

Original Research Article

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

ABSTRACT

Gillnet is a simple fishing gear that is widely used by fishermen in Pangandaran Regency. This study aims to determine the classification and calculate the value of hanging ratio gillnet and calculate 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 the length of each net is 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 by catch is 80%. The proportion of gillnet catches with a 4 inch mesh size shows main catch of 35,2% while the by catch proportion is 64.8%.

Keywords: Ggillnet, Hanging ratio, Mmackerel, selektivitySelectivity, Ssustainable fisheries

1. INTRODUCTION

Indonesia as an archipelago is a maritime zone that has the potential of capture fisheries [1]. One of the districts in West Java that has potential in the field of capture fisheries in Indonesia, is the namely 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 [2]. 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 [3]. 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 [4]. Gillnet is one of the most used fishing gear by fishermen in Pangandaran which is operated at night or early in the morning [5].

Gillnet catches various types of fish, and one of the commodities catch is mackerel (*S. commerson*) [6]. Mackerel fish including pelagic fish and high economic value in Indonesia

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35 [7]. Mackerel fish is an important commodity whose exploitation has been carried out
36 intensively to meet market needs, both domestic and export [8]. According to Pangandaran's
37 production data for 2016-2018 mackerel fish ranks seventh out of the top ten catches with
38 the highest number of commodities. Mackerel fish is a type of fish found throughout the year
39 in the water of Indonesia [9].

40 Gillnet fishermen in Pangandaran used to catch mackerel using two types of mesh size, at
41 3.5 inches and 4 inches. There are no specific calculations related to the hanging ratio
42 amount of gillnet used. Determination hanging ratio is only based on the habits of fishermen.
43 Based on Tang et al. [10] a smaller hanging ratio will result in lower mesh openings with
44 higher levels of slack. As for the hanging ratio, the higher the openings the wider the mesh.
45 ~~Based on p~~Previous researches conducted by Hamley [11]; Duman et al., [12]; and Ayaz et
46 al., [13] ~~indicatestate~~ that hanging ratio affects the number of catches obtained. Therefore,
47 the optimum hanging ratio for catching mackerel fish needs to be known. According to
48 Catanese et al. [14], ~~that~~ the difference in hanging ratio trammel net has a significant effect
49 on catches. The effect of hanging ratio and fishing depth on the catch rates of drifting tuna
50 gillnet in Sri Lanka waters shows that different hanging ratios have a significant effect on the
51 size of the catch [15].

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

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

68 Interviews were conducted with gillnet fishermen using questionnaires to explore and gather
69 information needed regarding the type of fishing gear used, mesh size, and length of fishing
70 gear. The selection of fishermen to determine the size of the sample size to be selected or
71 taken is using the purposive sampling method. According to Bell et al. [16] purposive
72 sampling is a sampling technique of data sources with certain considerations. Sampling is in
73 accordance with the boundaries of certain goals that represent a representative area.
74 Purposive sampling is done by taking the subject rather than based on strata, random or
75 regional but based on the existence of certain objectives [17]. The fishing gear used is gill
76 nets with different mesh sizes of 3.5 and 4 inches with the main catches of mackerel (*S.*
77 *commerson*). The data obtained were then analyzed descriptively by describing the condition
78 of gillnet for Tenggiri (*S. commerson*) fish in Pangandaran and analyzing the hanging ratio of
79 the gillnet. Calculation of hanging ratio fishing gear uses the following formula~~tions~~ [18] :

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

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81 E = Hanging ratio
82 L = Long after the nets installed
83 Lo= The length of the net before installed
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86 3. RESULTS AND DISCUSSION

87 3.1 Fishing Gear Characteristics

88 Pangandaran is a region that has the potential of capture fisheries with a sea area of 67,340
89 Ha and a coastal length of 91 km [19]. Pangandaran has a variety of fishing gear, one of
90 which is the gillnet. Gill nets are the catcher that has the most amount compared to other
91 fishing gears. It is based on the fisheries data of Pangandaran Regency [20] presented in
92 Table 1.
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94

95 **Table 1. Fishing gear operating in Pangandaran Regency.**
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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

98 *Source: Department of Fisheries, Marine and Food Security Pangandaran Regency 2016*
99

100 Gillnet is a unit of fishing gear that is rectangular with a certain mesh size and is the same
101 size in all nets with a smaller number of mesh sizes for depth compared to the mesh size to
102 the side. Gillnet is classified into a type of simple fishing gear consisting of a net with a
103 ballast hooked to the bottom rope section and a float on the upper rope, a float sign as a
104 marker of both ends of the net, and a rope to pull the net. Based on Martasuganda [21]
105 gillnets are one of a kind of fishing gear from monofilament or multifilament nets which are
106 formed into rectangles, in which at the top are equipped with floats and at the bottom are
107 equipped with sinkers so that the presence of two opposite forces allows the net gills can be
108 installed in the catching area in an upright condition facing the aquatic biota.

