(RESEARCH ARTICLE)

Purse Seine Selectivity Based on Catch Composition in West Sumatra Waters (FMA-RI 572), Indonesia

Eli Nurlaela, Rofi Sitra Utama, Aman Saputra, Danu Sudrajat, Diding Sudira Efendi, Harisjon, Agus Heri Kuswoyo, Andi Irawan and Erick Nugraha *

Faculty of Capture Fisheries, Jakarta Technical University of Fisheries, Pasarminggu 12520, South Jakarta, Indonesia.

Abstract

Purse seines are an efficient fishing gear for catching pelagic fish that live in schools and are found near the surface of the water. Purse seines are considered active because their operation involves blocking, trapping, and restricting the fish's movement, preventing them from escaping. Catching success is influenced by several factors, such as net rotation speed, sinking weights, and the speed of pulling the line, all of which influence the success of purse seine fishing. The continued increase in purse seine operations indicates a continuing increase in the exploitation of fish resources. This condition has led to the issue of overfishing and the increasing scarcity of fishery resources. Overfishing can result in a decrease in catch per unit effort (CPUE), which in turn reduces fishermen's income. Gear selectivity refers to the ability to select or catch fish based on specific species and sizes. Fishing gear with a high level of selectivity tends to prioritize catch quality over quantity. The research was conducted at the Ocean Fisheries Port (PPS) Bungus, from January 13 to May 12, 2025, using a purse seine vessel operating in the waters of West Sumatra (FMA-RI 572). During the research, based on the results obtained, fishing operations were carried out during the day and night. The composition of the catch obtained was a variety of species caught, consisting of bigeye scad (*Selar crumenophthalmus*), European pilchard (*Sardinella pilchardus*), Shortfin scad (*Decapterus* sp.), short mackerel (*Rastrelliger* sp.), narrow-barred spanish mackerel (*Scomberomorus* sp.), Largehead hairtail (*Trichiurus lepturus*), barracuda (*Sphyraena barracuda*), Kawakawa (*Euthynnus affinis*), and Squid (*Loligo* sp.). The total catch during the study was 20,050 kg. The percentage of main catch fish was 33% smaller than the percentage of bycatch of 67%. The main catch was *S. crumenopthalmus* fish, with a production of 6,645 kg (33%) of the total catch. Thus, it can be concluded that the selectivity of purse seine is relatively low, because bycatch is more dominant due to the large number of fish species caught.

Keywords: Composition; Purse Seine; Selectivity; *Selar crumenophthalmus*

1. Introduction

Indonesia is a country consisting of many islands and has abundant fish resources that can provide a source of income for its population and increase state revenue. The vastness of Indonesia's waters means that every province in the country has a coastline. This demonstrates the enormous potential of Indonesia's oceans, especially in the fisheries sector [1]. Fish resources in Indonesian waters are estimated to have a sustainable potential of 12.54 million tons annually. This amount is spread across Indonesian waters, including within the Exclusive Economic Zone (ZEE), which contains 37% of the total fish species worldwide [2].

According to [3], Ocean Fisheries Port (PPS) Bungus is in Padang City, West Sumatra Province. Geographically, the port is at coordinates between Longitude 0⁰54' N and 3⁰54' N. Latitude 030' S and 98⁰36' to 101⁰53' E. Ocean Fisheries Port (PPS) Bungus serves as the main center of fisheries activities in West Sumatra, with a focus on the fisheries sector. As

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* Corresponding author: Erick Nugraha.

the largest fishing port along the west coast of Sumatra Island, PPS Bungus carries out various activities that support the fisheries industry, such as providing logistics and ship supplies, landing catches, unloading fish, and distributing and marketing fishery products [4].

Purse seines are the dominant fishing gear used by fishermen in West Sumatra. Generally, purse seines produce catches consisting of small pelagic fish of economic value, such as Kawakawa (*Euthynnus affinis*), Shortfin scad (*Decapter* sp.), Yellowtail (*Selaroides* sp), and short mackerel (*Rastrelliger* sp.). [5]. This fishing tool is an active tool because it works by blocking, confining, and reducing the area of movement of fish so that the fish cannot escape.

