International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Effect of using time in small pelagic purse seine with two vessels (*slerek*) on breaking strength and mesh size change in Pengambengan Archipelago Fishing Port (PPN), Bali, Indonesia

I Putu Yoga Iswara Putra [1], Yusrizal [1], Erick Nugraha [1,*], Eli Nurlaela [1], Ratu Sari Mardiah [1], Maman Hermawan [1], Priyantini Dewi [1] and Bernadetta Candra Pratiwi [2]

[1] *Faculty of Fishing Technology, Jakarta Technical University of Fisheries, Pasarminggu 12520, South Jakarta, Indonesia.*
[2] *Center of Capture Fisheries, Semarang 50175, Central Jawa, Indonesia.*

International Journal of Science and Research Archive, 2024, 11(02), 1179–1188

Publication history: Received on 22 February 2024; revised on 01 April 2024; accepted on 04 April 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.11.2.0557

Abstract

The bunt net of a small pelagic purse seine with two vessels (*slerek*) serves as a place for captured fish before being loaded onto the boat. Seine nets that are operated within a certain of long time can be weathering and deterioration of the material caused by aging and environmental factors. This study aims to analyze the effect and relationship of the use time of a bunt net with *Multifilament polyamide* (PA) material 210 D/12 mesh size ¾ inch on breaking strength and changes in mesh size. The methods used are observation, interview, literature study and documentation to be further analyzed using descriptive analysis and MANOVA. The results showed a decrease in the breaking strength value of the net by 38% while on the contrary, a 5% increase occurred in the change in mesh size. The analysis conducted shows the influence of usage time on breaking strength by 95.9% with a very strong not unidirectional relationship level of -0.977 and the influence of usage time on changes in mesh size by 99% with a correlation coefficient value of 0.985 which means the level of relationship is very strong and unidirectional.

Keywords: Bunt net; Breaking Strength; Mesh Size; Slerek Type of Purse Seine

1. Introduction

Purse seine fishing gear can easily be found in Indonesia. One of several fishing gears that are effective for catching schooling fish [1, 2, 3]. One of the areas that has the potential for small pelagic fish and the majority of purse seine use is the Bali Strait area with boats based at the Pengambengan Archipelago Fisheries Port (PPN). The small pelagic purse seine with two vessels or also known as the local name *slerek*. The construction of *slerek* is not much different from other areas, consisting of buoys, top rope, selvedge, body, wings, bunt, bottom rope, weights, crimped lines and rings.

Purse seines are operated by hunting system and then wrapping the net around the schooling fish which then pulls the corrugated line so that the bottom of the net closes to resemble a bowl. In operation, net bunts are part of the gathering place for caught fish. The function of the bunt is to hold the weight of the fish caught, so the strength of the bunt must be stronger than the other parts [4]. According to [5], net bunt must have more strength because the caught fish gather in the bunt causing tension or shaking forces. This can cause part of the net body to tear under pressure from the moving mass of fish and if a part of the net is torn, there is a big possibility that the fish can escape from the gap.

Nets as a fishing gear material used by fishermen vary in quality. According to research by [6], fishermen are not yet aware that the strength of nets made from synthetic fibers can decrease if exposed to sunlight for a long time. So the time of use of purse seine nets is also considered to influence the damage that occurs to the net. Increasing the length

* Corresponding author: Erick Nugraha

of use time should increase the elongation of the mesh size and the weathering of the thread. A decrease in breaking strength can cause the net thread to break easily due to the movement of fish collected in the net bunt. The faster the net breaking strength decreases, the more the costs for repairing and purchasing nets will increase [7, 8, 9]. The addition of elongation can result in changes in the size of the mesh size, so that if the mesh becomes larger the target fish can escape from the net. The physical parameters or performance of the net can be seen by the value of the breaking strength of the net and changes in mesh size which can be determined by tensile testing and direct measurements.

Based on these problems, this research aims to determine the increase and decrease that occurs in breaking strength values and changes in mesh size and to analyze the influence and relationship between net usage time on breaking strength values and changes in mesh size of *slerek*.

2. Material and methods

The time of the research was carried out from 21 August to 8 December 2023. The sampling location was at PPN Pengambengan, Pengambengan Village, Negara District, Jembrana Regency, Bali and the testing location was at the testing laboratory in Fishing Center (BBPI) Semarang, Central Java.

