Original Research Article

Hanging Ratio Gillnets on Different Mesh Sizes for Mackerel (*Scomberomorus commerson*) : A Case of Pangandaran Regency, Indonesia

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ABSTRACT

Gillnet is a simple fishing gear that is widely used by fishermen in Pangandaran Regency. This study aims to determine the classification calculation of the value of hanging ratio gillnet and the catch of mackerel (*Scomberomorus commerson*) with different mesh sizes. This research was conducted in January 2019 in Pangandaran Regency, Indonesia. The method used in this research is the survey method. Gillnet used has 2 types of mesh sizes, 3,5 and 4 inch gill nets with each net length of 650 meters (7,312 mesh) and 750 meters (7,384 mesh). Gillnet has 12 meters with a net mesh size of 3,5 inches as many as 135 mesh and a 4 inch mesh size of 118 mesh. Hanging ratio for 3.5 inch gillnet is 0,56 while for mesh size 4 inch is 0,54. Based on these results, it can be concluded that the gill nets are selective. The proportion of catch results shows the number of target fish gill nets with a 3,5 inch mesh size is 20% and bycatch is 80%. The proportion of gillnet catches with a 4 inch mesh size shows main catch of 35,2% while the bycatch proportion is 64.8%.

Keywords: Gillnet, Hanging ratio, Mackerel, Selectivity, Sustainable fisheries

1. INTRODUCTION

Indonesia as an archipelago is a maritime zone that has the potential of capture fisheries [13]. One of the districts in West Java that has potential in the field of capture fisheries in Indonesia, is the Pangandaran Regency. The area of Pangandaran Regency is directly to the Indian Ocean so that it has generally been developed as a tourism conservation and fisheries area [24]. The Pangandaran border with the open sea makes the aspect of capture fisheries quite potential.

Capture fisheries is an effort made by humans to be able to get organisms in the waters, and to get these organisms needed by fishing gear [9]. Gill nets are one type of fishing gear that is widely used by fishermen, from encircling gillnets, bottom gillnets, and surface gillnets. Fishing effort using gill nets is already not a new technology for fishing, this is because the

material is more easily obtained, it is technically easy to operate, economically reachable by fishermen, and more selective on the size of fish caught [31]. Gillnet is one of the most used fishing gear by fishermen in Pangandaran which is operated at night or early in the morning [28].

Gillnet catches various types of fish, and one of the catch is mackerel (S. commerson) [23]. Mackerel fish including pelagic fish and high economic value in Indonesia [29]. Mackerel fish is an important commodity whose exploitation has been carried out intensively to meet market needs, both domestic and export [22]. According to Pangandaran's production data for 2016-2018 mackerel fish ranks seventh out of the top ten catches with the highest number of commodities. Mackerel fish is a type of fish found throughout the year in the water of Indonesia [17].

Gillnet fishermen in Pangandaran used to catch mackerel using two types of mesh size, at 3.5 inches and 4 inches. There are no specific calculations related to the hanging ratio amount of gillnet used. Determination hanging ratio is only based on the habits of fishermen. Based on Tang et al. [30] a smaller hanging ratio will result in lower mesh openings with higher levels of slack. As for the hanging ratio, the higher the openings the wider the mesh. Previous researches conducted by Hamley [14]; Duman et al., [11]; and Ayaz et al., [4] indicate that hanging ratio affects the number of catches obtained. Therefore, the optimum hanging ratio for catching mackerel fish needs to be known. According to Catanese et al. [7] the difference in hanging ratio trammel net has a significant effect on catches. The effect of hanging ratio and fishing depth on the catch rates of drifting tuna gillnet in Sri Lanka waters shows that different hanging ratios have a significant effect on the size of the catch [26].

Based on the description above, it is clear that the hanging ratio affects the gillnet catches. However, fishermen using gill nets in Pangandaran are not supported by information about the size of the hanging ratio. Therefore, it is necessary to conduct research on the hanging ratio value for gillnet used to catch mackerel (*S. commerson*). This study aims to determine the classification and calculate the value of hanging ratio gillnet and the catch of mackerel (*S. commerson*) with different mesh sizes.