The selectivity of fishing gear is the ability of fishing gear to catch certain fishing targets according to the type and size of fish during the fishing process and allows bycatch to be released without injury [6]. The use of fishing gear that has high selectivity will make the fishing process more effective.

The objectives of this research are to identify the fish caught and analyze the selectivity of purse seine fishing based on catch composition. It is hoped that this research will provide a more comprehensive understanding of purse seine selectivity and fisheries sustainability, which will impact future fish stocks.

2. Material and methods

The research was conducted at PPS Bungus, from January 13 to May 12, 2025 by Purse seiner which operates in the waters of West Sumatra (FMA-RI 572)
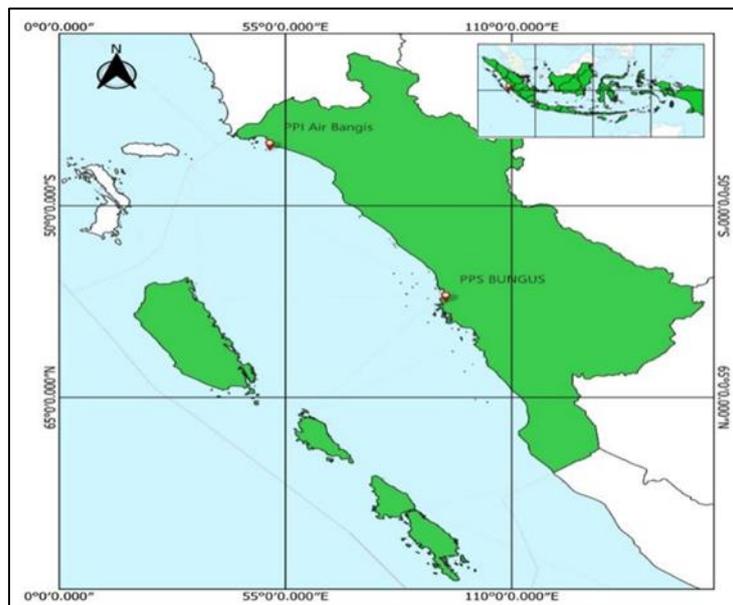

Figure 1 Research Location

Tools and materials serve to support and assist the research process, ensuring smooth progress and optimal results. The tools and materials used during the research include boats, fishing gear, cameras, writing materials, fishing journals, scales, rulers, and catch data.

2.1. Method of collecting data

According to [7] Data collection methods are the steps used to obtain the data or information needed in a study. Selecting a data collection method is crucial because it can impact the validity and accuracy of the research results. It must align with the study objectives, the type of information required, available resources, and relevant ethical aspects. The research method used was to directly participate in fishing activities operating in the waters of West Sumatra.

Data was collected using several data collection methods, including:

- Field observation, namely by following fishing operations.

- Conducting interviews with related parties, such as the Port, Company, Captain, and all persons related to the completeness of the report.

According to [8] Primary data is data collected directly by researchers in the field when conducting research. Primary data is obtained by conducting direct observations on board by following fishing operations on board. While on board the author actively participated in activities on board starting from preparations before departure, namely preparing supplies, fishing operations, handling fish on board, helping with maintenance and repair of fishing gear on board when damage occurs. The data collected are the type and amount of catch, and the level of selectivity of fishing gear.

Secondary data is data that has been processed from primary data sources and is usually presented in the form of tables, graphs or diagrams, either by the primary data collector or by other parties who reuse it [9]. Secondary data is useful for describing events or incidents that have been discovered by researchers, in accordance with the objectives to be achieved in the research [10].

2.2. Data analysis

Data analysis is a systematic process of processing, organizing, and interpreting data that has been obtained. The data obtained are then processed using descriptive analysis. Descriptive analysis aims to process raw data into a more concise and easily understood form, thus making it easier to draw conclusions [11].

