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ANALYSIS OF HOOK SIZE ON DEMERSAL FISH CATCHES USING BOTTOM LONGLINE IN THE WATERS OF ACEH ISLAND

Analisis Ukuran Mata Pancing Terhadap Hasil Tangkapan Ikan Demersal pada Rawai Dasar (Bottom Longline) di Perairan Pulau Aceh

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ABSTRACT

Demersal fish have an important role in the fishing industry in Indonesia due to their high economic value and important role in aquatic ecosystems. Bottom longline gear is a very effective fishing gear for catching demersal fish. The purpose of this study was to examine the effect of different fishing line sizes on demersal fish catches. This research was conducted from November 2023 to December 2023 in the waters of Aceh Island. The method used was experimental fishing, namely by conducting fishing operations directly in the demersal fishing area. The study showed that the fish catch consisted of five families and sixteen species of demersal fish with a total of 173 fish with an overall weight of 171.2 kg. Catches based on line size showed: line number 5 caught 24 fish weighing 47.1 kg, line number 6 caught 39 fish weighing 59.5 kg, line number 7 caught 50 fish weighing 33 kg, and line number 8 caught 60 fish weighing 31.6 kg. Data analysis tests showed that line size significantly affected the total weight of the catch ($F_{count} = 3.36 > F_{table} = 2.96$), meaning that variations in line sizes 5, 6, 7, and 8 had an effect on catch, with line number 6 providing the heaviest catch compared to other sizes.

Key words: Bottom Longline, Demersal Fish, Hook Size.

ABSTRAK

Ikan demersal memiliki peran penting dalam industri perikanan di Indonesia karena nilai ekonomis tinggi dan berperan penting dalam ekosistem perairan. Alat tangkap rawai dasar (*bottom longline*) adalah alat tangkap yang sangat efektif untuk menangkap ikan demersal. Tujuan dari penelitian ini adalah mengkaji pengaruh perbedaan ukuran mata pancing terhadap hasil tangkapan ikan demersal. Penelitian ini dilaksanakan dari bulan November 2023 hingga bulan Desember 2023 di perairan Pulau Aceh. Metode yang digunakan adalah *experimental fishing* yaitu dengan melakukan kegiatan operasi penangkapan ikan langsung di wilayah penangkapan ikan demersal. Penelitian menunjukkan bahwa tangkapan ikan terdiri dari lima *famili* dan enam belas spesies ikan demersal dengan total 173 ekor yang memiliki berat keseluruhan 171,2 kg. Hasil tangkapan berdasarkan ukuran mata pancing menunjukkan: mata

pancing nomor 5 menangkap 24 ekor dengan berat 47,1 kg, mata pancing nomor 6 menangkap 39 ekor dengan berat 59,5 kg, mata pancing nomor 7 menangkap 50 ekor dengan berat 33 kg, dan mata pancing nomor 8 menangkap 60 ekor dengan berat 31,6 kg. Uji analisis data menunjukkan bahwa ukuran mata pancing secara signifikan mempengaruhi berat total tangkapan (F_{hitung} = 3,36 > F_{tabel} = 2,96), yang berarti bahwa variasi ukuran mata pancing 5, 6, 7, dan 8 berpengaruh terhadap hasil tangkapan, dengan mata pancing nomor 6 memberikan hasil tangkapan terberat dibandingkan ukuran lainnya.

Kata Kunci: Rawai Dasar (*Bottom Longline*), Ikan Demersal, Ukuran Mata Pancing.

INTRODUCTION

Aceh Province is one of the regions in Indonesia that is rich in various fish resources, so it has significant fisheries potential, especially for demersal fish and coral fish. These two types of fish have high economic value and an important ecological role, making them a vital part of the fisheries sector in Indonesia. Usually, these fish are caught by small fishermen who operate around coral reef areas (Provinsi, 2023)

Demersal fish are a type of fish that live and feed near the seabed (Gaertner et al., 2005). Simbolon (2020), states that demersal fish are fish that live most of their lives in the deeper layers to the bottom of the waters, and generally live solitary lives within their species' environment. The demersal zone is influenced by various factors such as oceanographic conditions, habitat structure, and food availability, which influence the distribution and abundance of demersal fish species (Leitner et al., 2021).

