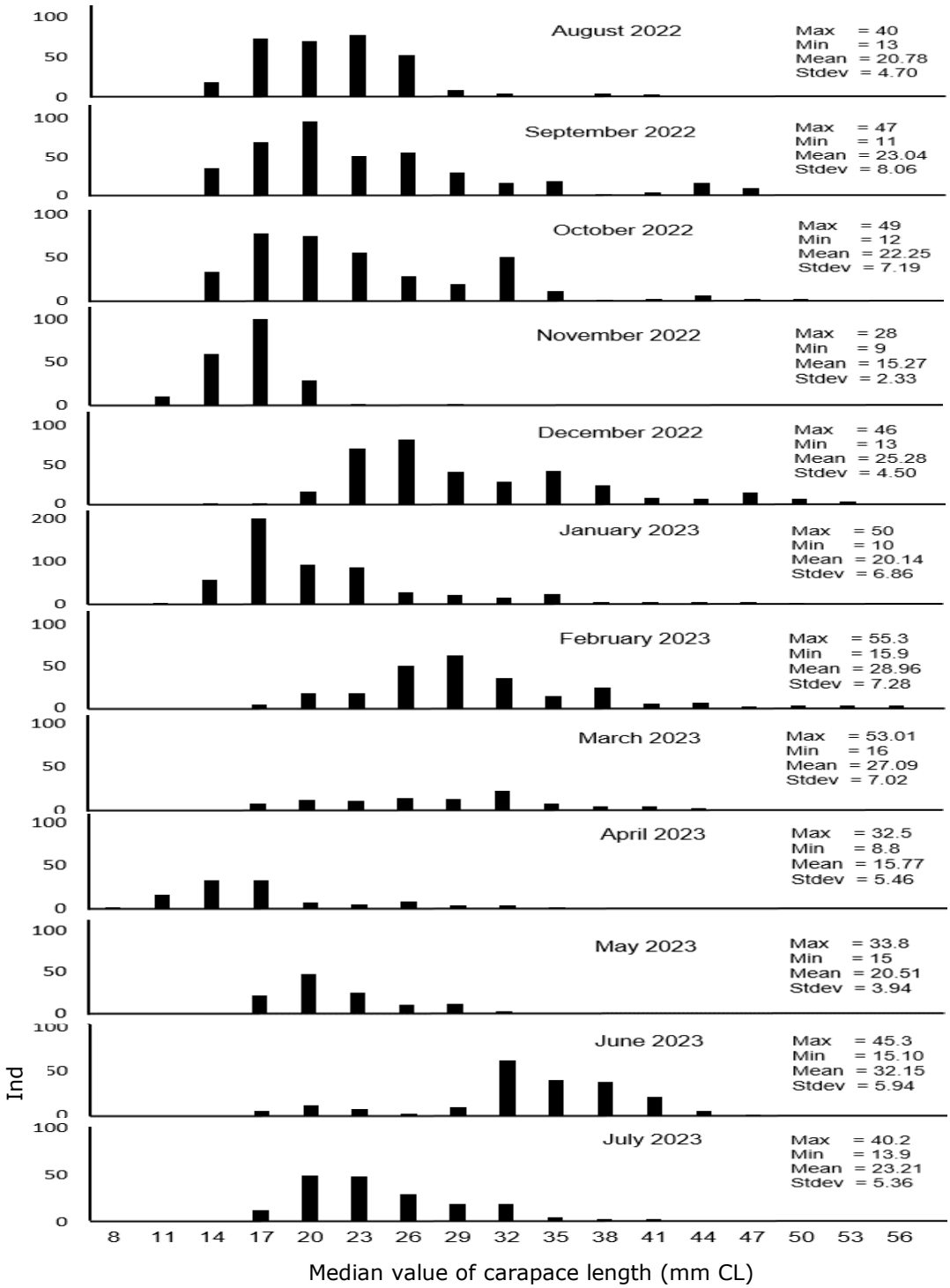

Figure 2. Structure of carapace length of *P. merguiensis* shrimp in the coastal waters of the Arafura Sea, Merauke, South Papua Province.

