The Selectivity of Purse Seine Againt *Euthynnus affinis* Catch in PPN Muara Angke Jakarta

Donny Samudra[1*], Junianto[1], Dedy Supriadi[1], Izza M. Apriliani[1] and Alexander M. A. Khan[1]

[1]Faculty of Fisheries and Marine Science, Universitas Padjadjaran, P.O.Box 45363, Jatinangor, Indonesia.

Authors' contributions

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

Original Research Article

ABSTRACT

Purse seine is one of the fishing gear that has been used by PPN Muara Angke fisher to catch pelagis fish. The selectivity of *purse seine* was still being researched until now . This research was conducted determine the selectivity of purse seine fishing gear with parameter the length of *Euthynnus affinis*, weight and numbers catch on purse seine fishing gear landed in PPN Muara Angke. The research used a survey method with quantitative descriptive analysis. The sampling method used in this was purposive sampling and random sampling. The data collected during the research were primary data and secondary data. Primary data included the number and weight of catches, fork length of *Euthynnus affinis* from five purse seine fishing vessel in PPN Muara Angke. Secondary data included production data of purse seine catches from 2015-2019 and vessel data obtained from Central Port Management Unit Jakarta and PPN Muara Angke. Purposive sampling used for the number of catch, weight of catch, production of purse seine catch from 2015-2019 and purse seine fishing vessels data. Random sampling used for fork length Euthynnus affinis fish, 250 samples were taken randomly on one purse seine fishing vessel. The research results pusre seine fishing gear which was landed at PPN Muara Angke was not selective due to the percentage length of the *Euthynnus affinis* was worth, proportion of amount and weight less than 60%.

_____

Corresponding author: Email: Putdon010@gmail.com;

Keywords: Purse seine; Euthynnus affinis; selectivity; eco-friendly.

1. INTRODUCTION

One of the attempts that can be carried out to continue the sustainability of fish resources is the use of selective fishing gear [1]. Selective fishing gear is a fishing gear that catches decent fish caught, both in age and size, and this fishing gear can escape fish that are not decent fish caught, protected fish, and unwanted fish without injuring or killing them [2]. A purse seine is a multi-species fishing gear, where it catches more than one type of fish because of catching fish by confining fish. In many cases, it is often found that the mesh size of purse sine fishing gear is very small. This can affect the catch obtained. In the study [3], the catch of purse seine in Muara Angke is very diverse, with the number of main catch is 1:4 with by-catches. High catch diversity is worried to threaten the reduced sustainability of marine biota species.

Euthynnus affinis is high productivity for the category of pelagic fish. According to the data obtained from the report of One Marine and Fishery Production Data 2017 [4], the productivity of *Euthynnus affinis* in Jakarta was 13,583 tons, and the economical price of *Euthynnus affinis* was IDR 271,670,094, so that *Euthynnus affinis* is highly sought after by fishermen due to its high selling price. The increasing *Euthynnus affinis* consumers make the fishermen have to meet the consumer demand by maximizing the *Euthynnus affinis* catches without looking at the sustainability of *Euthynnus affinis*. The tuna stocks in Indonesian waters have decreased due to poor recruitment, illegal fishing, and inadequate closed fishing season scheme [3]. The catch rate of *Euthynnus affinis* in the Java Sea has been fully exploited that can cause stock depletion of *Euthynnus affinis* [5]. Therefore, there must be control over the catches of *Euthynnus affinis* to create long-term sustainability, and *Euthynnus affinis* remains sustainable.

Identification in this research is how selective the purse seine to the catches of *Euthynnus affinis* landed in PPN Muara Angke. The aim of this research is to determine the selectivity of purse seine fishing gear with parameter the length of *Euthynnus affinis*, weight and numbers catch on purse seine fishing gear landed in PPN Muara Angke. The use of this research is to provide information regarding the selectivity of purse seine fishing gear to the catch of *Euthynnus affinis* of purse seine fishing gear landed in PPN Muara Angke.

2. RESEARCH METHODS

The data collection of this research was conducted from June 2020 to November 2020. The research site was in the PPN Muara Angke, Kecamatan Penjaringan, Jakarta Utara City, DKI Jakarta.

The data collection of this research was conducted from June 2020 to November 2020. The research site was in the PPN Muara Angke, Kecamatan Penjaringan, Jakarta Utara City, DKI Jakarta. Tool used during research is purse seine, scale with a precision of 0.1 gram, meter with a precision of 1 cm, camera to document research activities, stationery, hand taily counter and ingredient during research is catches and *Euthynnus affinis* from *purse seine*.

