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The Eco Friendly Level of Mini Purse Seine Based on Catch *Decapterus* spp in Pekalongan Nusantara Fishing Port, Central Java, Indonesia

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ABSTRACT

Excessive exploitation of fish resources with the use of fishing gear that is not selective and not eco-friendly will have an impact on the sustainability of capture fisheries, damage to fish resources and marine ecosystems. Mini purse seine is a fishing gear that is most widely used by fishermen in the sea of the north coast of Java and generated its results of the petroleum products at the Nusantara Fisheries Port (PPN) Pekalongan. The purpose of this research is to analyze the level of eco friendly of mini purse seine based on the main catch, which is (*Decapterus* spp.). The research method used survey method at PPN Pekalongan and follows the operation of 3 units of mini purse seine with fishing ground in the North Coast of Central Java, in January-February 2018. Data taken included total catches, catch composition, diversity index and the size of the fork length. Data analysis used the proportion of the main catch and by-catch, the proportion of fish worth catching and not catching and analyzing eco friendly. The results showed that the mini purse seine fishing gear caught 6 species with a total catch of 35,633 with a weight of 4,600 kg. The main catch is 51% compared to 49% by-catch. The length of the main catch fish in worth catching is 46% of all fish measured. Diversity index value is 1.42 (high diversity), based on research mini purse seine operated in the the Java Sea is not eco friendly as seen from the criteria of catch composition.

Keywords: *Decapterus* spp., Eco friendly, Mini purse seine

1. INTRODUCTION

Fish resources, even though they include renewable resources, but not unlimited resources, thus there is a need for controlled fisheries management so that their utilization can be sustainable. Fisheries Management Region Area 712 is not only a fishing ground for fishermen from Central Java but also from Banten, DKI Jakarta, East Java, South Kalimantan and even Lampung Province and Bangka Belitung. This condition further increases the high competition in fishing that occurs in this area. High competition accompanied by patterns of utilization that are not selective and eco friendly will have an impact on the sustainability of capture fisheries activities, damage to fish resources and marine ecosystems.

The highest capture fisheries production landed in the Pekalongan Nusantara Fisheries Port using mini purse seine fishing equipment, namely small pelagic fish, in 2016 reached 5,240.55 tons with a production value reaching Rp. 104,558 billion with a dominance of 30% was ikan layang (*Decapterus* spp.). The catch of fish in WPP 712 is landed mostly at Nusantara Fisheries Port (PPN) Pekalongan, which is one of the largest ports in the Java pantura region and is the center of fisheries economic activity and the production of capture fisheries in the Northern Central and surrounding areas. Based on the data of capture fisheries at the Pekalongan Nusantara Fisheries Port in 2016, the mini purse seine fishing gear is the most operating fishing gear with a dominance of 34% compared to other fishing gear. This fishing gear landed catches totaling 111 times / year.

Decapterus spp is an important economical fish that is in demand by the community and the price is affordable. Market demand for *Decapterus* spp is quite large and increasing so it plays a role in increasing the source of income for fishermen. This will make fishermen to increase their fishing efforts (Raje 2015). Seeing the number of capture fishermen operating so much with the type of mini purse seine fishing gear and high fishing rates, arrests occur every day thus it is indicated that over exploitation or over fishing has occurred, *Decapterus* spp resources to begin decreasing, large *Decapterus* spp measuring 20 - 25 cm is rarely found so many small fish that are not worthy of found are caught (Rohit 2005).

2. MATERIAL AND METHOD

This research was conducted in January - July 2018. The research location was in the waters of Java Sea with fishing base of Nusantara Fisheries Port (PPN) Pekalongan, Central Java (Figure 1). The first stage was data collection stage and the second stage was data processing. The research method used was by survey method. The survey was conducted by following 3 trips of 3 mini purse seine vessels measuring 30 GT in the waters of Java Sea. Analysis of the data used included the composition of the catch, the proportion of the main catch and by-catch, the proportion of the results of fish worth catching, the diversity index and the level of environmental friendliness of the fishing gear through scoring method.