The size of *P. merguiensis* shrimp in Merauke coastal waters ranged from 8 to 56 mm CL, but was dominated by several size groups with carapace length of 14-32 mm CL. This result is different from the research conducted by Saputra et al (2018) in the North coastal waters of Central Java, that found shrimps with carapace length ranging from 20 to 27.5 mm CL and different from previous research as elaborated in Table 1. The smallest shrimp size was 14 mm CL found in the coastal waters of Merauke in April 2023 (Figure 2), followed by a size of 15 mm CL obtained in Cilacap waters (Wagiyo et al 2018) while the longest structure size is dominantly 34-40 mm CL found in Cilacap waters (Rutiyaningsih et al 2013). The differences in size structure of the shrimps caught are caused by differences in oceanographic conditions (Motta et al 2005 in Suman et al 2020), fishing equipment, and the characteristics of each species (Nurdin & Kembaren 2015).

Table 1

Comparison of size structure of *P. merguiensis* shrimp in several Indonesian waters

Dominant CL (mm)	*Time of capture*	*Fishing capture tools*	*Authors*	*Waters area*
20-27.5	May 2016-July 2017	Arad Danish seine	Saputra et al (2018)	Northern coastal area of Central Java
24-28	2013-2017	-	Suman et al (2020)	Bengkalis waters
28	April-August 2015	Arad and trammel net	Tirtadanu & Ernawati (2016)	Northern coastal area of Central Java
32-38	February-November 2020	Trammel net	Tirtadanu & Chodrijah (2020)	Cilacap waters
34-40	October 2012-January 2013	Arad	Saputra et al (2013)	Cilacap waters
15.5	April-October 2013	Apong net	Wagiyo et al (2018)	Cilacap waters
32-34	January-November 2012	Basic Lampara	Nurdin & Kembaren (2015)	Sampit and its surrounding area
20-24	May-August 2016	Arad	Sari et al (2017)	North of Kendal

Carapace's length-weight relationship. Analysis of the relationship between carapace length and weight of *P. merguiensis* shows that male shrimp and female shrimp have negative allometry (b < 3). The equation for carapace length-weight for male shrimp is $W = 0.0066\ L^{2.4042}$, and for female is $W = 0.0109\ L^{2.2265}$ (Figure 3).

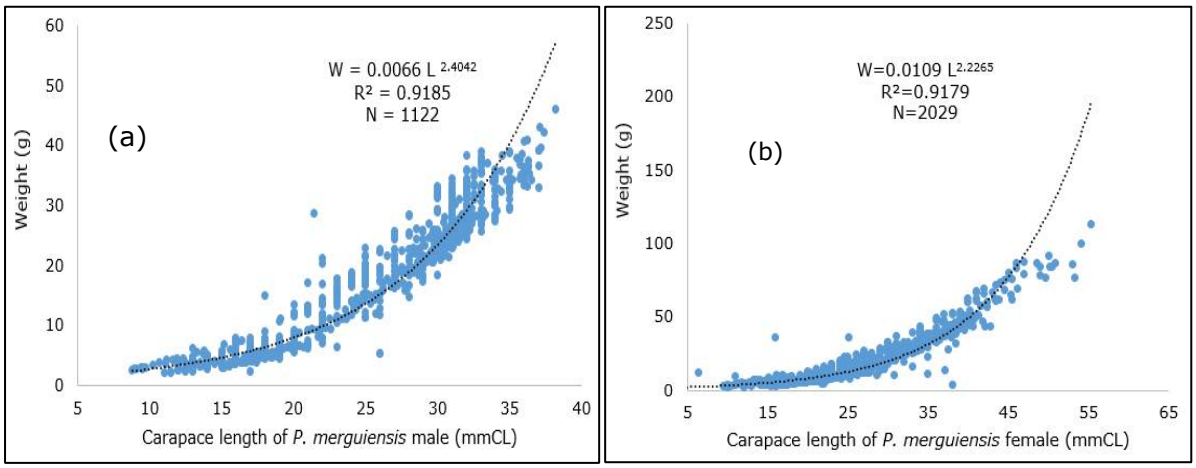

Figure 3. Relationship of carapace length and weight of *P. merguiensis* shrimp: (a) male, and (b) female.