The research used a survey method with quantitative descriptive analysis. The survey method was used to collect data and information. The sampling method used in this was purposive sampling and random sampling. The data collected during the research were primary data and secondary data. Primary data included the number and weight of catches, fork length of *Euthynnus affinis* from five purse seine fishing vessel in PPN Muara Angke. Secondary data included production data of purse seine catches from 2015-2019 and vessel data obtained from Central Port Management Unit Jakarta and PPN Muara Angke. Purposive sampling used for the number of catch, weight of catch, production of purse seine catch from 2015-2019 and purse seine fishing vessels data. Random sampling used for fork length *Euthynnus affinis* fish, 250 samples were taken randomly on one purse seine fishing vessel.

All data were analyzed descriptively like frequency table and percent to determine the rate of capture, selectivity of length size *Euthynnus affinis* catch and selectivity of the type of catch of each five fishing vessels.

2.1 Selectivity of Length Size *Euthynnus affinis* Catch

The analysis of the selectivity of length size *Euthynnus affinis* caught used Sturges formula [6] as follows:

1. The determination of the number of classes in *Euthynnus affinis* length

$$K = 1 + 3,3 \log n$$

Notes:

K= Number of class in *Euthynnus affinis* length (class)
n= Number of data in *Euthynnus affinis* length (fish)

2. The determination of the wide for each class in *Euthynnus affinis* length

$$C = \frac{Longest\ Data - Shortest\ Data}{K}$$

Notes:
C= Interval width for each class in *Euthynnus affinis* length (cm)
K= Number of classes in *Euthynnus affinis* length (class)

3. Determining the lower limit of the first class.
4. Writing the number of frequencies for each class in *Euthynnus affinis* length.
5. Classifying the *Euthynnus affinis* with decent size caught and decent size caught in the form of a percentage.

One of the indicators that fishing gear is selective to the catches is if Length of first capture (Lc) > Length of first matured (Lm) and the number of length proportion of decent *Euthynnus affinis* caught ≥ 60% from the number of length proportion of the whole *Euthynnus affinis* [7]. This research used the results [8], where the first value of gonad maturity from *Euthynnus affinis* of 43.2 cm was used as a reference for the fork length of decent *Euthynnus affinis* caught.

2.2 Selectivity for the Type of Catches

In the analysis of selectivity for the type of catches, it was seen from the proportion of the number and weight of catches. Stated that in order to find out the proportion of weight and number of catches, each fishing unit uses to catch fish using the formula [9] as follows:

1. **The proportion of the weight of main catch and by-catch from purse seine fishing gear**

   a. The proportion of the weight of the main catch from purse seine fishing gear ($P_{Main\ catch}$)

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

   b. The proportion of the weight of by-catch from purse seine fishing gear ($P_{By-catch}$)

   $$P_{By-catch} = \frac{b_1}{a_1 + b_1} \times 100\%$$

notes:
a_1: The weight of main catch from purse seine fishing gear (Kg)
b_1: The weight of by-catch from purse seine fishing gear (Kg)

2. **The proportion of the number of main catch and by-catch from purse seine fishing gear**

   a. The proportion of the number of main catch from purse seine fishing gear ($P_{Main\ catch}$)

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

   b. The proportion of the number of by-catch from purse seine fishing gear ($P_{By-catch}$)

   $$Q_{By-catch} = \frac{b_2}{a_2 + b_2} \times 100\%$$

Notes:
a_2: The number of main catch from purse seine fishing gear (Fish)
b_2: The number of by-catch from purse seine fishing gear (Fish)

The proportion of weight and number is made in the form of a percentage. If the proportion of the main catch obtained ≥ 60% of the total catches, then the fishing gear can be stated as selective [7].

3. RESULTS AND DISCUSSION

3.1 The Production of *Euthynnus affinis* in PPN Muara Angke

The catches of *Euthynnus affinis* landed in PPN Muara Angke were mostly obtained from the purse seine fishing vessel.