3. RESAULT AND DISCUSION

Nusantara Fishing Port Pekalongan (PPN Pekalongan) is the only type B port in the North Java Sea located in Pekalongan City. PPN Pekalongan is the Technical Implementation Unit of

the Directorate General of Capture Fisheries Ministry of Maritime Affairs and Fisheries as well as one of the oldest fishing ports in Indonesia, PPN Pekalongan has always had a major contribution to capture fisheries and was once one of the largest fish landing sites in Indonesia and even Southeast Asia.

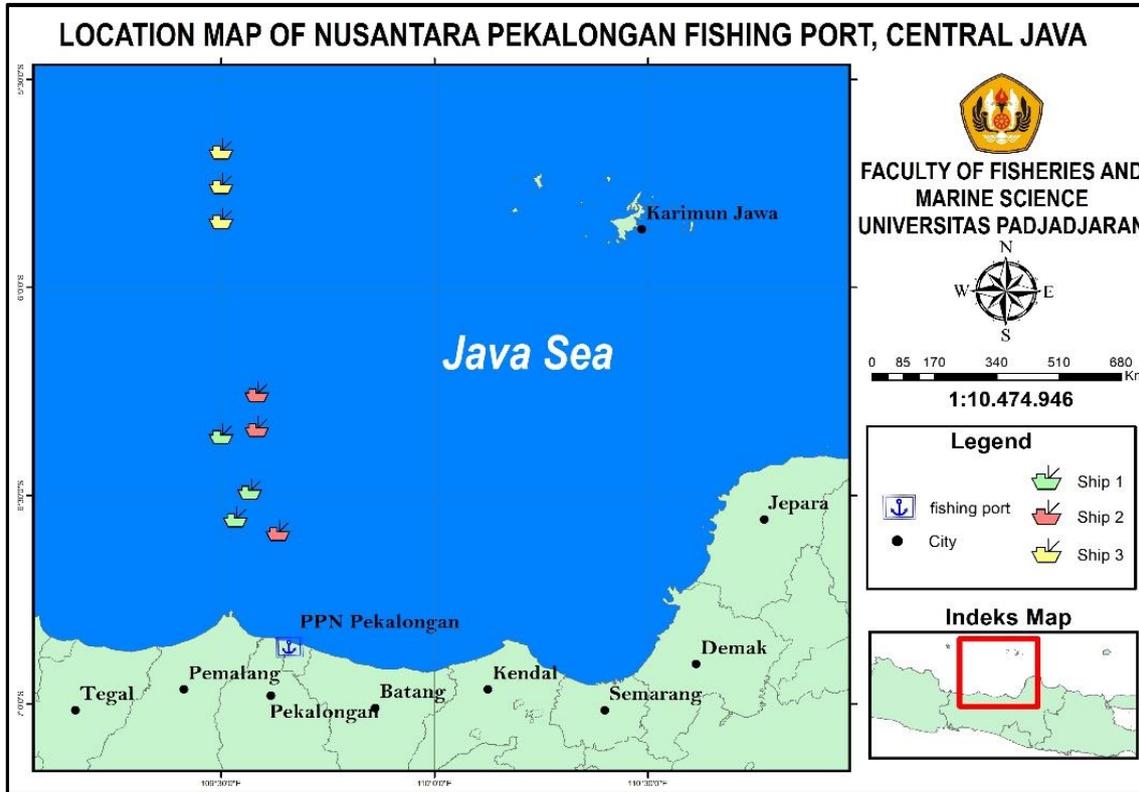


Figure 1. Research location map

3. 1. Composition of Catches

The results of identification of mini purse seine fish for 3 trips from January 18 2018 to February 4, 2018 in the waters of Java Sea obtained 6 species (Table 1). The catch was divided into two categories, namely the main catch and by-catch. The total catch were 35,633 fish with a total weight of 4,600 kg. The diversity of fish caught represent that the mini purse seine fishing gear is a multi-species fishing gear, which is more than one type of fish.