The results of this research are the same as that of Saputra et al (2018) on the south coast of Cilacap and other studies shown in Table 2, but different from the study of Sari

et al (2017) in North Kendal waters, which obtained growth of *P. merguiensis* classified as positive allometric (Table 2). Differences in shrimp growth are influenced by several factors, including stress level, diet, activity, growth and reproduction (Sparre & Venema 1992; King 1995). Such differences generally occur in different areas and at different sampling times (Hargiyanto et al 2013), but are also due to differences in the weight gain of male and female shrimp related to the shrimps' age (Rutiyaningsih et al 2013).

Table 2

Comparison of growth characteristics of *P. merguiensis* shrimps in several waters

The nature of growth		*Authors*	*Waters area*
Male	*Female*		
Negative allometric	Isometric	Saputra et al (2013)	Cilacap waters
Negative allometric	Negative allometric	Wagiyo et al (2018)	Cilacap waters
Negative allometric	Negative allometric	Tirtadanu & Chodrijah (2020)	Cilacap waters
Positive allometric	Positive allometric	Sari et al (2017)	North of Kendal
Negative allometric	Negative allometric	Tirtadanu & Ernawati (2016)	Northern coast of Central Java
Negative allometric	Negative allometric	Saputra et al (2018)	Northern coast of Central Java

Condition factors. The condition factor (CF) describes the level of fatness and health condition of the organism based on length and weight (Pauly 1983). Condition factors for *P. merguiensis* based on sex, and the combination of males and females, can be seen in Figure 4a. The condition factor value for males = 1.2143, females = 1.3132 and the combination of males and females = 1.2461.

