(RESEARCH ARTICLE)

Purse seine selectivity on small pelagic fish catches in Bangka Belitung Waters, Indonesia

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Abstract

Purse seine is the most widely used fishing gear by fishermen in Bangka Belitung. The fish caught in Bangka Belitung are of several types and sizes, namely Yellowstripe scad (*Selaroides leptolepis*), Yellowtail scad (*Atule mate*), Fringescale sardinella (*Sardinella fimbriata*) and others. This is because most ships still use mesh sizes that do not meet the requirements. Therefore, selective fishing gear should be selected to obtain the target of catching fish types and sizes that are suitable for catching and to minimize unwanted bycatch. This study is expected to provide information related to the positive impact of purse seine selectivity as a solution to reduce excessive fishing and support sustainable fisheries. The purpose of this study was to determine: Effective purse seine operating techniques, the composition of fish caught in purse seines, analyzing the level of purse seine selectivity based on the composition of the catch, and technical analysis of fishing gear selectivity. This study uses descriptive analysis with a survey method. Primary data were obtained from surveys, interviews, and documentation. Secondary data were obtained from ship documents and purse seine vessel production data in Bangka Belitung. Based on the results of the study, it was concluded that the composition of the fish caught consisted of *Selaroides leptolepis, Atule mate,* and *Sardinella fimbriata. Selaroides leptolepis* is the main and most dominant fish caught, which is 50%. Bycatch fish are 50%. The percentage of fish caught from the target species is 86%. The level of selectivity of the purse seine is relatively moderate. This is influenced by several factors such as the mesh size and the composition of the fish caught, which contain several types and sizes. To increase the level of selectivity of the purse seine, it is hoped that the mesh size will be enlarged, and better regulations will be implemented so that it can support sustainable fisheries.

Keywords: *Selaroides Leptolepis*; Komposisi; Composition; Level of Selectivity; Mesh Size; Gonad Maturity

1. Introduction

The potential of marine fisheries resources in Indonesia consists of pelagic fish and demersal fish [1] which is exploited by fishermen with various types of active fishing gear such as purse seine, trammelnet and gillnet [2]. The Bangka Belitung Islands Province has a water area of 65,301 km² (80%) and a coastline of 1,200 km. With these conditions, this province certainly has quite a diverse and large fisheries potential [3]. Geographically, the Bangka Belitung Islands Province is one of the provinces that have an interest in managing capture fisheries in FMA-RI 711 [4]. Utilization of fisheries potential is expected to accelerate development, especially a sustainable fisheries economy, but must pay attention to the sustainability of fish resources and the environment [5]. Purse seine is a fishing gear made from webbing sheets, which are generally rectangular [6]. This type of fishing gear that is widely used by fishermen in Bangka Belitung. However, currently, cantrang is a fishing gear that is prohibited from being used according to the Regulation of the Minister of Maritime Affairs and Fisheries (MMAF) No. 71 of 2016, so that purse seine is the dominant type of fishing

gear that lands the catch [7]. Purse seine is a fishing gear in the form of a net, in the form of a rectangular bag consisting of wings, a body equipped with a float, weight, upper ris rope, lower ris rope with or without a tightening rope (shrink), and one-part functions as a bag that is operated by encircling a school of pelagic fish [8]. The purse seine catch landed in Bangka Belitung is a type of small pelagic fish, such as: *Rastrelliger* Sp., *Carangidae* Sp., *Decapterus* Sp., and *Sardinella* Sp. This type of fish resource has great potential in Indonesia, including *Selaroides leptolepis, Atule mate*, and *Sardinella fimbriata* which play an important role in global fisheries [9].

The selectivity of fishing gear can be interpreted as the ability of fishing gear to obtain certain fishing targets according to fish type, size or gender (or a combination of the three) during the fishing process and allows all unwanted bycatch to be passed without injury [10]. Purse seine is a rectangular fishing gear equipment with a ring as a tool for the path of the rope and the rope functions to tighten the net so that it forms a bag. The target of the catch is pelagic fish that live in groups on the surface of the water. The purse seine is operated by circling the school of fish [11].

