JOURNAL OF FISH HEALTH JFH

Journal of Fish Health
Volume 5, Issue 1, February 2025
https://doi.org/10.29303/jfh.v5i1.6278

The Effect of Underwater LED Toward Catches of Gillnets in Central Tapanuli

Ricky Winrison Fuah[1*], Rosi Rahayu[2], Zahra Afranisa[1], Kurniawan Fazri[3]

[1]Utilization of Fisheries Resources, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Teuku Nyak Arief Street, Darussalam, Banda Aceh, Aceh, Indonesia
[2]Department of Fishery, Faculty of Fisheries and Marine Science, Universitas Teuku Umar, Alue Peunyareng Street, Aceh Barat, Aceh, Indonesia
[3]Department of Capture Fisheries Technology, College of Fisheries and Marine Science, KH. Dewantara Street, Tapanuli Tengah, Sumatera Utara, Indonesia

Correspondence:
rickyfuah9@usk.ac.id

Received:
January 9th, 2025
Accepted:
February 3rd, 2025

Keywords:
Fish Behavior, Gill Net, Light Fishing

ABSTRACT

Most of the Central Tapanuli Regency area is on the coast, which is part of the Indian Ocean waters and has great potential in the fishing industry, especially marine fisheries. One of the fishing gears widely used by fishermen in Central Tapanuli is the gill net. Although the amount of marine fisheries resources in Central Tapanuli is quite abundant, the catch of gillnet fishermen often fluctuates, so fishing aids are needed to increase catches, one of the efforts made is using LACUBA. This research was conducted from February to April 2024 in Sibolga Bay, Central Tapanuli. This study used a completely randomised design (CRD), with the first 30 metres of gill net treatment with LACUBA and the remaining 30 metres without LACUBA treatment with a total net length of 60 metres. The results showed that the catch of gill nets using LACUBA influenced the catch, the total catch was 16,845 grams, without LACUBA 8,290 grams for 14 times. Gill nets with LACUBA can increase catches compared to without LACUBA, due to the addition of attractants to the net, so that fish including positive phototaxis will be caught in the net, besides that fish that are looking for prey are also caught because they want to prey on their food in the gill net area.

INTRODUCTION

Central Tapanuli Regency is one of the regions in North Sumatra Province. Central Tapanuli has 200 km of coastline, and is rich in fisheries resources, which makes it the center of the local economy (Fuah *et al*., 2023). Most of the Central Tapanuli Regency area is on the coast and has great potential in the fishing industry, especially marine fisheries (Fuah *et al*., 2024a). Most of the population in coastal Central Tapanuli work as fishermen, and their main income is from selling fish catches from the sea (Harahap *et al*., 2023).

The large potential of fish resources makes fishermen on the coast of Central Tapanuli make fisheries activities a source of their income, especially in catching fish (Fuah *et al*., 2024b). One of the fishing gears widely used by fishermen in Central Tapanuli is the gill net. Although the number of resources is quite abundant, the catch of gillnet fishermen often fluctuates, where there are times when the results are many, and there are times when there are none at all. This can occur due to various factors, including the number of users of similar fishing gear and the number of fishing activities in the coastal areas of Central Tapanuli, and still using fishing methods that are still classified as traditional and without using fishing aids (Muna *et al*., 2024).

Based on the conditions stated above, it is necessary to have an innovation to increase the catch of fishermen, the innovation that can be done is to use technology that can increase catches, one of the efforts is to use the addition of lights as a fishing aid that serves to attract fish attention (Puspito *et al*., 2020; Muna *et al*., 2023). The use of additional light in the form of lights on fishing gear is based on fish behavior, which is called phototaxis or stimulation of the presence or absence of light in the water, especially in the sense of sight of fish (Reppie *et al*., 2016). The utilization of light lamps is intended to attract the attention of fish that have positive photosynthesis will react to light by approaching the light source, while fish that have negative photosynthesis will not be interested in light sources in the waters, but become a source of food for fish that are looking for prey (Rahayu *et al*., 2024a).