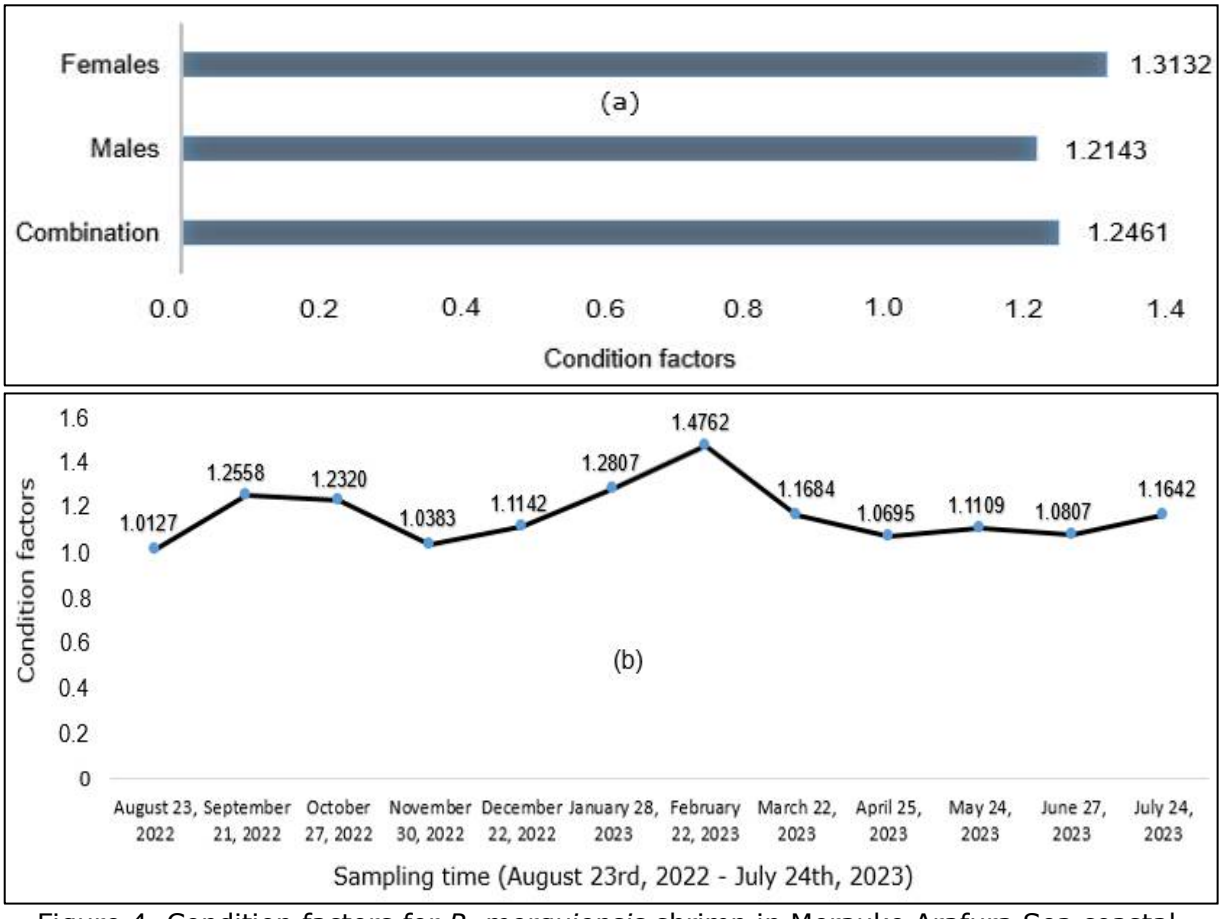

Figure 4. Condition factors for *P. merguiensis* shrimp in Merauke Arafura Sea coastal waters: (a) based on sex, and (b) based on the combination of males and females.

In comparison with previous studies (Table 3), male CF is greater than previous studies; and female CF is higher than that of the study conducted by Sari et al (2017), but smaller than Mudhifasari (2009) and Rutiyaningsih et al (2013). The combined CF of males and females is bigger than that of a study done by Tirtadanu & Ernawati (2016). There is one thing in this research which has similarities to previous studies listed in Table 3, i.e. the condition factor for female shrimp is always greater than male shrimps', except for Tirtadanu & Ernawati (2016) research conducted in the northern coast of Central Java, which combined shrimp and males into one. The range of CF values based on the combination of males and females during 23 August 2022 - 24 July 2023 (Figure 4b) is in the range of values 1.0127-1.4762. According to Saputra et al (2021), when CF value is at 1, it reflects the relative time does not affect the speed and balance of shrimp growth.

Based on the condition factor value shown in Figure 4, with a range of 1.0127-1.4762, it can be concluded that *P. merguiensis* caught in the Arafura Sea coastal waters of Merauke, South Papua Province are less flat in size (Effendie 1987 in Saputra et al 2021). Condition factors at the three research stations show that water conditions are still good to support shrimp growth. The condition factor value also shows that the coastal waters of the Arafura Sea in the Merauke Regency area have sufficient food and fewer predators. Apart from food availability, biotic and abiotic factors also influence condition factors (Blackwell 2000; Jumiati et al 2020).

Table 3

Comparison of condition factors for male and female *P. merguiensis* in several studies

Condition factors			*Authors*	*Waters area*
Male	*Female*	*Combined**		
1.152	2.051	-	Rutiyaningsih et al (2013)	Cilacap waters
1.547	1.743	-	Mudhifasari (2009)	Kendal waters
1.094	1.096	-	Sari et al (2017)	North of Kendal
-	-	0.09-0.11	Tirtadanu & Ernawati (2016)	Northern coast of Central Java

Description: *Combination of male and female

The sex ratio of male and female *P. merguiensis* in the coastal waters of the Arafura Sea, Merauke, South Papua Province is described as follows:

Sex	Amount (ind)	Sex ratio	Percentage (%)
Male	1.123	1	35.62
Female	2.030	1.81	64.38

The sex ratio of male and female *P. merguiensis* is 1:1.81, of which it was found that the number of females was greater than that of males. As found in previous studies described in Table 4, there are more females than males, except in Sari et al (2017) conducted in North of Kendal, Mollynda et al (2022) in Kendal, Central Java and Momeni et al (2016) in the waters of the Persian Gulf showing that the amount of sex ratio males are bigger than females.