2. MATERIAL AND METHODS

Research was conducted in August 2018 and January 2019 in Pangandaran Regency, West Java. The method used is the survey method using a sample of research objects observed. The data needed in this research are primary and secondary data. Primary data is in the form of direct data collected when conducting research in the field. Secondary data is data sourced from the Fisheries and Marine Service of Pangandaran Regency and literature studies. The research object is gillnet with a different mesh size of 3.5 and 4 inches.

Interviews were conducted with gillnet fishermen to explore and gather information needed regarding the type of fishing gear used, mesh size, and length of fishing gear. The selection of fishermen to determine the size of the sample size to be selected or taken is using the purposive sampling method. According to Bell et al. [5] purposive sampling is a sampling technique of data sources with certain considerations. Sampling is in accordance with the boundaries of certain goals that represent a representative area. Purposive sampling is done by taking the subject rather than based on strata, random or regional but based on the existence of certain objectives [1]. The fishing gear used is gill nets with different mesh sizes of 3.5 and 4 inches with the main catches of mackerel (*S. commerson*). Data fishing operations used in the research is gillnets operating activities for 8 times the size of the boat trip 2-3 GT. The data obtained were then analyzed descriptively by describing the condition

of gillnet for Tenggiri (*S. commerson*) fish in Pangandaran and analyzing the hanging ratio of the gillnet. Calculation of hanging ratio fishing gear uses the following formulations [20] :

$$E = \frac{L}{Lo}$$

Information:
E = Hanging ratio
L = Length after the nets installed
Lo= Length before the net installed

3. RESULTS AND DISCUSSION

3.1 Fishing Gear Caracteristics

Pangandaran is a region that has the potential of capture fisheries, in line with Apriliani et al. [3] Pangandaran has a sea area of 67,340 Ha and a coastal length of 91 km. Pangandaran has a variety of fishing gear, one of which is the gillnet. Gill nets are the catcher that has the most amount compared to other fishing gears. It is based on the fisheries data of Pangandaran Regency [10] presented in Table 1.

Table 1. Fishing gear operating in Pangandaran Regency.

No	Fishing Gear	Total (unit)
1	*Gillnet*	1.914
2	Trammel Net	305
3	Mini Purse seine	10
4	Liong Bun	30
5	Long line	50

Source: Department of Fisheries, Marine and Food Security Pangandaran Regency 2016

Gillnet is a unit of fishing gear that is rectangular with a certain mesh size and is the same size in all nets with a smaller number of mesh sizes for depth compared to the mesh size to the side. Gillnet is classified into a type of simple fishing gear consisting of a net with a ballast hooked to the bottom rope section and a float on the upper rope, a float sign as a marker of both ends of the net, and a rope to pull the net. Based on Martasuganda [18] gillnets are one of a kind of fishing gear from monofilament or multifilament nets which are formed into rectangles, in which at the top are equipped with floats and at the bottom are equipped with sinkers so that the presence of two opposite forces allows the net gills can be installed in the catching area in an upright condition facing the aquatic biota.

Gillnet used has 2 types of mesh sizes, 3.5 and 4 inch gill nets with the length of each net is 650 meters and 750 meters and within 12 meters. Another difference in the two gill nets is in addition to the size of the net, which is found in the net material used. Gillnet with 3.5 inch mesh size uses a net with green nylon material while gillnet with 4 inch mesh uses white millenium material. Millenium gill nets have fibers composed of strands which are arranged into one called Ply with Z-shaped twist. Gillnet millenium is used consisting of 10-12 ply. The gillnet with a 4 inch mesh size has a number of mesh lengths of 7,384 meshes while the mesh depth is 118 meshes. Gillnet of 3.5 inches has a total mesh length of 7,312 meshes and a mesh depth of 135 meshes.