One of the attractor innovations that is currently developing quite fast and easy to use is the underwater dipping lamp (LACUBA) (Fatma *et al*., 2022). The use of this type of lamp is more efficient in collecting fish, due to its placement at the bottom of the water so that the level of penetration is better when compared to lamps installed on the surface of the water. The operation of fishing gear using the light fishing method, which means fishing using fishing aids, namely lights (the addition of LACUBA), has proven to be able to increase fishing (Hartono *et al*., 2019). In addition, the use of LACUBA can be said to be suitable for use in gillnet fishing gear, because it is directly attached to the net wall so that the lamp becomes one with the net body in the water, making it easier for fish to get closer to the net body and be easily caught. Based on this analysis, underwater dipping lights are one of the attractors (lure), in order to increase the catch. Therefore, in this study it is necessary to optimize underwater dipping lights (LACUBA) as an attractor with a gill net to increase catch. The objectives of this study were to determine the composition of the catch in the gillnet with or without LACUBA, and to determine the effect of using LACUBA on the gillnet catch.

METHODS

Time and Place of Research

This research was conducted from January to February 2024. The research was conducted on Panjang Island, Central Tapanuli Regency.

Tools and Materials

The tools and materials used in the LACUBA innovation research on gill net fisheries in Central Tapanuli are presented in Table 1.

Table 1. Tools and Materials Used in the Research

No	Tools and Material	Amount	Function
1.	Gillnets	1 unit	As the main tool for implementing LACUBA
2.	Ship < 5 GT	1 unit	Sea transportation
3.	Camera	1 unit	For documentation
4.	Scales	1 unit	To weight of the fish
5.	Bucket	1 unit	Place/containe of caught fish
6.	3 Volt COB LED	4 unit	Lamp lighting sorce for LACUBA

No	Tools and Material	Amount	Function
7.	9 Volt Box Battery	2 unit	Power Source for LACUBA
8.	Jar	2 unit	LACUBA Container
9.	Swivel	2 unit	To hang the LACUBA on the body of the net
10.	Weights	2 unit	As a weight medium on the LACUBA
11.	2 mm Cable	3 m	Connectors for light and batteries
12.	Cable Ties	1 unit	Widespread attachment of swivels and bottles
13.	Cable Tape	1 unit	Cable Adhesive

Making the LACUBA

The making of the LACUBA (Figure 1) begins with preparing a jar/bottle container that is the same size as the width of the 3 Volt COB LED lamp (Hartono *et al*., 2019). After obtaining the appropriate size, 4 pieces of 3 Volt COB lights are inserted into the jar/bottle on all sides of the bottle, then in the center of the lamp is given a weight, then the top of the lamp and stone is given a base so that the position of the lamp and stone is fixed, 4 pieces of LED lights are connected to 2 9 Volt battery boxes in the top position of the lamp, and a switch is given on the outside of the bottle/jar. The bottle/jar is closed and the side of the jar is coated with duct tape so that water cannot easily enter, then the bottle/jar lid is given a swivel so that the LACUBA can be attached to the fishing gear.

Figure 1. LACUBA Construction

Illustration of LACUBA Installation on a Gillnets

After the LACUBA unit was made, the LACUBA was installed on a 40-sheet gill net with a total length of 600 m, where the side that used the LACUBA was 30 m away where it was installed in the middle of 15 m so that its range could fulfill the 30 m, and the rest was not installed LACUBA as a control. The placement of the LACUBA is presented in Figure 2 below.

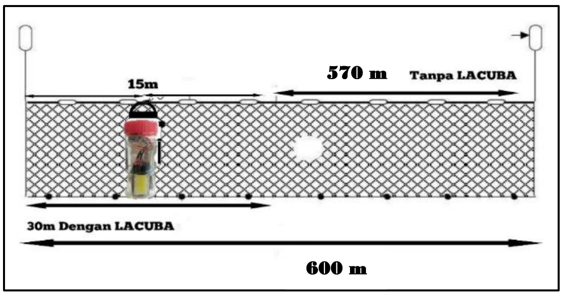

Figure 2. Illustration of LACUBA Installation on a Gillnets

Research Methods

The research was conducted using the experimental fishing method. According to (Martins *et al*., 2024), the experimental fishing method is catching fish using treated fishing gear. Hanafiah (2005) added that an experiment or experiment is a series of actions taken on an object to be investigated with the aim of knowing its effect. The experimental method uses 1 treatment, which is using LACUBA installed on the gillnet with a total length of 600 meters, where 30m is installed one LACUBA, while the next 30m is not given LACUBA which is referred to as control. This trial was conducted in the waters of Sibolga and Tapanuli Tengah bays (west coast waters of North Sumatra) with 30 replications of the operation of the gillnet fishing gear. The design used in the study was a completely randomized design (CRD) (Table 2).

