



(RESEARCH ARTICLE)



Purse Seine Selectivity Based on Catch Composition in the Banda Sea (Fish Management Area of Republic Indonesia FMA-RI 714)

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Abstract

Purse seine is the most widely used fishing gear by fishermen in Kendari. The fish caught landed at the Kendari Ocean Fishing Port (PPS) are of several types and sizes, namely Shortfin scad (*Decapterus macrosoma*), skipjack tuna (*Katsuwonus pelamis*), mackerel (*Euthynnus affinis*), bigeye scad (*Selar crumenophthalmus*) 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 of suitable types and sizes 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 identify the composition of fish caught by purse seine, analyze the level of selectivity of purse seine based on the composition of the catch and technical analysis of purse seine selectivity. This study used descriptive analysis with a survey method. Primary data were obtained from surveys, interviews, and documentation. Secondary data were obtained from ship documents and production data at PPS Kendari. Based on the research results, the composition of the fish catch consists of *D. macrosoma*, *K. pelamis*, *E. affinis*, *T. albacares*, *E. bipinnulata*, *S. crumenophthalmus*. *D. macrosoma* is the main and most dominant fish catch, which is 85%. Bycatch fish are 15%. The percentage of fish from the main catch that are suitable for catch is 25.58%. The level of selectivity of purse seine in Kendari is moderate. This is influenced by several factors such as the mesh size and the composition of the fish catch which contains several types and sizes. To increase the level of selectivity of 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: *Decapterus macrosoma*; Bycatch; Purse Seine; Composition; Selectivity

1. Introduction

Indonesia as an archipelagic country has many small islands and abundant marine resources. Based on production data from the Ministry of Maritime Affairs and Fisheries (KKP), the total national fisheries production in 2022 was 24,850,000 tons. This production is divided into capture fisheries with a total of 7,990,000 million tons and fisheries cultivation with a total of 16,870,000 tons. Capture fisheries productivity is the productivity of boats or ships used in fishing operations [1]. The relationship between the selectivity of fishing gear and the level of efficiency is very close, because the higher the selectivity of fishing gear, the greater the opportunity to get target fish according to the desired size and type. This can increase operational efficiency in terms of time, energy, and cost because fishermen do not need to carry out excessive sorting processes on board [2].

In addition, fuel consumption becomes more efficient because the process of searching for and catching target fish can be carried out more precisely. Thus, selective fishing gear not only plays a role in maintaining the sustainability of fish resources but also increases the efficiency of overall fishing efforts [3]. The fish caught landed at the Kendari Ocean Fishing Port (PPS) are of several types, namely Shortfin scad (*Decapterus macrosoma*), skipjack (*Katsuwonus pelamis*),

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mackerel (*Euthynnus affinis*), Spanish mackerel (*Scombridae*), fringescale sardinella (*Sardinella fimbriata*), Indian mackerel (*Rastrelliger* sp.) and others, for this reason, the selection of fishing gear should be carried out to obtain the target of catching the type and size of fish that are suitable for catching and minimizing bycatch [4].

The selectivity of fishing gear is a major problem in maintaining the sustainability of fish resources, because all fishermen tend to reduce the size of the net mesh to address the decreasing fish resources [5]. The level of selectivity of a fishing gear will have an impact on the creation of sustainable fish resources. The operation of fishing gear with a high level of selectivity will result in more efficient fishing efforts and the sustainability of fish resources in a water will remain sustainable, therefore it is necessary to study the selectivity of the purse seine [6].

The objectives to be achieved in this study are to identify the composition of the catch based on the type of fish and the measurement of the length of the main catch of fish caught, and the level of selectivity of the purse seine based on the composition of the catch, mesh size, and size of fish that are classified as suitable for fishing. It is expected that the results of this study can enrich the literature on the characteristics of purse seine selectivity and its impact on the composition of the catch, in the Banda Sea and for the government, the results of this study can be used as a consideration in the preparation and tightening of technical regulations for fishing gear, such as mesh size to reduce the amount of bycatch, and protect fish stocks that are not yet suitable for fishing.

