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Selectivity of Bottom Gillnets with Different Mesh Sizes for Mantis Shrimp in Kampung Laut Village, East Tanjung Jabung Regency

Yuditha Destiyana[1], Teja Kaswari[2], Rizky Janatul Magwa[1*], Nurhayati[2], Fauzan Ramadan[1], Ester Restiana Endang Gelis[1]

[1]Fishery Resources Utilization Study Program, Faculty of Animal Husbandry, University of Jambi
Jl. Jambi-Ma. Bulian KM 15, Mendalo Darat, Jambi
[2]Animal Husbandry Study Program, Faculty of Animal Husbandry, University of Jambi
Jl. Jambi-Ma. Bulian KM 15, Mendalo Darat, Jambi

Correspondence:
rizkymagwa@unja.ac.id

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ABSTRACT

The ability of fishing gear to select the type and size of fish caught is called the selectivity of the fishing gear. This study aims to determine the selectivity based on the size of the bottom gillnet fishing gear with a mesh size of 3.5 inches and 4 inches operated in Kampung Laut Village, Kuala Jambi District, East Tanjung Jabung Regency, Jambi Province. The study was conducted in April - May 2026 using a survey method with a simple random sampling data collection technique on fishermen who use bottom gillnets with a mesh size of 3.5 inches and 4 inches for 30 catches on each mesh. The results showed that the optimum length of Mantis Shrimp catches on 3.5 inches and 4 inches meshes were 22.84 cm (S = 0.99) and 26.10 cm (S = 1.00), respectively. Based on the research results, it can be concluded that the bottom gill nets with mesh sizes of 3.5 inches and 4 inches in Kampung Laut Village are said to be selective based on size towards Mantis Shrimp because they produce an optimum size that is higher than the size of the first gonad maturity.

INTRODUCTION

Kampung Laut Village is a sub-district in Kuala Jambi District. Kuala Jambi District is one of the capture fisheries centers in Jambi Province, located in the Berbak River estuary area. This condition causes the majority of residents in this area to make a living as fishermen. Common fishing gear used includes sondong (fishing nets), belat (fish traps), bubu (fish traps), trawls, longlines, and gillnets. Of the 235 fishermen, 150 use gillnets, and 114 of them use bottom gillnets with mesh sizes of 3.5 inches and 4 inches (Ramadan *et al*., 2023).

Bottom gillnets are one of the fishing gears widely used by fishermen in Kampung Laut Village to catch demersal fish. Differences in mesh sizes used will affect the type, size, and number of organisms caught, and selecting the appropriate mesh is an important factor for more effective catches, reducing the capture of small organisms and bycatch, and supporting the sustainable use of fishery resources. Bottom gillnet catches consist of main catches and bycatch. Previous research stated that Mantis Shrimp (*Harpiosquilla raphidea*) is the main

catch, while bycatch includes Gulamah (*Johnius trachycephalus*), Stingray (*Dasyatis* sp.), Thorn (*Hexanematichthys sagor*), Senangin (*Eleutheronema tetradactylum*), Pomfret (*Pampus argenteus*), and Crab (*Liocarcinus holsatus*) (Ardiansyah *et al*., 2023).

Using inappropriate mesh sizes can lead to high levels of bycatch and the capture of small (juvenile) fish. This is related to the selectivity of fishing gear, which is the gear's ability to capture organisms based on their species and size. The higher the selectivity of fishing gear, the lower the chance of catching non-target organisms or fish that are not yet suitable for fishing, thus supporting the sustainability of fishery resources (Apriliani *et al*., 2025).

Although bottom gillnets have long been used by fishermen in Kampung Laut Village, information on the level of selectivity based on size using 3.5-inch and 4-inch meshes is still limited. Therefore, this study was conducted to determine the selectivity based on size of bottom gillnet fishing gear with 3.5-inch and 4-inch meshes so that it can become the basis for more effective and sustainable capture fisheries management in Kampung Laut Village, Kuala Jambi District, East Tanjung Jabung Regency.