2.2.1. Retrieval Method Sampling

Samplingis the taking of a portion of a population that is used to represent the values or characteristics of the entire population. The portion of the population that is taken is called a sample. One example of the application of the random sampling method is the stratification technique, where the population is divided into several strata, then a random sample is taken from each population.12].

According to [13], Simple random sampling is a sampling technique from a population in which each individual has an equal opportunity to be selected as part of the research sample. In research activities, the author obtains a sample *S. Crumenopthalmus*. A total of 170 individuals were randomly selected during fishing activities. The samples were then measured using a ruler and weighed using a digital scale with a maximum capacity of 1,000 grams.

One method to combat overfishing is to regulate the size of fish that can be caught. Fish measurement is a simple, easy-to-use method that can be used as basic information for fisheries management. According to [14], Fisheries management should be based on scientific studies of fish stock conditions, which require data and various biological factors as a basis for decision-making. Restrictions on the size of fish that can be caught and the frequency of fish lengths can form the basis for selectivity purse seine.

2.2.2. Data Processing Method

Data processing techniques are the process of processing data to obtain information. Data processing methods aim to assess the extent to which this fishing gear can select certain sizes and species of fish, as well as its impact on the sustainability of fishery resources. The data processed aims to determine various objectives related to testing the selectivity of the fishing gear, one of which is to determine the level of selectivity of the fishing gear, for example as low, medium, or high selectivity, based on the results of data analysis [15].

The data obtained is then calculated and processed using Microsoft excel, aims to find out whether the size of the catch obtained has reached the target according to the predetermined size, which will later have an impact on the sustainability of fisheries production results.

2.3. Data Analysis Methods

2.3.1. Descriptive Analysis

Descriptive analysis is used to process data by providing an explanation or description of the information that has been collected [16]. Descriptive analysis of catch Purse seine. The aim is to systematically describe catch results based on variables such as fish species, quantity, and size relative to fishing gear. The results of this analysis will be useful for determining the compliance of fishing gear with the level of selectivity. Purse seine based on the results of fish catches obtained during research activities in the waters of West Sumatra (FMA-RI 572).

2.3.2. Analysis of Catch Composition

Catch Composition Analysis is a crucial step in fisheries studies to determine the proportion, dominance, and diversity of fish species caught by a given fishing gear over a given period. This analysis aims to identify the dominant species captured during fishing activities and assess ecosystem balance and the impact of fishing gear on the composition of the catch.

According to [17] The composition of the catch is calculated to identify the number of fish species in a given volume. According to [18] The composition of the types of fish caught can be calculated using the following equation:

$$\text{Pi} = \left(\frac{\text{ni}}{\text{N}} \right) x \ 100\%$$

Information:

Pi   : Abundance of Catch Results (%)

In   : Number of Species Catch (kg)

N   : Total Catch Amount (kg)

The catch measured in the study was the bentong scad, which is the main catch with a production volume during the 2-month fishing period of 6,645 kg.

2.3.3. Selectivity Analysis

Fishing gear selectivity is an important concept in fisheries management that relates to the ability of the gear to select certain species or sizes of fish, while reducing or avoiding the capture of non-target fish [19]. Food and Agriculture Organization (FAO) has guidelines and standards on fishing gear selectivity that aim to ensure sustainable fishing practices and reduce negative environmental impacts.

Analysis of fishing gear selectivity purse seine aims to determine to what extent this tool can catch target species (the desired type and size of fish), as well as reducebycatchor fish that are not yet fit to catch (juvenile). Several methods used to determine the level of selectivity of fishing gear towards the fish caught are as follows:

Mesh size

Mesh size is one of the most important factors influencing selectivity Purse seine, especially in terms of the size of the fish caught. The mesh size of the net plays an important role in preventing the capture of juveniles, which biologically have not had time to reproduce. The use of fishing gear with a larger mesh size is believed to reduce the possibility of catching small fish.20].