This research requires tools and materials for its implementation to support the process of collecting, processing and analyzing data. Special equipment for laboratory scale testing uses tools that have been calibrated from BBPI Semarang in the form of a Shimadzu tensile testing machine type AG-10KNIS MS with a tensile strength of 10 kN with an accuracy of 0.001 kgf and a digital caliper with an accuracy of 0.01 mm. The material or focus of the object used is a sample of the bunt of purse seine at PPN Pengambengan with *Multifilament polyamide* (PA) material 210D/12 mesh size ¾ inch or 19.05 mm, at different lengths of use, namely the use time range 1, 2, 3, 4 and 5 years plus new nets as control.

The data collection method used in this research is observation and interviews conducted with competent sources, both ship owners and fishing masters, then using literature studies related to the research topic and documentation. In line with this, in this study the primary data required is in the form of purse seine net specifications including size, material, usage time and operating techniques and maintenance of the net, then net testing data in the form of breaking strength values and changes in mesh size. Meanwhile, the secondary data for this research is in the form of *slerek* references and net testing guidelines.

The data analysis method used is descriptive analysis and statistical analysis. Descriptive analysis is used to describe the average, maximum and minimum values of breaking strength and changes in mesh size as well as describing graphs and tables in the research. Meanwhile, the statistical analysis used in this research begins with an experimental design that groups data based on usage time, then because the dependent variable in the study is more than one or equal to two, it is continued with Multivariate Analysis of Variance (MANOVA) analysis to determine the effect of the independent variables on dependent variable simultaneously and to determine the relationship between the independent variable and the two dependent variables, Pearson correlation analysis is used.

2.1. Research Hypothesis

The hypothesis in this study assumes that the use of nets in different time periods can influence and have a relationship with breaking strength and changes in mesh size. To find out the research allegations, the research hypothesis is prepared as follows.

- Hypothesis of the influence of breaking strength and changes in mesh size
  H_0: There is no effect of different net usage times on breaking strength and changes in mesh size in the *slerek* bunt.
  H_1: There is an influence of different net usage times on breaking strength and changes in mesh size in the bunt section of the *slerek*.
- Correlation hypothesis of breaking strength and mesh size
  H_0: There is no relationship between breaking strength and changes in mesh size with the time of use of slerek.
  H_1: There is a relationship between breaking strength and changes in mesh size with the time of use of slerek.

2.2. Net Testing

This research tested the values of breaking strength and changes in mesh size using test procedures based on Indonesian Standardization Agency (SNI) ISO 1806:2002, entitled fishing gears made from nets, determining the breaking force of nets. and SNI 8326:2023 with the title fishing equipment made from nets, how to measure of mesh size. The test requirements in this research are that all samples to be tested in dry conditions must refer to standard

test room conditions, namely 20 ± 2°C and relative humidity of 65% ± 4% until they reach equilibrium. For artificial fiber nets, the adjustment period is 24 hours. The average test time should be 20 ± 3 seconds. The average must be determined during preliminary testing. The test is carried out at least 10 times on each sheet of net sample using a confidence interval of 95%.

2.2.1. Net Sample

The samples taken were bunt nets made from 210D/12 *Multifilament polyamide* (PA) material with a mesh size of ¾ inch or the equivalent of 19.05 mm (Figure 1) and were used in fishing operations based on usage times of 1, 2, 3, 4, and 5 years, as well as a new net as a control net. This sample was obtained based on the results of observations and interviews with ship owners and fishing masters at PPN Pengambengan. The number of samples taken in this study was 50 x 50 meshes.