Gillnet used in this research is surface gillnet. This is because the main fish caught are mackerel fish belonging to the pelagic fish species. As stated by Scales et al. [27], the surface gillnets are operated on the surface of the water column with the aim of catching pelagic fish. Printed sinkers flattened round shape with a diameter the size of 10 cm and 2 cm thick. Buoys made from used plastic drinks. It is the ballast and buoys at the bottom and top that give the pulling force between the nets so that the nets stretch vertically facing the fish to swim so they are caught in the net. Raju et al. [25] state that gillnets on each fishing gear are tied floats on the upper side of the net and singkers on the lower side of the net with fewer mesh depts compared to the number of mesh lengths. The presence of bouyancy and the force force is generated by buoys and sink which results in two forces acting in opposite directions as long as the gillnet is in the water. The buoys and ballast used amounted to 45 pieces each.

The components of the gillnet compiler are a unit that has the function of each forming an operated fishing device. Operation of fishing gear is good depending on each component of the fishing gear. Chirwa [8] stated that several things that need to be considered to support the success of fishing using gill nets are equipment specifications (type of net material, net length and height, net shrinkage, mesh size, and net color), fishermen's knowledge and skills , knowledge of seasons, and oceanographic influences.

Gillnet captures various types of fish according to the size of the mesh size used and the fishing season. One of the commodities that is the main catch of gill nets is mackerel fish. Mackerel fish is a type of fish with high economic value [6]. Noegroho et al. [22] stated that mackerel fish is an important commodity whose operations have been carried out intensively to meet market needs, both for domestic and for export. According to Pangandaran's production data for 2016-2018 mackerel fish ranks seventh out of the top ten catches with the highest number of commodities. Mackerel fish are sold for 50-60 thousand per kilogram. The high selling price of mackerel is one of them caused by the taste of the meat that is so good that it is much in demand by local and outside markets [19].

Gillnet ships in Pangandaran Regency that caught mackerel fish in this research were 2 GT with a length of 1129 cm and a width of 141 cm. This ship uses a Yamaha 15 PK outboard motor type engine. This ship only contains fishermen about 2-3 people. The number of fishermen that can be transported by the ship is adjusted to the size of the ship that is related to safety during the trip to the sea and the need for the operation of fishing gear [2].

3.2 Hanging Ratio

Hanging ratio is the percentage of the length of the net that is attached to the ris rope divided by the length of the net that is stretched perfectly (the length of the net before it is made a fishing gear) [33]. Its usefulness is to determine how much influence can be generated by the net on how to entangle captured fish. According to Duman et al. [11] hanging ratios normally used gill nets range from 0,50 to 0,70.

The results showed that gillnet with a 3.5 inch mesh size had a hanging ratio of 0,56 and a 4 inch net mesh of 0,54. Based on these results, it can be concluded that gill nets with 3.5 and 4 inch mesh sizes are selective. Murdiyanto et al. [21] stated that horizontal hanging ratio on gillnet is generally 0,5. Hanging ratios smaller than 0.5 nets tend to be entangled and will capture a variety of different fish species. Conversely, if the hanging ratio is 0,5, then the net tends to trap fish and is more selective. The other influential factor is the formation of a net body because of the currents and waves that cause up and down movements of buoys that affect the formation of the net body.

3.3 Catch of Gillnets in Pangandaran

The catch is classified into two types, namely main catch and bycatch. Main catch is the catch fish which is the main target in fishing which has high economic value while bycatch is the catch fish which is not the main target in catching or bycatch that can be utilized or not. This is in line with the statement of Eayrs [12] which states that the catch is divided into two groups, namely main catch which is a catch in the form of fish or other marine biota which is the main target (target species) in fishing and bycatch catch which is a type of fish or other marine biota that are not the main target as illustrated in Table 2.

Table 2. Types of Gillnet Catch in Pangandaran.