Table 4

Comparison of the sex ratio of male and female *P. merguiensis* shrimp in several studies

Sex ratio		*Authors*	*Waters area*
Male	*Female*		
0.6:1.0		Suman et al (2022)	Aru waters (Arafura Sea)
0.8:1.0		Wagiyo et al (2018)	Cilacap waters
1.2:1.0		Mollynda et al (2022)	Kendal, Central Java
1.0:4.4		Tirtadanu & Ernawati (2016)	Northern coast of Central Java
1.0:0.95		Sari et al (2017)	North of Kendal
1.0:1.6		Rutiyaningsih et al (2013)	Cilacap waters
1.1:1.0		Momeni et al (2016)	Persian Gulf waters

According to Rutiyaningsih et al (2013), if the number of males and females is balanced or there are more females, it can be interpreted that the *P. merguiensis* in the coastal waters of the Arafura Sea, Merauke, South Papua Province are still ideal for preserving shrimp resources.

Size of first caught (L_{c50}). In Figure 5 the carapace length of the first male *P. merguiensis* shrimp caught was 32 mm CL (station A), 17.8 mm CL (station B) and 21.5 mm CL (station C). Meanwhile, for females the length was 35.5 mm CL (station A), 21 mm CL (station B) and 24 mm CL (station C). The main fishing gear used by fishermen to catch *P. merguiensis* in Naukenjerai District (Station A) is trammel net; Merauke District (Station B) and Semangga District (Station C) are towed trawlers or *Sapurata* in the local language because the mesh size is small, 10-25 mm, so they can catch fish/shrimp with relatively all sizes. In addition to trawls, at the peak of shrimp fishing, fishermen also use gill nets and trammel nets with mesh sizes greater than 25 mm to catch large/jumbo-sized Penaeid shrimp or gross shrimp as local fishermen in Merauke Regency usually name it.