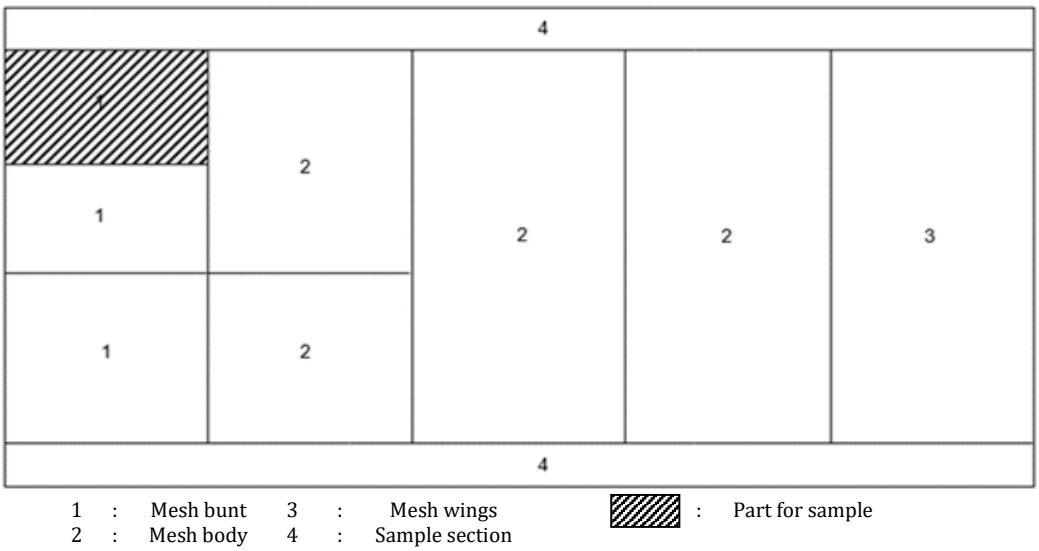

Figure 1 Research Samples

2.2.2. Net Specimen

The samples obtained will then be made into test specimens, where samples of the pocket mesh will be made or cut into complete mesh units called specimens (Figure 2). The number of samples taken is 50 x 50 meshes which will then be cut into mesh units with a total of 20 meshes as an experiment for the testing machine method (the method in question is determining the time and force on the machine) and 10 meshes as test material after the machine method The test has been determined, the number of 10 meshes is adjusted based on repetition 10 times.

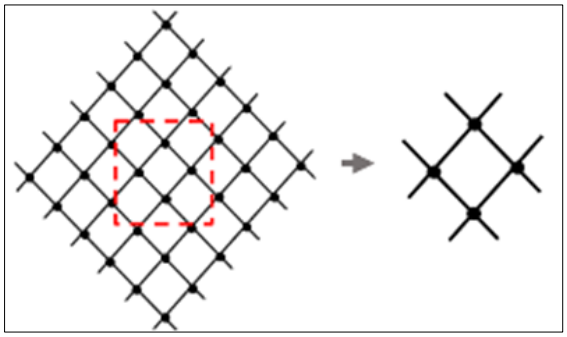

Figure 2 Sample Cutting to Specimens.

2.2.3. Net Breaking Strength Test

Mesh breaking strength testing (Figure 3) was carried out on samples that had been made into test specimens. Testing is carried out based on the test procedures specified in SNI ISO 1806:2002 (established by BSN in 2021). The breaking strength value and net breaking graph will be directly read by the Trapezium 2 application. If the repetition has been

carried out 10 times, the next step is to determine whether the data obtained is uniform or not by calculating the upper control limit and lower control limit.