METHODS

This research was conducted in the waters of Berbak River, Kampung Laut Village, Kuala Jambi District, Tanjung Jabung Timur Regency from April to May 2026. The material used in this research was mantis shrimp caught by bottom gill nets with mesh sizes of 3.5 inches and 4 inches. The equipment used included bottom gill net fishing gear with mesh sizes of 3.5 inches and 4 inches, each with a length of 400 meters and a height of 1.5 meters, a meter, a ruler, scales, stationery, and a camera (cell phone).

The method applied in this study was a survey method through direct observation of fishermen's mantis shrimp catches during the operation of the fishing gear. According to Sugiyono (2019), the survey method is a quantitative research approach used to obtain data from a sample taken from a population to describe occurrences, distributions, and relationships among variables. Data collection was carried out on 30 fishing trips for each mesh size, so that the total observation covers 60 fishing trips. Data collection was carried out directly in the field through several stages. It began with the preparation of fishing gear which was neatly placed in the boat and had been installed with bait and checked the water conditions at the fishing base before heading to the fishing ground. The bottom gillnet fishing gear was then operated through the setting stage, namely spreading the net that begins with lowering the marker buoy, main buoy, net body, and ends with lowering the weight. Next, the net was immersed (immersed) for 2 hours, then lifted (hauled) gradually until all parts of the net were on board the boat. The catch was separated by species, then observations were made of the number of individuals and the length of each species caught. All data obtained was then processed and analyzed using Microsoft Excel.

The collected data included the number of species caught and the length of individual catches. The collected data were then analyzed descriptively after being classified, tabulated, interpreted, and presented in tables and curves. The bottom gillnet selectivity analysis began by entering catch length data to determine the number of classes and class intervals using the formula according to Musnaini *et al*. (2021) as follows.

$$K = 1 + 3.3 \log n$$

$$I = \frac{R}{K}$$

Where:
K : Number of classes
n : Amount of data
I : Class interval
R : Largest value – smallest value

Then calculate the Y value for each length group using the equation Sparre & Venema (1998) as follows.

$$Y = \ln\left(\frac{Cb}{Ca}\right)$$

Where:
Y : Natural logarithm of the net catch Cma and Cmb
Ca : Catch on net mesh a
Cb : Catch on net mesh b

According to Sparre & Venema (1998), the optimum length is expressed by the symbol Lm. However, to avoid using the same symbol as the length at first maturity (Lm), this study uses the symbol Lopt to express the optimum length. Thus, Lm is used for the length at first maturity, while Lopt is used for the optimum length. To obtain the optimum length, the catch caught in each net can be calculated using the following formula.

$$Lopt = Sf \times m$$

Where:
Lopt : Optimum length catches results at a certain eye size
SF : Selectivity factor constant (selection factor)
m : Mesh size

The selection factor (SF) value is calculated using the intercept (a) and slope (b) values obtained from a linear regression analysis between the logarithm of the catch ratio and fish length at two overlapping mesh sizes. The selection factor (SF) value is calculated using the following equation.

$$SF = \frac{-2a}{b(ma+mb)}$$

Meanwhile, to determine the variance value, it can be calculated using the following equation.

$$S2 = \frac{-2a(mb-ma)}{b^2(ma+mb)} SF \frac{mb-ma}{b}$$

where:
a : Intercept
b : Slope
ma : Mesh size a
mb : Mesh size b

After obtaining the optimum length value (Lopt) and variance value (S), the selectivity value can be calculated using the following equation.

$$S_L = \exp\left[-\frac{(L-Lopt)^2}{2 \times S^2}\right]$$

Where:
SL : The probability of a catch with a length of L (cm) is the result of a catch at a certain mesh size
Lopt : Optimum length catch results at a certain eye size
L : Total length of catch at a certain mesh size
S : Variety value

RESULTS

Selectivity of Fishing Gear for Mantis Shrimp (*Harpiosquilla* sp.)

The selectivity of fishing gear for Mantis Shrimp (*Harpiosquilla* sp.) is the ability of fishing gear to catch Mantis Shrimp at a certain size or length class more effectively than other sizes (Jamal *et al*., 2024). The calculation is done by creating a frequency distribution table of the total length of the Mantis Shrimp. The calculation of the frequency distribution of the total length of the Mantis Shrimp (*Harpiosquilla* sp.) can be seen in Table 1.