Bottom longline is a fishing tool that has a simple construction consisting of a main line, branch line, hook, which is equipped with a float and weight or anchor, operated at the bottom of the water and settled with the target catch of bottom fish using bait (KKP, 2023). Classification Based on Indonesian Fisheries Statistics The bottom longline consists of a series of main ropes, and on the main rope at a certain distance there are several branch ropes that are shorter and smaller in diameter. At the end of this branch rope is tied a baited fishing line (Direktorat Jenderal Perikanan Tangkap, 2009). Until now, bottom longlines are considered the most effective fishing gear used to catch demersal fish because bottom longlines are operated at the bottom of the waters (Hadi, 2019).

Demersal fish in Aceh waters are caught with six types of fishing gear, namely drift gillnets, set gillnets, spearguns, hand lines, beach seines, longlines. bottom (bottom longline). Based on data from the Aceh government in 2023, bottom longline had the highest fishing effort for catching coral and demersal fish (Provinsi, 2023). Chaliluddin (2019), stated that the procedures for operating bottom longlines are very safe for habitat, biodiversity, fishermen, socially acceptable and profitable for fishermen but also do not conflict with government regulations.

Factors that can influence the number of catches using bottom longlines include the use of the right size of hook, equipment depth placement, type of bait, soaking time of the fishing gear (Giman et al., 2006). Sokyan et al. (2021), stated the success of the bottom longline fishery using the size of the hook, including the size of the hook used and the fishing zone. Rincón-Sandoval et al. (2019), emphasized the importance of considering variables such as fishing zone, hook size and bait, to increase catches in bottom longline fisheries. Ingólfsson *et al.* (2017), stated that hook size influences bottom longline catches, where smaller hooks increase fishing efficiency while larger hook sizes catch larger fish. The continuous use of small fishing hook sizes is predicted to disrupt the sustainability of fish resources (Fuah, 2019). However, the fact is that in the bottom longline field operated by fishermen in the waters of Aceh Island generally use fishing hook sizes that are relatively small in size (no. 10-8) so that the fish caught are also relatively small.

With this background, research on hook size analysis of demersal fish catches on bottom longlines is very important to face challenges and achieve sustainability goals in the demersal fisheries sector. This research aims to examine the impact of different hook sizes on demersal fish catches.

METHODS

Research Methods

The experimental fishing method is a research method used in this research by carrying out fishing operations directly in the field. Variations in hook size were used as treatment variables, with one bottom longline unit used for the research. Fishing hooks are installed sequentially, starting with size number 5, 50 pieces, then size number 6, 50 pieces, followed by number 7, 50 pieces, and finally size number 8, 50 pieces, for a total of 200 hooks used.

This research was carried out from November to December 2023 in the waters of Aceh Island, Meulingge Village, Aceh Besar Regency, Aceh Province. Data was collected from 10 fishing points. More detailed research locations can be seen in the following image.

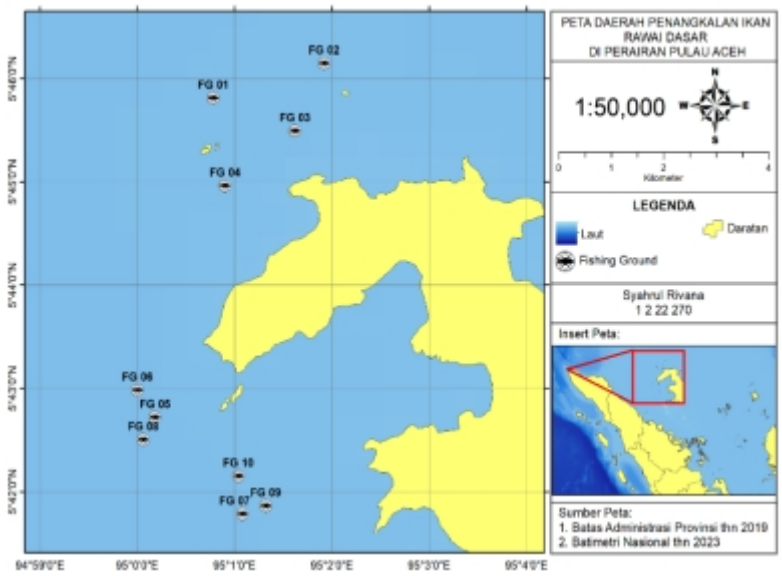

Figure 1. Research Location

Experimental Design

The method used in this research is experimental fishing, namely carrying out fishing trials using bottom longlines to catch demersal fish using 4 (four) different types of hook sizes to see which type of hook size provides the best catch results. Good.