The objectives to be achieved in this study are to analyze the level of selectivity of purse seine, analyze the composition of fish caught by purse seine, and analyze the distribution of length of fish caught. It is expected that this study can help reduce bycatch and can also formulate more effective and sustainable fisheries management policies and increase public awareness of the importance of sustainable fisheries.

2. Material and methods

The research location was carried out on February 15th - May 16th, 2024, on a vessel with small pelagic Purse seine fishing gear based at Nusantara Fishing Port (PPN) Sungailiat, Bangka Belitung Province, FMA-RI 711. As can be seen in Figure 1 below. The tools and materials needed include Meter, Camera, Digital Scale, Vernier Caliper, Laptop, Microsoft Excel, and Stationery.

Figure 1 Research Location

2.1. Data Collection Method

The methods used in data collection are observation, interviews, documentation, and literature studies. There are two types of data taken in this study, namely primary data and secondary data [12]. Primary data is data obtained directly in the field. Primary data can be in the form of notes from observations in the field related to conditions, situations, events or other data. Primary data obtained during the research is in the form of data from interviews, observations, active participation, and documentation. Secondary data is data obtained indirectly in the field or in other words obtained from several related sources [13]. Observations are made during the fishing process starting from the

preparation of the operation to the unloading process at the Port. Each stage of the operation is stated in the activity journal.

Primary data is data obtained or collected by researchers directly from the data source. Primary data is also known as original data or new data that has new characteristics. To obtain primary data, researchers must collect it directly [14].

- Recording and calculating several samples of the target species (measurement of fork length and fish diameter) as one of the assessments of the level of selectivity.
- Measuring the opening of the net mesh.
- Interviews, aiming to obtain information by asking questions to the captain, crew, harbormaster and other parties related to the writing of this scientific work.
- Documentation, conducted to obtain data and evidence of information in the form of images and videos.

Secondary data is data obtained from external parties in the form of external data on matters related to the research material and is already available from the relevant parties. The secondary data used as a reference are

- Ship and crew documents
- Annual port report data and annual port statistics report.

2.2. Data Processing Method

The data obtained, both primary and secondary data, are then processed by grouping the types and sizes of fish caught as material for further data analysis related to the selectivity of fishing gear. Data is processed using Microsoft Excel related to the composition of the target species.

2.3. Data Analysis Method

Data analysis is an analysis that the author conducted on the data obtained during the study. Data analysis can provide information whose characteristics can be understood and are useful for drawing relevant conclusions. This analysis process includes data grouping activities based on their characteristics, data cleaning, data transformation, data modeling and finding important information from the data.

The analysis used in this study is descriptive analysis, namely analyzing data by explaining the information collected. The descriptive analysis process in purse seine operations is to conduct direct observation of all technical activities on the ship. Starting with preparation, operation, handling of catches, and unloading catches [15]. The analysis used in this study is selectivity analysis based on the composition of the catch, analysis of the relationship between the length of the target species and technical analysis of purse seine selectivity.

2.3.1. Composition Analysis

In this study, the author used small pelagic fish as the target species variable for measuring the length of the fork to determine the level of selectivity of the purse seine. The composition of the catch types was calculated based on the composition of each hauling time of the fish unit (Kg) using the following calculation [16]

$$P = \frac{N_1}{N} \times 100\%$$

Description

P = Percentage of one type of fish caught
N1 = number of fish caught 1 (Kg)
N = Total number of catches (Kg)

2.3.2. Selectivity Analysis

The selectivity of fishing gear can be interpreted as the ability of fishing gear to obtain certain fishing targets according to the type of fish and size during the fishing process and allows all unwanted bycatch to be passed without injury [17]. Environmentally friendly fishing gear is fishing gear that does not damage the fish habitat (aquatic ecosystem) during the process or after fishing activities are carried out. Several ways to measure the selectivity of fishing gear involve direct observation in the field and using catch data. Some common methods used to measure the level of selectivity of fishing gear include the following:

2.3.3. Mesh size

One of the most common ways to measure the selectivity of fishing gear is to pay attention to the size of the mesh on the fishing gear, such as trawls or purse seines. Larger or smaller mesh sizes can affect which fish can enter the net, and the extent to which bycatch can escape. A fishing gear is said to be selective if target species ≥ 60% with the formula [18]

$$S = \frac{NT}{NC} \times 100\%$$

Description

S   = Selectivity of fishing gear
NT = Number of target species
NC = Number of fish that can be caught

Analysis of the number of catches is the focus in purse seine selectivity studies because this composition provides very relevant information about the effectiveness of fishing gear in catching target species and the potential impact on bycatch species or unwanted species.