Based on the figure above, the highest total production of *Euthynnus affinis* in 2017 was 865,493 kg, while the lowest total production of *Euthynnus affinis* in 2019 was 200,547 kg. The production of *Euthynnus affinis* has increased from 2015 with 384,280 kg to 2017 with 865,493

kg. When entering 2018 to 2019, the production of *Euthynnus affinis* has decreased up to 200,547 kg in 2019. Based on the results of the interview with the harbormaster officer and vessel owner, in 2018, the vessels that previously used purse seine fishing gear switched to stick-held dip-net fishing gear. This is because the company's board targeted squid catches for the raw material needs of the company.

3.2 Purse Seine Fishing Gear Unit

3.2.1 Purse Seine Fishing Gear

Purse seine gear consists of main nets, wing nets, bad nets, selvage, upper rigging, rope lifeline, top rigging rope, bottom rigging rope, corrugated rope, ballasts, and rings [10]. The number of fishing gear used in this research was five purse seine fishing gears, each of which has a different size and number (Table 1).

The net material used in purse seine fishing gear is nylon. Ballast and ring materials used in purse seine fishing gear are tin coated with brass. The ballast used in purse seine has 1,000 grams by one ballast, and the ring is 500 grams by one ring. According to the purse seine vessel captain, each meter of net contains two to three ballast, one ring, and four to five lifebuoys. This made so that when conducting a setting, the net will widen to the bottom perfectly.

3.2.2 Fishing Vessel

As a critical success factor in the catching operation, the Purse Seine coat should have size and propulsion according to the type of fishing gear used [11]. Purse seine vessels used in this study were Sumber Mulya 02, Makmur Jaya 78, Selat Jaya 06, Bintang Makmur, and Sumber Makmur (Table 2).
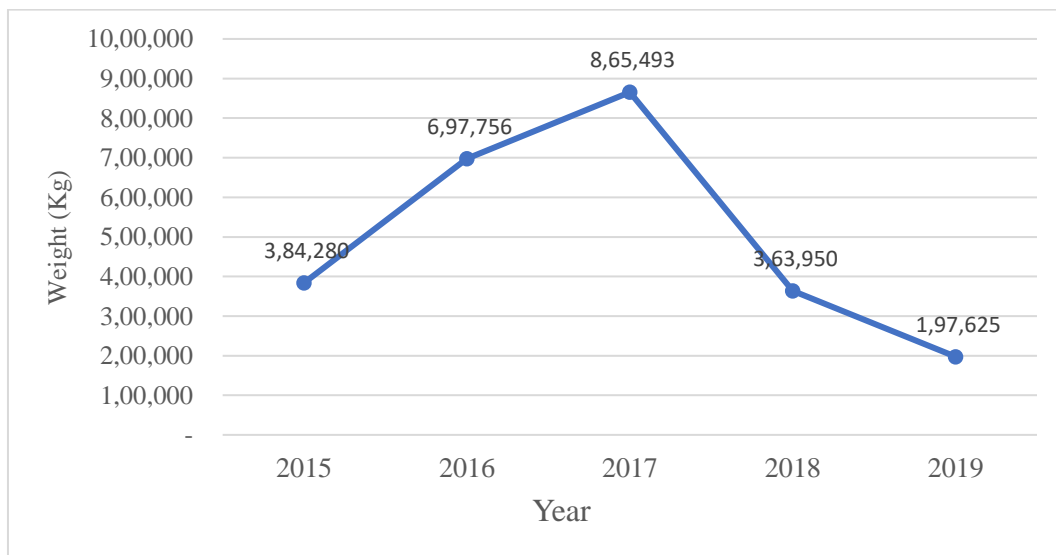
Fig. 1. Graph Production of *Euthynnus affinis* Catches with Purse Seine Fishing Gear in 2015-2019

Table 1. Purse Seine Fishing Gear Data

	Vessel				
	Sumber Mulya 02	Makmur Jaya 78	Selat Jaya 06	Bintang Makmur	Sumber Makmur
Fishing Gear Length (Meter)	400	400	400	400	400
Fishing Gear Wide (Meter)	100	100	130	120	120
Mesh Size (Inch)	1	1	1	1	1
Ballast (Unit)	900	900	850	880	880
Ring (Unit)	400	400	400	400	400
Lifebuoy (Unit)	1750	1750	2500	2200	2200

