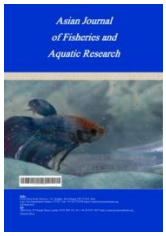

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Composition and Catch Rate of *Purse Seine* Fishery Unit at the Tegal Fish Landing, Central Java

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Purse seine fishing gear is one of the fishing gear used by the fisherman at the Tegal Fish Landing to catch pelagic fish. This study aims to analyze the composition of *purse seine* catches and catch rates based on the number of catches and trips to sea, determine the selectivity of *purse seine* fishing gear base on the number and species. The research method used survey methods and data in quantitative analysis, the analysis of the composition of the catch is secondary to the volume of *purse seine* catches at Tegal Fish Landing throughout September to November 2019. The capture rate was calculated using secondary data on the number of trips and the total production *of purse seine* at the Tegal Fish Landing from 2014 to 2018. Selectivity of *puse seine* fishing gear using primary data includes the number and weight of catches, identification of fishing gear, work equpment, safety equipment, supplies, navigation tools, accident history. The dominant variety of catch species was small pelagic fish, namely *Decapterus macrosoma, Sardinella lemuru,* and *Rastrelliger kanagurta*. The largest percentage of catches in September was 52% *Decapterus macrosoma*, 13% *Sardinella lemuru*, and *Rastrelliger kanagurta*. The location of the fishing grounds is in the WPP area 712 and 713 the average CPUE *purse seine* per year at Tegal Fish Landing was 26.710 kg or 26,7 tons per trip for each vessel. This shows that *purse seine* capture productivity was still quite low when compared to the size *of Gross Tonnage*. *Purse seine* gear for five fishing vessels that landed at Tegal Fish Landing selectively. During the study the proportion of the amount and weight of the five vessels was more thant 60%.

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Keywords: Purse seine; catch composition; catch rate; selectivity of fishing gear.

1. INTRODUCTION

Tegal Fish Landing is the "*fishing base*" of *purse seine fishing vessels*. The size *of the Gross Tonnage* (GT) *purse seine* ranges from 30 – 105 GT with a length of about 15 – 32 meters, a width of 5.5 – 8.5 meters, and a height of 1.7 – 10.0 meters. The larger the main dimensions of the vessel, the greater the ability of the vessel to carry nets and other fishing aids, thus the wider the distance of the *fishing ground* [1]. *Purse seine* is a multi-species fishing gear, in which it catches more than one species of fish because it catches fish by confining fish. In many cases, it is often found that the mesh size *of purse seine* fishing gear is very small. This can affect the catch obtained. At Tegal Fish Landing the *purse seine* is operated by one boat (one boat operated *purse seine*). The target of *purse seine* fishing is a herded pelagic fish or "*pelagic shoaling species*". The size of the vessel used purse *seine* fishing gear at Tegal Fish Landing < 60 GT with an engine power of < 250 PK [2]. Based on [3], regarding fishing lines article 22 paragraph 1c., the classification of *purse seine* is with a *minimum upper float rope* length of 600m and a mesh size of ≥ 1 inch and a boat size of ≥ 30 GT – 100 GT. The fishing grounds are on line III (> 12 nautical miles) WPPRI 571, 711, 712, 713, 715, and 718.

The waters around the Tegalsari Fishing Port have a sustainable potential of 35,838 tons / year. Fishing activities at sea are carried out by fishermen at the Tegal Fish Landing to meet local needs in the form of fresh fish or sent to markets in the form of pindang or salted fish [4]. Based on [5] the production factors of *the purse seine* capture unit were the size of the vessel, the power of the engine, the amount of fuel oil, the number of trips, the length of the trip, and the number of crew. The use of production factors carried out by fishermen is only based on their habits, not on adequate needs so that the use of these production factors is not necessarily efficient and appropriate.

The identification in this study is how productivity the yield and the rate of capture *of purse seine* operated by the fisherman at the Tegal Fish landing. The purpose of this study was to analyze the composition of *purse seine* catches and the rate of capture and how selective *purse seine* fishing gear landed at the Tegal Fish Landing.