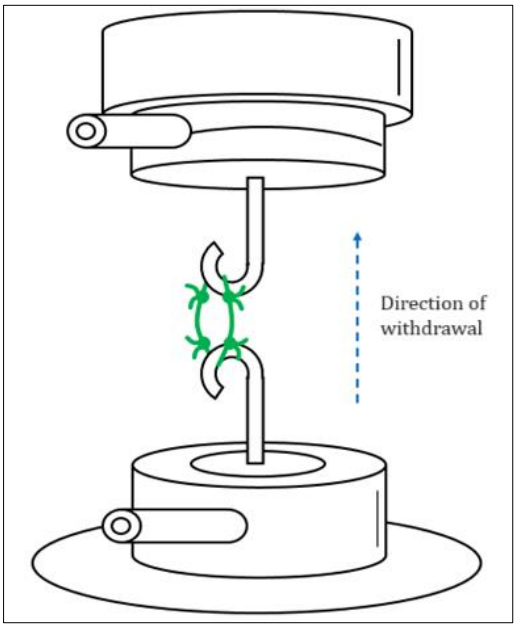

Figure 3 Tensile Test of Mesh Breaking Strength

2.2.4. Mesh Size Change Test

The value of the change in mesh size is carried out based on the test procedure in SNI 8326:2023, which is measured using a digital caliper. The mesh calculation is obtained from the mesh opening (OM) added to the height of one of the nodes. The step to measure the mesh, first the net must be in a tight condition with two mesh nodes meeting each other. Then measurements are taken using a caliper starting from the eye opening or mesh opening (OM) and continuing with the height of one of the nodes. Information about the measurements can be seen in Figure 4. Mesh size testing was carried out with 10 (ten) repetitions and the selection of samples to be measured was carried out randomly so that they could represent the entire net (Figure 5).

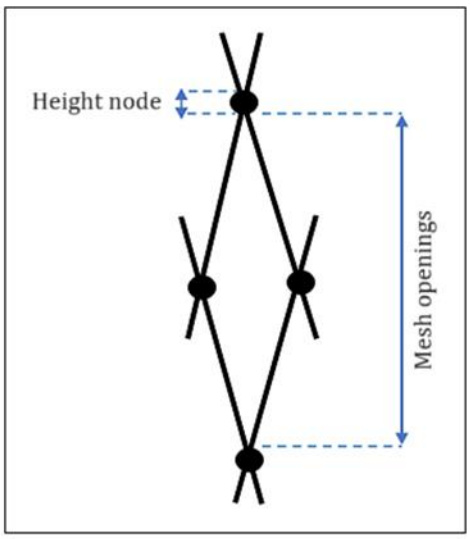

Figure 4 Opening Mesh and Knot Height

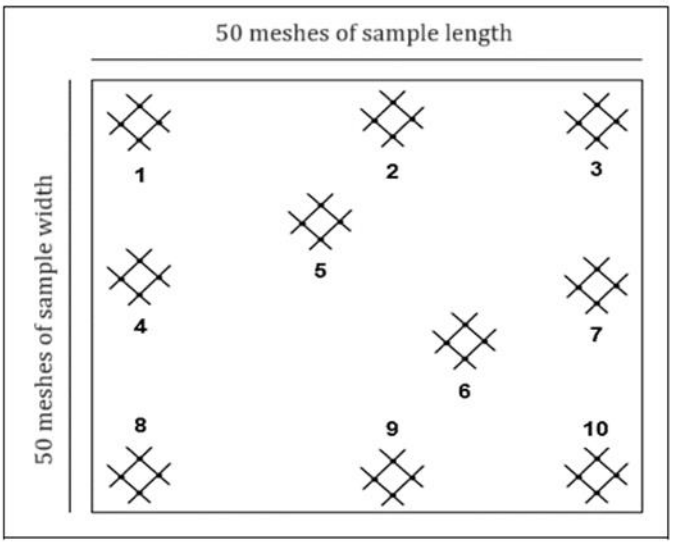

Figure 5 Random Sampling of Specimens

3. Results and discussion

3.1. Small pelagic purse seine with two vessels (*slerek*)

S*lerek* is locally name in Bali, if referring to Minister of Maritime Affairs and Fisheries Regulation number 36 of 2023, this *slerek* is included in the code 01.1.2.1 PS2-K. The construction of the *slerek* is listed in the Indonesian National Standard (SNI), precisely in SNI 8979:2021 with the title small pelagic purse seine with two vessels, which states that this fishing gear is rectangular in shape consisting of bouy, bouyline, wing, main body, shoulder, purse line, purse ring, and bunt.

On average, the net material used is *Multifilament polyamide* (PA) 210 D with light green color, various sizes according to the parts of the net based on their location and function. *Slerek* operations start from the preparation stage on land and at sea, the journey to the fishing ground, hunting schooling fish, the stages of *setting*, *pursing, hauling* and *drilling* as well as the boat returns to fishing port. The *slerek* caught in the Pengambengan PPN are sardin, mackerel, tuna and bonito.

3.2. Net Breaking Strength Test Results

Testing of the breaking strength of the mesh during use was carried out with a total of 6 samples. The breaking strength value was obtained from the application of Trapezium 2 on a breaking strength machine tester. The unit produced in the breaking strength test is kilogram force (kgf). The breaking strength test results for each net sample can be seen in Table 1.