Table 1. Frequency of Median Values of Total Length of Mantis Shrimp

Class Interval (cm)	Mesh Size		Ln = cb/ca
	3.5 inches	4 inches	
	Ca	Cb	
17 – 18.9	15	2	-2.01
19 – 20.9	23	48	0.74
21 – 22.9	58	76	0.27
23 – 24.9	47	53	0.12
25 – 26.9	15	18	0.18
27 – 28.9	5	4	-0.22

Description: Ca (Number of Individuals Caught in a 3.5 Inch Mesh), Cb (Number of Individuals Caught in a 4 Inch Mesh)

Based on the frequency distribution data for the total length of Mantis Shrimp in Table 1, a selectivity analysis was conducted to determine the probability of catching Mantis Shrimp in each length class using a bottom gillnet with a mesh size of 3.5 inches. The results of this analysis are presented in the form of a selectivity curve in Figure 1.

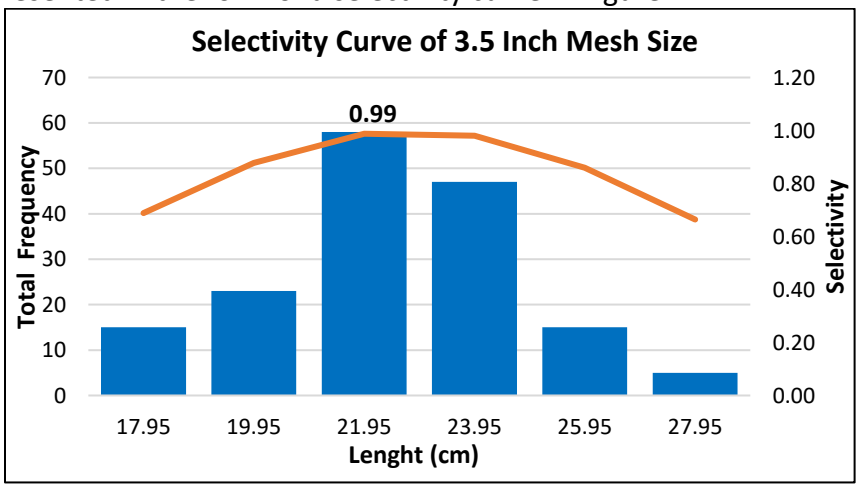

Figure 1. Selectivity Curve of 3.5 Inch Mesh Size Against Mantis Shrimp

Further selectivity analysis was conducted on a 4-inch mesh bottom gillnet to determine selectivity patterns based on the length class of Mantis Shrimp caught. The selectivity curves resulting from the analysis at this mesh size are presented in Figure 2.

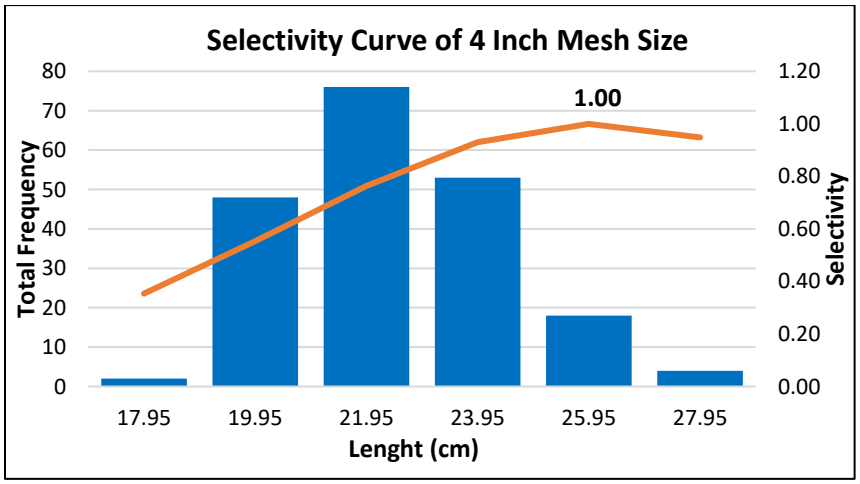

Figure 2. Selectivity Curve of 4 Inch Mesh Size Against Mantis Shrimp

To determine the differences in selectivity patterns between the two mesh sizes, a comparison was made between the selectivity curves of 3.5-inch and 4-inch bottom gillnets for mantis shrimp. This comparison aims to illustrate the differences in the probability of catching mantis shrimp based on body length and to indicate the optimum catch length for each mesh size. The results of the selectivity curve comparison are presented in Figure 4.