2. RESEARCH METHODS

The data collection was carried out from September 2019 to November 2019. The research location is in the Tegal Fish Landing, Central Java. The tools used during the study were *purse seine*, scales, stationery, cameras to document the results of activities and the material during the study was the catch using *purse seine* fishing gear.

The study used a survey method with descriptive analysis. Survey methods are used to collect data and information. The data collected during the study are primary data and secondary data. Primary data includes the number and weight of catches from five *purse seine* vessels at the Tegal Fish Landing. Secondary data includes production data on *purse seine* catches as well as the number of trips and the number of vessels in 2014 – 2018 obtained from the Tegal Fish Landing.

All data were analyzed descriptively such as frequency and percent tables to determine the composition of the results, the rate of capture and the selectivity of the catch species of each of the five fishing vessels.

2.1 Selectivity of Catch Species

In the analysis of selectivity for the species of catch is seen from the proportion of the number and weight of the catch. It is stated that in order to find out the proportion of weight and the number of catches, each fishing unit uses the formula for catching fish [6] as follows:

2.1.1 Proportion of weight of the main catch and by-catch of *purse seine* fishing gear

a. Proportion of weight of the main catch of *purse seine* fishing gear (P_{HTU})

$$P_{HTU} = \frac{a_1}{a_1+b_1} \times 100\%$$

b. Proportion of weight of *purse seine* fishing gear (P_{HTS}) by-catch

$$P_{HTS} = \frac{b_1}{a_1+b_1} \times 100\%$$

Description:

a_1 : Weight of the main catch of *purse seine* fishing gear (Kg)

a_2 : Weight of the purse seine fishing gear by-catch (Kg)

2.1.2 Proportion of the number of main catches and by-catches of *purse seine* fishing gear

a. Proportion of the number of main catches *of purse seine* fishing gear (Q_{HTU})

$$Q_{HTU} = \frac{a_2}{a_2+b_2} \times 100\%$$

b. Proportion of the number of *by-catches of purse seine* fishing gear (Q_{HTS})

$$Q_{HTS} = \frac{b_2}{a_2+b_2} \times 100\%$$

Description:

a_1 : Weight of the main catch of *purse seine* fishing gear (Tail)
a_2 : Weight of the bycatch of *purse seine* fishing gear (Tail)

2.2 Capture Rate

In the analysis of the capture rate, the data collected is the catch (species, kg/trip) and trip period. The collection of secondary data (*desk study*) came from the invetarization of official publications on the number of fishermen in *purse seine* fishing units, catches and aspects of the catch rate from *other publications* of the research results. Formula used for capture rate [7]

Capture Rate (cr) = Catch/Effort

Description:

Cr : Capture rate (kg/hour)
Catch : Catch (kg)
Effort : Attempted arrest (Trip)

3. RESULTS AND DISCUSSION

3.1 General State of the Research

The fishing gear used by PPP Tegalsari fishermen amounted to 913 units of fishing gear. The fishing gear consists of 168 units of *purse seine* fishing gear, 23 units of *gillnet* fishing gear, 76 units of *trammel nets*, 87 units of squid net fishing gear, 293 units of cantrang fishing gear, 19 units of beach trawl fishing gear, and 46 units of folding bubu fishing gear.

The fishing gear that is commonly used after the cantrang fishing gear in The Tegal Fish Landing is *purse seine* fishing. Purse *seine* fishing gear is a fishing gear that contributes to a fairly high catch at the Tegal Fish Landing. Purse *seine* fishing gear contained in Tegal Fish Landing has a GT size, vessel dimensions, and a fairly high capacity compared to other dominant fishing gear.

