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Analysis of Biological Aspects of Endeavour Shrimp (*Metapenaeus endeavouri*) in the waters of Cirebon Regency

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----------*ABSTRACT*----------

Exploitation of M.endeavouri shrimp by net fishing gear is suspected to improve gradually marked with increased production in the last three years. Overfishing can threaten its sustainability. The purpose of this study is to examine biological aspects such as catch composition, catch distribution, size structure, first caught size (L50%), infinity length (L∞), sex ratio, gonad maturity level (GML), growth properties , and condition factors. In addition, made the concept of M.endeavouri shrimp fisheries resource management was made. The method used in sampling is the survey method with systematic random sampling. Shrimp samples are taken proportionally which is about 10% of the total catch. The results showed that the first size was caught (L50%) 25.5 mm carapace length. The length of infinity (L∞) of M.endeavouris shrimp is about 44.74 mm. Comparison of male and female sex ratios 1,1: 1. M.endeavouri shrimp is dominated by GML I around 74.35%. The growth of male M.endeavouri shrimp is negative allometric, namely the increase in length faster than the weight gain, because the b value is 2.854. The level of female M.endeavouri has isometric growth properties, namely the increase in length in line with weight gain, due to the value of b of 3.024. Factors of male M.endeavouri shrimp are 1.094 and females are 1.179, so M. endeavouri shrimp are more plump female than male M.endeavouri shrimp. M.endeavouri shrimp is suitable to be caught in a size that exceeds the initial length of carapace length> 30.53 mm.

Keywords: *Endeavour shrimp, biological aspects, Cirebon waters*

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I. INTRODUCTION

Management of coastal resources in Indonesian waters is an interactive and evolutionary process for realizing optimal and sustained coastal development. The management process is carried out by identifying and analyzing management or utilization issues that are expected to emerge and then formulating and implementing action policies and programs to overcome the problem developing. Integrated and sustainable coastal area management processes have at least four main stages: (1) structuring and planning, (2) formulation, (3) implementation, and (4) evaluation (Cicin-Sain and Knecht, 1998). The development of coastal areas in Indonesia can be carried out by managing capture fisheries activities on an ongoing basis. Cirebon Regency has quite potential waters in the field of capture fisheries and also aquaculture. Fish resources that are the leading commodities of capture fisheries in Cirebon Regency include endeavour shrimp (*M.endeavouri*).

The coastal area of Cirebon Regency is an area located in the northern part of Java Island which has a coastal marine ecosystem which is very good for shrimp growth because it is rich in nutrient elements such as Nitrate and phosphate which are important for phytoplankton biomass photosynthesis in waters. Shrimp production in Cirebon Regency in 2008 reached 7,575 tons; in 2011 it reached 1,653 tons and in 2015 around 7,414 tons. However, production continues to decline compared to the current *M.endeavouri* shrimp production. In addition to the decline in shrimp production, the quality of the aquatic environment in Cirebon Regency also decreased, where there was a decrease in estuary area and mangrove cover area. Fisheries activities must be assessed from the economic, aquatic, social and cultural aspects of fisheries production areas. This is to reduce the negative impact on fisheries resources directly. The negative impact can be said to be a symptom of fish resource degradation, which is caused by the high intensity of fishing.

Based on the above conditions, it is very necessary to make a hybrid model of sustainable shrimp fisheries management. The management model is expected to involve stakeholders and accommodate the interests of all parties, especially fishermen as the main actors in shrimp fisheries management. The initial step

of making a model of dogol shrimp resource management in the waters of Cirebon Regency is to analyze the biological aspects of *M. endeavouri* shrimp so that they are expected to be able to answer the sustainability of catching dogol shrimp (*M.endeavouri*).

II. METHODE

Time and Place

The research was carried out in the waters of Cirebon Regency, West Java for 6 (six) months starting November-April 2017. *M. endeavouri* shrimp samples originated from the catch of the Trammel net in the waters of Cirebon Regency landed at the Gerbang mekar Fish Landing Base (FLB), Bandengan FLB, Bungko Lor FLB and Mundu FLB

Materials and tools

The tools in this study can be seen in Table 1. The sampling process of *M. endeavouri* shrimp was carried out by experimental fishing through five different vessels each week for 3 (three) months as many as 30-40 shrimp on each basket.