2.3.4. Catch Diversity Index Formula

The Food Agriculture Organization (FAO) has established a series of criteria for environmentally friendly fishing technology Weighting Fishing Gear Criteria. The selectivity score of fishing gear is as follows

- Gear catching more than three species with very different sizes score 1
- Gear catching three species with very different sizes score 2
- Gear catching less than three species with approximately the same size score 3

2.3.5. Length of fish caught.

Measuring the length of fish caught can provide an indication of the extent to which the fishing gear targets adult fish that have reached reproductive size. If most of the fish caught are young, then the fishing gear may not be selective. The number of samples taken in this study was 500. The sampling method in this study was purposive sampling (random sampling) with a sample of 250 per trip for 2 trips [19].

2.3.6. Analysis of catch data.

Statistical analysis of catch data can provide an overview of the composition of species caught, the distribution of fish sizes, and the extent to which fishing gear can select target species.

2.3.7. Analysis using the scoring method

According to [20] states that a score of 1 indicates a low level of selectivity, a score of 2 indicates a moderate level of selectivity and a score of 3 indicates a high level of selectivity. The way to obtain a score is by adding up all the scores from each selectivity assessment factor and then finding the average.

3. Results and discussion

3.1. Composition of Catch

The purse seine catch is a small pelagic fish. Small pelagic fish are types of fish that live or are in the surface layer to the mid layer [21]. Some types of fish caught include *Atule mate, Selaroides leptolepis*, and *Sardinella fimbriata.* The types of catch can be seen in Figure 2 below.

Atule mate   *Selaroides leptolepis*


Sardinella fimbriata

Figure 2 Types of Fish catches

Details of the composition of the catch are presented in table 1 below.

Table 1 Composition of the Catch

Species	Trip (kg)		Amount (kg)
	1	2	
Yellowtail scad (*Atule mate*)	250	50	300
Yellowstripe scad (*Selaroides leptolepis*)	2,500	0	2,500
Fringescale sardinella (*Sardinella fimbriata)*	260	1,900	2,160
Total	3,010	1,950	4,960

Based on the diagram above, it can be concluded that the most dominant fish caught during the 2 trips were *Selaroides leptolepis*, followed by *Sardinella fimbriata* and *Atule mate*. The total number of *Selaroides leptolepis* caught during the 2 trips was 50% or 2,500 kg of the total catch of 4,960 kg. The number of *Sardinella fimbriata* caught was 44% or 2,160 kg of the total fish caught of 4,960 kg. The number of *Atule mate* caught was 6% of the total fish caught.
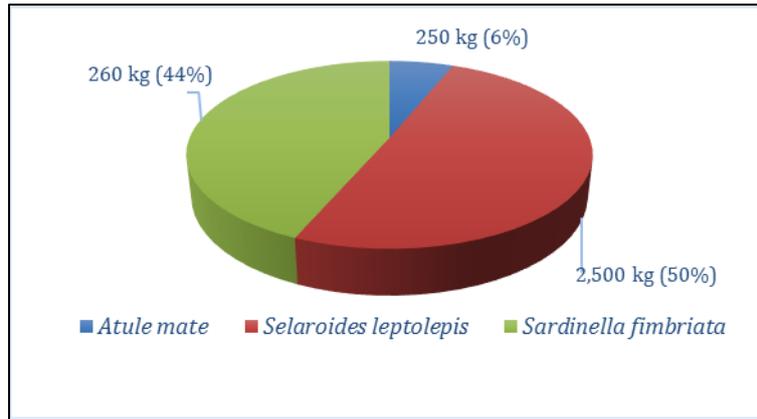
Figure 3 Diagram of Fish Composition

The many variations in the types of fish caught are influenced by seasonal factors and the natural characteristics of fish around the fish aggregating devices, namely the presence of prey between small fish that become prey for large fish.