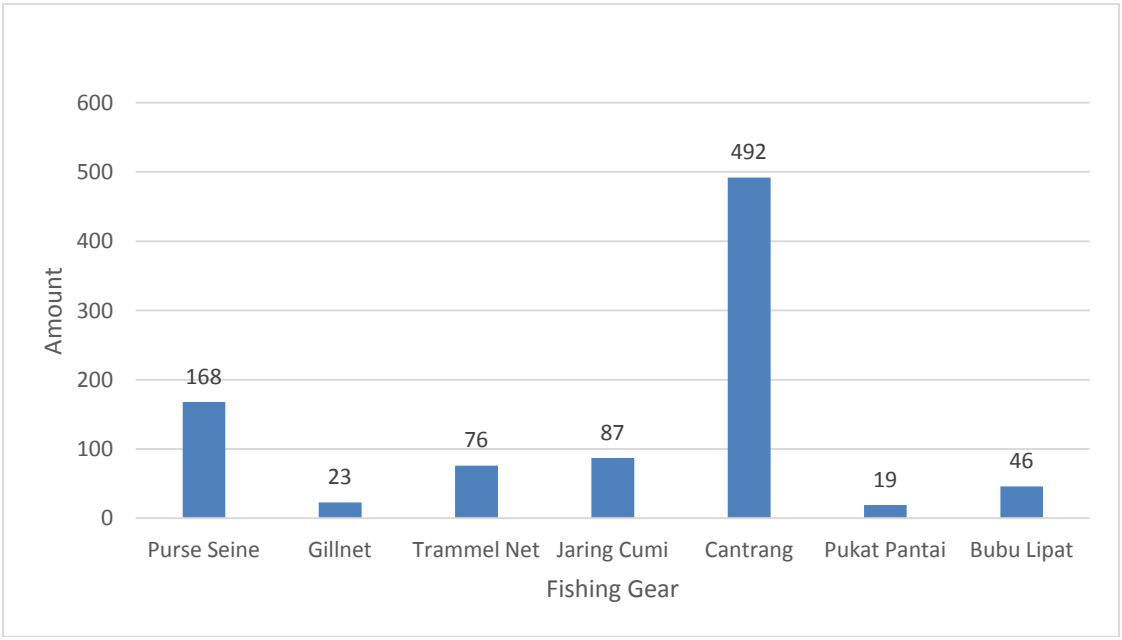

Fig. 1. Number of fishing gear in the tegal fish landing

3.2 Fish Fisheries Production at Tegal Fish Landing

The catch of fish that landed at the Tegal Fish Landing was mostly obtained from *purse seine fishing vessels*.

Based on Fig. 2. The highest amount of fish production in 2015 was 15,243,980 kg, while the lowest total production in 2018 was 10,523,317 kg. Fish production has decreased from 2016 with a weight of 13,035,910 kg until 2018 reaching 10,523,317 kg. The decrease in fish catches in 2016 – 2018 occurred due to a decrease in the number of *purse seine* fishing gear at the Tegal Fish Landing.

3.3 *Purse Seine* Fishing Gear Unit

3.3.1 *Purse Seine* fishing gear

Purse seine fishing gear consists of pouches, wing bodies, wings, *selvadge,* upper ris rope, lower ris rope, ballast, buoy, color rope, and ring [8]. The number of tools used in this study were five *purse seine* fishing gear, each of which had a different size and number (Table 1).

The mesh material used by *purse seine* fishing gear is nylon or also called *polymide* 6.6. The ballast and ring material used in *purse seine* fishing gear is tin coated by brass. The ballast used on the *purse seine* weighs 1,000 grams and the ring weighs 500 grams in one ballast and ring unit. Based on the interview results of the skipper of the *purse seine* vessel, each meter of net there are two to three ballast units, one ring unit and four to five buoy units, this is made so that when *setting* the net will widen to the bottom perfectly.

3.3.2 Fishing vessels

As a determining factor for success in fishing operations, it should have a vessel size and propulsion that corresponds to the type of fishing gear used [9]. The *purse seine* vessels used as research are the Budi Luhur vessel, Sumber Rezeki, Usaha Maju, Abadi Makmur, and Wijaya 5 (Table 2).