Table 1. Equipment used during sampling

No	Tools	Specification	Number	Function
1	Digital Scales	Accuracy 0,1 gram	1 Unit	Weigh the weight of shrimp
2	Ruler	Accuracy 1 mm	1 Unit	Measure the length of shrimp
3	Dissecting set	Stainless steel	1 set	Dissecting shrimp
4	Tray	Wood	1 Unit	Shrimp disseting Place
5	Writing equipment	Book, pencil, Pen, Eraser	@1 Unit	Write the data obtained
6	Camera	13 megapixel (MP)	1 Unit	Takes Picture
7	Calculator	Scientific calculator	1 Unit	Calculate data
8	Measure Glass	Littlenees	1 Unit	Calculating fecundity
9	Shrimp identification key	Motoh, 1981 in Ernawati And Kembaren, 2015	@1 Unit	Shrimp sampel Identification

Data analysis

Sex ratio.

The sex ratio between male and female shrimp can be known by using the Chi-square test (X^2) based on GML and Yates Correction based on the number of male and female caught. According to Effendie (2002), sex comparisons can be determined using the following calculations:

$$\%X = \frac{X}{(X+Y)} * 100\%$$

$$\%Y = \frac{Y}{(X+Y)} * 100\%$$

Comparison of the sex of male endeavour shrimp and female penaeid shrimp was obtained using the chi-square test or (X^2):

$$X^2 = \sum_{1-i}^{k} \frac{(f_0 - f_h)}{f_h}$$

with:

χ^2 : chi - square

f_0 : Frequency of observed male and female shrimp / observation results.

f_h : The expected frequency of male shrimp and female shrimp.

The value χ^2 is obtained from this calculation, then the value is compared with the χ^2 table value with a confidence level of 95% and free degree (fd) = 1 (one) with the hypothesis:

H_0 = there is no significant difference between the number of male shrimp and female shrimp.

H_1 = there is a significant difference between the number of male and female shrimp.

f, $\chi^2_{count} < \chi^2_{table}$ = H_0 is accepted, H_1 is rejected

$\chi^2_{count} > \chi^2_{table}$ = H_0 is rejected, H_1 is accepted

Long-Weight Relationship.

According to Effendie (2002), the relationship between the length and weight of fish or shrimp almost follows the cubic law, although it does not always follow the cubic law which is expressed by the formula $W = aL^3$, because fish or shrimp will grow and develop for long and the weight of fish or shrimp always changes, then the formula is written in a general form, namely:

$$W = aL^b$$

With :

W	=	fish/shrimp weight (gram),
L	=	fish/shrimp lenght (cm) and
a dan b	=	constanta

Analysis of the length and weight of *M. endeavouri* shrimp based on analysis with the model or the Hille equation (1936) in Effendie (2002).

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

This equation can be transformed into linear equations as follows:

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

Furthermore, it can be made into a simple linear regression equation as follows:

$$Y = a' + bx$$

with:

Y	= bound variable
X	= free variable
a ’	= antilog intercept
b	= slope

To find out the closeness of the length and weight values in the equation, the correlation coefficient value must be known by using the following equation:

$$r^2 = \frac{\left(\sum xy\right)^2}{\left(\sum x^2\right)\left(\sum y^2\right)}$$

$$r = \sqrt{r^2}$$

r = correlation coefficient which is an abstract measure of the degree or closeness of the relationship between variables x and y.

According to Effendie (2002) to find out the possibility of the value of b analyzed (b <3: b> 3: b = 3), then the t-test is used as follows:

$$S^2yx = \frac{\sum d^2yx}{n-2} \quad Sb = \sqrt{Sb^2}$$

$$Syx = \sqrt{S^2yx} \qquad T_{count} = \left|\frac{3-b}{Sb}\right|$$

$$Sb^2 = \frac{S^2yx}{\sum x^2} \qquad A \;\; \pi \;\; A = \;\; r^2 \;\; =$$

with:

SB = standard deviation from b

Test table at 95% (n-2) real level

Hypothesis: H_0: b = 3 (isometric)

H_1: b ≠ 3 (allometric)

$t_{count} > t_{table}$ = real or significant difference (reject H_o accept H_1).

$t_{count} < t_{table}$ = not real or non-significant difference (accept H_o reject H_1).