This study is important to conduct even though various previous literatures state that purse seine fishing gear has a low level of selectivity and is not environmentally friendly. This is a strong reason for the need for empirical field evaluation. This study aims to provide the latest and specific information on the selectivity of the fishing gear based on the composition of the actual catch. With this approach, the technical factors that influence selectivity can be identified, as well as recommendations for improvements such as adjusting the mesh size, so that the use of purse seine can be directed to be more environmentally friendly and support sustainable fisheries.

2. Material and methods

This research activity was carried out for 4 months, starting from January 6 to April 5, 2025, using a purse seine ship operating in the Banda Sea (FMA-RI 714). The tools and materials needed include a ship, purse seine net, meter, scales, stationery, camera, and laptop.

2.1. Sampling and Data Collection Methods

The data that was successfully collected directly during this study included identifying the type and number of catches per boat trip, especially *D. macrosoma* as the main result, and measuring the length of the fish caught to determine the level of selectivity of the purse seine fishing gear. Secondary data is supporting data in research obtained from documentation, observation results, and information provided by existing units or institutions [7].

This data is used to complement and strengthen the primary data that has been collected. In this study, the author uses secondary data as a complement and supports the primary data collected directly during field practice. Secondary data is used to strengthen arguments, clarify concepts, and add depth to the analysis of the level of selectivity of the purse seine fishing gear and the composition of the fish catch.

2.1. Data Analysis Methods

Data analysis is an analysis that the author does on the data obtained during the research. Data analysis can provide information whose characteristics can be understood and are useful for drawing relevant conclusions. This analysis process includes activities such as grouping data based on their characteristics, cleaning data, transforming data, creating data models and finding important information from the data [8].

2.1.1. Descriptive Analysis

The analysis used in this study is descriptive analysis, namely analyzing data by describing it or 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 from operational preparation, handling the catch, and unloading the catch [9]. The analysis used in this study is a selectivity analysis based on the composition of the catch, an analysis of the relationship between the length and weight of the main catch and a technical analysis of the selectivity of fishing gear.

2.1.2. Composition of Catch Results

The composition of the fish catch is calculated to determine the number of fish species in a certain volume unit. According to [10]. The composition of the fish catch can be calculated using the following formula

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

Description

P = percentage of one type of fish caught;
 N₁ = number of catches to-i (kg); and
 N = total catch.

In this study, the author used *D. macrosoma* as the main catch variable for measuring the length of the fork to determine the level of selectivity of the purse seine fishing gear.

2.1.3. Selectivity Analysis

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 [11]. 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, laboratory testing, or using catch data. Some common methods used to measure the level of selectivity of fishing gear include the following [12]

- Mesh size.
- Length of fish caught.
- Analysis of catch data.
- Class interval scale formula

Data range (R)

Range is the difference between the highest data and the lowest data in a data set. The range provides a rough idea of how far the values in the data are spread out from the central value. The larger the range, the higher the level of spread of the data [13]. The formula used to calculate the range is as follows

$$\text{Range (R)} = X_{\max} - X_{\min}$$

Description

R = Range
 X_{max} = Maximum value
 X_{min} = Minimum value

Class Number Formula (Sturges Rule)

Sturges' rule is used to determine the optimal number of interval classes in presenting grouped data, especially in histograms or frequency distributions. This rule was developed by Sturges (1926), which assumes that the data is approximately normally distributed and uses logarithms as a mathematical approach [14], The formula used is

$$k = 1 + 3.3 \times \log(n)$$

Description

k: Number of classes
 n: Number of data

Class Interval Length Formula

The class interval length is used to determine the width of each class in the frequency distribution. This value is obtained by dividing the data range by the number of classes [15] the class interval length is calculated using the formula

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

Description

- I: Class interval length
- R: Data range
- K: Number of classes

Fish Length-Weight Relationship Formula [16].

$$W = aL^b$$

Description

- W : fish weight (g)
- L : fish length (mm)
- a and b : Condition Factor Constants

3. Results and discussion

3.1. Fishing ground

The fishing grounds in this study include the waters around Muna Island, Kabaena Island, and the northern waters of the Banggai Islands, all of which are still in FMA-RI 714. This location is known as a potential fishing ground for small pelagic fisheries, especially scad, which is the main target.