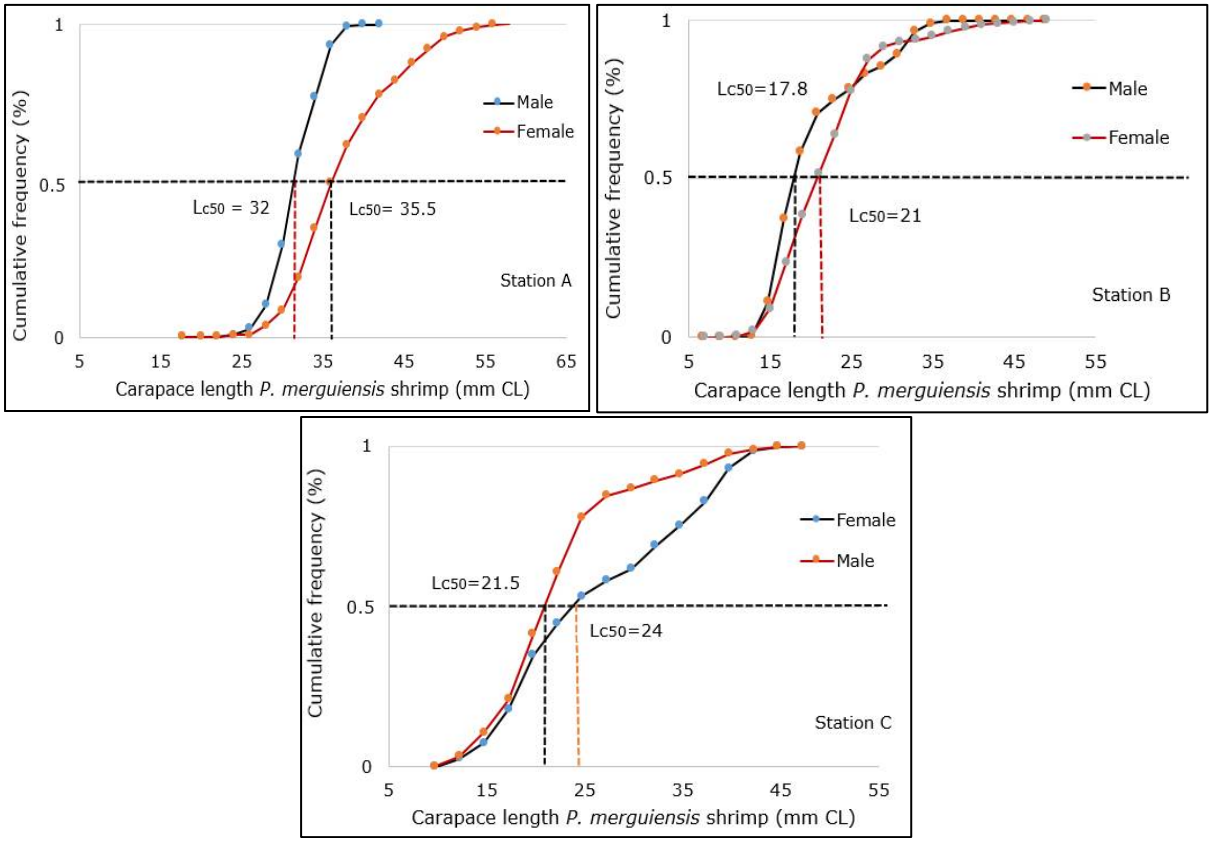

Figure 5. Curve of size of first caught (Lc_{50}) *P. merguiensis* shrimp in Merauke Arafura Sea coastal waters, South Papua Province in the three stations.

The Lc_{50} at the three stations was greater than that in the research of Wagiyo et al (2018) but smaller than previous studies described in Table 5. Lc of female shrimp from this study was greater than the studies conducted by Saputra et al (2018) and Wagiyo, (2018) but smaller than other studies (Table 5). Differences in Lc values are not only caused by the size of the mesh used but also due to the time and location of fishing. Susetiono & Setyono (1990) in Hargiyatno et al (2013) stated that groups of *P. merguiensis* in shallow water tend to be smaller when compared to the same shrimp caught in deep water. Hargiyatno et al (2015) confirmed Staples et al (1981) that the juvenile phase of *P. merguiensis* is usually caught at a depth of less than 10 m with muddy bottom waters and relatively low salt content (< 27‰). Furthermore it will grow into juvenile (sub-adult) and adult phases along with the fish migration towards deeper waters for spawning. Adult *P. merguiensis* shrimp spawn at a depth of between 20-30 m.

Table 5

Size of first caught *P. merguiensis* shrimp in waters area

Sex	$L_{C50\%}$ *(mm CL)*	*Capture tools*	*Authors*	*Waters area*
M	20.9	Mini trawl	Saputra et al (2018)	Northern coast of Central Java
F	19.6	Danish seine		
C	39.0	Trammel net	Tirtadanu & Chodrijah (2020)	Cilacap waters
C	43.0	Arad	Rutiyaningsih et al (2013)	Cilacap waters
C	17.2	Apong net	Wagiyo et al (2018)	Cilacap waters
M	28.0	Arad	Sari et al (2017)	North of Kendal
F	27.0			
C	27.8	Shrimp trawl	Hargiyatno et al (2013)	Dolak – Arafura sea
C	29.4	Arad, trammel net	Tirtadanu & Ernawati (2016)	Northern coast of Central Java
M	23.3	-	Momeni et al (2016)	Persian Gulf waters
F	24.2			

Description: M = male; F = female; C = combination of male and female.