Condition Factor (C).

The condition factor is the condition or plumpness of fish stated in numbers based on data length and weight. The condition factor value (C) can be calculated by the following formula (Effendie 2002):

$$K = \frac{W}{aL^b}$$

K is a factor of condition,
W is the weight of shrimp (gram),
L is the length of shrimp (mm),
a and b are regression constants.

Gonad Maturity Level (GML).

Taking gonad samples was carried out since the study went on until the study ended. Observation of gonad maturity was carried out by morphology. Morphological observations were carried out visually after measuring the length of shrimp based on Table 2.

Table 2: Gonad Maturity Level Criteria (GML) in Warehouse (Motoh, 1981).

GML	Female Shrimp
I (immature)	Ovaries are thin, clear and colorless.
II (early maturity)	Ovaries expand, the front and center develop.
III (advanced maturity)	Ovaries are light green and can be seen through the exoskeleton, the front and center are fully developed.
IV (ripe gonads)	Ovaries are dark green and ova are larger than the previous level. This level is considered as the final maturity level.
V (spent)	Ovari was soft and shriveled. Ova has been released. Usually the shrimp body feels soft and the upper abdominal cavity is empty

First Size Captured (Lc).

The formula used to get the first captured size value (Lc) by taking the relationship between the x axis and y (Sparre and Vanema, 1999), as follows:

$$SL = \frac{1}{1+\exp(S_1 - S_2 * L)} \quad L50\% = \frac{S_1}{S_2}$$

$$Ln\left[\frac{1}{SL} - 1\right] = S_1 - S_2 * L$$

with:
SL = logistics curve.
L 50% = length / height where 50% of shrimp is retained.
a = S1; b = S2;
X = midpoint; Y = Ln[$\frac{1}{SL} - 1$]

To determine the number of class intervals and the number of classes, a formula from Effendie (2002) can be used:

Number of classes = 1 + 3,322 log n

Class interval = $\frac{Range}{K}$

with:
K = Number of classes

In obtaining an Lc (length at first capture) that is by taking a line of relations on the X axis for a value of 50% on the Y axis (Beverton & Holt, 1957 in Sparre & Venema, 1999).

Length of Infinity (L∞).

Length of infinty (L∞) is the average size of shrimp length at a very old age. According to Pauly (1984) in Saputra (2009), the infinty long association is as follows:

L∞ = Lmax / 0.95
Information:
Lmax = Maximum length (mm)

First Size Mature Gonad (Lm).

To estimate the average size of the first gonad (Lm) maturity, the Sperman-Karber method was used (Sparre and Vanema, 1999), as follows:

$$Logm = xk + \frac{x}{2} - (X.qi)$$

$$Antilog\ m = m \pm 1{,}96 \sqrt{x^2 \Sigma + \frac{pi\ x\ qi}{ni - 1}}$$

with:

xk : the logarithm of the middle value when the gonadal ripe fish is 100%
X : the difference between the logarithm of the middle value
pi : ri / ni
ri : the number of ripe gonad fish / shrimp in the first class
m : number of fish in class i
qi : 1 - pi

III. RESULT VIEW

Overall a sample of 800 shrimp consisting of 386 female (48.25%) shrimp and 414 male (51.75%) shrimp with a *M. endeavouri* shrimp sex ratio was 1: 1,1. Based on the Chi-square test performed, it was shown that the male and female sex ratio of *M. endeavouri* shrimp was significantly different between male and female shrimp. According to Wahyuono et al (1983) that is if males and females are unbalanced or more males can be interpreted that the population is less ideal to maintain sustainability. If the sex ratio is not balanced then potential degradation will occur so that the spawning process cannot take place even if extinction can occur. Changes in sex ratio can be caused by the intensity of catching high from year to year, biological conditions, and environmental factors and selectivity of fishing gear. The same opinion was also expressed by Romimohtarto and Juwana (2001), which states that knowledge of the sex ratio is related to maintaining preservation of the shrimp population studied, it is expected that the comparison of male and female shrimp is balanced. The balance of the comparison between male and female individuals results in the possibility of fertilization of eggs by spermatozoa to become increasingly new individuals (Effendie, 2002).