Table 2. Purse Seine Vessel Size and Engine Data

No	Vessel	Gross Ton	Length (Meter)	Wide (Meter)	Deep (Meter)	Machine	Paarden Kracht (PK)
1	Sumber Mulya 02	89	21.37	6.83	2.66	Mitsubshi	215
2	Makmur Jaya 78	84	23.90	6.60	2.00	Mitsubishi	280
3	Selat Jaya 06	87	20.30	6.70	2.63	Mitsubishi	200
4	Bintang Makmur	81	22.00	6.20	2.50	Nissan	300
5	Sumber Makmur	87	21.50	6.50	2.40	Nissan	280

The material of the purse seine vessel uses wood. Furthermore, the purse seine vessel uses two to three drive engines, one line hauler for pull purse line, and a cold storage machine in the vessel hatch. Purse seine vessel operates for three to six months in one trip. Purse seine vessel landed in PPN Muara Angke had 21-28 crews. This is because when pulling the net on to the vessel still uses human power. The fishing vessel that has the largest GT is Sumber Mulya 02, with 89 GT and the fishing vessel that has the smallest GT is Bintang Makmur, with 81 GT. On average, purse seine fishing gear in PPN Muara Angke have 80-90 GT and machine 200-300 PK.

3.3 Selectivity of Purse Seine Fishing Gear

3.3.1 Selectivity of Fork Length Size of *Euthynnus affinis*

The length of the initial level of gonad maturity used in this research was the result of the study by Masuswo et al. [8], which obtained the first value of *Euthynnus affinis* gonad maturity was 43.2 cm. According to Maulidin [6], the catches with decent size caught can provide the opportunity for catch target fish to be able to spawn before being caught so that the

recruitment process can run properly and the resource stock is still maintained. Knowing the length of caught *Euthynnus affinis* can be used to find out the level of selectivity of fishing gear based on the feasibility of catch size.

Based in Table 3, Sumber Mulya 02 fishing vessel on class 45,2-47,2 cm has the highest frequency of 53 fish and class 49,4-51,4 cm has the least frequency of 4 fish. Average earned on Sumber Mulya 02 fishing vessel was 40,5 cm. Makmur Jaya 78 fishing vessel on class 36,7-38,9 cm had the highest frequency of 55 fish and class 50,5-52,7 cm had the least frequency of 1 fish. Average earned on Makmur Jaya 78 fishing vessel was 40,6 cm. Selat Jaya 06 fishing vessel on class 37,7-39,8 cm had the highest frequency of 55 fish and class 50,9-53 cm had the least frequency of 3 fish. Average earned on Selat Jaya 06 fishing vessel was 41 cm. Bintang Makmur fishing vessel on class 37,2-39,2 cm had the highest frequency of 55 fish and class 49,8-51,8 cm had the least frequency of 3 fish. average earned on Bintang Makmur fishing vessel was 40,8 cm. Sumber Makmur fishing vessel on class 36,8-39 cm and 43,7-45,9 cm had the highest frequency of 60 fish and class 50,6-52,8 cm had the least frequency of 1 fish. Average earned on Sumber Makmur fishing vessel was 40,4 cm.

Table 3. Fork Length *Euthynnus affinis* Class during the Research

No	Vessel									
	Sumber Mulya 02		Makmur Jaya 78		Selat Jaya 06		Bintang Makmur		Sumber Makmur	
	A	B	A	B	A	B	A	B	A	B
1	32,6-34,6	30	32,1-34,3	10	33,3-35,4	27	33-35	27	32,2-34,4	17
2	34,7-36,7	59	34,4-36,6	55	35,5-37,6	49	35,1-37,1	49	34,5-36,7	54
3	36,8-38,8	48	36,7-38,9	61	37,7-39,8	55	37,2-39,2	55	36,8-39	60
4	38,9-40,9	15	39-41,2	23	39,9-42	24	39,3-41,3	24	39,1-41,3	17
5	41-43	3	41,3-43,5	15	42,1-44,2	16	41,4-43,4	16	41,4-43,6	5
6	43,1-45,1	4	43,6-45,8	37	44,3-46,4	35	43,5-45,5	35	43,7-45,9	60
7	45,2-47,2	53	45,9-48,1	36	46,5-48,6	33	45,6-47,6	33	46-48,2	33
8	47,3-49,3	34	48,2-50,4	12	48,7-50,8	8	47,7-49,7	8	48,3-50,5	3
9	49,4-51,4	4	50,5-52,7	1	50,9-53	3	49,8-51,8	3	50,6-52,8	1

Information: A : Class (cm)
B : Frequecy (fish)