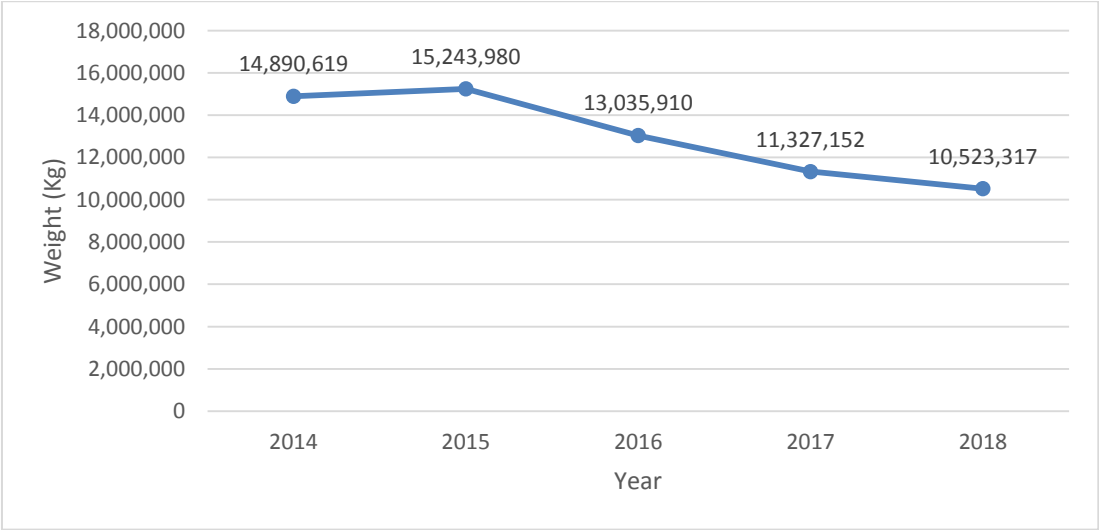

Fig. 2. Graph of Fish Production in the tegal fish landing with fishing gear *Purse Seine* 2014 – 2018

Table 1. *Purse Seine* fishing gear data

Vessel Name	Budi Luhur	Sumber Rezeki	Usaha Maju	Abadi Makmur	Wijaya 5
Fishing Gear Lenght (Meter)	500	400	400	400	400
Fishing Gear Wide (Meter)	150	100	120	100	120
Mesh Size (Inch)	1	1	1	1	1
Ring (Unit)	500	400	400	400	400
Ballast (Unit)	850	900	880	900	880
Lifebuoy (Unit)	2750	1750	2200	1750	2200

The material of *the purse seine* vessel uses wood material. The vessel used has a GT larger than 60 GT and has a PK of more than 200. Based on [10] the larger the GT of the vessel the larger the PK engine used to increase the production and operation of fishing gear with minimum expenditure. The *purse seine* operates for 58 days on a single trip. The *purse seine* vessel that was researched had a crew of 18-30 people, this was because at the time of lifting the net on the vessel still used human labor and *the whinch hauler* was only used to help raise fishing gear onto the vessel.

3.3.3 Arrest aids

The fishing aids used in *purse seine* vessels are usually lights and sponges. These tools can be used simultaneously, but they can also be used interchangeably. The rumpon used by *purse seine* fishermen at Tegal Fish Landing is made of waring. According to local fishermen, waring material is used because it is more durable compared to coconut leaves. Purse *seine* vessels at Tegal Fish Landing use three types of lights as fishing aids, namely squid lights, galaxy lights, and ancak lights (Table 3).

The function of the three lights is the same, that is, to lure the fish to come, except that they are different in the time of operation. The first time the lamps operated were galaxy lights, because the light range of the galaxy lights was quite wide, so the chances of the fish approaching the *purse seine* vessel were greater, after the fish gathered closer, the galaxy lights were turned off and replaced by squid lights and ancak lights that were operated at the same time as the sponge.

The placement of squid lights and galaxy lights is on board vessels, while ancak lights are operated at the same time as the rumpon is placed in the waters. The number of these aids varies greatly for each *purse seine* vessel, squid lights range from 5 -72 sets, galaxy lights 0 - 36 pieces, ancak lamps 0 - 22 pieces, while rumpon only ranges from 0 - 1 pieces.