109 Gillnet used has 2 types of mesh sizes, 3.5 and 4 inch gill nets with the length of each net is
110 650 meters and 750 meters and within 12 meters. Another difference in the two gill nets is in
111 addition to the size of the net, which is found in the net material used. Gillnet with 3.5 inch
112 mesh size uses a net with green nylon material while gillnet with 4 inch mesh uses white
113 millenium material. Millenium gill nets have fibers composed of strands which are arranged
114 into one called Ply with Z-shaped twist. Gillnet millenium is used consisting of 10-12 ply. The
115 gillnet with a 4 inch mesh size has a number of mesh lengths of 7,384 meshes while the
116 mesh depth is 118 meshes. Gillnet of 3.5 inches has a total mesh length of 7,312 meshes
117 and a mesh depth of 135 meshes.

118 Gillnet used in this research is surface gillnet. This is because the main fish caught are
119 mackerel fish belonging to the pelagic fish species. As stated by Scales et al. [22], the
120 surface gillnets are operated on the surface of the water column with the aim of catching
121 pelagic fish. Printed sinkers flattened round shape with a diameter the size of 10 cm and 2
122 cm thick. Buoys made from used plastic drinks. It is the ballast and buoys at the bottom and
123 top that give the pulling force between the nets so that the nets stretch vertically facing the
124 fish to swim so they are caught in the net. Raju et al. [23] state that gillnets on each fishing

125 gear are tied floats on the upper side of the net and sinkers on the lower side of the net with
126 fewer mesh depths compared to the number of mesh lengths. The presence of buoyancy and
127 the force force is generated by buoys and sink which results in two forces acting in opposite
128 directions as long as the gillnet is in the water. The buoys and ballast used amounted to 45
129 pieces each.

130 | The components of the gillnet compiler are a unit that has the function of each forming **ana**
131 operated fishing device. Operation of fishing gear is good depending on each component of
132 the fishing gear. Chirwa [24] stated that several things that need to be considered to support
133 the success of fishing using gill nets are equipment specifications (type of net material, net
134 length and height, net shrinkage, mesh size, and net color), fishermen's knowledge and
135 skills, knowledge of seasons, and oceanographic influences.

136 Gillnet captures various types of fish according to the size of the mesh size used and the
137 fishing season. One of the commodities that is the main catch of gill nets is mackerel fish.
138 Mackerel fish is a type of fish with high economic value [25]. Noegroho et al. [8] stated that
139 mackerel fish is an important commodity whose operations have been carried out intensively
140 to meet market needs, both **for** domestic and **for** export. According to Pangandaran's
141 production data for 2016-2018 mackerel fish ranks seventh out of the top ten catches with
142 the highest number of commodities. Mackerel fish are sold for 50-60 thousand per kilogram.
143 The high selling price of mackerel is one of them caused by the taste of the meat that is so
144 good that it is much in demand by local and outside markets [26].

145 Gillnet ships in Pangandaran Regency that caught mackerel fish in this research were 2 GT
146 with a length of 1129 cm and a width of 141 cm. This ship uses a Yamaha 15 PK outboard
147 motor type engine. This ship only **contains** about 2-3 people. The number of fishermen that
148 can be transported by the ship is adjusted to the size of the ship that is related to safety
149 during the trip to the sea and the need for the operation of fishing gear [27].

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150 **3.2 Hanging Ratio**

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152 Hanging ratio is the percentage of the length of the net that is attached to the ris rope divided
153 by the length of the net that is stretched perfectly (the length of the net before it is made a
154 fishing gear) [28]. Its usefulness is to determine how much influence can be generated by
155 the net on how to entangle captured fish. According to Duman et al. [12] hanging ratios
156 normally used gill nets range from 0,50 to 0,70.

157 The results showed that gillnet with a 3.5 inch mesh size had a hanging ratio of 0,56 and a 4
158 inch net mesh of 0,54. Based on these results, it can be concluded that gill nets with 3.5 and
159 4 inch mesh sizes are selective. Murdiyanto et al. [29] stated that horizontal hanging ratio on
160 gillnet is generally 0,5. Hanging ratios smaller than 0.5 nets tend to be entangled and will
161 capture a variety of different fish species. Conversely, if the hanging ratio is 0,5, then the net
162 tends to trap fish and is more selective. The other influential factor is the formation of a net
163 body because of the currents and waves that cause up and down movements of buoys that
164 affect the formation of the net body.