Table 2. Gillnets Experimental Design

Treatment	Repeat				Total
	1	2	…	N	
Without LACUBA (Control)	…	…	…	…	…
With LACUBA (Treatment)	…	…	…	…	…
Total	…	…	…	…	…

Data Analysis Method

Types of Fish Caught with or Without LACUBA

In this study, the parameters observed were the number of catches, the type (species) of catches, and the effectiveness of gill net fishing gear using LACUBA and without using LACUBA. The percentage of the number of catches based on the weight and type of catch was calculated using the formula (Rosalina *et al*., 2024) as follows:

$P = \frac{ni}{N} \times 100\%$ ....(1)

Description:

P = Total fish caught (grams)

ni = Number of species to 1. (grams)

N = Total number of fish caught LACUBA/non LACUBA

The percentage of catch effectiveness using LACUBA was calculated using the following formula (Basuki, 2006):

Lamp effectiveness = hauling/JHTI × 100% ....(2)

The indicator of the effectiveness value is if the effectiveness value is less than 30%, it can be said that the bagan fishing gear has less effective effectiveness, the value of 30%-60% of the fishing gear has an effective value, and the value greater than 60% of the fishing gear has a very effective effectiveness (Rahayu *et al*., 2024b).

Effect of LACUBA on GillNets Catches

In this study, the effect of LACUBA on the catch of the gillnet was tested using statistical analysis consisting of several statistical tests, ranging from normality, homogeneity, and annova tests. The use of these statistical tests is intended so that the data obtained in the field is valid and can be presented in the form of tables or diagrams. Data on the number and type of catches are presented in the form of graphs and tables to facilitate the analysis process. Data that has been made in tabular form is then analyzed for normality and homogeneity using the Kolmogorov-Smirnov test to test whether the data is normally distributed or not. If the data is normally distributed and homogeneous, then the next analysis uses the One-Way ANOVA test.

RESULTS

Absolute Weight Growth

Absolute weight is the increase in fish weight throughout the research, calculated as the difference between the fish's weight at the end and the beginning of the research. The results showed that the weight of catfish after immunostimulant administration ranged from 2.59-2.8 g. The absolute weight of catfish post-infection ranged from 0.61-1.26 g.

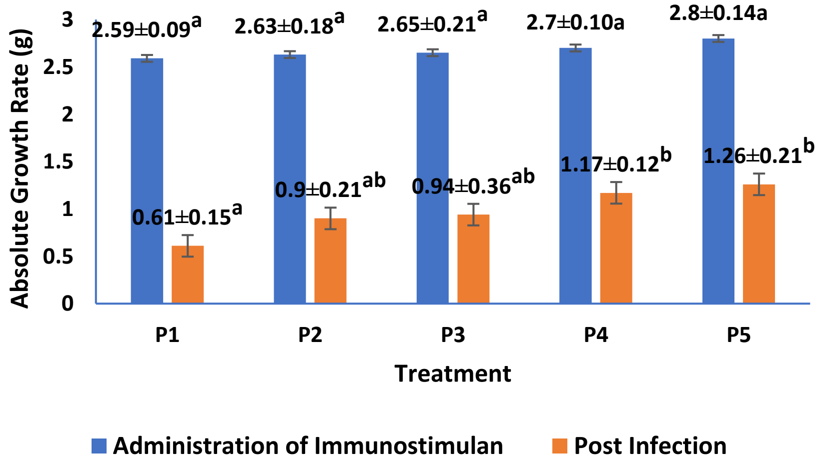

Figure 3. Absolute Growth Rate of Catfish (*Clarias* sp.)

Absolute Length Growth

Absolute length is the measurement of fish growth in length during the research, calculated as the difference between the fish's length at the end and the beginning of the research. The results of this research showed that the absolute length growth of catfish over 45 days of maintenance with different doses of octopus ink extract ranged from 2.73-5.03 cm. The absolute length of catfish post-infection ranged from 0.67-1.5 cm.