Table 1 Breaking Strength Test Results

Repetition	Breaking strength value (kgf)					
	Control	1 year	2 years	3 years	4 years	5 years
1	14.95	13.19	12.31	10.87	9.90	8.85
2	14.01	12.87	12.02	11.04	10.35	8.65
3	14.96	12.65	11.57	10.78	10.49	9.52
4	14.92	13.56	12.68	11.09	9.95	9.09
5	13.82	12.69	12.26	11.48	9.55	9.11
6	15.06	13.14	12.01	11.32	10.66	9.07
7	14.39	12.76	12.45	11.45	10.77	9.26
8	14.62	12.84	12.47	11.59	10.09	8.70
9	13.73	13.22	11.61	11.42	10.99	8.90
10	14.68	12.99	12.44	11.37	10.63	8.69
Average	14.51	12.99	12.18	11.24	10.34	8.98

The values obtained from each sample will then focus on the average value obtained. The average breaking strength test value for all net samples is used to determine whether there is an increase or decrease in the breaking strength value. Next, a comparison was made between the averages of all net samples. The graph of the average value of breaking strength results for the entire net can be seen in Figure 6.

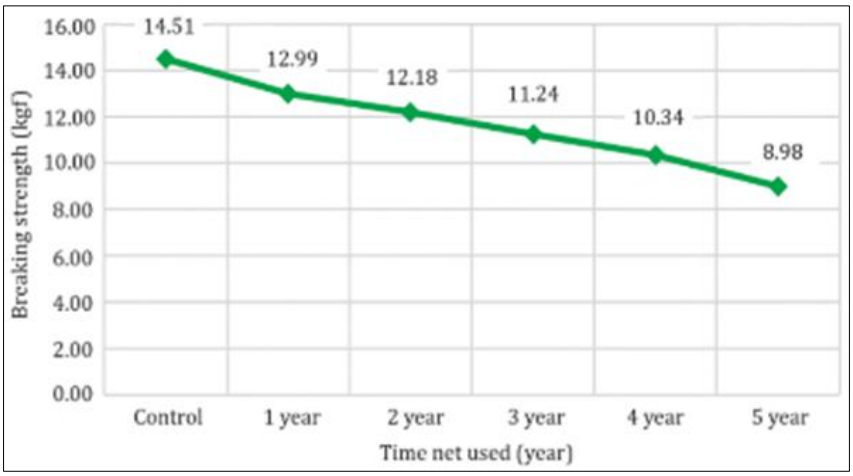

Figure 6 Breaking strength decrease graph

Based on this graph, increasing the time of net is used will cause a decrease in the breaking strength of the net. If viewed in percentage terms, the reduction in breaking strength of the control net over a period of 5 years of use is 38%. According to [7], a good fishing gear material is a base material that has high strength. The higher the breaking strength value, the better it will be used as a fishing gear material. A decrease in the breaking strength of the net can result in a reduction in the net's fishing capacity, besides that, fishermen also have to incur additional costs to replace damaged nets. Nets that have low breaking strength will be susceptible to damage and can potentially be damaged when operating fishing gear. The damage that can occur is that the net breaks and the net can become marine debris and have an impact on ghost fishing. This agrees with [10], who stated that low breaking strength of fishing nets can cause ghost fishing which can endanger marine biota and have an impact on the marine environment.

3.3. Mesh Size Test Results

Tests for changes in mesh size during use were carried out similarly with 6 samples. Mesh size is defined as the distance between two mesh nodes when they are perfectly stretched. The value of change in mesh size was tested using a caliper with an accuracy of 0.01 mm. The results of mesh size testing can be seen in Table 2.

Table 2 Mesh Size Test Results

Repetition	Mesh size (mm)					
	Control	1 year	2 years	3 years	4 years	5 years
1	19.05	19.10	19.23	19.38	19.44	19.58
2	19.03	19.09	19.20	19.41	19.47	19.59
3	19.04	19.16	19.17	19.42	19.49	19.58
4	19.06	19.13	19.19	19.37	19.52	19.58
5	19.07	19.12	19.21	19.40	19.48	19.56
6	19.04	19.14	19.22	19.41	19.50	19.58
7	19.07	19.13	19.21	19.38	19.48	19.56
8	19.05	19.15	19.18	19.40	19.51	19.57
9	19.05	19.11	19.20	19.36	19.46	19.55
10	19.06	19.13	19.17	19.39	19.46	19.55
Average	19.05	19.13	19.20	19.39	19.48	19.57

The average change in mesh size in the sample is used as a comparison sample and to determine whether there is an increase or decrease in the change in mesh size in the sample. Changes in the mesh size of each sample will then be collected and compared which can be seen in the graph (Figure 7).