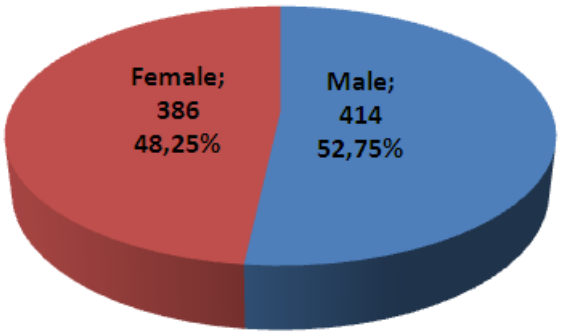

Figure 1 Composition of Catches of Endeavour Shrimp *(M.endeavouri)*

The relationship of shrimp length and weight is one parameter that can be used to analyze the growth patterns of a group of shrimp that are useful in fisheries management activities. The relationship of the length of the weight of endeavour shrimp (*M.endeavouri*) can be seen in Figure 2. Based on testing the value of b in endeavour shrimp as a whole (mix) with t-test, it turns out t-count > t table so it can be concluded that the length of endeavour shrimp is more dominant than its weight gain (allometric negative). Male endeavour has a value of 2,854 and has negative allometric properties. While female endeavour shrimp has isometric properties based on testing with t-test. This means that the increase in length of female endeavour shrimp is proportional to its weight gain. According to Badrudin and Wudianto (2004), the benefits of long weight information include that through these mathematical equations ($W = a.L^b$) it can estimate the weight of the fish at a certain length and vice versa.

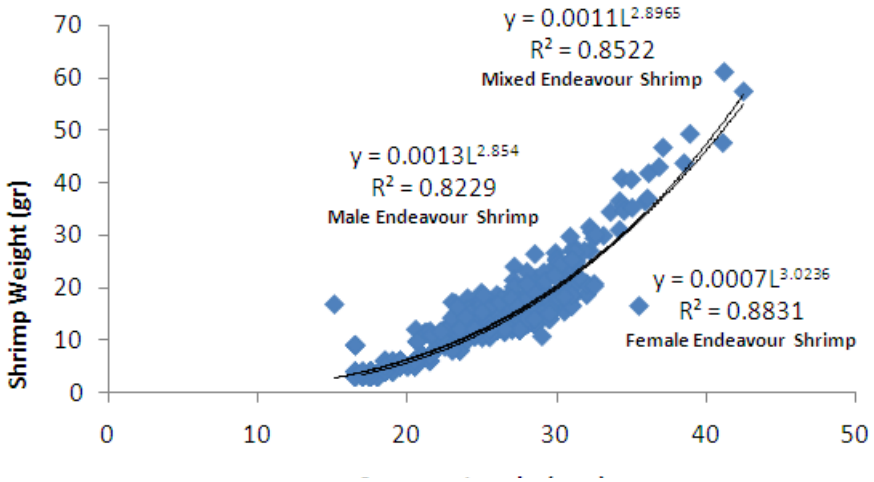

Figure 2 Graph of the Length-Weight Relationship of Endeavour Shrimp

The difference in weight gain of male and female *M. endevouri* shrimp is related to the age of shrimp. In addition, female *M. endeavouri* shrimp have a better ability to adapt with the environment and assimilate food into meat than male *M. endeavouri* shrimp. Based on the relation curve of carapace length and individual weight, it can be seen that long growth is very fast in young shrimp and vice versa, weight gain is very slow. In adult shrimp the length increase slows and weight gain gets faster. According to Murni (2004), the older the shrimp age greater than the increase in length, while in young shrimp length increase is greater than weight gain. This means that at a certain age, weight gain will be faster than the increase in length and when it reaches a certain level of maturity, it will reach the point where the shrimp does not experience long changes. According to Anggraeni (2001), the speed of growth is in line with the amount and quality of food eaten and the ability to assimilate food into meat.