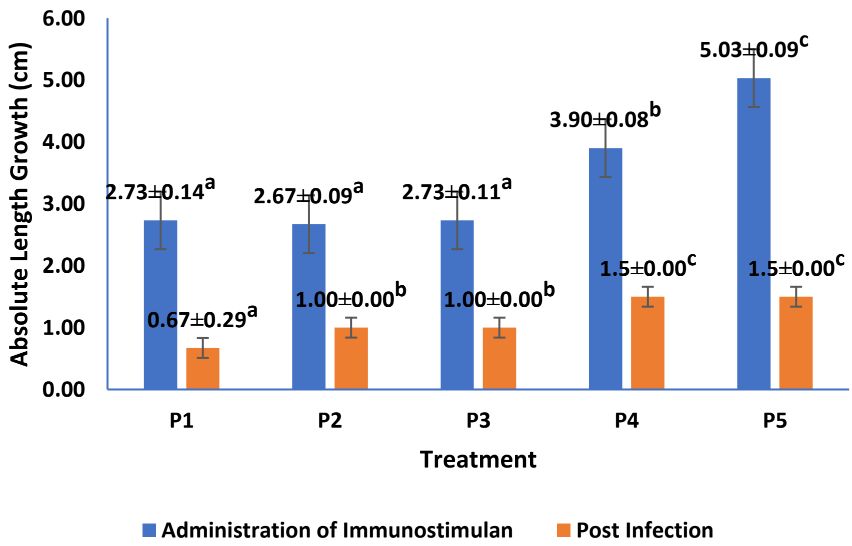

Figure 4. Absolute Length Rate of Catfish (*Clarias* sp.)

In Figure 4, it can also be observed that the weight of kerong fish is heavier than that of peperek fish, which, although it has a larger number of fish, when compared to kerong fish.

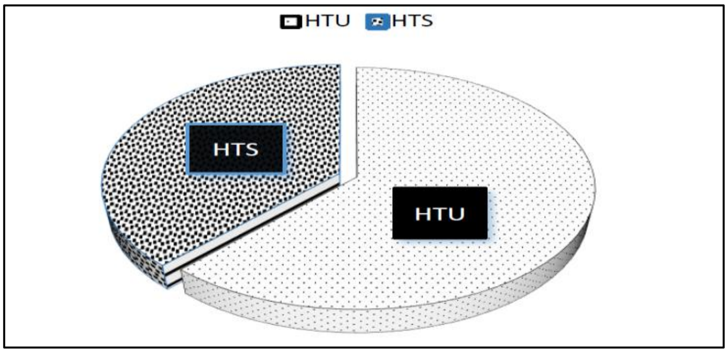

Figure 5. Percentage of HTU and HTS with LACUBA

Figure 5 shows the percentage of bay net catch using LACUBA divided into two categories: main catch (HTU) and by-catch (HTS). The results show that the main fish catch is more, which is 62% and compared to the by-catch, there is only 38% of the total fishing activity. The fish caught without using LACUBA during the 14 fishing trips was 8,200g. The main fish catch consisted of short mackerel, indian mackerel, golden thteatfish, goatfish, shrimp, baraccuda and trumpeter whiting, while the by-catch consisted of consists of ponyfishes, crescent grunter, flounders, cottonmounth jack, croaker, bluespot mullet, spotted bigeye, yellowstripe scad, emperors and cottonmouth. The following are the main catch and by-catch results of the gillnet without LACUBA.

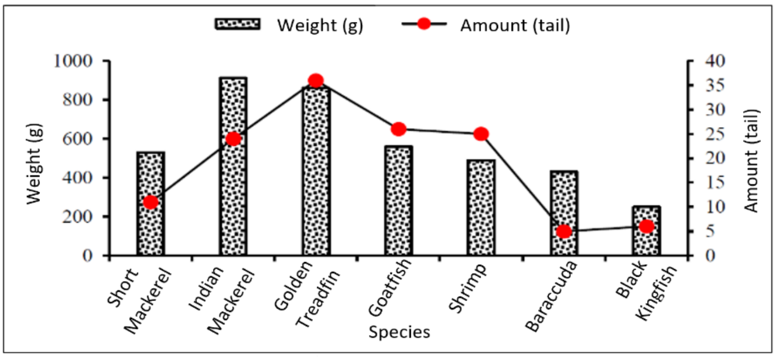

Figure 6. Main catch (HTU) without LACUBA

In Figure 6, it can be seen that the main catch of the gillnet without using LACUBA is less than the main catch of the gillnet using LACUBA. The fish that has the heaviest weight in the gillnet without LACUBA is male mackerel with a weight of 910 g, and the fish with the highest number is kurisi fish as many as 36 fish.