Beside *Decapterus* spp as the main catch mini purse seine also obtained several types of small pelagic fish, *Selar crumenophthalmus*, *Dussumieria acuta*, *Leiognatus equulus*, *Sardinella vimbriata* and *Loligo* spp. At each fishing location for each vessel, there are 2-3 species caught. Mini purse seine is designed to catch some small pelagic fish. The types of fish entangled in mini purse seine fishing gear usually form a schooling (Aanondsen 2006).

Decapterus spp is one of the small pelagic fish with important economic value that can increase the income of fishermen, especially mini purse seine fishermen. The main catch of *Decapterus* spp was 2,500 kg or 51% of the weight of the entire catch. *Decapterus* spp caught have an average weight of each individual amounting to 100 g.

Table 1. Composition of Catches by Mini purse seine

No	Species	Total		Weight	
		Individual	%	Kg	%
1	<i>Decapterus spp.</i>	18.333	51	2.500	54
Results of by catches					
1	<i>Selar crumenophthalmus</i>	2.800	8	400	9
2	<i>Dussumieria acuta</i>	2.800	8	400	9
3	<i>Loligo spp</i>	1.200	4	100	2
4	<i>Leiognatus equulus</i>	4.500	13	600	13
5	<i>Sardinella vimbriata</i>	6000	18	600	13
Total by catches		17.300	49	2.100	46
Grand total catches		35.633	100	4.600	100

The number of the main caught fish caught can be said to be a lot because at the time of the research carried out was the peak of migratory fish *Decapterus spp* entering WPP 712, especially Java Sea. According to (Bullimore 2001), in the western season (January - March), there are 2 (two) populations of *Decapterus spp* that enter Java Sea, namely the western *Decapterus spp* and the northern *Decapterus spp*. The west *Decapterus spp* population spawned in the Indian Ocean to the south of Sunda Strait and the surrounding area then migrated or carried into Java Sea.

Two groups of *Decapterus ruselli* and *Decapterus macrosoma* recruits were identified in the Java Sea. The major recruits enter the fisheries during the southeast monsoon (June-July) and the minor one during November. From back calculation of the age of youngest groups of the major recruits, we can conclude that these recruits were not the offsprings descended by the adult fishes stayed in this area in last year period. The peak of maturity of the fishes staying in the Java Sea occurs in January-mei, and peak spawning season would be on July-November, while the approximate spawning of the major recruits was about November. The scarce of ripe and spawning stage specimens in the samples indicate that the spawning grounds of this species was not in the Java Sea. at least this was not in the fishing ground of the purse seine fleets (Rohit 2005).

3. 2. Proportion of Main Catches and By Catches

The total catches of mini purse seine during research when viewed from weight (kg) was dominated by the main catches as much as 54%, and the proportion of by-products was 46%. When viewed from the quantity of fish (tail), the main catch was 49% and by-catch was 51%

(Figure 2). Of these two parameters, the main catch dominated in terms of weight and by-products dominated in terms of numbers.