In general, the level of maturity of the shrimp *M. endeavouri* gonads in the waters of Cirebon, dominated by first level GML (immature) which is equal to 74.35% and GML II at 15.55%. *M. endeavouri* shrimp which is said to be ripe gonads when it reaches level III GML. This is also supported by Motoh in Melmambbessy (2011), gonad-mature female shrimp are shrimp whose gonads have developed to reach GML III. Endeavour's mature gonads reach GML III. *M. endeavouri* Shrimp gonad mature female ranges from 10.10% while those included in the criteria for gonad immature are 89.90%. The low proportion of gonad mature *M. endeavouri* shrimp is suspected to have changes in fishing areas by fishermen. Fishermen make catchments in more shallow and more close to land because it is limited by unfavorable weather conditions. In June-August is the beginning of the east season, conditions of waters in the Java Sea often occur hurricane (Najid et al., 2012), so fishermen are unable to capture in more areas far where gonad ripe shrimp are in deeper waters. In the early phase of life, live shrimp in shallow waters then migrate in deep waters after gonadal maturation (Lowry, 2007).

The research was carried out from November to April (6 months) in a short period of research that could not be used to determine the time of spawning. Spawning time can be determined if doing research for approximately 1 year. According to Naamin in Adi (2007), shrimp *M. endeavouri* experiences spawning throughout the year and reaches its peak in January, April, August, and November. The lowest spawning occurs in February and October. The peak of shrimp spawning paradise every region is different. The difference in the occurrence of peak spawning may be influenced by environmental factors such as rainfall, salinity and temperature.

Table 3 Gonad Maturity Levels female endeavour shrimp

Month	Number			
	GML I	GML II	GML III	GML IV
January	69	17	2	0
February	70	0	0	0
May	8	43	36	0
June	140	0	1	0
Total	**287**	**60**	**39**	**0**

The results also showed that the size of the first *M. endeavouri* shrimp matured gonad ranged from 30.53 - 34.14 mm. The first size of gonad ripe shrimp is important because knowing the value of Lm can be used to compile a concept of management of aquatic environments. Caught before gonadal ripening, will threaten the sustainability of shrimp resources *M. endeavouri* in Cirebon waters. According to Anggraeni (2001), the size of shrimp when first gonads are mature is not always the same. The difference in size occurs due to differences in the ecological conditions of the waters. The gonad of shrimp is influenced by two factors, namely internal factors and external factors. Internal factors include species, age and size. While external factors that influence include temperature, flow and rainfall.

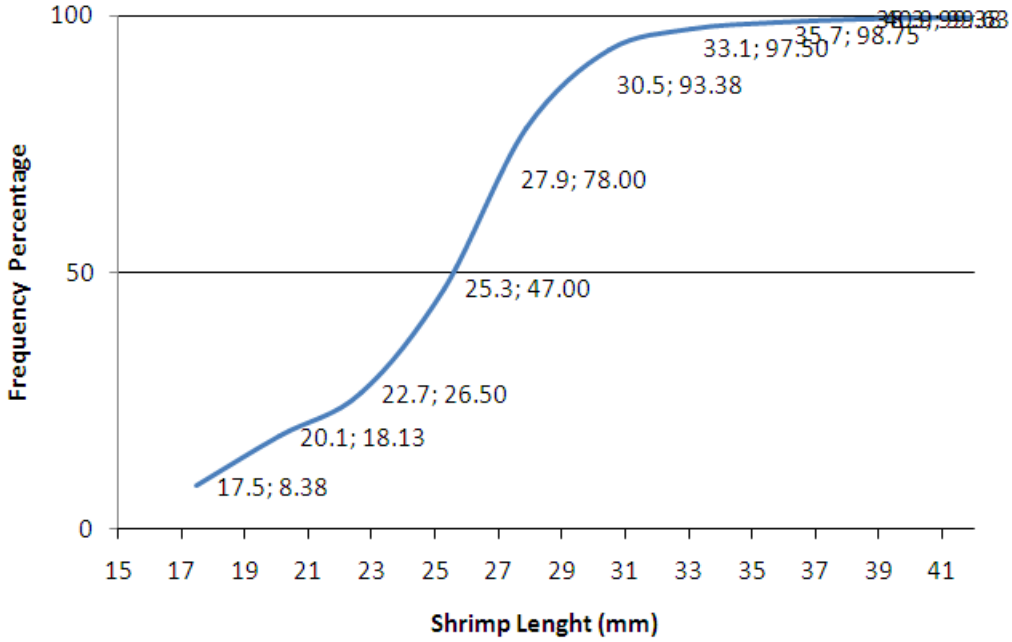

Figure 3 First Size Graph of *M. endeavouri* Shrimp Caught (Lc)

The first size was caught (L50%) of *M. endeavouri* shrimp in Cirebon waters in the size of 25.5 mm carapace length. The average size of shrimp caught during the research was around 24.87 mm and the size of the first gonad ripe was around 30.53 mm. while the infinity of *M.endeavouri* shrimp is around 44.74 mm. This shows that caught shrimp includes small-sized shrimp. If the average size is caught less than half the length of infinity (L∞) and Lc is lower than Lm, the size of caught shrimp is included in the small size. The size of shrimp can be caused by various things. The size difference occurs due to differences in ecological conditions waters, such as salinity, temperature, flow, and food availability (Anggraeni, 2001).