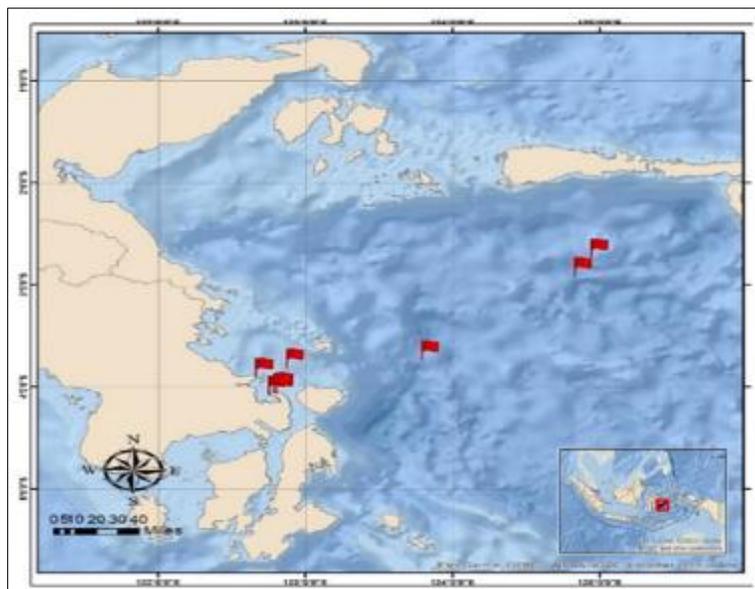


Figure 1 Fishing ground

3.2 Composition of Catch Results

The purse seine catch is large pelagic fish and small pelagic fish. Small pelagic fish are a group of fish that live in the surface layer to the mid layer and tend to form schooling. [17]. Some types of fish caught include *D. macrosoma*, *K. pelamis*, *E. affinis*, *T. albacares*, *E. bipinnulata*, *S. crumenophthalmus*. The target species is *D. macrosoma*.



Figure 2 Shortfin scad (*D. macrosoma*) as a target species

3.1.1. Composition of Fish Catch

The target species is the fish catch sought and expected by fishermen in carrying out fishing operations [18]. The target species is *D. macrosoma* depending on the fishing season. *D. macrosoma* is one of the small pelagic fish resources that has high potential and economic value in Southeast Sulawesi. The utilization of *D. macrosoma* resources in Southeast Sulawesi is generally carried out by purse seine [19].

Composition of Catch Results for the Entire Trip

Table 1 Composition of Catch Results for the Entire Trip

No.	Species	Composition of Catch Results (trip/kg)				Amount (kg)
		1	2	3	4	
1	<i>D. macrosoma</i>	1,396	2,510	481	3,620	8,007
2	<i>K. pelamis</i>		50			50
3	<i>T. albacares</i>		50			50
4	<i>E. affinis</i>		200		470	670
5	<i>E. bipinnulata</i>	100				100
6	<i>S. crumenophthalmus</i>		85		500	585
	Total	1,496	2,875	481	4,690	9,542

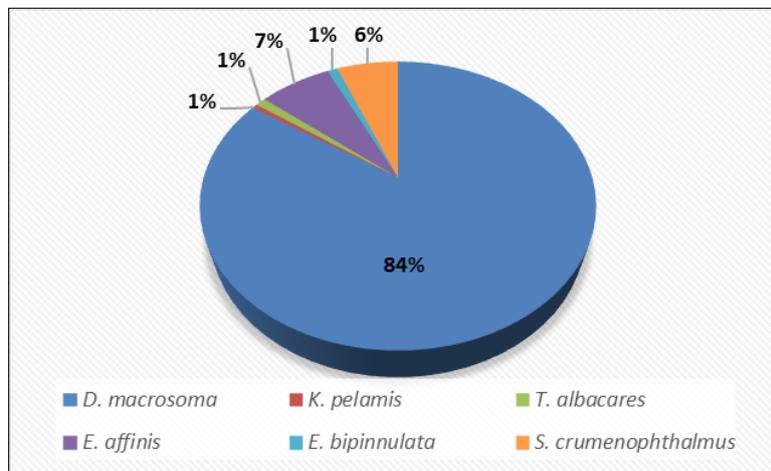


Figure 3 Composition of Catch Results

Based on the diagram above, it explains where the type of fish that has the highest composition value on land is *D. macrosoma* with a composition value of 85%, and the lowest composition value on land is *E. affinis* with a composition