Selectivity to the Proportion of the Catch

According to [21] a fishing gear is said to be selective if the Main Catch Result is $\geqslant$ 60%.

$$S = \frac{\text{Target species}}{\text{Amounth Catch}} x \ 100\%$$

Keterangan :

S   : Selectivity

N_T : Target species

N_C : Amount catches

Selectivity Purse seine impact on catch yields is closely related to the fishing gear's ability to efficiently capture target fish, minimize bycatch, and avoid fish that are not yet suitable for capture. This selectivity test is expected to provide the public, especially fisheries practitioners, with an understanding of the importance of fisheries sustainability and its impact on catch yields.

- Analysis Using Scoring Method

The analysis of fishing gear selectivity using the scoring method aims to assess how well the fishing gear can catch the main target while minimizing bycatch. According to [22] Scoring is an assessment method that involves assigning a score to each parameter based on performance measured against predetermined criteria. This approach plays a vital role in supporting the implementation of sustainable fisheries.

The following is a weight score for selectivity. Purse seine according to FAO reference in 1995:

- The tool catches more than three species with very different sizes score 1.
- The tool caught three species with very different sizes, score 2.
- The tool catches less than three species of approximately the same size, score 3.

In the analysis using the scoring method, a score of 1 indicates a low level of selectivity, a score of 2 indicates a medium level of selectivity, while a score of 3 indicates a high level of selectivity [23].

- Class Interval Scale Formula

According to [24] Class interval is the interval given to define classes in a distribution.

Data Range

$$R = Nmax - Nmin$$

Information :

R   : *Range*

Nmax   : Maximum value

Nmin   : Minimum value

Number of classes (Formula *Struges*)

According to [25] explains that determining the number of classes is calculated using the following equation.

$$k = 1 + 3,3 \, log \, (n)$$

Information :

K   : Number of interval classes

n   : Number of observation data

Interval Kelas

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

Information :

i   : Class interval

R   : Range

K   : Number of classes

Calculation of the Relationship between Length and Weight of Fish

According to [26] The relationship between length and weight can be calculated using the following equation:

$$W = a.L^b$$

Information:

W : Weight (g)

L : Total length

a - b : *Constanta*

Here's how to interpret the values of b and R in the calculation using the formula above, as follows.

Table 1 Fish growth criteria

Mark	Growth Type	Information
b < 3	Negative allometric	Length growth is faster than weight
b = 3	Isometric	Length growth equals weight
b > 3	Positive allometric	Faster weight growth and length

Table 2 Interpretation of the (R) value between fish weight and length

R-value	Meaning
0,00-0,19	Very weak correlation
0,20-0,39	Weak correlation
0,40-0,69	Moderate correlation
0,70-0,89	Strong correlation
0.90-1,00	Very strong correlation

3. Results and discussion

3.1. Purse Seine vessel

Figure 2 Purse seine vessel used during research.

Boat Purse seine conducted practical fishing activities during the day and night. The fleet used was a 30 GT wooden ship that carried out loading and unloading activities at the PPS Bungus.

3.2. Fishing ground

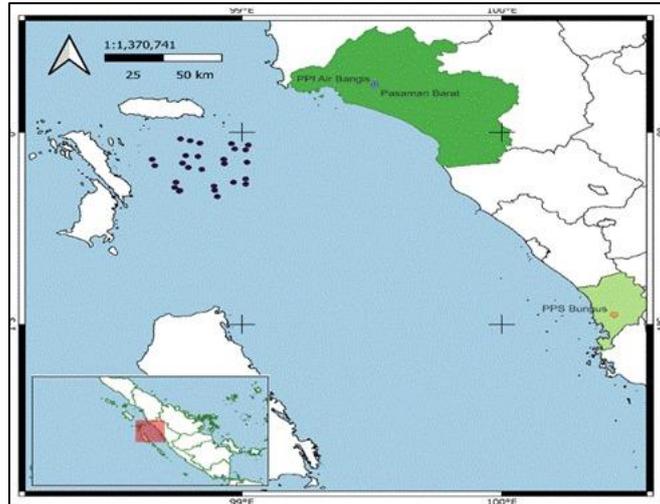Fishing Ground is usually at a water depth of around 40–100 m with a sandy and muddy water base.