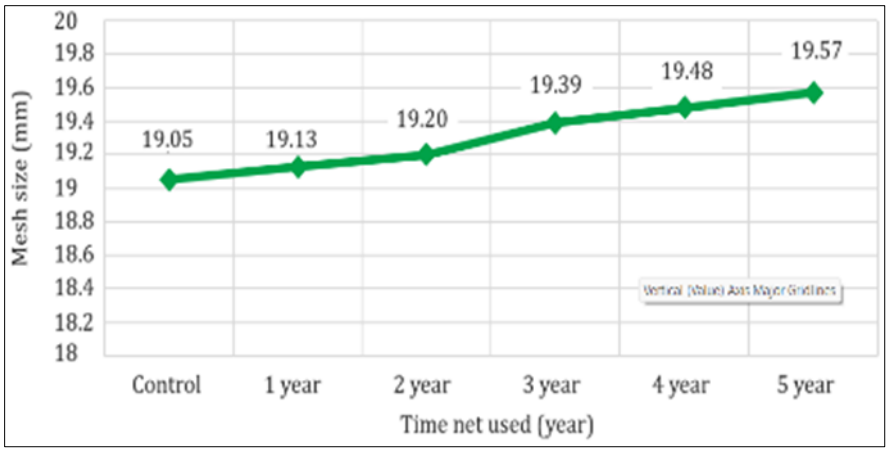

Figure 7 Mesh size increase graph

Based on the graph, it shows that as the net usage time increases, it will cause an increase in the mesh size. If viewed in percentage form, the increase in eye size from the control net to the 5 years use net is 3%. The size of the net mesh is related to the catch target which is one of the factors determining the size of the catch. Mesh size can be influenced by elongation. According to [11], elongation is the increase in length of a test sample. If the elongation is too high, it will result in a change in the construction of the net, in this case the mesh size will change, causing caught fish to escape the net easily [12].

3.4. Effect of Net Usage Time

MANOVA analysis was used to determine the effect and average differences in the time of using *slerek* type vessels on net breaking strength and changes in net mesh size. The results of the MANOVA assumption test in the form of a normality test, homogeneity test of the variance-covariance matrix and variance homogeneity test in this study have fulfilled these assumptions. Test analysis can be continued with the MANOVA test with results in the form of a multivariate test and Tests of Between-Subjects Effects. The first results obtained were the results of the multivariate test with *Pillae Trace, Wilk Lambda, Hotelling Trace, Roy's Largest Root* analysis which can be seen in Table 3.

Table 3 Multivariate Test

Effect	Model	Value	F	Hypotesis df	Error df	Sig.
Using times (X)	*Pillae Trace*	1.503	32.675	10.000	108.000	0.000
	Wilk Lambda	0.004	157.076	10.000	106.000	0.000
	Hotelling Trace	122.321	636.069	10.000	104.000	0.000
	Roy's Largest Root	121.275	1309.765	5.000	54.000	0.000

Based on the table of multivariate test results, the four models show a Sig. smaller than the significance level (α) = 0.05, which means that the time of using *slerek* has different abilities in terms of influencing breaking strength values and changes in mesh size simultaneously or according to [13], the multivariate test shows a significance value of <0.05, so it can be concluded that the model used in the research is good and can be used to test the research hypothesis. To test the hypothesis used in the research partially or for each variable, the MANOVA Test of Between-Subjects Effect test was used.