3.4 Composition of the Catch

Purse seine vessels at Tegal Fish Landing generally catch eight species of catches, namely kite fish, pomfret, mackerel, selar fish, minnows, cob fish, lemuru fish and mackerel. Kitefish is the most dominant catch among the other eight species of catches (Table 4).

Based on Table 4. It shows that the catch of *purse seine* fishing gear at the Tegal Fish Landing during September – November has fluctuated. The dominating average catch production is kite fish of 254,822 kg with a percentage of 53.47% and lemuru fish of 90,916 kg with a percentage of 13.70%, while the fish with the lowest production is mackerel at 1,566.66 kg with a percentage of 0.24%. The average production of *purse seine* fishing gear for the last three months (September – November) of 2019 was 666,632.7 kg. The highest production in September was 1,229,065 kg. October was the lowest catch production month, at 284,417 kg.

Table 2. *Purse Seine* fishing vessel data

No	Vessel Name	Gross Ton (GT)	Length (P) (Meter)	Width (L) (Meter)	In (D) (Meter)	Horses Power (PK)	Long Trip	Crew
1	Budi Luhur	69	22,30	6,87	2,25	270	58	25
2	Sumber Rezeki	64	22,70	6,20	1,83	250	58	23
3	Usaha Maju	67	21,90	6,75	2,10	260	58	24
4	Abadi Makmur	64	23,00	6,30	1,86	260	58	20
5	Wijaya 5	64	22,50	6,60	1,90	250	58	21

Table 3. *Purse Seine* vessel fishing aids at tegal fish landing

No	Arrest Aids	Sum	Price (Rp)
1	Galaxy Lights	0 – 36 pieces	1,000,000/piece
2	Squid Lamp	5 – 72 set	5.000.000/set
3	Ancak Lights	0 – 22 pieces	3.000.000/set
4	Rumpon	0 – 1 piece	1,000,000/piece

Table 4. Composition of the catch September – November 2019

Species	Catch (kg)						Average	%
	September	%	October	%	November	%		
Decapterus kurroides	637.055	52%	142.660	50%	284.751	60%	354.822	53,47%
Parastromateus niger	4.531	0%	814	0%	1.799	0%	2.381,33	0,36%
Rastrelliger kanagurta	134.111	11%	26.806	9%	44.894	9%	68.603,67	10,34%
Selar crumenophthalmus	71.501	6%	3.705	1%	25.986	5%	33.830,67	5,08%
Sardinella fimbriata	114.064	9%	55.378	19%	17.638	4%	62.360	9,40%
Auxis rochei	108.195	9%	9.411	3%	30.151	6%	49.252,33	7,42%
Sardinella lemuru	157.320	13%	45.449	16%	69.979	15%	90.916	13,70%
Scomberomorus commerson	2.288	0%	194	0%	2.218	0%	1.566,66	0,24%
Total Catch	1.229.065	100%	284.417	100%	477.416	100%	663.632,7	100%

3.5 Selectivity of Catch Species

Selectivity analysis of the species of catch is carried out by knowing the proportion of the number and proportion of the main catch with the by-catch.

3.5.1 Proportion of catch weight

The proportion of the weight of the catch is an analysis method used to determine the selectivity of the catch of a fishing gear. The proportion of the weight of the catch is seen from the comparison of the number of main catches with the by-catches in the form of percentages (Fig. 3).

Based on Fig. 3, the percentage of total weight of the main catch obtained was 78.64%, while the percentage of by-catch weight obtained was 21.36%. The total weight obtained in the main catch was 1,565,693 kg and the total weight obtained in the by-catch was 425,205 kg.

Purse seine fishing gear used in TPI Pelabuhan fishermen is selective in the selectivity of catches in the calculation of the proportion of catch weights, this is obtained ≤ 60% of the total catch, then the fishing gear can be said to be selective [11].