Figure 3 Fishing ground

3.3. Composition of Catch Results

Catch Purse seine has a variety of species. The main catch includes species that are specifically targeted in fishing operations, while bycatch consists of non-target species that are caught even though they are not targeted in fishing activities [27]. The following are the types of catches obtained during research activities during 24 trips (February to March 2025) using purse seine vessels in the waters of West Sumatra (FMA-RI 572).

Table 3 Types of Catch

| *Selar crumenophthalmus* | *Rastrelliger sp* | *Decapterus Sp* |
| *Euthynnus affinis* | *Sardina pilchardus* | *Scomberomorus* |

Trichiurus lepturus	*Loligo Sp*	*Sphyraena barracuda*

3.3.1. Composition of Catch Results for Each Setting

Composition of catches persettingpresented in the table below.

Table 4 Composition of catch based on fishing trips during the study.

Trip	Species (kg)									Amount (kg)
	S. crumenophthalmus	*Scomberomorus*	*S. barracuda*	*Rastrelliger sp*	*S. pilchardus*	*T. lepturus*	*E. affinis*	*Decapterus sp*	*Loligo sp.*	
1	120	220	25	0	0	0	0	0	0	363
2	80	150	37	0	0	0	0	0	0	267
3	240	150	0	0	0	0	0	0	0	390
4	310	190	28	0	0	0	0	0	0	528
5	80	0	0	0	0	0	0	0	0	80
6	100	0	0	0	0	0	0	0	0	100
7	100	50	20	60	100	30	0	0	0	360
8	210	30	25	100	0	70	0	0	0	435
9	490	0	55	200	10	50	0	0	0	805
10	0	0	0	2,900	0	0	0	0	0	2,900
11	500	0	40	50	225	0	120	0	0	935
12	700	0	30	30	450	0	0	0	0	1,210
13	1,000	0	50	45	300	0	0	0	0	1,395
14	300	0	50	110	200	0	0	0	0	660
15	120	75	0	130	400	0	0	120	0	845
16	155	50	0	100	800	0	0	80	0	1,185
17	250	120	0	100	500	0	0	0	0	970
18	200	0	50	50	120	0	0	150	0	570
19	200	0	0	0	70	0	0	30	0	300
20	600	0	30	0	200	0	0	0	0	830

21	420	180	0	80	0	10	0	0	0	690
22	140	120	0	30	0	30	0	0	0	320
23	250	90	0	30	0	20	0	0	0	390
24	0	0	0	0	0	0	3,400	0	0	3,400
25	80	0	30	0	0	0	0	0	10	120
Total	6,645	1,425	470	4,015	3,375	210	3,520	380	10	20,048

3.3.2. Selectivity Analysis Based on Main Catch and Bycatch Results

Selectivity analysis based on catch results is an evaluation of the ability of fishing gear to catch the desired type and size of fish, as well as avoiding fish bycatch [28] fishing gear has a selective level of catch if the primary catch yield (HTU) is ≥60%. The main objective of this analysis is to assess the effectiveness and sustainability of fishing methods.

According to [29], The main catch is the type of fish targeted during fishing activities. Conversely, bycatch refers to species that are not specifically targeted but are caught during the fishing process. The following shows the production volume and catch percentage during the two-month fishing period.

Table 5 Target species Catch Results

No	Species	Catch (Kg)	Percentage (%)
1	*S. crumenopthalmus*	6.645	33
	Total	6.645	33

The main catch production results are *S. crumenopthalmus.* The percentage of the main catch obtained from 25 trips (2 months) was 33% or 6,645 kg of the total number of fish caught.