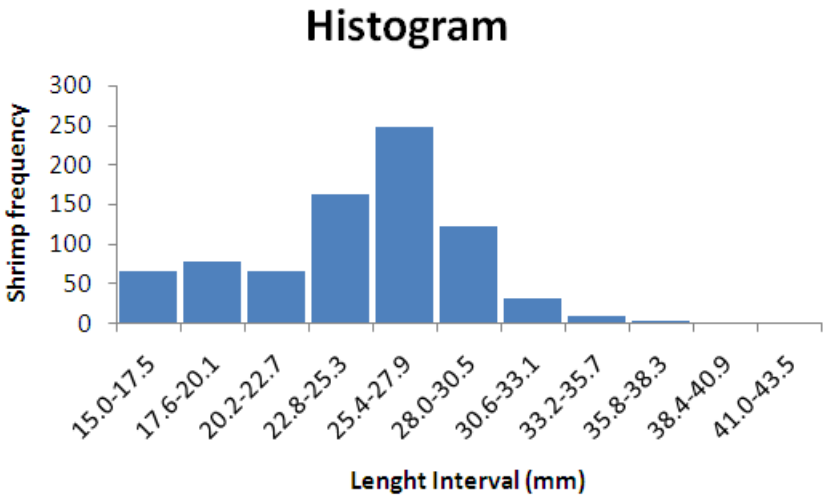

Figure 1 Endeavour Shrimp Frequency Histogram in Cirebon Waters

Based on the results of the analysis from the research data, obtained the factor value of different female and male *M. endeavouri* shrimp which is equal to 1.179 and 1.094. This indicates that *M. endeavouri* shrimp are more plump female than male *M. endeavouri* shrimp. This indicates that the waters where shrimp *M. endeavouri* life provides sufficient food stock to the shrimp population that lives in habitat and predator density is still balanced. According to Saputra (2009), the value of K does not mean anything if seen alone as a single number. This happens when compared to other individuals or groups or sizes of other sizes that come from different locations. Based on the frequency and long interval of *M.endeavouri* shrimp caught, it can be seen that the aquatic environment will be degraded due to non-environmentally friendly catches so that it will certainly affect the condition of the shrimp.

IV. CONCLUSION

Based on the results of research that has been conducted on the analysis of biology aspect of endeavour shrimp (*M. endeavouri*), conclusions can be drawn as follows:

1. Some aspects of *M. endeavouri* shrimp biology are:
   a. The size of L50% (Lc) of *M. endeavouri* shrimp caught was having a carapace length of ± 25.5 mm.
   b. The size of the first breath of shrimp *M. endeavouri* gonad (Lm) is the range of 30.53 mm - 34.14 mm
   c. Infinity length (L∞) for *M. endeavouri* shrimp is around 44.74mm.
   d. The sex ratio of male and female *M. endeavouri* shrimp during the study 1.1: 1.
   e. *M. endeavouri* shrimp caught in the waters of Cirebon Regency is dominated by level I GML.
   f. Male *M. endeavour* shrimp has negative allometric growth properties while isometric female M. endeavour shrimp.
   g. The condition factor of Female *M. endeavouri* shrimp was 1,179 and male 1,094 means female *M. endeavouri* shrimp is more plump compared to male *M. endeavouri*.
2. Management concept for *M. endeavouri* shrimp Cirebon waters by providing opportunities for young shrimp to grow and spawn, by increasing the size of the mesh used. The size of *M. endeavouri* shrimp should be suitable for capture at a size that exceeds the initial Lm, which is the size of the carapace length> 30.53 mm. The limitation on the number of fishing gear operating, the time of arrest and the limitation of fishing volume is done to preserve *M. endeavouri* shrimp.

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