Gonad maturity rate and size of first mature gonad (L_m). *P. merguiensis* caught in the coastal waters of the Arafura Sea, Merauke Regency, South Papua Province are dominated by 94.01% shrimp with immature gonads (GML I and GML II) and 5.99% gonad mature shrimp (GML III and GML IV) (Figure 6). The size of the first mature gonad of *P. merguiensis* shrimp had the following values: at station A = 42.2 mm CL; station B = 40.2 mm CL; and station C = 42 mm CL (Figure 7). These sizes were larger than those found by Chodrijah & Suman (2017) in Tarakan waters; Hargiyanto et al (2013) in the Dolak waters of the Arafura Sea; Nurdin & Kembaren (2015) in Sampit waters and its surroundings, but smaller than Tirtadanu & Ernawati's (2016) study in the northern waters of Central Java. Different aquatic environmental factors such as temperature, salinity and food availability influence maturity (Kembaren & Suman 2013).

The Lm size as a result of the study was greater than the size of Lc at all three stations: station A male = 32 mm CL, female = 35.5 mm CL; station B male = 17.8 mm CL, female 21 mm CL; and station C males = 21.5 mm CL and females = 24 mm CL. These differences indicate that the shrimp caught are still small and have immature gonads which dominate the catch in the coastal waters of the Arafura Sea in the Merauke Regency region. This is caused by the use of small mesh sizes (mesh size = 10-25 mm) and the shrimp fishing area is less than one nautical mile with a depth of 0.3-1.5 meters, i.e. the habitat for post-larval and juvenile shrimp.

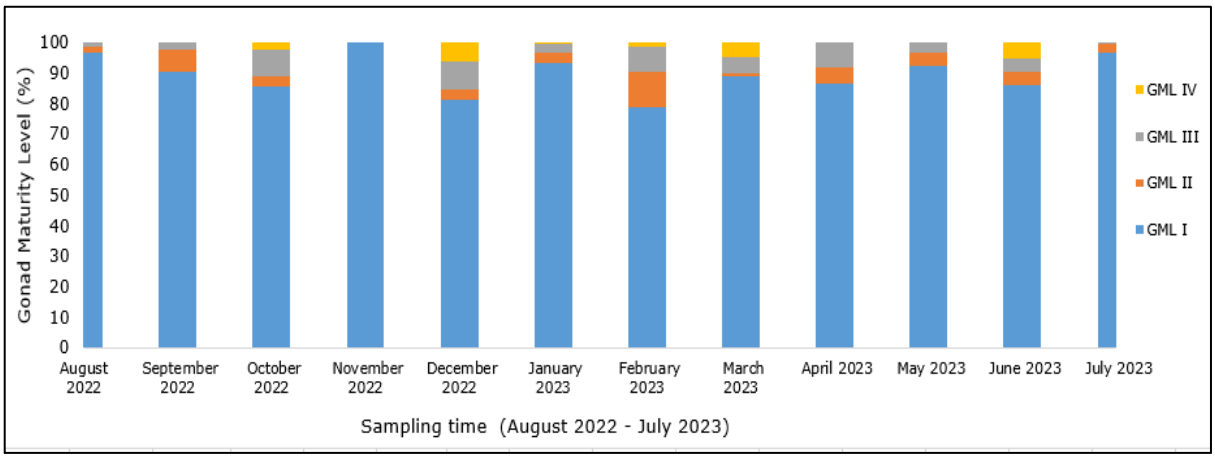

Figure 6. Percentage of gonad maturity level of the combination of males and females *P. merguiensis* shrimp in the coastal waters of the Arafura Sea, Merauke Regency, South Papua Province.