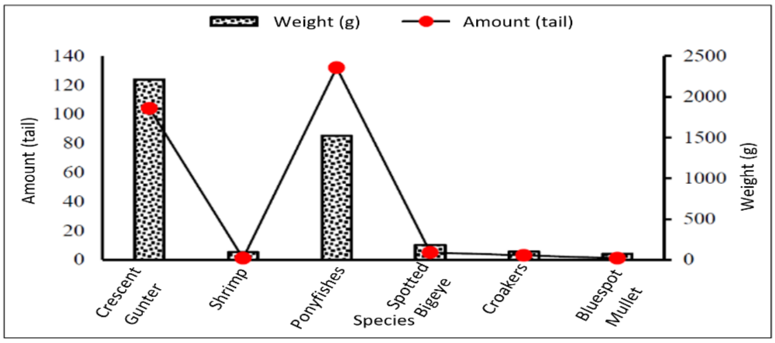

Figure 7. Bycatch (HTS) without LACUBA

From the previous statement in Figure 7, the main catch of bay nets weighed less overall than bay nets using LACUBA. This is also similar to the bycatch of the bay net without LACUBA, the fish with the heaviest total weight is kerong fish weighing 2,210 g and the fish with the highest number is peperek fish with 132 fish.

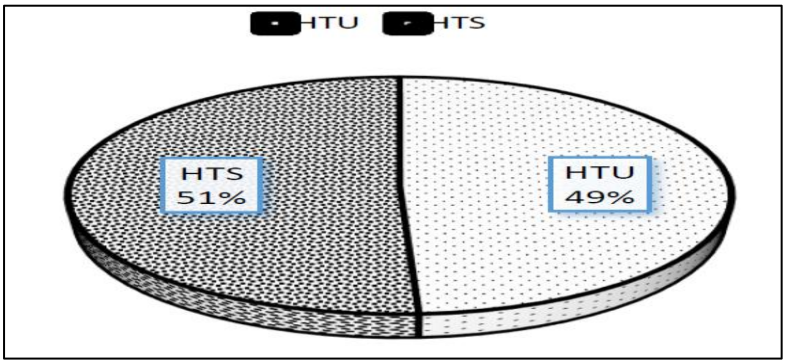

Figure 8. Percentage of HTU and HTS without LACUBA

Figure 8 shows that in the 2 categories between the main catch and bycatch without using LACUBA, the bycatch fish is slightly more dominant than the main catch. The bycatch is in the range of 51% while the main catch is 49% of the total catch of the gillnet without LACUBA. There are several factors that cause this to happen, due to the absence of attractors in the seawater when conducting fishing, which has an impact on random catches, so that the targeted fish are only obtained less than the by-catch fish.

Catch Ratio of Gillnets with or Without LACUBA

The comparison of the catch of the gillnet using or without LACUBA is quite large, because the fish caught using LACUBA is more than the fish caught without using LACUBA. As explained in the background of this research, the LACUBA innovation is intended to make fishing carried out by fishermen more efficient and get more catches than without using LACUBA itself. Therefore, the concept of using LACUBA is intended to be a lure for fish, especially pelagic fish or marketable target fish, in order to get more catches when compared to fishing without using LACUBA.