165 **3.3 Catch of Gillnets in Pangandaran**

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167 | The catch is classified into two types, namely main catch and by_catch. Main catch is the
168 catch fish which is the main target in fishing which has high economic value while bycatch is
169 the catch fish which is not the main target in catching or bycatch that can be utilized or not.
170 | This is **in line with** the statement of Eays [30] which states that the catch is divided into
171 two groups, namely main catch **which** is a catch in the form of fish or other marine biota

172 | which is the main target (target species) in fishing and bycatch catch **which** is a type of fish
173 | or other marine biota that are not the main target **as illustrated in** (Table 2).
174 |

175 | **Table 2. Types of Gillnet Catch in Pangandaran.**
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No	Main Catch
1	Mackerel (<i>S. commerson</i>)
No	By Catches
1	<i>Sardinella fimbriata</i>
2	<i>Ethynnuss</i> sp
3	<i>C. ignobilis</i>
4	<i>Chirocentrus</i> spp
5	<i>Auxis rochei</i>
6	<i>Selaroides leptolepis</i>
7	<i>Spyhraena barracuda</i>

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193 | Mackerel is a catch fish that is the target of species. Non-targeted catch (bycatch) consists
194 | of seven species belonging to large and small pelagic fish which are accidentally caught
195 | along with the main catch, but these fish are still used and sold even though they do not
196 | have high economic value. According to Walker et al. [31], the diversity of species caught is
197 | due to the similarity of habitat between target fish and non-target fish.

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

203 | Apriliani et al. [19] states that Pangandaran Regency has a tropical climate with 2 seasons
204 | namely the dry season and the rainy season. Fishing activities in Pangandaran are highly
205 | influenced by the climate, where during the dry season (east season) that is from May to
206 | October Pangandaran waters **are** in calm conditions and fishing activities are not disturbed.
207 | The rainy season (western season) occurs in November - April where the waters **are** in large
208 | choppy conditions and fishing activities are slightly disturbed. The interview with gillnet
209 | fishermen **indicated-said** that the average increase in mackerel catches occurred **between**
210 | December to February. Based on production, data shows that in 2016 - 2018 the highest
211 | number of production is in August to January. This is different from the results of interviews
212 | with gillnet fishermen who said that in August mackerel fish production was classified as
213 | **small** due to the bright moon events. This causes the nets in the waters to be seen by fish as
214 | a result of bright moonlight so that the catch decreases. According to local fishermen,
215 | mackerel fish are the most popular fish and are the main catch of the main catch, especially
216 | during the mackerel fishing season in March, May, July, November and December. This
217 | difference is thought to occur due to changes in fishing season patterns and changes in the
218 | spawning season.

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219 The proportion of the catch results shows the number of target fish gill nets with 3.5 inch
220 mesh size is 20% (92 fish) and bycatch is 80% (369 fish). The proportion of gillnet catches
221 with a 4 inch mesh size shows a main catch of 35.2% (96 fish) while the bycatch proportion
222 is 64.8% (177 fish). Based on the proportion of the number of catches it can be concluded
223 that 3.5 and 4 inch gill nets are not selective because they have a proportion of bycatch >
224 main catch and the main catch is less than 60%. Kalogirou et al. [32] states that if the
225 proportion of the main target catch is greater and equal to 60%, a fishing gear can be called
226 selective because it includes environmentally friendly fishing gear.

227 The diversity of fish caught by gill nets is because Indonesia is a tropical country with high
228 biodiversity, so it is very difficult to determine and catch fish with certain species without the
229 presence of bycatch. In addition, there are similarities in habitat between one species and
230 another in spawning, feeding ground or fishing ground. Kelleher [33] ~~which~~ states that the
231 existence of by-products is a contribution from the low selectivity of a fishing gear and is a
232 characteristic of a multi-species fishing area. Characterization of by-products is necessary
233 considering that fisheries in Indonesia are multispecies that are influenced spatially and
234 temporally and in the aquatic environment. According to Walker et al. [31], the diversity of
235 species caught is due to the similarity of habitat between target fish and non-target fish.

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237 4. CONCLUSION

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239 Gillnet used has 2 types of mesh sizes, 3.5 and 4 inch gill nets with each net having a length
240 of 650 meters (7,312 mesh) and 750 meters (7,384 mesh). Gillnet has 12 meters with a net
241 mesh size of 3.5 inches as many as 135 mesh and a 4 inch mesh size of 118 mesh.
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245 80%. The proportion of gillnet catches with a 4 inch mesh size shows a main catch of 35,2%
246 while the bycatch proportion is 64,8%.

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250 COMPETING INTERESTS

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252 Authors have declared that no competing interests exist.

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