Table 4. Feasible Proportion of *Euthynnus affinis* Lenght Catches

Vessel	Fork Length	
	> Lm (%)	**< Lm (%)**
Sumber Mulya 02	37,6	62,4
Makmur Jaya 78	35,6	64,4
Selat Jaya 06	34,4	65,6
Bintang Makmur	38,0	62,0
Sumber Makmur	40,0	60,0

Based on the data above (Table 4), Sumber Mulya 02 fishing vessel 94 fish was worth catching and 156 fish was not worth catching. Makmur Jaya 78 fishing vessel 89 fish was worth catching and 161 fish was not worth catching. Selat Jaya 06 fishing vessel 86 fish was worth catching and 164 fish was not worth catching. Bintang Makmur fishing vessel 95 fish was worth catching and 155 fish was not worth catching. Sumber Makmur fishing vessel 100 fish was worth catching and 150 fish was not worth catching.

Purse seine fishing gear for each vessel was not selective because each vessel obtained a percentage less than 60%. Based on [7], one of the indicators that fishing gear is selective to the catches is if Length of first capture (Lc) > Length of first matured (Lm) and the number of length proportion of decent mackerel tuna caught ≥ 60%. The ability of fishing gear in catching decent fish caught, both age or size, can escape not decent fish caught, protected fish, and unwanted fish without injuring or killing them [12]. Purse sine fishing gear used in each purse seine is not selective to catch *Euthynnus affinis* because it is more dominant the not decent size caught than decent caught. Purse seine fishing gear is unselective due to the small mesh size and the cluster of *Euthynnus affinis* with various types of size so that the size of decent *Euthynnus affinis* caught and no decent *Euthynnus affinis* caught cannot be selected.

3.3.2 Selectivity for the Type of Catches

The selectivity for the type of catches is the comparison between the main catch and by-catch. This analysis used the composition of *Euthynnus affinis* as the main catch, and the rest is the by-catch.

Decapterus kurroides was the largest catch weigh from five purse seine fishing vessels. The least catch weight from Sumber Mulya 02 was *Rachycentron canadums* and the least catch weight form Makmur Jaya 78, Selat Jaya 06,

Bintang Makmur and Sumber Makmur fishing vessel was *Parastromateus niger*.

Large catch numbers from Sumber Mulya 02, Selat Jaya 06, Bintang Makmur and Sumber Makmur fishing vessel is *Rastrelliger kanagurta* and Makmur Jaya 78 fishing vessel is *Loligo pealei*. The least catch numbers from Selat Jaya 06, Bintang Makmur and Sumber Makmur fishing vessel is *Tetrapturus angustirostris*, Sumber Mulya 02 fishing vessel was *Rachycentron canadums* and Makmur Jaya 78 fishing vessel was *Coryphaena hippurus*.

Amount earned from Sumber Mulya 02 and Makmur Jaya 78 fishing vessel is 22 species as well as Selat Jaya 06, Bintang Makmur and sumber Makmur fishing vessel is 24 species. Many species caught due to the nature of purse seine which confines the fish and small mesh size in net bag, which prevent the fish from escaping.

Purse seine fishing gear used by the five fishing vessels is not selective because the percentage value obtained was less than 60%. If the proportion of the main catch obtained ≥ 60% of the total catches, then the fishing gear can be stated as selective.

Weight of catches on Sumber Makmur 02 fishing vessel is 2.525 kg (12,14%) to main catch and 18.272 kg (87,86%) to by catch, Makmur Jaya 78 fishing vessel is 2.347 kg (11,90%) to main catch and 17.375 kg (88,10%) to by catch, Selat Jaya 06 fishing vessel is 2.422 kg (12,21%) to main catch and 17.411 kg (87,79%) to by catch, Bintang Makmur fishing vessel is 2.326 kg (11,33%) to main catch and 18.202 kg (88,67%) to by catch, Sumber Makmur fishing vessel is 2.347 kg (11,59%) to main catch and 17.896 kg (88,41%) to by catch.

Amount of catches on Sumber Makmur 02 fishing vessel is 3.898 fish (1,87%) to main catch and 152.226 fish (98,13%) to by catch, Makmur Jaya 78 fishing vessel is 3.772 fish (1,89%) to

main catch and 144.205 fish (98,11%) to by catch, Selat Jaya 06 fishing vessel is 3.877 fish (1,96%) to main catch and 143.934 fish (98,04%) to by catch, Bintang Makmur fishing vessel is 3.614 fish (1,80%) to main catch and 142.511 fish (98,20%) to by catch, Sumber Makmur fishing vessel is 2.347 fish (1,83%) to main catch and 143.773 fish (98,36%) to by catch.