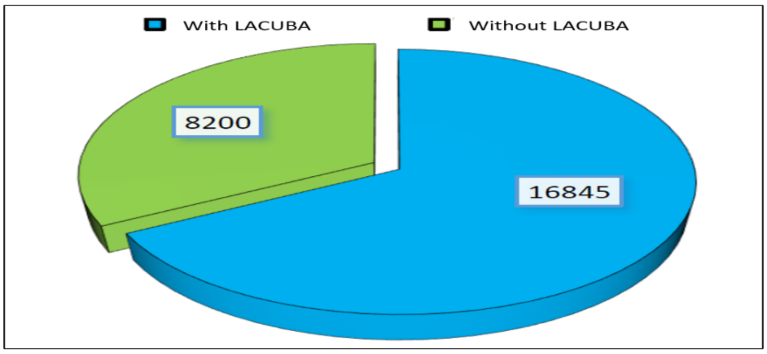

Figure 9. Comparison of Catch with and without LACUBA

Figure 9 shows that the ratio of catches with or without the use of LACUBA is quite far, with 67% of the catches using LACUBA and only 33% of the total catches without LACUBA. In the results listed above, it can be seen that the fish caught by the bay net using LACUBA is more than the catch of the bay net without using LACUBA. The comparison between the gillnet and LACUBA amounted to 16,845g consisting of 15 species of fish and 1 species of crustaceans namely short mackerel, indian mackerel, golden thteatfish, goatfish, shrimp, baraccuda, and trumpeter whiting. The main fish catch using LACUBA ranged from 10,480 g which was dominated by mackerel with a weight of 2,160 g and by-catch fish using LACUBA ranged from 6,365 g which was dominated by kerong fish with a weight of 2,805 g. Meanwhile, the fish caught by the gillnet without using LACUBA only weighed 8,200 g consisting of 11 species of fish and 2 species of crustaceans. The fish species caught are short mackerel, indian mackerel, golden thteatfish, goatfish, shrimp, baraccuda, trumpeter whiting, ponyfishes, crescent grunter, flounders, cottonmounth jack, croaker, bluespot mullet, spotted bigeye, yellowstripe scad, emperors and cottonmouth. The main catch of fish in the gillnet without using LACUBA ranged less than the bycatch of the gillnet without LACUBA, weighing 4,030 g which was dominated by male mackerel weighing 900g, while the bycatch of fish without using LACUBA was 4,170 g which was dominated by kerong fish weighing 2,210 g.

From the total catch of the gillnets in 14 fishing trips using or without LACUBA, it was dominated by the gillnets that used LACUBA, which was around 67% more caught than the gillnets without LACUBA, which was only around 33% of the total number of fishing trips. Therefore, the use of LACUBA has an impact on the catch of the gillnet, because it has a significant influence on the catch.

Effect of LACUBA on Gillnet Catches

The results of the research conducted to determine the catch through 14 fishing trips using LACUBA tools are presented in the following table:

Table 3. Total Catch with and without LACUBA

Repeat	Weight (g)	
	With LACUBA	Without LACUBA
1	820	740
2	955	300
3	675	550
4	1.240	360
5	1.270	710
6	1.100	610
7	1.330	400
8	630	380
9	920	450
10	1.330	510
11	1.590	450
12	1.215	570
13	1.950	910
14	1.820	1.430
Total	16.846	8.370

In table 3 above, it can be observed that the amount of fish caught by the bay net using LACUBA is more than the bay net without the LACUBA treatment. The total weight of the bay net catch using LACUBA was 16,845g while the total weight of the bay net catch without using LACUBA was only 8,370g.

From Table 3 it can also be seen that the total catch of the gillnet using LACUBA is more than the gillnet without using LACUBA, this is also supported by the results of data analysis using 3 statistical analysis tests ranging from data normality analysis using the Kormogolov Smirnov data normality test with normal distribution (P> 0.05) (Sintia et al., 2022) which is 0.722, so that it can be called this data is normally distributed, after that it is tested again, with a homogeneity test, where the data obtained is homogeneous or has similar properties (Usmadi, 2020) with a significance value (P> 0.05) with a significance value of 0.240 and the last analysis using the One Way Annova analysis test with a Complete Randomized Design, getting significant results, where (P < 0.05) which is 0.000.

DISCUSSION

Gillnet is one of the most widely used fishing gears in small-scale and commercial fisheries. The use of additional technologies such as underwater submersible lights (LACUBA) is growing to increase the effectiveness of fishing gear (Arimoto *et al*., 2010). LACUBA functions to attract fish with light that resembles natural conditions, so that it can affect the composition of the catch. Several studies have shown that the use of underwater lights in fishing gear can increase the number and diversity of species caught. Light can attract fish and certain aquatic organisms, increasing the likelihood of fish entering the net. Gillnets with LACUBA tend to catch more small pelagic fish such as sardinella (*Sardinella* spp.), mackerel (*Rastrelliger* spp.), and squid (*Loligo* spp.) compared to gillnets without LACUBA which more often catch demersal fish such as snapper (*Lutjanidae*) or grouper (*Serranidae*). This is in line with research by Marchesan *et al*., (2005) who stated that certain light spectra can attract pelagic fish more effectively.