No	Main Catch
1	Mackerel (*S. commerson*)
No	**By Catchs**
1	*Sardinella fimbriata*
2	*Ethynnuss* sp
3	*C. ignobilis*
4	*Chirocentrus* spp
5	*Auxis rochei*
6	*Selaroides leptolepis*
7	*Spyhraena barracuda*

Mackerel is a catch fish that is the target of species. Non-targeted catch (bycatch) consists of seven species belonging to large and small pelagic fish which are accidentally caught along with the main catch, but these fish are still used and sold even though they do not have high economic value. According to Walker et al. [32], the diversity of species caught is due to the similarity of habitat between target fish and non-target fish.

Based on data from capture fisheries in Pangandara Regency in 2016 - 2018 mackerel fish production is always available every month. Research conducted in August and January showed that the catch in January was more than that in August and mackerel fish in January had a much larger size. Factors that affect the size of the catch are weather, fishing area, catching time and season.

Apriliani et al. [3] states that Pangandaran Regency has a tropical climate with 2 seasons namely the dry season and the rainy season. Fishing activities in Pangandaran are highly influenced by the climate, where during the dry season (east season) that is from May to October Pangandaran waters are in calm conditions and fishing activities are not disturbed. The rainy season (western season) occurs in November - April where the waters are in large choppy conditions and fishing activities are slightly disturbed. The interview with gillnet fishermen indicated that the average increase in mackerel catches occurred in December to February. Based on production data shows that in 2016 - 2018 the highest number of production is in August to January. This is different from the results of interviews with gillnet fishermen who said that in August mackerel fish production was classified as small due to the bright moon events. This causes the nets in the waters to be seen by fish as a result of

bright moonlight so that the catch decreases. According to local fishermen, mackerel fish are the most popular fish and are the main catch of the main catch, especially during the mackerel fishing season in March, May, July, November and December. This difference is thought to occur due to changes in fishing season patterns and changes in the spawning season.

The proportion of the catch results shows the number of target fish gill nets with 3.5 inch mesh size is 20% (92 fish) and bycatch is 80% (369 fish). The proportion of gillnet catches with a 4 inch mesh size shows a main catch of 35.2% (96 fish) while the bycatch proportion is 64.8% 5 (177 fish). Based on the proportion of the number of catches it can be concluded that 3.5 and 4 inch gill nets are not selective because they have a proportion of bycatch> main catch and the main catch is less than 60%. Kalogirou et al. [15] states that if the proportion of the main target catch is greater and equal to 60%, a fishing gear can be called selective because it includes environmentally friendly fishing gear.

The diversity of fish caught by gill nets is because Indonesia is a tropical country with high biodiversity, so it is very difficult to determine and catch fish with certain species without the presence of bycatch. In addition, there are similarities in habitat between one species and another in spawning, feeding ground or fishing ground. Kelleher [16] states that the existence of by-products is a contribution from the low selectivity of a fishing gear and is a characteristic of a multi-species fishing area. Characterization of by-products is necessary considering that fisheries in Indonesia are multispecies that are influenced spatially and temporally and in the aquatic environment. According to Walker et al. [32], the diversity of species caught is due to the similarity of habitat between target fish and non-target fish.

4. CONCLUSION

Gillnet used has 2 types of mesh sizes, 3.5 and 4 inch gill nets with each net having a length of 650 meters (7,312 mesh) and 750 meters (7,384 mesh). Gillnet has 12 meters with a net mesh size of 3,5 inches as many as 135 mesh and a 4 inch mesh size of 118 mesh. Hanging ratio for 3,5 inch gillnet is 0,56 while for mesh size 4 inch is 0,54. Based on these results, it can be concluded that the gill nets are selective. The proportion of the catch results shows the number of target fish gill nets with a 3,5 inch mesh size is 20% and bycatch is 80%. The proportion of gillnet catches with a 4 inch mesh size shows a main catch of 35,2% while the bycatch proportion is 64,8%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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