The research used a randomized block design (RAK), because the conditions at the research locations were not uniform (Susilawati, 2015). The types of fishing hook sizes used in the research consist of 4 numbers, namely (1) A: Fishing hook number 5; (2) B: Fishing hook no. 6; (3) C: Fishing hook no. 7; and (4) D: Fishing hook number 8. The four treatments will be grouped based on the time of fishing operations. For more details, the number of treatments and groups can be seen in Table 1.

Table 1. Research Design

Arrest Operation Group/Time	Treatment: Fishing Eye Size			
	Number 5	Number 6	Number 7	Number 8
Trip 1	1A	1B	1C	1D
Trip 2	2A	2B	2C	2D
Trip 3	3A	3B	3C	3D
Trip 4	4A	4B	4C	4D
Trip 5	5A	5B	5C	5D
Trip 6	6A	6B	6C	6D
Trip 7	7A	7B	7C	7D
Trip 8	8A	8B	8C	8D
Trip 9	9A	9B	9C	9C
Trip 10	10A	10B	10C	10D

Data collection

Data collected during the research consisted of primary and secondary data. Primary data is data collected and processed by organizations or individuals directly from the object (Nuryadi et al., 2017). Primary data was obtained from testing fishing equipment and documentation in the form of data on the number of catches (tails), weight (weight) of fish (kg), and types of species caught. Meanwhile, secondary data collected was fisheries potential data in the waters of Aceh Island, Aceh Besar Regency. For details, see table 2.

Table 2. Data collected by purpose

Objective	Data Type	Data source	Method of Collection	Analysis
Analyze the most suitable hook size for catching demersal fish	Type of fish, and weight of fish	Primary	Experimental Fishing	Descriptive

Data analysis

Data on size, weight, number of catches and fish species are presented in graphs and tables to facilitate the analysis process. Based on the experimental design carried out, one factor Analysis of Variance (Anova) will then be used.

The analysis used to approach the first objective was a Randomized Block Design (Susilawati, 2015). The general equation used in the Randomized Block Design is as follows:

$$Y_{ij} = \mu + T_i + \beta_j + \varepsilon_{ij}$$

Where:
i = 1,2, 3, …., r (fishing operation time group)
j = 1, 2, …., t (hook eye size treatment)
yij = Observations on all experimental units,
μ = general average,
ti = influence of the ith group,
bj = effect of the jth treatment,
Ɛij = Effect of the ith group and jth treatment.

The Randomized Block Design (RAK) will be processed using the SPSS (Statistical Product and Service Solutions) program. The treatments used were four different hook sizes, namely numbers 5, 6, 7 and 8 with repetitions 10 times. To fulfill the analysis requirements in drawing conclusions, the following hypothesis is formulated:

- H0 is $\eta = 0$, (j = 1, 2, …. r), which means that different hook sizes have no effect on the size (weight) of the fish caught.
- H1 is $\eta \neq 0$, (j = 1, 2, …. r), which means that different hook sizes affect the size (weight) of the fish caught.

The hypothesis was tested using the F test on the analysis of variance table with the following criteria:

- Fcount < Ftable, then H0 is accepted and H1 is rejected, meaning that different hook sizes have no effect on the size (weight) of the fish caught.
- Fcount > Ftable, then H1 is accepted and H0 is rejected, meaning that different hook sizes affect the size (weight) of the fish caught.

Table 3. Variety fingerprint analysis (Anova)

SK	DB	JK	KT	F Count	F Table	
					5%	1%
Group	k-1=v1	JKK	JKK/v1	KTK/KTG	(v1,v3)	
Treatment	t-1=v2	JKP	JKP/v2	KTP/KTG	(v2,v3)	
Error	Vt-v1-v2=3	JKG	JKG/v3	-		
Total	Kt=1=vt	JKT				

Source: Susilawati (2015)

If the results of the Anova test of the treatment provide a different effect, then the test is continued with further tests using the Duncan Test. The further test used is Duncan's Multi Range Test (DMRT) or commonly known as the Duncan test to determine whether there is a significant difference between the average treatment values, as well as to determine which treatments are significantly different.