value of 7%, *S. crumenophthalmus* with a composition value of 6%, *K. pelamis* and *T. albacares* with a composition value of 1% and *E. bipinnulata* with a composition value of 1%.

The description of the explanation related to the composition value of the types of fish caught shows varying values, where based on the research report [20] that fish resources in an aquatic environment including in Indonesian waters are combined or multi-species, causing differences in fish distribution patterns and having an impact on differences in fishing areas and the number and types of fish caught also have an impact on differences in the use of fishing gear for the types of fish that are the target of the catch [21]. A similar thing is explained by [22], that the difference in the number of fish species in an environment is influenced by the preferences of each type of fish regarding the water conditions that are their habitat for living and growing.

3.2. Fishing Gear Selectivity Analysis

3.2.1. Analysis Based on Composition of target species

The nature of fishing gear that catches fish of a certain size 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 the fishing gear to catch certain species with a specified size as well [23]. Fishing gear is said to be selective if the Main Catch Results (HTU) $\geq 60\%$ [24].

The percentage of *D. macrosoma* catches, which are the main target, is relatively high, namely 85% of the total catch because fishing operations during the practice were carried out in mid-February to April. Then the *D. macrosoma* fishing season based on *D. macrosoma* production data at the PPS Kendari occurred from March to September [25].

Table 2 Target species

No.	Target Species	Amount (kg)
1	<i>D. macrosoma</i>	8,007
	Total	8,007

The presentation of bycatch fish, namely *K. pelamis*, *E. affinis*, *T. albacares*, *E. bipinnulata*, *S. crumenophthalmus*, is 15% or 1,455 kg of the total fish catch.

Table 3 Bycatch

No.	Bycatch species	Amount (kg)
1	<i>K. pelamis</i>	50
2	<i>E. affinis</i>	670
3	<i>T. albacares</i>	50
4	<i>E. bipinnulata</i>	100
5	<i>S. crumenophthalmus</i>	585
	Total	1,455

The total main catch is greater than the total bycatch, so the selectivity value of the fishing gear is relatively high when viewed from the composition of the main catch. The comparison of the catch can be seen in the following diagram.

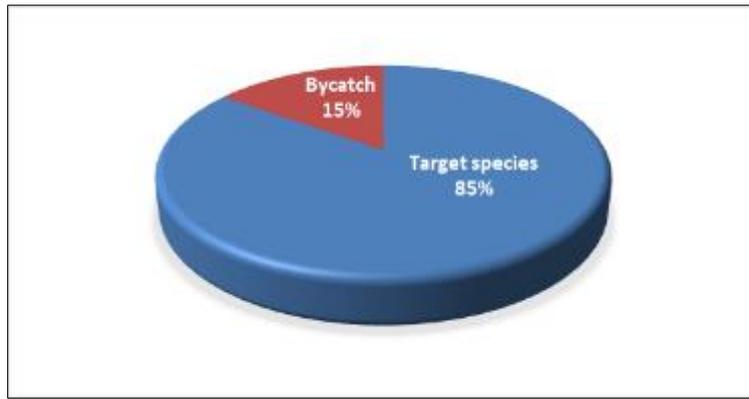


Figure 4 Comparison diagram of main and bycatch

Analysis of catch composition also helps in assessing the impact of bycatch. If the catch is dominated by bycatch, then this indicates a lack of selectivity in purse seine operations. From the diagram above, the number of target species dominates the total number of catches, which is 85%. This shows that the level of selectivity of the purse seine is at a high level.