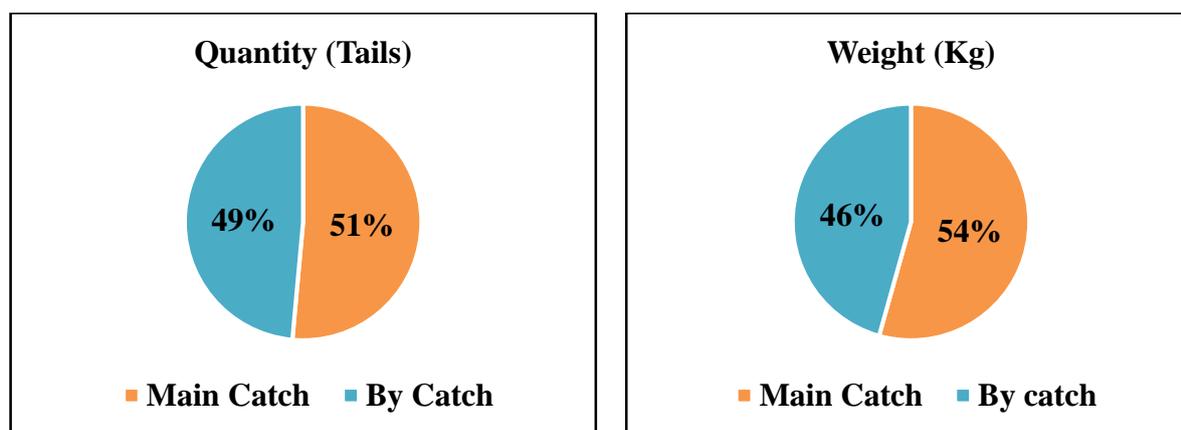


Figure 2. Proportion of main catch and by catch

Mini purse seine gets a variety side catches and various sizes. The diversity of species caught is due to the similarity of habitat between catch target fish and non-target fish and the nature of small pelagic fish that cluster, and the similarity of habitat in the epipelagis and neritic areas in warm waters (Lars G. Rudstam 2011). In general, small pelagic fish enjoy warm waters and live on the surface layer to a depth of 40 meters with an optimum temperature range between 20 – 28 °C. Temperatures of water in the Java Sea including warm waters have an average temperature ranging between 25 – 31 °C (Supriyantini 2006).

3. 3. Distribution of *Decapterus* spp Fork Length Frequency as Main Catch

Catched *Decapterus* spp have different fork lengths ranging from 10.6 to 20.5 cm. The fish caught are young fish that are still in the juvenile stage. Judging from the captured catch, there is one long class which is a large number, namely 12.6-14.5 cm 199 fish (Figure 3).

The existence of small-sized fish caught due to the size of the mesh size is very small, measuring 0.5 inch. The mesh size used is not in accordance with rules of fisheries and marine ministers Indoneian No.42 of 2014 article 22 which requires purse seine fishing equipment operating in the Java Sea must have a mesh size of ≥ 1 inch. The influence of migration patterns and seasons also affects the size of fish caught.

The raw length of the first maturity is 14 cm (Sreenivasan 2015). If *Decapterus* spp caught is less than 14 cm in length, it is said that the fish is not worth catching. The spawning time of fish and the standard length of the known fish aims to control the catch, so that the floating fish that have not or are spawning are not caught.

The size of the fish caught will influence the prevailing selling price. In addition, more importantly the size of the fish caught will affect the sustainability of the fish resources, the nature of pelagic fish that schooling causing caught pelagic fish to have several size groups (Hufiadi 2014). If from the fishing operation that is caught are small fish then it can be estimated that other fish caught are small fish too. *Decapterus* spp is one of the most important small pelagic fishes supporting the commercial fishery in Indonesia. This species has a high market

demand locally due to its cheaper price relative to other pelagic fishes. Despite its significant contribution to the fishery and economic value, there are no adequate data pertaining to this species in north Arabian Sea. This study was undertaken to investigate the population dynamics and fishery of the *Decapterus russelli*. The objectives of the present study were to establish the population parameters and fishery demographics towards management practices by providing significant input in decision making for sustainable management of the fish stocks (Kalohoro M.T 2017).