3.5.2 Proportion of number of catches

The selectivity of the catch is also seen from the proportion of the number of catches. The proportion of the number of catches looks at the comparison of the number of main catches with by-catches in the form of percentages (Fig. 4).

Based on the picture above, the percentage of the number of main catches was obtained at 77.53% while the percentage of by-catches obtained was 22.47%. The total number obtained in the main catch was 9,762,121 heads and the total number of by-catches was 2,829,588 heads. Based on the analysis of the proportion of the number of catches, the percentage value of the proportion of the main catch of the five vessels is more than 60%. Based on [12] that the factors that cause many of these non-target resources can be influenced by seasonal or habitat conditions and geographical areas that have a potential impact on species composition and community structure.

3.5.3 *Purse Seine* arrest rate at tegal fish landing

The catch rate or *Catch per unit Effort* (CPUE) is calculated to find out what the average production amount of catch is for each unit of fishing gear per fishing trip. With the total number of arrested vessels in 2014 – 2018 shows that there are fluctuations in *purse seine* vessels at the Tegal Fish Landing. This affects the total production of *purse seine* catches per year. The results of the calculation of the capture rate can be seen in (Table 6).

The decrease in the number of trips occurred from the period 2015 - 2018. Declines ranged from 1% to 5% in the last five years. Impact on

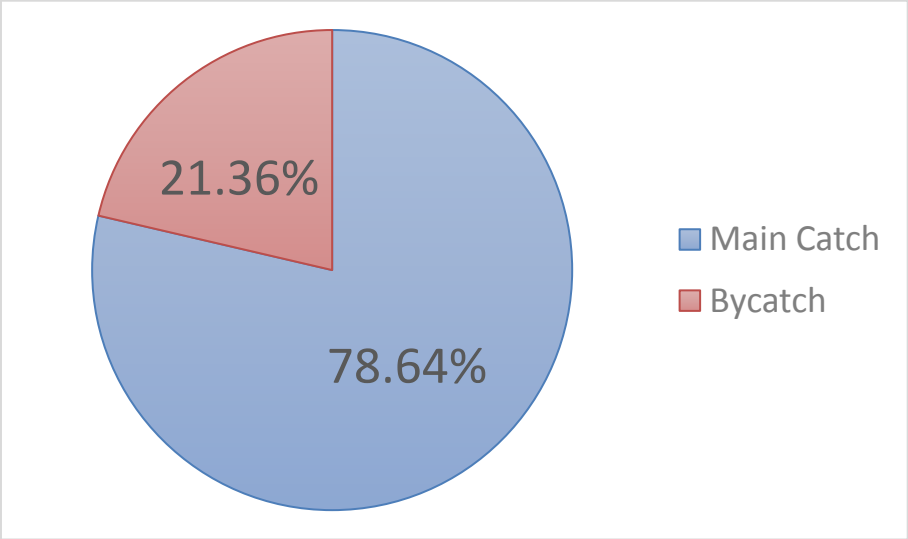

Fig. 3. Proportion of total weight of main catch and By-Catch September – November 2019