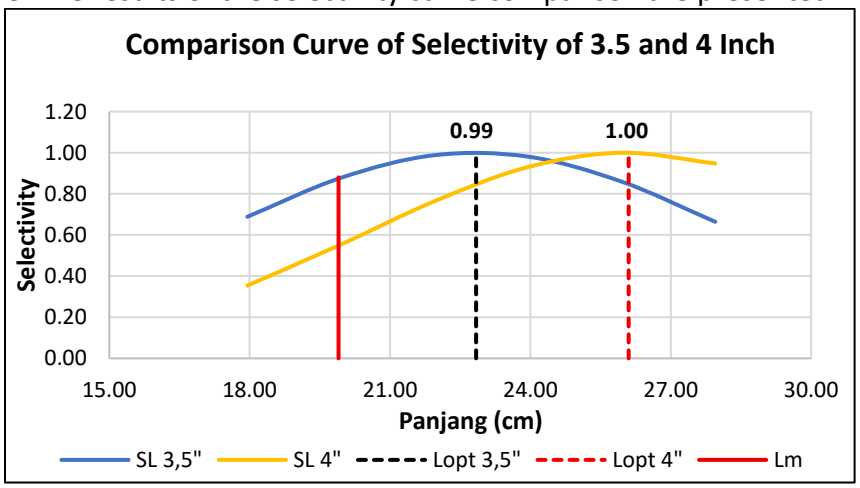

Figure 3. Comparison Curve of Selectivity of 3.5 and 4 Inch Mesh Sizes Against Mantis Shrimp

Different mesh sizes produce different selectivity patterns for Mantis Shrimp. Therefore, comparing selectivity values and optimum catch length is necessary to determine the mesh size that has the highest chance of catching Mantis Shrimp of a given size.

DISCUSSION

The calculation results of the basic gill net selectivity equation (Table 1) for Mantis Shrimp. Ca and Cb are the total length frequencies of Mantis Shrimp in the same class at mesh sizes ma and mb (Tambunan *et al*., 2021). The intercept and slope values obtained from the regression between the natural logarithm of the number of catches with the midpoint of the total length class of Mantis Shrimp at both eye sizes, obtained an intercept value, a = -2.50 and a slope value, b = 0.10. These values were then used to calculate the selection factor (SF), optimum length (Lopt), and variance (S2) values. The SF value obtained was 6.52 and Lopt at 3.5 inch and 4 inch eye sizes were 22.84 cm and 26.10 cm, respectively. The S2 value obtained

was 31.95. Fishing gear selectivity is not only related to its ability to capture target species but also to its capacity to minimize the capture of non-target organisms. Ramdhani *et al*. (2019) reported that gillnet operations targeting mantis shrimp generated considerable proportions of bycatch and discarded organisms, accounting for 22.69% and 54.99%, respectively. These findings highlight the importance of evaluating fishing gear selectivity to support more responsible fisheries exploitation.

The relationship between mesh size and the length of captured organisms has also been demonstrated in previous gillnet selectivity studies. Dewanti *et al*. (2020) reported that gillnets with a mesh size of 3 inches exhibited greater selectivity for hairtail (*Trichiurus lepturus*) than those with a 2-inch mesh size, based on the estimated L75 values. Similarly, Bukhari *et al*. (2022) found that the average length of bilih fish increased from 6.680 cm to 9.460 cm as the gillnet mesh size increased from 5/8 inch to 1 inch. These findings support the importance of mesh size as a factor influencing the size composition of organisms retained by gillnets.

The difference in optimum length between the two mesh sizes indicates that mesh size is related to the size of Mantis Shrimp that has the highest chance of being caught. In this study, the optimum catch length for 3.5-inch and 4-inch mesh sizes was reported to be 22.84 cm and 26.10 cm, respectively. These results indicate that the 4-inch mesh size has a greater optimum catch length than the 3.5-inch mesh size. However, interpretation of the sustainability of resource utilization needs to consider the validity of selectivity values, relevant first gonad maturity sizes, and catch characteristics at the study site. A similar relationship between mesh size and optimum catch length has been reported in previous studies. Harlyan *et al*. (2021) also reported that gillnets with a mesh size of 3.17 cm were more suitable for capturing larger-sized *Sardinella gibbosa* than those with a mesh size of 2.54 cm. These findings are consistent with the present study, in which the 4-inch mesh size exhibited a greater optimum length of mantis shrimp than the 3.5-inch mesh size.