3.2.2. Analysis based on the size of the main fish pole and the weight of the main fish catch.

The body length of the fish measured from the tip of the front mouth to the fork point of the caudal fin is called the fork length [26]. Each individual fish has a girth size and weight that varies depending on age, sex, and environmental conditions. *D. macrosoma* caught in February to March using purse seine fishing gear had a length ranging from 11.5 cm to 28.5 cm, and a weight ranging from 17 grams to 320 grams. Based on the length and weight measurements, an analysis of the relationship between length and weight was carried out to determine the growth pattern of the captured *D. macrosoma*. The following is a graph of the results of calculating length and weight against fish growth.

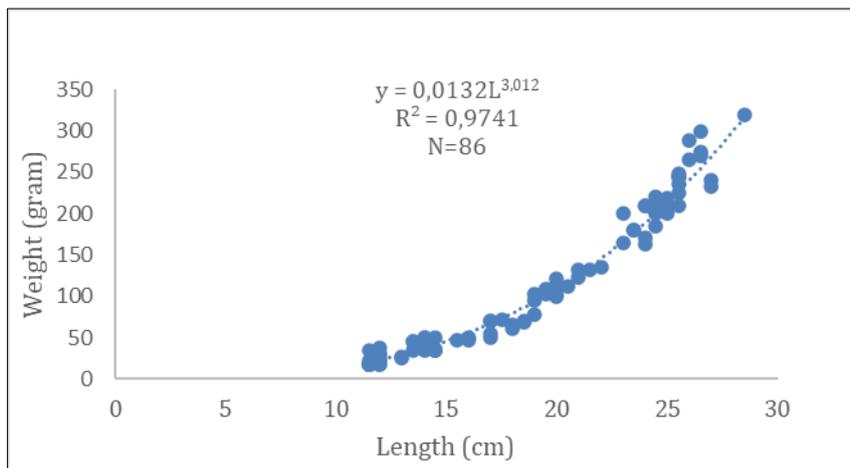


Figure 5 The relationship between length and weight in relation to the growth of *D. macrosoma*

Based on the analysis results in the graph above, the relationship between the length and weight of *D. macrosoma* shows a comparable pattern, but the growth in length is more dominant than the growth in weight. This is indicated by the growth coefficient value $b < 3$, which indicates that *D. macrosoma* experiences negative allometric growth. In other words, the fish grow longer faster than they gain weight. The determination coefficient value of $R^2 = 0.97$ indicates that 97% of the variation in fish weight can be explained by the increase in body length, while the rest (3%) is influenced by other factors such as the environment, food, and physiological conditions. The R^2 value approaching +1 also indicates that there is a very close relationship between the length and weight of *D. macrosoma*. This is in line with research [27] which states that the higher the R^2 value, the stronger the relationship between the length and weight of the fish. In addition, according to [28], an R^2 value approaching 1 means that the growth of fish weight is directly proportional to its body length. As for the distribution of the *D. macrosoma* class with a sample size of 86 with the highest fish length of

28.5 cm and the lowest fish length of 11.5. Class determination uses the Sturges rule, with the results seen in the graph below