3.2. Composition of target species

The target species catches are the fish catches or main targets sought and expected by fishermen in carrying out fishing operations [22]. The target species is *Selaroides leptolepis* depending on the fishing season. According to [23], *Selaroides leptolepis* is one type of economical, potential fish and is widely used by fishing communities. *Selaroides leptolepis* is caught using various fishing gear in Bangka Belitung. The composition of the 1st month's catch is shown in Figure 4.
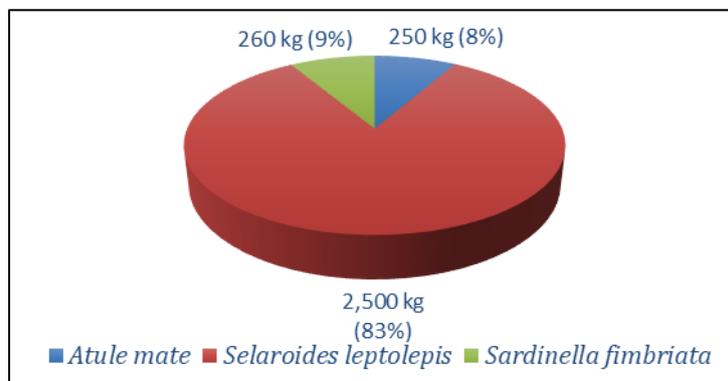
Figure 4 Composition of Fish Catch in the 1st Month

The number of fish caught in the 1st month was dominated by the target species namely *Selaroides leptolepis* which was 83% of the total catch. This is because the fishing process was carried out in April, which is the season for the *Selaroides leptolepis* itself. Then the second largest number of catches was *Sardinela fimbriata*, which was 9% of the total fish catch in the 1st month. The catch in the 2nd month is shown in Figure 5.
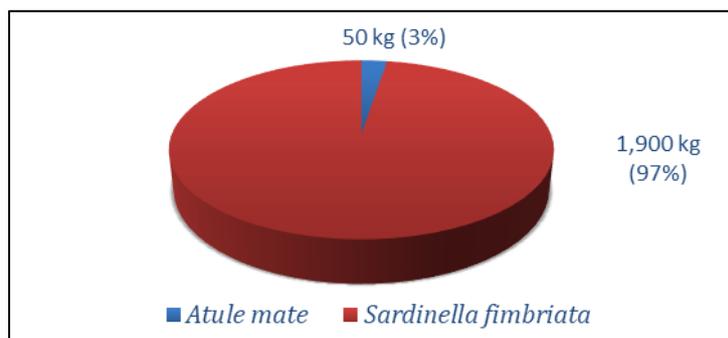
Figure 5 Composition of Fish Catch in the 2nd Month

Entering the 2nd month or May, *Sardinella fimbriata* dominates the fish catch by 97% of the total fish catch obtained this month. It can also be seen that several other types of fish were caught but have a small percentage. From the diagram above, it can also be seen that *Sardinella fimbriata* experienced a process of increasing the number of catches from previously in the 1st month of 260 kg, then increased in the 2nd month to 1,900 kg.

The data above also shows that the number of targets specieses, namely *Selaroides leptolepis*, dominates the total fish catch. However, besides that, there are also by-catch fish that number more than 1 species which also have a selling value in the market.

3.3. Analysis of the Composition of Fish Catches

The nature of fishing gear that catches fish with certain sizes and species is called selectivity. The composition of the resulting catch varies according to the type of fishing gear used. The composition of the catch is related to the selectivity of fishing gear to catch certain species with a specified size as well [24]. The percentage of the catch of *Selaroides leptolepis* which is the main target species, is relatively moderate, namely 50% of the total catch because the fishing operation during the study was carried out in mid-April to May. Then the percentage of *Sardinella fimbriata* catch is in 2nd place, namely 44%. This is because the fishing season for *Selaroides leptolepis* in Bangka Belitung occurs from March to June [25]. The target specieses are shown in Table 2.