Table 6 Bycatch Results

No	Species	Catch number (Kg)	Percentage (%)
1	*Sardina pilchardus*	3,375	17
2	*Decapterus Sp*	380	2
3	*Rastrelliger Sp*	4,015	20
4	*Scomberomorus*	1,425	7
5	*Trichiurus Lepturus*	210	1
6	*Sphyraena baarracuda*	470	2
7	*Euthynnus affinis*	3,520	18
8	*Loligo Sp*	10	0
	TOTAL	13,405	67

From the results obtained during the research activities, the author obtained the results that Purse seine caught nine species of fish. Based on the catch, the percentage of bycatch was greater than the percentage of the main catch. Therefore, it can be concluded that the selectivity of the purse seine is low.
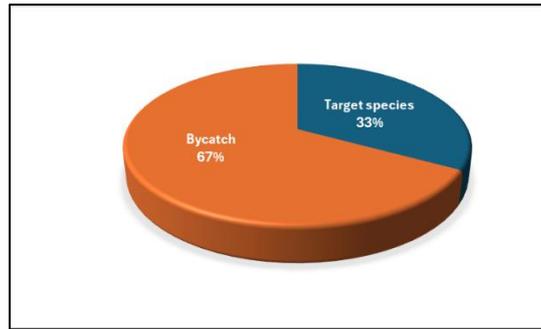
Figure 4 Percentage of Catch Results

Catch composition analysis aims to determine the level of selectivity of fishing gear towards the target fish, both in terms of the number of fish species caught, as well as the length and weight of the fish caught. With this analysis, it is hoped that fisheries operators will comply with the fishing gear sizes permitted by the government. This regulation aims to create sustainable fisheries for the number of fish stocks. From the diagram above, bycatch is more dominant than the main catch. From these results, it can be concluded that selectivity Purse seine the composition of the catch is relatively low.

3.3.3. Analysis Based on the target species Fork length

Fork length selectivity is the practice of selecting fish based on a specific size. Fishing gear designed to be size selective can help avoid catching undersized fish or other undesirable species [30]. Fishing conducted after the fish reach their first reproductive size allows the target species to undergo the spawning process before being caught. This supports the continuity of the fish's life cycle, especially in ensuring the transition from the adult phase to the adult stage youth to the adult phase occurs optimally. The following measurement methods *S. crumenopthalmus* can be seen in the image below:
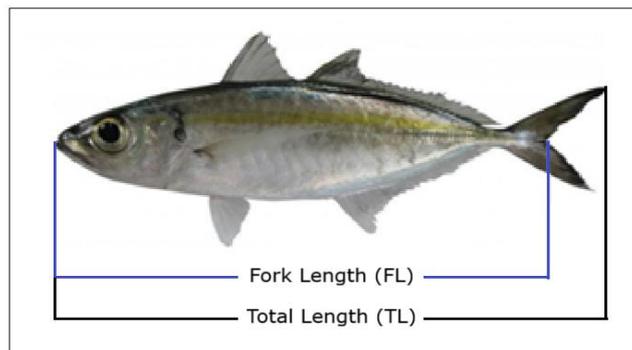

Figure 5 How to measure *S. crumenopthalmus.*

Measurements were conducted over a 2-month fishing period, from February 2025 to March 2025. A total of 170 fish were measured, randomly selected from the smallest to the largest catch. The scad is a small pelagic fish with high economic value. The main catch of scad weighed 6,645 kg, or 33% of the total catch weight. During the fishing operation, scad dominated every haul. *S. crumenopthalmus* caught measured 12-24 cm in fork length, with each fish weighing between 70-180 grams. The following table shows the relationship between length and weight of the fish:

Table 7 Length-weight relationship of bentong selar fish

N	Total length (cm)	Weight (gr)	$W = a. L^b$			
	Min - Max	Min - Max	a	b	r	Grow pattern
170	12 - 24	70 - 180	1,77	1,46	0,99	Negative Allometric