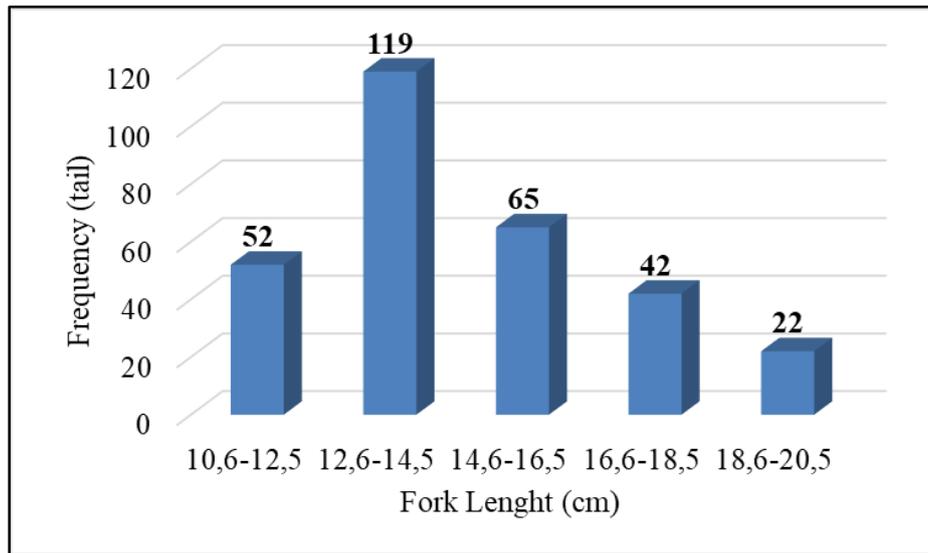


Figure 3. Distribution Fork Length of *Decapterus* spp

3. 4. Proportion of Fish Worth Catching Results of Main Catches

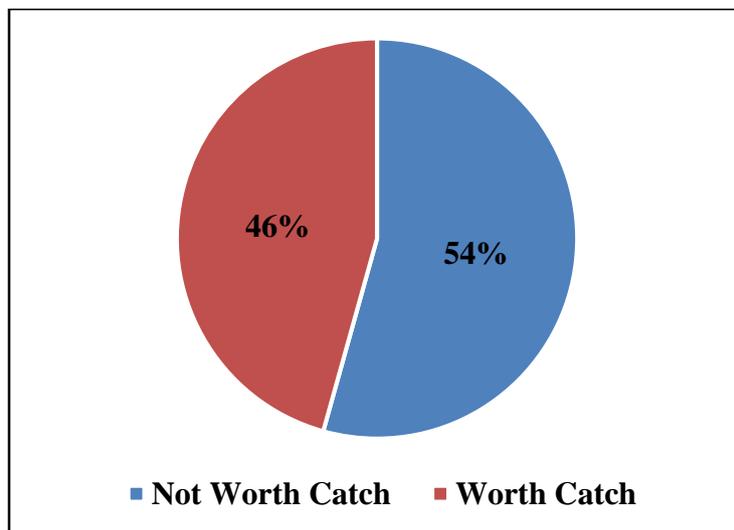


Figure 4. Catch Proportion of *Decapterus* spp

The composition of the size of the caught fish can be an indicator of the selectivity of a fishing gear. During the research main catch was *Decapterus* spp of 18,333. During the fishing operation *Decapterus* spp dominated every time of hauling. Data on the frequency distribution of long-tailed *Decapterus* spp in a sample of 300 fish were 137 fish worth catching and 163 fish were not worthy to catch.

According to (Jorge M.S. Goncalves 2008), *Decapterus* spp in Java Sea its first maturity is at a size of 13.9 cm with the first decent size catching 14.8 cm. Furthermore, Prihatini (2006) stated that 14 cm sized fish has been considered mature for the first time because they have reached TKG III. The proportion of catches of *Decapterus* spp worth catching is 46% (Figure 4). *Decapterus* spp catch results during the research were mostly fish that were not suitable to catch. The proportion of catches of *Decapterus* spp worth catching is 46% (Figure 4). Catching fish during the research were mostly fish that were not worthy to catch.