Table 4 Test of Beetween-Subjects Effect

Independent	Dependent	Type III Sum of Squares	df	Mean Square	F	Sig.
Using times (X)	Breaking strength (Y_1)	192.596	5	38.519	277.976	0.000
	Mesh size changes (Y_2)	2.162	5	0.432	1155.61	0.000

a. R^2= 0,959; b. R^2 = 0,990

Based on this table, it can be seen that the Sig. From the variable net breaking strength value which is 0.000 < significance (α) = 0.05, it is concluded that the time when the net is used has a significant effect on the net breaking strength value. The Between-Subject Effect test also obtained an R^2 value of 0.959, which means that the time when the net is used has a 95.9% effect on breaking strength and the remaining 4.1% is influenced by other factors. Then the Sig value. From the variable value of changing the size of the net is 0.000 < significance (α) = 0.05, it is concluded that the time of use of the net has a significant effect on the value of changing the size of the net. The Between-Subject Effect test also obtained an R^2 value of 0.990, which means that the time when the net is used has a 99% effect on breaking strength and the remaining 1% is influenced by other factors.

Based on the results of the analysis carried out, it can be seen that the length of time the net is used affects the breaking strength and changes in the mesh size of the bunt part of the *slerek*. This is due to the frequency of use of the net during the time of use which causes the net to experience tension forces, interactions from the environment in the form of nets placed on the boat will be exposed to heat from the sun and currents when operating the net. The results in the field are in line with the opinion of [14] who stated that fishing gear depreciation occurs because of the age of the fishing gear. A similar thing was also conveyed by [15], polyamide thread has several limitations in that it has weak resistance to light for long periods of time at high temperatures. Meanwhile, if submerged in sea water, fishing nets can absorb water. Aging and environmental factors will result in a decrease in the technical life of the net.

3.5 Relationship between Net Usage Time

Relationships were obtained to determine the relationship between the variables in this study which were analyzed using Pearson correlation analysis. The Pearson correlation test in this study was to determine the relationship between the effect of usage time and breaking strength and changes in mesh size and to also determine the relationship between the dependent variable, namely breaking strength and changes in mesh size. The results of the Pearson test correlation analysis can be seen in Table 5.

Table 5 Pearson Correlation Results

	P-Value	Correlation Coefficient (r)	Level of Relationship
Using times & Breaking strength (kgf)	0.000	-0.977	Very strong
Using times & Mesh size (mm)	0.000	0.985	Very strong

The results of data analysis using the Pearson correlation test based on this table show that there is a relationship between usage time and breaking strength and usage time and mesh size which is proven by a p-value of 0.000 < 0.05. The correlation coefficient value between usage time and breaking strength is -0.977 with a very strong relationship level. The correlation between usage time and breaking strength is negative or the relationship is not unidirectional, meaning that the longer the net usage time will cause a decrease in the breaking strength value of the net or vice versa. The relationship between usage time and mesh size obtained a correlation coefficient of 0.985 with a very strong relationship level. The correlation between usage time and changes in mesh size is positive or a unidirectional relationship, meaning that the longer the usage time of the net will cause an increase in the value of changes in mesh size or reverse.

4. Conclusion

The results of the analysis using the MANOVA test show that there is an influence of usage time on breaking strength and changes in mesh size. The Between-Subject Effect test obtained a value of Sig. each of 0.000 < 0.05, it is concluded that the time the net is used has a significant effect on the value of breaking strength and mesh size. The breaking strength value of the net graphically decreased by 38% in 5 years of use. The breaking strength value obtained an R Square of 0.959, which means that the time when the net is used has an effect of 95.9% on the breaking strength and

the remaining 4.1% is influenced by other factors. The value of changes in mesh size has increased by 3% if seen based on the graph over 5 years of use. The value of the change in mesh size obtained an R Square value of 0.990, which means that the time when the net is used has a 99% effect on the breaking strength and the remaining 1% is influenced by other factors.

The results of data analysis using the Pearson correlation test show that there is a relationship between usage time and breaking strength and changes in mesh size with the Sig value. equal to 0.000 < 0.05. The correlation coefficient value between usage time and breaking strength is -0.977 with the relationship level being very strong and negative or unidirectional. The relationship between usage time and mesh size obtained a correlation coefficient of 0.985 with a very strong level of relationship and is positive or in the same direction.

Based on the research results, the suggestion in this research is that the scientific information in this research can be used as a reference in improving maintenance in the form of avoiding net exposure to direct sunlight and should be able to determine repair times and replacement of fishing gear efficiently.