Results of length and weight measurement *S. Crumenopthalmus* results show that this fish has a negative allometric length relationship, with a b value of 1.46 <3, which means that the length growth is faster than the weight. Based on the equation above, the coefficient of determination obtained is 0.99, which means that the length variable has a strong influence (correlation) of 99% on the weight variable with a correlation value of 0.99, while 1% is explained by other factors. The following is a picture of the relationship between length and weight *S. crumenopthalmus*, as follows.
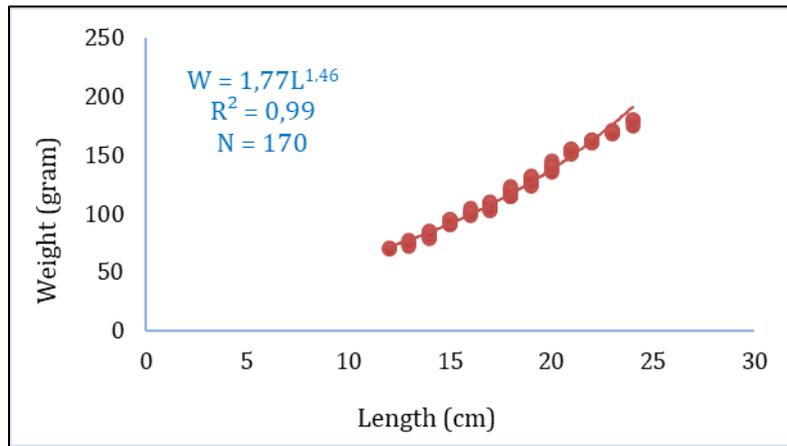

$$W = 1{,}77L^{1{,}46}$$
$$R^2 = 0{,}99$$
$$N = 170$$

Figure 6 Length-weight relationship *S. crumenopthalmus.*

According to [31], *S. crumenopthalmus* belongs to the family Carangidae, is a type of fish that actively searches for food at night (nocturnal). This fish typically lives in groups in coastal waters down to a depth of 80 meters. It tends to live in neritic waters, especially around islands. Furthermore, it tends to be nocturnal and is often found in murky waters [32]. Production quantity *S. crumenopthalmus* during the 2-month fishing period, the catch was 6,645 kg, or 33% of the total catch. The length of the fish caught ranged from 12 cm to 24 cm.

S. crumenopthalmus gonads first mature at a length of 21.5 cm. This statement is the same as the statement made [33], meaning that the fish that are worth catching must be 21.5 cm or more in size.

The study involved 170 randomly selected fish. Twenty-seven fish, or 16% of the total sample catch, were viable. Therefore, it can be concluded that the selectivity of the fishing gear for the size of the fish caught is low. The following size intervals are shown *S. crumenopthalmus* obtained during fishing activities.

Table 8 Size Interval Class of *S. crumenopthalmus*

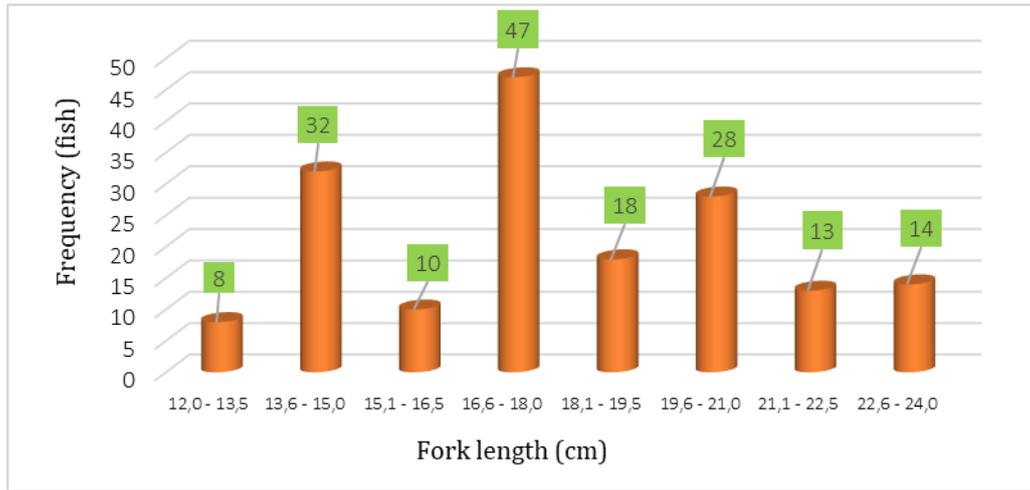| Class (CM	Number (fish)	Percentage (%)	Information
12,0 - 13,5	8	5	Not Worth Arresting
13,6 - 15,0	32	19	Not Worth Arresting
15,1 - 16,5	10	6	Not Worth Arresting
16,6 - 18,0	47	28	Not Worth Arresting
18,1 - 19,5	18	11	Not Worth Arresting
19,6 - 21,0	28	16	Not Worth Arresting
21,1 - 22,5	13	8	Worth Catching
22,6 - 24,0	14	8	Worth Catching
Total	170	100	