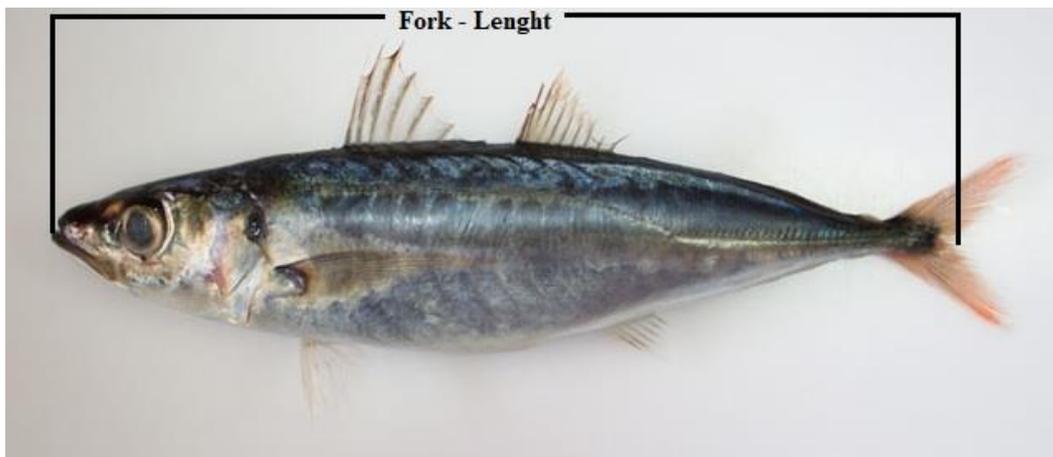


Figure 5. Fork Lenght of *Decapterus* spp

The length of the fish caught can be used to determine whether or not the fish is worthy of catching by knowing the length of the fish size was first matured gonad (Length at first maturity). Capturing the size of the fish length at first maturity can provide an opportunity for the target catch fish to be able to reproduce and spawn before being caught. Therefore the recruitment process for the small fish phase into the adult fish phase can run (Jesaja A. Pattikawa 2017). Therefore the criteria for catching size was the strongest criteria for determining the environmental friendliness of fishing operations.

3. 5. Diversity Index

The catch with 3 mini purse seine obtained 35,633 tails consisting of 6 species. The dominant species caught based on the number of tails is *Decapterus* spp 51% (18,333 tails) and the lowest species is 3% *Loligo* sp (1,200 tails). The diversity of catches obtained because the mini purse seine is multi species. The catch of each ship (3 times of setting) at different fishing ground locations, showed the different composition of catches of main catch and by catch and different fish diversity indexes.

Table 2. Composition of Catches and Diversity Indexes

Spesies	Quaitity	pi	ln(pi)	pi*ln(pi)	H'
<i>Decapterus</i> spp	18.333	0,51	-0,66	-0,34	0,34
<i>Selar crumenophthalmus</i>	2.800	0,08	-2,54	-0,20	0,20
<i>Dussumieria acuta</i>	2.800	0,08	-2,54	-0,20	0,20
<i>Loligo</i> spp	1.200	0,03	-3,39	-0,11	0,11
<i>Leiognatus equulus</i>	4.500	0,13	-2,07	-0,26	0,26
<i>Sardinella vimbriata</i>	6.000	0,17	-1,78	-0,30	0,30
Total	35.633	1,00			
DIVERSITY					1,42

The results of the diversity index analysis using the Shannon-Wiener (H') formula showed that the diversity index value ($H' = 1.42$) (Table 2). Based on this it can be seen that the mini purse seine fishing gear used when research had a high diversity or in other words the tool had a low level of selectivity ($H > 1$) to the catch.

Mini purse seine fishing gear had low selectivity in catching operations thus the catch was not dominated by certain species but the species captured were very diverse, catches of economic value triggered fishermen to catch as much fish as possible to cover the high operational costs of catching (Madsen 2007).

Technical regulations, improving the selectivity of mini purse seine, have been a major management strategy and the Baltic Sea is likely to be the area where most fishing gear selectivity studies, focussing on size selectivity, have been conducted over time. Factors affecting the selectivity of trawl and gill nets are considered. Alternative ways to improve the size and species selectivity of trawls using selective devices are reviewed. Selectivity parameters from available literature are listed and the correlations of selectivity parameters to the mesh size for different gears are estimated. The historical legislation on selectivity is reviewed and the expected selectivity for trawls is estimated. Management considerations concerning the mortality of escaping and discarded fish and wider management impacts have to be considered if improving selectivity. (Madsen 2007).