The Lopt and S2 values are then substituted into the basic gillnet selectivity equation, thus obtaining the selectivity curve equation. The selectivity curve is a calculation to determine whether a fishing gear is selective or not by calculating the probability value or chance of catching the catch on each fishing gear. The selectivity curve can only describe the chance of catching one species of catch on a particular fishing gear which contains a combination of X and Y axis coordinates, where the X axis is the size of the catch while the Y axis is the chance of catching a certain size caught on a particular fishing gear (Dewanti et al., 2019).

Gillnet selectivity analysis requires consideration of the relationship between organism length and the probability of capture rather than relying solely on catch frequency. Millar & Mainguy (2025) emphasized that gillnet selectivity curves can exhibit different functional forms, including normal, gamma, lognormal, and bimodal distributions. They also highlighted the importance of distinguishing between the length distribution of organisms encountering the gear and the selectivity of the gear itself. Therefore, the interpretation of selectivity curves in the present study should consider both the estimated optimum length and the distribution of captured individuals across length classes.

The selectivity curve of the bottom gill net (Figure 1) with a mesh size of 3.5 inches for Mantis Shrimp (*Harpiosquilla* sp.) shows that Mantis Shrimp at a length of 17-18.9 cm (midpoint 17.95 cm) with a frequency of 15 individuals produces a selectivity value of 0.69, at a length of 19-20.9 cm (midpoint 19.95 cm) with a frequency of 23 individuals produces a selectivity value of 0.88, at a length of 21-22.9 cm (midpoint 21.95 cm) with a frequency of 58

individuals produces a selectivity value of 0.99, at a length of 23-24.9 cm (midpoint 23.95 cm) with a frequency of 47 individuals produces a selectivity value of 0.98, at a length of 25-26.9 cm (midpoint 25.95 cm) with a frequency of 15 individuals produces a selectivity value of 0.86, and at a length of 27-28.9 cm (midpoint 27.95 cm) with a frequency of 5 individuals, the selectivity value was 0.66. The highest selectivity value of 0.99 was found at a length of 21-22.9 cm (midpoint 21.95 cm) with a frequency of 58 individuals. This indicates that a 3.5-inch mesh is the most effective in catching Mantis Shrimp measuring 21-22.9 cm. Because the greater the L (length) value and the closer the selectivity value to 1.00, the more selective the fishing gear can be said to be (Tambunan *et al*., 2021).

The selectivity curve of the bottom gill net (Figure 2) with a mesh size of 4 inches for Mantis Shrimp (*Harpiosquilla* sp.) shows that Mantis Shrimp at a length of 17-18.9 cm (midpoint 17.95 cm) with a frequency of 2 individuals produces a selectivity value of 0.35, at a length of 19-20.9 cm (midpoint 19.95 cm) with a frequency of 48 individuals produces a selectivity value of 0.55, at a length of 21-22.9 cm (midpoint 21.95 cm) with a frequency of 76 individuals produces a selectivity value of 0.76, at a length of 23-24.9 cm (midpoint 23.95 cm) with a frequency of 53 individuals produces a selectivity value of 0.93, at a length of 25-26.9 cm (midpoint 25.95 cm) with a frequency of 18 individuals produces a selectivity value of 1.00, and at a length of 27-28.9 cm (midpoint 27.95 cm) with a frequency of 4 individuals yielded a selectivity value of 0.95. The highest selectivity value of 1.00 was found at a length of 25-26.9 cm (midpoint 25.95 cm) with a frequency of 18 individuals. This indicates that a 4-inch mesh net is most effective in catching Mantis Shrimp measuring 25-26.9 cm. This condition is in line with Hutubessy & Syahilatua (2010) which states that each mesh size has a different optimum length. Furthermore, the optimum length is also directly proportional to the mesh size, so that increasing the mesh size will increase the optimum size of the organisms caught (Sandhya *et al*., 2023; Mardhan *et al*., 2019). If a fishing gear is designed with a large mesh size, the resulting catch will also be large (Shabrina *et al*., 2021).