Table 2 Target species

Species	Amount (kg)	
	Target Species	Bycatch
Selaroides leptolepis	2,500	
Atule mate	0	300
Sardinella fimbriata	0	2,160
Total	2,500	2,460

The percentage of bycatch fish, namely *Atule mate*, and *Sardinella fimbriata*, is 50% or 2,460 kg of the total catch of fish. The total number of target species and bycatch is the same, so the selectivity value of the fishing gear is considered moderate when viewed from the composition of the fish catch. The comparison of target species and bycatch can be seen in Figure 6.
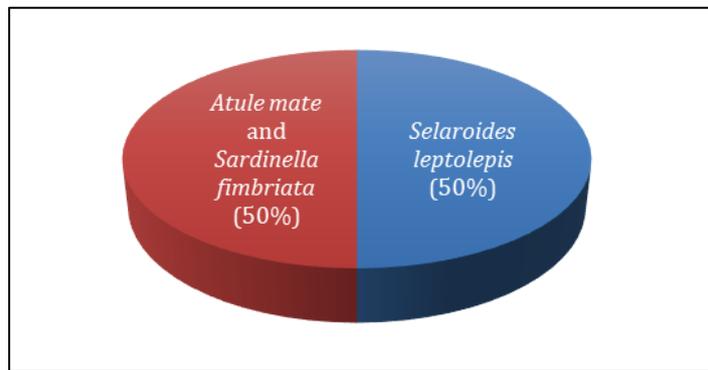
Figure 6 Comparison diagram of target species and bycatch

Catch composition analysis is the focus in purse seine selectivity studies because this composition provides very relevant information about the effectiveness of fishing gear in catching target species and the potential impact on bycatch species or unwanted species. By analyzing the catch composition, researchers and fisheries managers can identify the fish species that are the main targets in purse seine operations. This helps to understand the extent to which the fishing gear is successful in catching the desired fish. The catch composition provides an overview of the level of selectivity of the purse seine towards certain species. The level of selectivity refers to the ability of fishing gear to select target species and avoid catching bycatch or those that have not reached adult size.

Catch composition analysis also helps in assessing the impact of bycatch or bycatch species. If the catch is dominated by bycatch species or unwanted species, then this indicates a lack of selectivity in purse seine operations. From the diagram above, the number of target species fish is quite large from the total catch, which is 50%. This shows that the level of selectivity of the purse seine is at a moderate level. When catching fish species of approximately 3 types and the size of the target species caught is still in the category of fish that are suitable for catching. In environmentally friendly fishing, bycatch also affects the selectivity of a fishing gear.

3.4. Analysis Based on the Total Length of the target species

Selectivity based on the total length of the target species fish that are suitable for catching can be seen from the distribution of the existing class lengths. *Selaroides leptolepis* generally has a size of 14 - 17.5 cm. The fish measured had the smallest class length of 12.0 cm and the largest was 16.0 cm. According to research by [26], yellow scad caught in the South China Sea began to mature gonads at a length of 14 cm. Research by [27] also showed something similar, namely *Selaroides leptolepis* caught in the South China Sea began to mature gonads at a length of 14 cm. Fishing operations carried out during the study were carried out in two trips. The following is table 3 of the overall length and weight of *Selaroides leptolepis*.

Table 3 Length weight of Selaroides leptolepis

N	Total Length (cm)	Weight (gr)	W = a. L^b			Growth Pattern
	Min. – Max.	Min. – Max.	α	b	r	
500	12-16	20-49	1.79	0.24	0.94	Negative allometric

The relationship between the length and weight of Selaroides leptolepis shows that the fish has a negative allometric length-weight relationship, the b value is 0.24 <3, so it can be interpreted that the captured *Selaroides leptolepis* has a faster fork length growth pattern than weight growth. Based on the equation above, the determination coefficient obtained is 0.94, indicating that the length variable has a very strong influence of 94% on the weight variable with a closeness value of 0.94, while 6% is explained by other factors. For more details, see Figure 7.
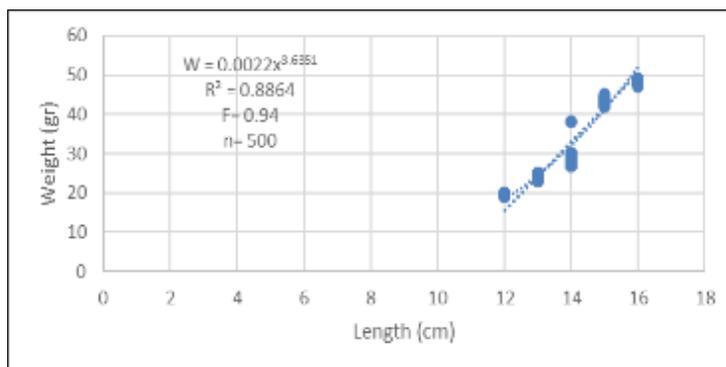
Figure 7 Relationship between length and weight of *Selaroides leptolepis*