The percentage of total by-catch was greater than the percentage of the main catch. It is caused by several factors: purse seine fishing gear is multi-species and has a small mesh size, as well as the habitat of *Euthynnus affinis* along with other fish. The larger the proportion of fish with decent size caught and main target catch resulted, it can be stated that the fishing gear is selective to catch target fish [1]. Factors causing many of these non-target resources are caused by seasonal and habitat conditions and geographic area that has potential impact in the composition of species and community structure [13]. The difference in the selectivity assessment can occur because Indonesia has high biodiversity; Indonesia is a tropical country, and it is difficult to cat target fish without the by-catch so that causing the determination of selectivity can be seen from various things [7].

Table 5. Weight Compotition Purse Seine Fishing Vessels Catches During The Research

Catch	*Species*	Vessel (Kg)				
		Sumber Mulya 02	**Makmur Jaya 78**	**Selat Jaya 06**	**Bintang Makmur**	**Sumber Makmur**
Main Catch	*Euthynnus Afinnis*	2.525	2.347	2.422	2.326	2.347
By Catch	*Sphyraena argentea*	346	152	164	124	197
	Parastromateus niger	120	43	38	27	36
	Selar crumenophthalmus	1.332	1.216	1.367	2.089	1.630
	Rachycentron canadumz	101	98	100	122	132
	Sardinella fimbriata	2.033	1.878	2.035	2.135	2.077
	Muraenesox talabon	-	-	324	296	397
	Eubleekeria splendens	502	321	653	611	721
	Abalistes stellaris	236	122	324	355	315
	Rastrelliger kanagurta	2.011	1.832	1.823	1.773	1.655
	Caranx ignobilis	201	146	186	211	122
	Decapterus kurroides	2.632	2.743	2.814	2.714	2.748
	Trichiurus lepturus	141	211	123	114	192
	Coryphaena hippurus	153	82	125	172	147
	Dussumieria acuta	102	133	121	142	103
	Sardinella lemuru	2.122	2.032	1.345	1.228	1.178
	Arius thalassinus	-	-	781	988	788
	Mene maculate	393	423	322	378	302
	Scomberomorus commerson	312	211	321	311	342
	Megalaspis cordyla	2.438	2.467	2.259	2.389	2.458
	Auxis Thazard	544	521	455	518	533
	Loligo Pealei	2.451	2.612	1.433	1.327	1.587
	Tetrapturus angustirostris	-	-	143	43	73
	Scomberoides tol	102	132	155	135	163
	Total By Catch	18.272	17.375	17.411	18.202	17.896

Table 6. Numbers Compotition Purse Seine Fishing Vessels Catches During the Research

Catch	*Species*	Vessel (Fish)				
		Sumber Mulya 02	Makmur Jaya 78	Selat Jaya 06	Bintang Makmur	Sumber Makmur
Main Catch	*Euthynnus Afinnis*	3.898	3.772	3.877	3.614	3.673
By Catch	*Sphyraena argentea*	370	158	168	129	202
	Parastromateus niger	403	147	130	94	126
	Selar crumenophthalmus	8.594	7.845	8.819	13.477	10.516
	Rachycentron canadumz	140	134	137	167	181
	Sardinella fimbriata	15.355	13.911	15.074	15.815	15.385
	Muraenesox talabon	-	-	423	384	487
	Eubleekeria splendens	14.343	9.171	18.657	17.457	20.600
	Abalistes stellaris	543	280	745	816	724
	Rastrelliger kanagurta	26.813	24.427	24.307	23.640	22.067
	Caranx ignobilis	227	165	210	238	138
	Decapterus kurroides	9.180	17.144	21.318	18.717	20.356
	Trichiurus lepturus	677	1.232	566	554	1.027
	Coryphaena hippurus	255	110	150	197	174
	Dussumieria acuta	191	249	226	265	193
	Sardinella lemuru	22.688	14.514	10.935	8.469	8.238
	Arius thalassinus	-	-	756	1.003	811
	Mene maculate	5.311	5.716	4.351	5.108	4.081
	Scomberomorus commerson	243	153	247	215	279
	Megalaspis cordyla	21.200	21.452	19.643	20.246	19.984
	Auxis thazard	1.554	1.489	1.300	1.480	1.523
	Loligo pealei	23.343	24.876	14.546	12.983	15.408
	Tetrapturus angustirostris	-	-	3	1	2
	Scomberoides tol	797	1.031	1.211	1.055	1.273
	Total By Catch	152.226	144.205	143.924	142.511	143.773