RESULT

Composition of Catch

The composition of the number of bottom longline catches which had different hook sizes during the 10 fishing operation trips consisted of five families and sixteen species of demersal fish with bottom longline catches reaching 173 fish with a total weight of 171.2 kg.

Table 4. Bottom longline catch species

No	Lokal Name	Family	Species	Common Name
1	Kakap merah	*Lutjanidae*	*Lutjanus gibbus*	*Humpback red snapper*
2	Kerapu Gunting	*Epinephelidae*	*Variola albimarginata*	*Lyretail Grouper*
3	Kerapu Tomat	*Epinephelidae*	*Cephalopholis sonnerati*	*Tomato Grouper*
4	Kerapu Macan	*Epinephelidae*	*Epinephelus longispinis*	*Longspine Grouper*
5	Kerapu merah	*Epinephelidae*	*Cephalopholis miniata*	*Coral hind*
6	Karapu Sunu Karet	*Epinephelidae*	*Epinephelus fasciatus*	*Blacktip Grouper*
7	Kerapu minyak	*Epinephelidae*	*Epinephelus undulosus*	*Wavylined Grouper*
8	Kuwe	*Carangidae*	*Caranx Ignobilis*	*Giant Trevally*

9	Lencam	*Lethrinidae*	*Lethrinus microdon*	*Smalltooth emperor*
10	Lencam	*Lethrinidae*	*Lethrinus rubrioperculatus*	*Spotcheek emperor*
11	Tambak Pasir	*Lethrinidae*	*Gymnocranius grandoculis*	*Bluelined Large-eye Bream*
12	Tambak Pasir	*Lethrinidae*	*Gymnocranius griseus*	*Grey large-eye bream*
13	Tambak Pasir	*Lethrinidae*	*Gymnocranius microdon*	*Bluespotted Large-eye Bream*
14	Kurisi Peran	*Lutjanidae*	*Aphareus rutilans*	*Rusty Jobfish*
15	Kurisi Hijau	*Lutjanidae*	*Aprion viresces*	*Green Jobfish*
16	Ikan Kambing	*Balistidae*	*Balistoides viridescens*	*Titan Triggerfish*

The composition of the catch is shown in Figure 2 below:

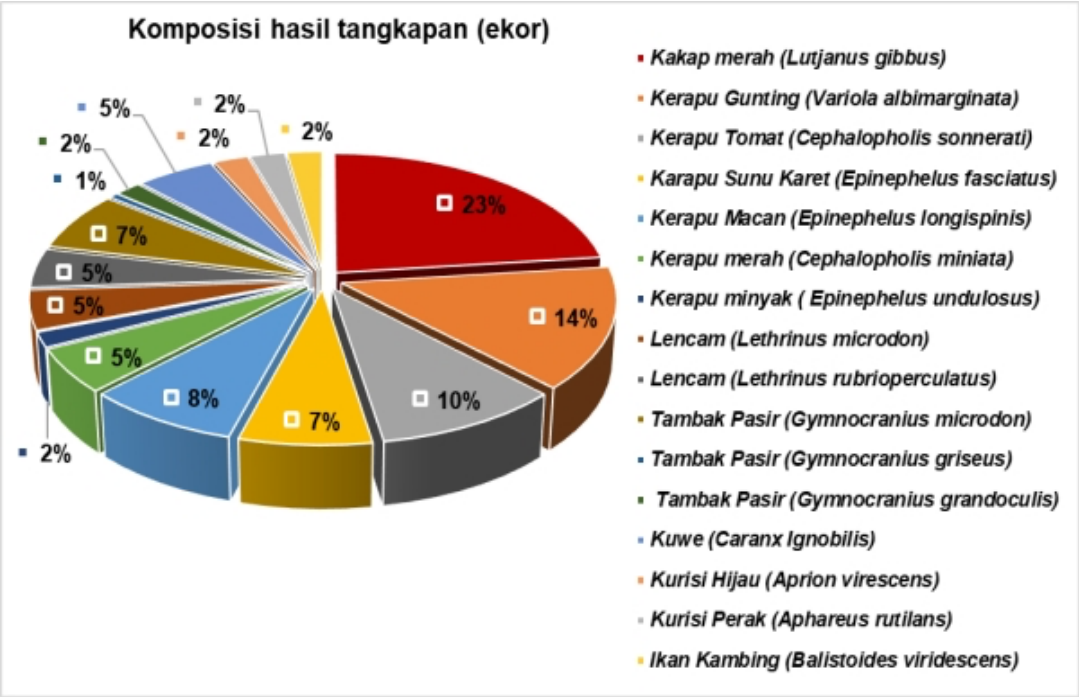

Figure 2. Composition of catch (tail)

At the time of the catch trial, fish were dominated by types/species caught using bottom longlines based on the number of tails, namely 40 red snapper (*Lutjanus gibbus*) or 23.1%, 25 scissor grouper (*Variola albimarginata*) or 14.5%, Tomato grouper (*Cephalopholis sonnerati*) 17 or 9.8%, Tiger grouper (*Epinephelus longispinis*) 14 or 8.1%, Sunu Karet grouper (*Epinephelus fasciatus*) 12 or 6.9% , Sand Pond (*Gymnocranius microdon*) as many as 12 individuals or 6.9%, red grouper (*Cephalopholis miniata*) as many as 9 individuals or 5.2%, trevally (*Caranx ignobilis*) as many as 9 individuals or 5.2%, lencam (*Lethrinus microdon*) as many as 8 birds or 4.6%, lencam (*Lethrinus rubrioperculatus*) as many as 8 birds or 4.6%, green turtle (*Aprion virescens*) as many as 4 birds or 2.3%, silver turtle (*Aphareus rutilans*) as many as 4 birds or 2, 3%, goatfish (*Balistoides viridescens*) as many as 4 or 2.3%, oil grouper (*Epinephelus undulosus*) as many as 3 or 1.7%, Sandfish (*Gymnocranius grandoculis*) as much as 3 or 1.7%, and fish pond sand (*Gymnocranius griseus*) as much as 1 fish or 0.6%. This is

directly proportional to the statement from Muis (2020), research conducted in the waters of Makarangana Island, Pangkep Regency, South Sulawesi, the results of bottom longline catches showed that red snapper (*Lutjanus erythropterus*) was the dominant type of fish caught. According to Pratama et al. (2020), types of fish that have high economic value and are often caught by bottom longline include sheep snapper (*Lutjanus analyst*), white trevally (*Caranx sexfaciatus*), red snapper (*Lutjanus campechanus*), and sunu grouper (*Plectropomus leopardus*). According to Sudirman et al. (2015), at night snapper fish are predatory fish and look for food such as shrimp, squid, octopus, crabs, snails, plankton and crustaceans.

Catch Results Based on Fishing Hook Size

During the research with four types of hook sizes in 10 rips/repetitions, a total of 173 demersal fish were caught with a total weight of 171.2 kg.

Table 5. Results of basic longline catches using different types of hook sizes

PI Operating Time	Treatment: Fishing Eye Size								Total	
	Number 5		Number 6		Number 7		Number 8			
Trip	Amount (tails)	Amount (Kg)	Amount (tails)	Amount (Kg)	Amount (tails)	Amount (Kg)	Amount (tails)	Amount (Kg)	Tails	Kg
1	1	5,2	3	6,6	4	2,3	9	3,0	17	17,1
2	3	3,9	3	2,2	4	2,1	4	4,2	14	12,4
3	1	2,2	4	5,4	4	3,3	3	2,0	12	12,9
4	3	2,7	7	5,3	9	5,3	11	6,1	30	19,4
5	4	7,6	6	8,9	6	3,9	6	3,6	22	24,0
6	4	7,4	7	9,2	3	1,9	6	2,8	20	21,3
7	1	1,0	2	1,8	3	0,8	5	1,1	11	4,7
8	1	1,3	2	11,7	7	4,2	7	3,3	17	20,5
9	3	10,3	3	6,9	6	6,8	4	2,4	16	26,4
10	3	5,5	2	1,5	4	2,4	5	3,1	14	12,5
Total	24	47,1	39	59,5	50	33,0	60	31,6	173	171,2