Compliance with ethical standards

Acknowledgments

Thanks are especially addressed to the ship owner or fishing master, who has provided support for net samples for research and thanks are addressed to all parties at the BBPI Semarang testing laboratory as well as parties who have helped carry out this research.

Disclosure of conflict of interest

No conflict of interest to be disclose.

References

[1] Bere, C. G., & Eoh, C. B. (2021). Composition and Production of Fish Caught by Mini Purse Seine in Kupang Bay. Papadak Maritime Journal, 2(2), 55–61.

[2] Elasari, N. (2021). Correlation Analysis of Oceanographic Parameters on Purse Seine Net Catch Results in Kranji Waters, Pacitan District, Lamongan Regency. In Sunan Ampel State Islamic University. 27(3) 371-381.

[3] Masud, F. H., Tangke, U., & Daeng, R. A. (2023). Strategy for a Good System for Handling Fresh Flying Fish on the Purse Seine FV. Woka Ruju 01. Journal of Science, Social and Humanities (JSSH), 3(1), 1–17.

[4] Mainnah, M., Khikmawati, L. T., & Jaya, M. M. (2023). Construction Design Study of Purse Seine Type Fishing Equipment in the Waters of the Bali Strait. ALBACORE, 7(1), 37–46.

[5] Junaidi, T., & Mahdiana, A. (2020). Analysis of the Purse Seine Business as a Tool for Catching Skipjack Tuna (*Katsuwonus* Sp.) at the Cilacap Ocean Fishing Port. Proceedings of the National Seminar, 2(November), 64–72.

[6] Yaroh, S. (2017). Relationship of Mesh Size of Monofilament Yarn Netting 0.25 to Breaking Strength and Elongation Values at PT. Arteria Daya Mulia Cirebon, West Java (Vol. 53, Issue 9).

[7] Hasly, I. R. J., Pramitasari, S. D., & Setiyanto, I. (2017). The Effect of Soaking in Fresh Water and Sea Water on the Breaking Strength and Elongation Values of *Monofilament polyamide* (PA) Yarn with a Diameter of 0.4 Mm. Journal of Capture Fisheries: Indonesian Journal of Capture Fisheries, 1(2) (2017)

[8] Iskandar, M. D., & Prasetyo, A. P. (2017). Breaking Strength of PA Multifilament Yarn 210D/6 in Open Space Storage. BAWAL Widya Capture Fisheries Research, 3(1) 57-63

[9] Sari, L. P., Pramitasari, S. D., & Setiyanto, I. (2017). Analysis of the Environmental Friendliness of Fishing Gear at the Tanjungsari Fish Auction Place (TPI), Rembang District, Rembang Regency. Journal of Capture Fisheries, 1–10.

[10] Sharif, N. F. H., & Mon, S. Z. K. (2021). A Review on The Strength of Fishing Net; The Effect of Material, Yarn Diameter and Mesh Size. Progress in Engineering Applications and Technology, 2(1) 1030–1036.

[11] Vanson, J., Isnaniah, & Syofyan, I. (2015). Studies Of Water Hyacinth (*Eichhornia crassipes*) As the Base of Fishing Gear Material.

[12] Kusumasteti, E., Sardiyatmo, & Kurohman, F. (2017). Analysis of the Effect of Differences in Soaking *Monofilament Polyamide* (PA) No. 35 Mesh Size 3.5 Inch Mesh in Fresh Water, Sea Water and Diesel Diesel on Breaking Strength and Elongation. Journal of Fisheries Resources Utilization Management and Technology, 6(35), 1–10.

[13] Safitri, D. A. (2015). Sustainability Report on Financial and Market Performance. Journal of Accounting Science & Research, 4(4), 1–15.

[14] Mustasim, M., Gunaisah, E., Ulat, M. A., Handayani, H., Ismail, I., Suruwaky, A. M., Sururi, M., Katili, V. R. A., & Poltak, H. (2021). Training on Making Environmentally Friendly Fishing Equipment. Mitra Mahajana: Journal of Community Service, 2(1), 41–48.

[15] Halim, N. A., Zaharah, S., & Mon, K. (2021). A Review on Impact of Environmental Conditions on Fishing Net Mechanical Properties. Progress in Engineering Applications and Technology, 2(1), 957–964.