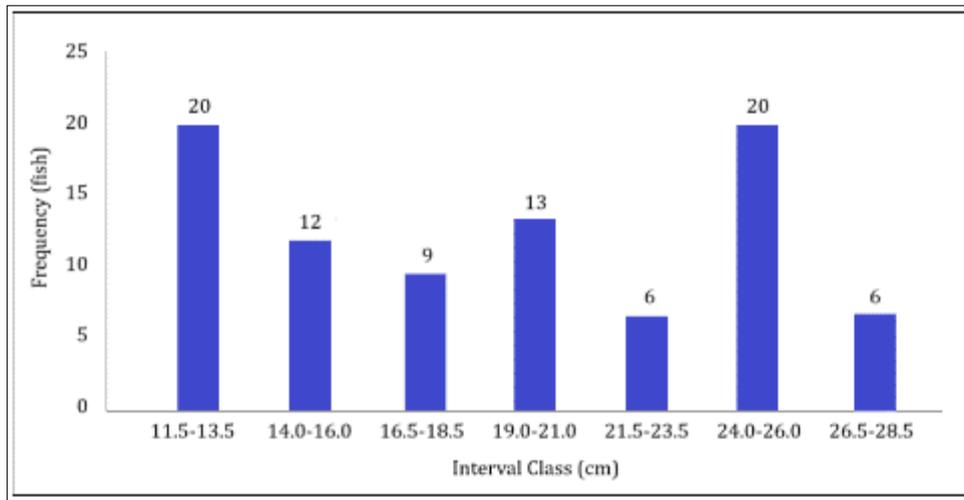


Figure 6 Distribution graph of *D. macrosoma* size classes

Furthermore, to determine the level of selectivity of purse seine, a data tabulation process can be carried out based on the *D. macrosoma* size class interval. According to [29]. The first size of male and female *D. macrosoma* gonad maturity is achieved at almost the same size, namely 24.5 cm and 24.7 cm respectively. and according to [30] the first size of male and female *D. macrosoma* gonad maturity is 24.7 cm and 25 cm, this indicates that the fish caught have experienced gonad maturity, so they are included as fish that are suitable for catching. The following table illustrates the percentage of *D. macrosoma* that are suitable for catching

Table 4 *D. macrosoma* Size Interval Class

No	Interval Class (cm)	Frequency (fish)	Gonad Mature	Immature Gonad	Capture Status	Information
1	11.5-13.5	20		20	not worth	
2	14-16	12		12	not worth	
3	16.5-18.5	9		9	not worth	
4	19-21	13		13	not worth	
5	21.5-23.5	6		6	not worth	
6	24-26	20	16	4	some are worth catching	16 fish \geq 24,5 cm (gonad Mature)
7	26.5-28.5	6	6		worth to catching	
	Amount	86	22	64		

Based on the table above, the number of samples used was 86 fish with various fork lengths. The largest number of fish was in the 11.5–13.5 cm size interval of 20 fish, while the smallest number was in the 26.5–28.5 cm size interval of 6 fish. The fish that were classified as suitable for catching were 22 fish (25.58%) of the total samples, namely fish with a minimum fork length of 24.5 cm and had mature gonads.

Meanwhile, the fish that were not suitable for catching were 64 fish (74.42%), consisting of fish that had not reached a suitable size for catching or had not matured gonads. Based on the number of fish caught that were suitable for catching, the level of selectivity of the purse seine can be categorized as still low, because most of the fish caught did not meet the size and condition of the gonads that were suitable for catching.

3.2.3. Selectivity scoring percentage

Table 5 Selectivity Level Factor

No.	Selectivity Level Factor	Selectivity Indicator	Value	Selectivity Criteria
1	Target species	≥ 60 %	85%	Selective
2	Fish Size Worth Catching	24,5 cm	25,58%	not Selective
3	Number of Fish Species Caught	Maximal 3 Species	6 Jenis	not Selective
4	Fishing Gear Specification Mesh Size	≥1 Inch	1 Inchi	Selective
5	Fishing Gear Specification Top Rope Length	≤400 m	625 m	not Selective

Based on the results of the level of selectivity, it shows that the purse seine fishing gear has a moderate level of selectivity. Because the main catch exceeds 60% of the total catch. However, there is still potential to increase its selectivity in order to minimize the capture of fish that are not yet suitable for capture and reduce bycatch.

4. Conclusion

The conclusions that can be drawn based on the research are as follows

- The composition of the catch is dominated by *D. macrosoma* at 85%, accompanied by bycatch such as *K. pelamis*, *E. affinis*, *T. albacares*, *E. bipinnulata*, and *S. crumenophthalmus*. Although the amount of the main catch is quite large, only 25.58% of *D. macrosoma* are classified as suitable for catch based on the minimum size, while most of the other fish are included in the category of not yet suitable for catch. This reflects that the level of selectivity of the fishing gear is still relatively moderate to low in relation to the species caught, so increasing selectivity is very much needed so that the fishing gear is more environmentally friendly and supports the sustainability of resources.
- The level of selectivity of the purse seine fishing gear is moderate. Although the target species (*D. macrosoma*) dominates the catch (85%), most of them are still not suitable for catch (only 25.58% are suitable). In addition, there are more than three types of bycatches, which show that this gear is not fully selective.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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