With the calculations produced in the table 4 below, it can be concluded that the length of the *Selaroides leptolepis* class that is included in the category that is worth catching is 14.00 - 16.9 cm with a total of 430 individuals, while the length of the *Selaroides leptolepis* class that is included in the category that is not worth catching is 12.00 - 13.9 cm with a total of 70 fish. Thus, from the total number of *Selaroides leptolepis* measured, 500 fish were taken when the setting was finished or when the ship was docked at the port with the category worth catching, 430 fish, while those that are not worth catching are 70 fish or 14%.

Table 4 Distribution of *Selaroides leptolepis* length classes

Length Class (cm)	Number of fish	Percentage (%)	Description
12.00-12.99	23	4.6	Not Worth Arresting
13.00-13.99	47	9.4	Not Worth Arresting
14.00-14.99	100	20	Worthy of Arresting
15.00-15.99	232	46.4	Worthy of Arresting
16.00-16.99	98	19.6	Worthy of Arresting
Total	500	100	

Furthermore, to determine the level of selectivity of purse seine, a data tabulation process can be carried out based on the size class interval of *Selaroides leptolepis*. According to [28] that the size of *Selaroides leptolepis* when the gonads first mature is at a size of 14 cm so that it is included in the fish that are suitable for catching. Based on Table 4, the number of samples used was 500 fish with various sizes of fork length. The largest number was at a size of 15.00-15.99 cm, which was 232 fish, and the smallest number was at a size of 12.00-12.99 cm, which was 23 fish.

The total number of fish that were suitable for catching was 430 fish or 86% of the total samples. While the fish that were not suitable for catching were 70 fish or 14% of the total samples. This is in accordance with the opinion of [29] who stated that determining whether fish are suitable for catching is closely related to determining the selectivity of fishing operations, of the three factors used to assess the level of selectivity, the purse seine gets a score of 3. Based on this score, the purse seine is classified as a fishing gear that has a relatively high level of selectivity.

3.5. Percentage of Selectivity Scoring

The selectivity scoring can be seen in Table 5 below.

Table 5 Selectivity Scoring

Selectivity level factor	Indicator	Score	Criteria Kriteria
Composition of target species weight	50%	2	Medium selectivity
Size of catchable fish	86%	3	High selectivity
Mesh size	1 inch	1	Low selectivity
Number of types of catch	3 types	1	Low selectivity
Total		7	
Average		2	

The number of selectivity scores obtained from the four factors is 7. In the composition of the main catch weight, medium selectivity is obtained with a score of 2, the size of catchable fish is obtained with high selectivity with a score of 3, the mesh size is obtained with low selectivity with a score of 1 and the type of catch fish is obtained with low selectivity with a score of 1. Based on the selectivity scores obtained from the four factors used in determining the level of selectivity of the purse seine, the purse seine is classified as a fishing gear that has a moderate level of selectivity. This is in line with the statement of [30] that a score of 2 indicates moderate purse seine selectivity.

4. Conclusion

The percentage shows that purse seine is quite selective in catching fish. However, there are still 14% of *Selaroides leptolepis* that are not yet suitable for catching. This can be seen from the size of the fish caught which has not yet reached the mature size of the gonad.

The types of fish caught include *Selaroides leptolepis, Atule mate*, and *Sardinella fimbriata*. and the most dominant catch caught is *Selaroides leptolepis* with a total caught during 2 trips of 2,500 kg or 50% of the total catch of 4,960 kg.