The number of Mantis Shrimp caught at a length of 21-22.9 cm (midpoint 21.95 cm) was greater, namely 76 individuals compared to a length of 25-26.9 cm (midpoint 25.95 cm) which was only caught as many as 18 individuals, but the selectivity value at a length of 21-22.9 cm was lower than that of 25-26.9 cm. This shows that the number of catches does not always indicate a high selectivity value. A length of 25-26.9 cm is the most suitable length for a 4-inch mesh, so it has the highest chance of being retained in the net and produces a selectivity value of 1.00. Conversely, Mantis Shrimp with a length of 21-22.9 cm were caught more often, presumably because this size is more abundant in the fishing area. Thus, although the number of catches at a length of 21-22.9 cm is greater, this size is not the optimum size that best suits a 4-inch mesh, so the selectivity value is lower than that at a length of 25-26.9 cm. This condition also shows that the frequency of catches is influenced by the abundance of organisms in the water, while the selectivity value is influenced by the level of compatibility between the organism's body size and the mesh size (Tambunan *et al*., 2021). Therefore, the size of the organism that is most frequently caught is not necessarily the size that has the highest selectivity value.

The distinction between catch frequency and gear selectivity is also important in evaluating gillnet performance. Bukhari *et al.* (2022) demonstrated that different mesh sizes produced different mean body lengths and weights of captured bilih fish, indicating that the size composition of catches varies according to mesh dimensions. Furthermore, Rananmasse *et al.* (2022) showed that bottom gillnet selectivity can be influenced by net construction characteristics, including mesh size and twine thickness. Therefore, the number of organisms

caught in a particular length class should not be interpreted as a direct representation of the selectivity of the fishing gear.

Based on Figure 3, the selectivity comparison curve of 3.5-inch and 4-inch mesh sizes of bottom gill nets for Mantis Shrimp (*Harpiosquilla* sp.) shows that the 3.5-inch mesh size achieved the highest selectivity value of 0.99 at a length of 22.84 cm, while the 4-inch mesh size achieved the highest selectivity value of 1.00 at a length of 26.10 cm. This shows that the 3.5-inch mesh size is most effective in catching Mantis Shrimp measuring 22.84 cm, while the 4-inch mesh size is more effective in catching Mantis Shrimp measuring 26.10 cm. This condition also shows that the larger the mesh size used, the larger the size of the organism that has the highest chance of being caught (Sandhya *et al*., 2023). The red vertical line indicates the length of the first gonad maturity (Lm) at a length of 19.9 cm, while the black and red dotted lines indicate the optimum catch length for each mesh size. The evaluation of optimum catch length should consider the biological characteristics of mantis shrimp, particularly their length at first maturity. Ramdhani *et al.* (2023) used 19 cm as the reference length at first maturity. This biological reference can be used to assess whether the optimum length of mantis shrimp vulnerable to capture has reached the size associated with reproductive maturity.

According to Mulyono *et al.* (2017), the first time Mantis Shrimp mature gonads (Lm) when they are 19.9 cm long. Because the optimum catch size (Lopt) in both meshes is above the Lm value, all Mantis Shrimp caught are estimated to have mature gonads. Thus, both mesh sizes are classified as selective, but the 4 inch mesh has the highest selectivity value of 1.00 which means that it is more supportive of catching mature Mantis Shrimp so it is better for resource sustainability and the larger the mesh size used, the size of the Mantis Shrimp that has the highest chance of being caught is also larger.

CONCLUSION

Based on the research findings, bottom gillnets with mesh sizes of 3.5 and 4 inches demonstrated size selectivity in catching mantis shrimp in Kampung Laut Village. The estimated optimum lengths (Lopt) for the mantis shrimp caught by both mesh sizes were higher than the reported length at first gonadal maturity (Lm), indicating that the highest capture probability occurred at lengths above the size at first maturity. These findings suggest that both mesh sizes have the potential to support more responsible mantis shrimp harvesting by targeting larger individuals. However, the presence of smaller individuals in the catch indicates that further consideration of the length distribution and proportion of immature individuals is necessary when evaluating the biological sustainability of these fishing gears.

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