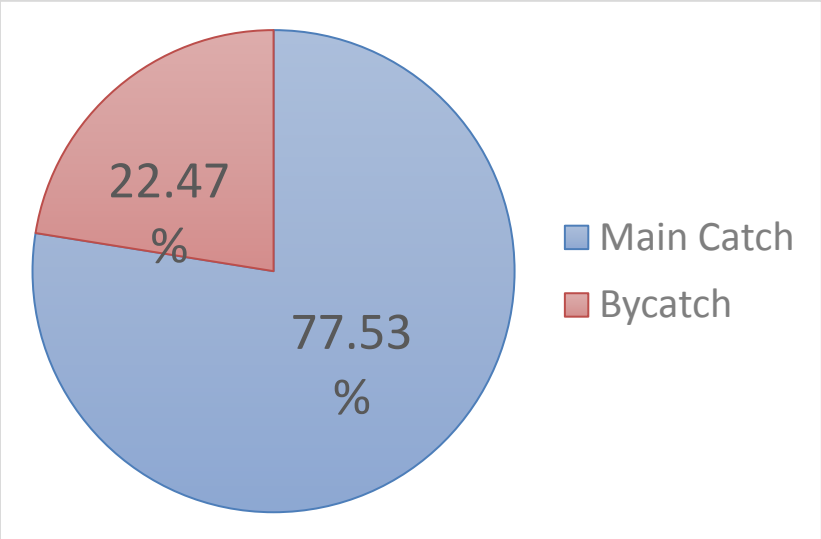

Fig. 4. Proportion of total number of main catch and by-catch September – November 2019

Table 5. Number of vessels, total trips per year *Purse Seine* at the tegal fish landing in 2014 – 2018

Year	Number of Vessels (units)	Total trips/year	Production per year (kg)
2014	132	528	14. 900. 619
2015	129	516	15. 035. 910
2016	125	500	13. 035. 910
2017	117	468	11. 327.252
2018	102	408	10. 573. 334

Table 6. CPUE *Purse Seine* and total trips per year at the Tegal Fish Landing in 2014 – 2018

Year	CPUE (kg/trip)	Trip
2014	28. 220,87	528
2015	29. 139,36	516
2016	26. 071,82	500
2017	24. 203,53	468
2018	25. 915,03	408

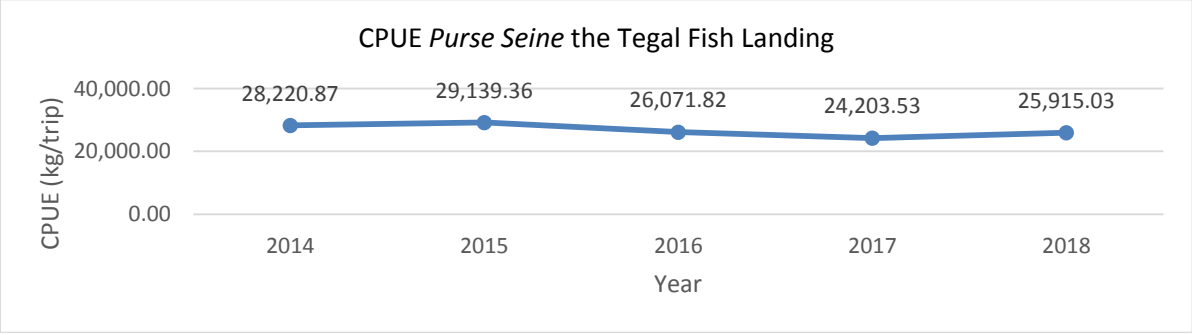

Fig. 5. CPUE *Purse Seine* chart per year at the tegal fish landing in 2014 – 2018

the decrease in the number of trips and the number of *purse seine* fishing vessels at the Tegal Fish landing. However, there were several years that showed an increase in the rate of arrests, namely in 2015, which was 29,139.36 with a percentage of 22%. Meanwhile, the

decrease in the rate of arrests in 2018 was 24,203.53 with a percentage of 18%. The average CPUE *purse seine* per year at Tegal Fish Landing is 26,710 kg or 26.7 tons per trip for each vessel. This shows that the productivity of *purse seine* capture is still quite low when compared to the *gross tonnage* size of vessels of 69 to 125 tons.

4. CONCLUSIONS

Based on the results of the research that can be concluded are:

1. The dominance of the species of fish caught by the purse seine fleet is a small pelagic fish with the following composition:
   a. *Decapterus macrosoma*
   b. *Sardinella lemuru*
   c. *Rastrelliger kanagurta*
2. CPUE averages 26,710 kg or 26.7 tons per trip for each vessel. This shows that the productivity *of purse seine* capture is still quite low when compared to the *gross tonnage* size of vessels of 69 to 125 tons.
3. *Purse seine* fishing gear for five fishing vessels that land at Tegal Fish Landing selectively. During the study, the proportion of the amount and weight of the five vessels was more than 60%

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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