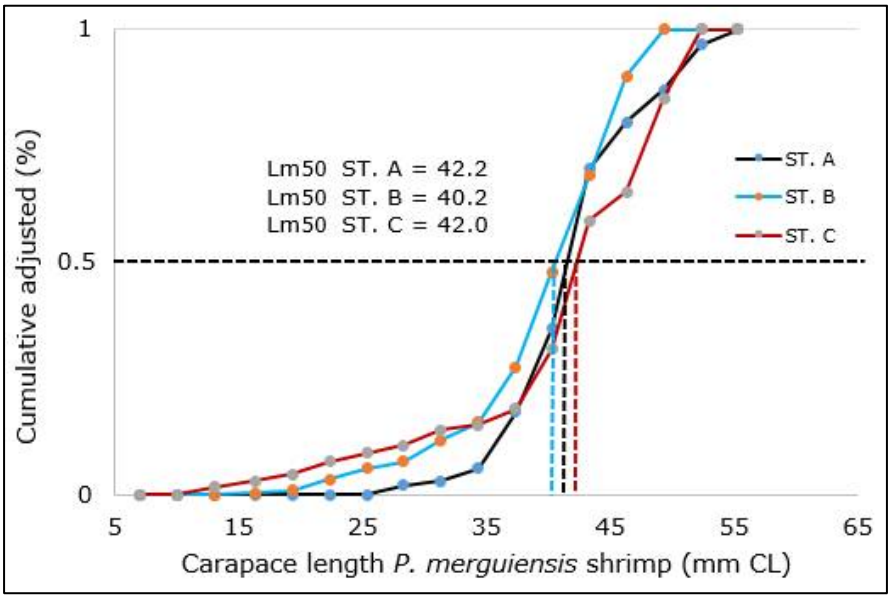

Figure 7. Size of first mature gonads (Lm_{50}) in female *P. merguiensis* shrimp in the waters of the Arafura Sea coast, Merauke, South Papua (ST = station).

The average first mature gonad size of *P. merguiensis* shrimp in the waters of Merauke Beach was 41.47 mm CL, greater than previous research: Chodrijah & Suman (2017) in Tarakan waters; Hargiyanto et al (2015) in Dolak waters (Arafura Sea); Nurdin & Kembaren (2015) in Sampit waters (Table 6). However, it is smaller than in the research of Tirtadanu & Ernawati (2016) in the waters in north of Central Java. This is due to differences in fishing gear and fishing routes at sea or only in coastal waters.

Table 6

Size of first mature gonads of *P. merguiensis shrimp* in several waters

Sex	*Average size (mm CL)*	*Size range (mm CL)*	*Authors*	*Waters area*
G	33.58	-	Chodrijah & Suman (2017)	Tarakan waters
G	38.70	34.60-40.30	Hargiyanto et al (2015)	Dolak waters of the Arafura Sea
G	39.40	-	Nurdin & Kembaren (2015)	Sampit waters and surrounding areas
G	42.85	-	Tirtadanu & Ernawati (2016)	Northern waters of Central Java

Description: G = combination of male and female.

Conclusions. *Penaeus merguiensis* shrimp in the Arafura Sea coast of Merauke, South Papua have a small to medium size structure, with a negative allometric growth pattern. The sex ratio of male and female shrimp is not balanced, while the level of gonad maturity is dominated by immature. The size at first maturity (L_m) of shrimp is larger than the size of first caught (L_{c50}), so it is necessary to regulate the mesh size of trawl and trammel nets for the preservation and sustainability of shrimp population in these waters.

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Authors:
Edy H. P. Melmambessy, Doctoral Program - Aquatic Resources Management, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia; Aquatic Resources Management Study Program, Faculty of Agriculture, Musamus University, Kamizaun Street, Mopah Lama-Merauke, South Papua, Indonesia, e-mail: melmambessy@unmus.ac.id
Suradi Wijaya Saputra, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: suradiwsaputra@yahoo.co.id
Agus Hartoko, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: agushartoko.undip@gmail.com
Abdul Kohar Mudzakir, Department of Capture Fisheries, Faculty of Fisheries and Marine Science, Diponegoro University, Tembalang, Prof. Jacub Rais street, Semarang, Central Java, Indonesia, e-mail: akohmud@gmail.com

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