The composition of catches based on different types of hook sizes can be seen in Figure 3 below:

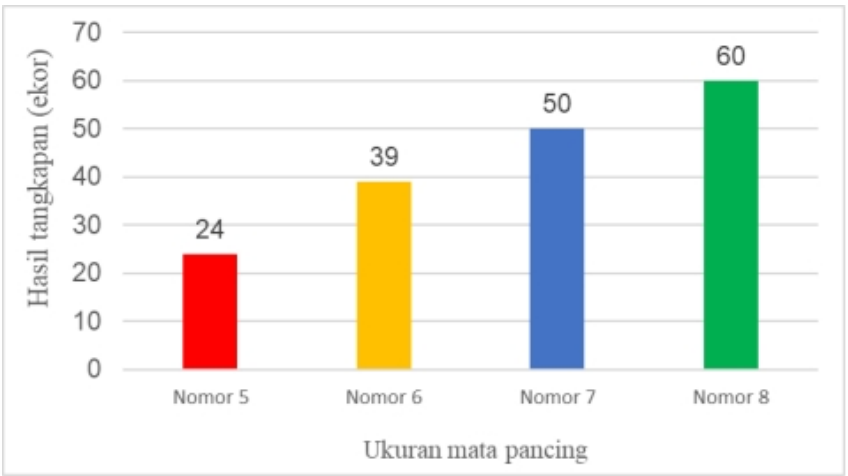

Figure 3. Catch results during research in number (heads)

Based on the graph above, the number 8 hook treatment gave the highest catch of demersal fish based on the number (of tails) of 60 fish or 34.7%, the number 7 hook treatment gave the catch of 50 demersal fish or 47.1 kg 28.5%, the eye treatment fishing line number 6 gave a catch of 39 demersal fish or 22.5%, and the treatment of hook number 5 gave the least demersal fish catch based on the number (of tails) of 24 fish (13.9%).

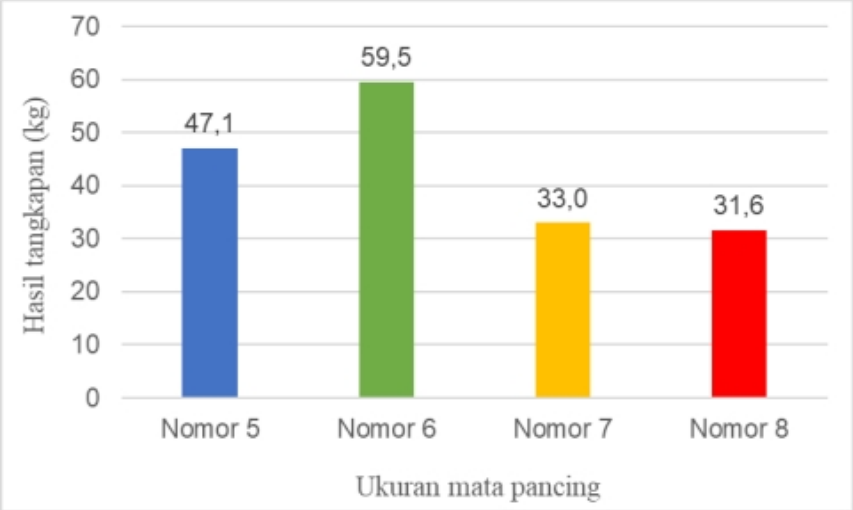

Figure 4. Catch during the research in quantity (kg)

Based on the graph above, hook number 6 treatment gives the largest catch of demersal fish based on total weight or weight of 59.5 kg or 34.8%, hook number 5 treatment gives demersal fish catch with a total weight of 47.1 kg or 27.5%, hook hook treatment number 7 gives a catch of demersal fish with a total weight of 33.0 kg or 19.3%, and hook treatment number 8 gives the lowest catch of demersal fish based on the total weight or weight with a weight of 31.6 kg or 18.5%. Therefore, hook size number 6 is more effective based on the amount of weight or weight than other hook sizes because it has a larger percentage.