Based on the results of this study, it can be concluded that the level of selectivity of the purse seine is classified as moderate with a score of 7 out of 4 assessment indicators. In the composition of the weight of the main catch, moderate selectivity was obtained with a score of 2, the size of the fish that is suitable for catching obtained high selectivity with a score of 3 and the size of the mesh also obtained low selectivity with a score of 1 and the composition of the catch was low selectivity with a score of 1.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed

References

[1] Nugraha, E., Santoso, D. W. A., Hermawan, M., Husen, E. S., Hutajulu, J., Kemhay, D., Annur, M. Y., Sepri, Putri, E. T., and Purwanto, Y. (2024). Mapping bullet tuna (*Auxis rochei*) potential fishing grounds in Prigi waters, East Java, Indonesia, using satellite imagery and in-situ oceanographic parameters. AACL Bioflux 17(5), 2043-2058.

[2] Suharti, R., Asar, N., Triyono, H., Setiadi, A., Maulita, M., Leilani, A., Hutajulu, J., Sudrajat, D., Nurlaela, E., and Nugraha, E. (2024). Biological aspects and utilization of shortfin scad (*Decapterus macrosoma*) in the waters of Ternate, North Maluku, Indonesia. AACL Bioflux 17(3), 916-929.

[3] Kusnadi, S. A., Farhaby, A. M., and Muftiadi, M. R. (2024). Analysis of CPUE and Seasonal Patterns of Fishing for Spanish Mackerel (*Scomberomorus* spp.) at the Kurau Fishing Fish Landing Base (PPI) Central Bangka Regency. Journal of Aquatic Resources, 18(1), 83-95.

[4] Susanto, I. M., Supratman O., and Gustomi A. (2023). Composition and Conservation Status of Fish Caught by Payang Fishing Gear Landed at PPN Sungailiat Bangka Regency. Aquatic Science 5(2), 35-44.

[5] Mustaruddin, Puspito, P., Baskoro, M. S., and Wisudo, S. H. (2024). Sustainable Fisheries Management and Development of Partnership Institutions in Citemu Village, Cirebon. Albacore 8(2), 121-129.

[6] Dewi, P., Hutajulu, J., Nugraha, E., Yusrizal, Sumbung, S., Johari, and Leilani, A. (2020). Financial analysis of purse seine fisheries in Natuna waters, Indonesia. AACL Bioflux 13(3), 1374-1382.

[7] Kurniawan, Asmarita, and Supratman O. (2017). Identification of Fish Types (Local, National and Scientific Name) Result of Fisheries (HTU) Fisheries and Classification of Fishing Tools in Bangka Island, Bangka Belitung. Akuatik 13(1), 42-51.

[8] Subani, W., and Barus, H. R. (1989). Fishing and Shrimp Fishing Gear in Indonesia. Journal of Marine Fisheries Research, 50, 248 p.

[9] Sari, I. P., and Wibowo, I. M. S. M. (2023). Results of Target and Bycatch Species for Purse Seine Fishing Gear at Coastal Fishing Port (PPP) Bajomulyo, Central Java. Fisheries Journal, 13(2), 447-455.

[10] Nurdin, E., and Hufiadi. (2006). Selectivity of Stingray Fishing Gear in Java Sea Waters. BAWAL 1(1), 25-30.

[11] Chaliluddin, M. A., Ikram, M., and Rianjuanda, D. (2019). Identification of Eco-Friendly Fishing Gear Based on CCRF in Pidie Regency, Aceh. Journal Galung Tropika, 8(3), 197-208.

[12] Yusrizal, Y., Kusumo, T., and Rachmalio, M. F. (2022). Study on Purse Seine Catch Results Reviewed from Fishing Areas on KM. Anugrah in the Banda Sea Region – FMA 714. Journal of Applied Marine and Fisheries (JKPT) 4(2), 127-135.

[13] Asni, A., Kasmawati, and Sugianto, H. T. (2022). Study of The Level of Enviromental Friendliness of Purse seine Fishing Gear in PPI Pontap Palopo City. Journalof Indonesian Tropical Fisheries 5(2), 228–240.

[14] Siyoto, S., and Sodik, A. (2015). Basic Research Methodology (1st edition). Literasi Media Publishing 190 p.

[15] Ginting, P., Zamdial, and Muqsit, A. (2022). Analysis of Technical and Financial Aspects of Rawai Fishing Gear at Baai Island Port in Bengkulu City. Indonesian Journal of Marine and Fisheries 2(1): 15-30.