3. 6. The level of eco friendliness of mini purse seine fishing gear

Analysis of the level of environmental friendliness was seen from several parameters, the composition of the catch, the proportion of the main catch with the by-catch, the proportion of fish worth catching, diversity index and scoring value to determine the level of mini purse seine fishing equipment. The summary of the results of the assessment of the level of eco friendliness of the mini purse seine fishing unit is presented in Table 3.

The results of *Decapterus* spp as the main catch was 2.500 kg (54%) or 18.333 (51%) of the total catch. Based on this proportion, the mini purse seine fishing unit was not eco friendly when viewed from catches and catch weight. The high level of catch diversity was 1,42 and the number of by-products obtained was too many more than 3 species causing the selectivity value of mini purse seine to be eco friendly.

The number of fish worth catching during the research was 137 out of 300 tails, the number of flying fish was sampled. With a percentage of 46%, based on this information it can be seen that *Decapterus* spp was the main catch. Mini purse seine mostly included fish that were not suitable to catch, because the number of fish worth catching <60% then it can be said that the mini purse seine fishing gear was not eco friendly.

Table 3. Results of Evaluation of the Level of Eco Friendliness

Observation	Criteria	Result	Scoring
Main Catch Results	$\geq 60\%$ (Eco friendly)	Based on weight (kg) 54%	Not eco friendly
	$< 60\%$ (Not eco friendly)	Based on total (fish) 51%	Not eco friendly
Size of fork length are worth catching	$\geq 60\%$ (Eco friendly) $< 60\%$ (Not eco friendly)	Size of <i>Decapterus</i> spp 46%	Not eco friendly
Diversity index	$H' > 1$ (High diversity) $0 < H' = 0$ (low diversity)	$H' = 1,42$	Not eco friendly

Scoring values that are used to explain the level of fishing gear friendliness based on several criteria according to FAO (1995) defined several criteria for the level of eco friendliness into several sub-criteria that can be used as scoring parameters. Giving weight (value) of mini purse seine fishing gear is one (1) to four (4).

Table 4. The results of the assessment the level of eco friendly fishing gear.

No	Criteria	Results	Score
1	Has high slivity	Capture more than three species of fish with varying sizes	1
2	Produce high quality fish	Dead and fresh fish	3
3	Low catch	By-catch there are several species and there are types that sell well in the market	2
4	Does not harm protected fish	Protected fish are never caught	4
5	Does not damage habitat	Causes damage to some habitats in narrow areas	3

6	Impact on biodiversity	Causes the death of several species and damages habitat	2
7	Production does not endanger consumers	Relatively safe for consumers	3
8	Operation of fishing gear does not endanger fishermen	May result in permanent disability in fishermen	2
9	Socially acceptable	Profitable	2
Total score			22

According to Mallawa (2006) there are several criteria for scoring the results, namely if the total score > 31.5 then it can be categorized as eco friendly, if the score <22.5 or ≤ 31.5 then it is less eco friendly, if the score is <13.5 or ≤ 22.5 it is not eco friendly, if the score is ≤ 13.5 then the fishing gear is categorized as damaging the ecosystem. Based on research that has been carried out the number of scoring values the level of mini-purse seine not eco friendliness is 22, it is included in the category of fishing gear that is not eco friendly. Sub-criteria for eco friendliness need attention because it is feared that it can threaten to reduce the sustainability of species of marine biota, aquatic resources and the safety of human resources.

4. CONCLUSIONS

Based on the analysis of *Decapterus* spp catch results, the results proportion of main catch is 51% based on total, 54% based on weight, proportion of *Decapterus* spp catch is 46% and the high value of index of diversity on the type of catch results is 1,42 caught more than 3 species with varied size. Mini purse seine operated in the waters of Java Sea is not eco friendly.

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