DISCUSSION

Analysis was carried out to understand the impact of variations in hook size (number) on demersal fish catches in weight units (kg), using the normality test, ANOVA test, and Duncan's advanced test to identify treatments that provide optimal catch results. The data normality test aims to show that the data sample comes from a population with a normal distribution. According to Basuki & Prawoto (2019), if the sample is larger than 30 then the Kolmogorov-Smirnov test is used, however if the sample is smaller than 30 then the Shapiro-Wilk test is used, because the data is classified as large data (n>30) so the normality test uses Kolmogorov -Smirnov. Based on the results of the normality test, it can be seen that the significance value of 0.200 is greater than 0.05 (p>0.05). Because the significance is greater than 0.05, it is concluded that the data is normally distributed.

After the data is declared normal or normally distributed, the next step is to carry out the F test. Next, the SPSS series 26 application is used for one-way ANOVA analysis of variance (Oneway Analysis of Variance) with a confidence level of 95% and a significance level of 0.05 (5%) on the total results. catch (kg).

Table 6. Analysis of Variance (ANOVA)

SK	DB	JK	KT	F Count	F Tabel 5%	F Tabel 1%	information
Group	9	95,809	10,65	2,07	2,25	3,15	tn
Treatment	3	51,886	17,30	3,36	2,96	4,60	*
Error	27	138,889	5,14				
Total	39	286,584					

Based on the results of the analysis of variance (ANOVA), it was found that the Fcount value of the fishing hook treatment was 3.36, while the Ftable at 5% significance was 2.96, so it was known that Fcount > Ftable, namely 3.36 > 2.96, so the treatments were significantly different. Thus, the treatment of the hook has a significant effect on the number of catches (kg) or has an influence on the number of catches (kg). So H1 is accepted and H0 is rejected so that the treatments are significantly different. This means that statistically differences in hook size have a real influence on the number of catches (kg). Based on this, further tests are needed. The further test used is Duncan's Multi Range Test (DMRT) or commonly known as the Duncan test to determine whether there is a significant difference between the average treatment values, as well as to determine which treatments are significantly different.

Table 7. Notation of Duncan test results for number of catches (kg)

Fishing Eyes	Average	Notation
Number 8	3.16	a
Number 7	3.30	a
Number 5	4.71	ab
Number 6	5.95	b

Based on the results of Duncan's test calculations, it was found that hook size number 8 had an average value of 3.16 with the notation "a", while size number 7 had an average value of 3.30 also with the notation "a". Hook size number 5 has an average value of 4.71 with the notation "ab", while size number 6 has the highest average value of 5.95 with the notation "b".

Duncan's test results confirmed that hook sizes number 8 and 7 did not show a statistically significant difference in the number of catches (kg), so both can be considered to provide similar catches. On the other hand, the size of hook number 5 shows a significant difference with sizes number 8 and 7, indicating that the catches are statistically different. Hook size number 6 also showed a statistically significant difference from sizes number 8, 7, and 5, indicating that size number 6 provided a higher number of catches (kg) than the other sizes. Therefore, it can be concluded that the use of hook number 6 is the most effective in increasing the number of catches (kg) compared to hook sizes number 5, 7, and 8. Research from (Surya, 2019) explains that the size of hook number 6 has the most effective catch in increasing catches (kg) compared to other hook sizes. According to Kurnia et al. (2015), differences in the weight and quantity of each type of catch relative to the size of the hook used are due to the physical influence of the size of the hook. Herrmann et al. (2018), explained that fishing using larger hooks will change the exploitation pattern of the catch with a higher proportion of larger fish.

CONCLUSION

Bottom longline catches during 10 fishing operations with various hook sizes showed that the total catch consisted of five families and sixteen species of demersal fish, totaling 173 fish with a total weight of 171.2 kg. Red snapper (*Lutjanus gibbus*) dominates with 40 fish or 23.1% of the total catch. The size of the hook significantly influences the weight of the catch.

Test of data variance (F calculated = 3.36 > F table = 2.96) confirmed that variations in hook size 5, 6, 7, and 8 had an impact on catch results, with hook size number 6 providing the heaviest catch compared to other sizes. other.

Further research is needed to understand the influence of other factors such as time of day, fishing location and water conditions on catch results. This information will be useful for fishermen, especially that the use of hook number 6 is the most effective for catching demersal fish.

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