[16] Purwanto, Y., Santoso, H., Manohas, J., Zaini, M., Tumiwa, J. H., and Nugraha, E. (2021). Analysis of the diversity index and dominance of bottom gillnet catches in Kulu waters, North Minahasa Regency, Indonesia. AACL Bioflux 14(5), 2639-2649.

[17] Purnama, N. R., Ulfa, M., Miswar, E., Afranisa, Z., and Mardhatillah, I. (2024). Selectivity of basic longline fishing tools in Deah Raya, Banda Aceh. Indonesian Journal of Marine and Fisheries 4(3), 124-133.

[18] Dewanti, L. P., Burhanuddin, M. A. R., Ayi Yustiati, A., Ismail, M. R., and Apriliani, I. M. (2023). Selectivity of Purse Seine Waring Fishing Gear at Dadap Coastal Fishing Port (PPP) Indramayu Regency. Gorontalo Fisheries Journal 6(2), 108-118.

[19] Widyastuti, P. F., and Aini, N. (2021). The Influence of CAR, NPL, LDR on BANK Profitability (ROA) in 2017-2019. JIMAT 12(3), 1020-1027.

[20] Pamenan, A. R., Sunarto, S., and Nurruhwati, I. (2017). Selectivity of Purse Seine Fishing Gear at Muara Angke Fish Landing Base. Depik 6(2), 100-105.

[21] Sari, I. P., and Wibowo, I. M. S. M. (2023). Main and Bycatch Results of Purse Seine Fishing Gear at the Bajomulyo Coastal Fishing Port (PPP), Central Java. Unram Fisheries Journal 13(2), 447–455.

[22] Yuliawati, Brown, A., and Rengi, P. (2019). Differences in Main Catch, By-catch, and Discard Catch in Gombang Operated Day and Night in Sialang Pasung Village, Meranti Islands Regency. Journal of the Faculty of Fisheries and Marine Sciences, University of Riau 9(5), 1–10.

[23] Diningrum, T. D. B., Triyono, H., and Jabbar, M. A. (2019). Biological Aspects of Skipjack Tuna (*Katsuwonus pelamis*, Linnaeus 1758) in Southeast Sulawesi. Journal of Fisheries and Marine Extension 13(2), 139–147.

[24] Sartika, I., Sumaryono, Y., and Fadhilah, A. (2017). Analysis of Business Feasibility and Selectivity of Purse Seine Vessels 30 GT in Sibolga Waters, North Sumatra Province. Marine Fisheris 2(1), 5-7.

[25] Jumriani, B., Alimina, N., and Arami, H. (2020). Season of catching mackerel (*Decapterus* Spp.) landed in Kendari City. Journal of Aquatic Resources Management 5(1), 17–23.

[26] Mustofa, M. B., and Setyobudiandi, I. (2019). The relationship between gonad maturity of yellowtail scad (*Selaroides leptolepis* cuvier, 1833) and sea surface temperature in the Sunda Strait. Journal of Tropical Fisheries Management 3(1), 24-29.

[27] Sinaga, F., Tilaar, F. F., and Bataragoa, N. E. (2018). Reproductive characteristics of yellowtail scad *Selaroides leptolepis* (Cuvier, 1833) in Manado Bay Waters. Platax Scientific Journal 6(2), 46-57.

[28] Anggraeni, R., Solichin, A., and Saputra, S. W. (2015). Several aspects of the biology of yellowtail scad (*Selaroides leptolepis*) in relation to fisheries management at PPP Sadeng, Gunungkidul Regency, Yogyakarta. Journal of Maquares Management of Aquatic Resources 4(3), 230–239.

[29] Monintja, D. Z. R., and Mawardi, W. 1994. Study on the Abundance of Scad (*Sardinella fimbriata*) in Pelabuhan Ratu Waters (Phase I: recruitment and fishing mortality). Research Report. Faculty of Fisheries, Bogor Agricultural University. Bogor 104 p.

[30] Dhany, A. F., Prihantoko, K. E., and Setiyanto, I. (2023). The Level of Environmental Responsibility Small Pelagic Purse Seine Based on The Code of Conduct for Fisheries (CCRF) in Tanjungbalai Asahan Fishing Port, North Sumatra. JUPERTA 7(1), 24–33.