Figure 7 Class Distribution Graph *S. crumenopthalmus*

Determination of fishing gear selectivity based on size class intervals *S. crumenopthalmus* purpose of the catch was to determine the dominant size of the catch during the research. During the research, 170 samples of scad were measured, randomly selected after the fishing operation.

From the results of the study, the results obtained were 27 fish (16%) of the total sample of 170 fish. After tabulating the data by the author, it was found that the dominant class of fish caught was in the 16.6 to18.0 cm class interval with a total of 47 fish (28%) of the total sampled fish. Meanwhile, the least fish interval class caught was 12.0-13.5 cm with a total of 8 fish (5%) of the total sampled scad fish during the research activity.

Thus, it can be concluded that the level of selectivity Purse seine has low criteria. This is because the number of unsuitable fish is more dominant than the number of suitable fish.

Table 9 Percentage *S. crumenopthalmus*

Criteria	Number (fish)	Percentage (%)
Worth Catching	27	16
Not Worth Arresting	143	84
Total	170	100

In this study, testing the level of selectivity of fishing gear for fish caught, there are four factors that serve as references in determining the level of selectivity of fishing gear. These factors are: the number of main catches, catchable fish size, number of fish species caught, and fishing gear specifications. Selectivity testing is important to determine the ability of fishing gear to catch target fish in fishing activities, both in terms of fish species, and fish size that are good and appropriate for carrying out fishing operations. The following factors are in the level of selectivity testing.

Table 10 Selectivity Level Factors

No	Selectivity Level Factor	Selectivity Indicator	Mark	Selectivity Criteria
1	Main catch	≥ 60% [21]	33%	Low
2	fish size suitable to catching	21,5 cm [23]	16% measuring > 21.5 cm	Low
3	Number of types of fish caught	Maximum 3 species [34]	9 Types	Low
4	Fishing gear specifications			
	- Mesh Size	≥ 1 inch [35]	1 inch	Selective
	- length of the top strap	≤ 400 m [35]	500 m	Not Selective

From the description of the table above, it can be concluded that the selectivity Purse seine is considered low. Assessing the selectivity level of fishing gear involves numerous calculations, including the construction of the gear itself and the number and size of fish caught during fishing operations. Given these low criteria, improving regulations related to gear selectivity is necessary to ensure sustainable fisheries for the future of Indonesia's fishing industry.

4. Conclusion

During the fishing activities, a total catch of 20,050 kg was obtained. The main catch was *S. Crumenopthalmus* reached 6,645 kg (33%), while bycatch out numbered the main catch at 13,405 kg (67%). This was due to the large number of fish species caught by fishing gear.

The analysis showed that the selectivity of the fishing gear was relatively low, marked by the dominance of bycatch at 67% compared to the main catch. The fishing gear was found to catch more than three species, indicating inaccuracy in target fish selection. Testing of 170 individuals was carried out *S. Crumenopthalmus* showed that only 16% (27 individuals) were considered suitable for fishing, while 84% (143 individuals) had not yet reached gonad maturity. This situation indicates a potential threat to the sustainability of fish resources, necessitating increased compliance with the principle of gear selectivity to support sustainable fisheries management.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed

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