Table 7. Percentage Weight and Amount of Five Fishing Vessels Catch

Vessel	Catch Percentage			
	Weight (Kg)		Amount (Fish)	
	Main Catch	By Catch	Main Catch	By Catch
Sumber Mulya 02	12,14%	87,86%	1,87%	98,13%
Makmur Jaya 78	11,90%	88,10%	1,89%	98,11%
Selat Jaya 06	12,21%	87,79%	1,96%	98,04%
Bintang Makmur	11,33%	88,67%	1,80%	98,20%
Sumber Makmur	11,59%	88,41%	1,83%	98,36%

4. CONCLUSION

Based on results of the research is purse seine fishing gear of five fishing vessels which was landed at PPN Muara Angke was not selective. During the research, percentage length of the *Euthynnus affinis* worth, proportion of amount and weight of five fishing vessels less than 60%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Boesono H, Nugrogo W, dan Setiyanto I. Friendliness Analysis of Mackerel Nets (Gillnet Millennium) in Starch Waters Against Catches. Jurnal Perikanan Tangkap. 2017;1(3).
2. Krismatama S. Selectivity of Fishing Equipment to Commodity of Mackerel (Scromberomonus guttatus) in Fishing Areas in Pangandaran Waters, West Java. Skripsi. Fakulty fisheries and marine science. Padjadjaran Univesity. Sumedang; 2019.
3. Hertika A. Purse Seine fisheries diversity at PPI Muara Angke, North Jakarta. Skripsi. Fisheries and marine science. Institut Pertanian Bogor. Bogor; 2014.
4. Khan AMA, Mill AC, Gray TS, Jiang M, Arief H, Brown A, Karman A, dan Polunin NVC. Reliability of the data on tuna catches obtained from the dockside in Indonesia: A study of stakeholders' perceptions. Marine Policy. 2020;122:1-5.
5. Chodrijah U, Hidayat T, Noegroho T. Estimation of Population Parameters of Komo tuna (Euthynnus affinis) in Java Sea Waters. Bawal. 2013;5(3):167–174.
6. KKP. 2018. Report on Capture Fishery Production Volume and Value by Main Commodity and Province. Kementerian Perikanan dan Kelautan.
7. Simanjorang DFL. Selectivity of Gillnet Fishing Equipment Against White Pomfret (Pampus argenteus) Catches in Pangandaran, West Java. Skripsi. Faculty fisheries and marine science. Padjadjaran University. Sumedang; 2019.
8. Martasuganda, S, Sudrajat AO, Saad S, Purnomo J, Basuki R, Asyik MN, Rustam S, Christanto D, Susanto H, dan Nurhudah. Technology for empowering coastal communities Fishing Equipment Series. Departement marine fisheries. Direktorat Jendral Pesisir dan Pulau-Pulau Kecil. Direktorat Pemberdayaan Masyarakat Pesisir. Jakarta. 157 hlm; 2005.
9. Rambun A, Sunarto P, dan Nurruhwati I. Selectivity of Purse Seine Fishing Equipment at the Muara Angke Fish Landing Base (PPI) Jakarta. Jurnal Perikanan Kelautan. 2016;7(2):97–102.
10. Masuswo, Rudy dan Widodo A. Biological Characteristic of Kawakawa (Euthynnus affinis) Caught By Drifting Gillnet in the Java Sea. BAWAL. 2016;8(1):57–63.
11. Suadela P. Analysis of the Environmental Friendly Level of the Crab Net Catching Unit (Case Study in Banten Bay). Skripsi. Faculty fisheries and marine science. Institut Pertanian Bogor. Bogor; 2004.
12. Hehanussa KG, Martasuganda S, Dan Riyanto M. Selectivity Of Pot In Wakal village Water and Central Maluku Regency. ALBACORE Jurnal Penelitian Perikanan Laut. 2017;I(3):309–320.
13. Zairion Z, Purnama I, dan Wardiatno Y. Diversity of Non-Target Fish Resources in Crayfish Fisheries in Coastal East Lampung. Jurnal Biologi Tropis. 2019; 19(1):8-13.