In a study conducted by Nguyen *et al*., (2018), the use of LACUBA on gillnets resulted in a 20-30% increase in catch compared to unlit nets. This factor could be attributed to the increased response of fish to light under darker environmental conditions. Gillnets with LACUBA may have lower selectivity for certain fish sizes, especially for species that are more attracted to light, such as small fish and juveniles (Winger *et al*., 2010). Therefore, further studies on mesh size are needed so as not to increase the catch of unfit fish. Although LACUBA can increase catches, its use must be well regulated to avoid overexploitation of fisheries resources. The application of this technology must be accompanied by regulations that ensure the use of nets with the right mesh size and consider ecological aspects (FAO, 2021). The use of LACUBA on gillnets has the potential to increase the number and diversity of catches, especially for pelagic species. However, there is a potential decrease in the selectivity of the gear which should be further assessed. Therefore, combining the use of this technology with sustainable fisheries management policies is essential to ensure responsible utilization of fisheries resources.

CONCLUSION

The conclusions of this study are as follows: 1) The types of fish caught in the gillnet using LACUBA are more when compared without using LACUBA; and 2) The use of LACUBA influenced the catch. various related hypotheses. There is a need to increase the number of LACUBA units installed in gill nets, so that the number of fish caught will be greater. Further studies related to the selectivity of fishing gear to ensure that species that are not yet suitable for fishing are not caught in large numbers. In addition, it is also necessary to apply other technology combination methods such as automatic sensors to increase the effectiveness of fishing gear while minimizing bycatch.

ACKNOWLEDGEMENT

We would like to thank the gillnet fishermen in Central Tapanuli who gave permission and support for this research. In addition, to every institution that supported the success of this research.

REFERENCES

Arimoto, T., Takeuchi, Y., & Inoue, Y. (2010). Influence of Artificial Light on Fish Behavior in Fishing Operations. *Fisheries Science, 76*(2): 225-232.

Basuki, S. (2006). *Metode Penelitian*. Jakarta: Wedatama Widya Sastra.

FAO (2021). The State of World Fisheries and Aquaculture 2021. Food and Agriculture Organization of the United Nations.

Fatma, U., Kurnia, M., Musbir., Sahil, M.S.R., Putera, D.P., & Haq, S.I.A.l. (2022). Efektivitas Underwater Light Emitting Diode (LED) sebagai Alat Pengumpul Ikan pada Bagan Tancap di Perairan Pangkep. *Torani: Journal Fisheries and Marine Sciece*, *6*(1): 1–13.

Fuah, R. W., Samiaji, J., & Rahayu, R. (2023). Analisis Tingkat Kesesuaian dan Kesenjangan Penerapan Traceability Perikanan Tuna Sirip Kuning di Sibolga. *Marine Fisheries: Journal of Marine Fisheries Technology and Management*, *14*(1), 65-76.

Fuah, R. W., Lase, W. F., Samiaji, J., Rahayu, R., & Riza, F. (2024). Pendugaan Potensi Lestari Ikan Layang Biru (*Decapterus macarellus*) di Perairan Sebelah Barat Sumatera Utara. *Jurnal Teknologi Perikanan dan Kelautan*, *15*(1), 93-102.

Fuah, R. W., Rahayu, R., & Muna, Z. (2024). Dinamika Populasi Ikan Layang yang di Daratkan di Sibolga. *Jurnal Marshela* (*Marine and Fisheries Tropical Applied Journal*), *2*(2), 66-77.

Hanafiah, K.A. (2005). *Dasar-Dasar Ilmu Tanah*. *Divisi Buku Perguruan Tinggi*. Jakarta: PT. Raja Grafindo Persada.

Harahap, M. A., Fuah, R. W., Rumondang, A., & Muna, Z. (2023). Pengaruh Faktor-Faktor Produksi Terhadap Keberhasilan Operasi Penangkapan Purse Seine Di Pelabuhan Perikanan Nusantara (PPN) Sibolga. *Jurnal Perikanan Terpadu*, *4*(1), 28-34.

Hartono, A., Puspito, G., & Mawardi, W. (2019). Uji Coba Lampu Celup LED pada Jaring Insang Sebagai Upaya Meningkatkan Hasil Tangkapan. *Jurnal Teknologi Perikanan dan Kelautan, 10*(1), 15-26.

Marchesan, M., Spoto, M., Verginella, L., & Ferrero, E. A. (2005). Behavioural Effects of Artificial Light on Fish Species of Commercial Interest. *Fisheries Research, 73*(1): 171-185.

Martins, L.V., Yanto, F., Novianto, U., Dewi, K.A.K., Sugianto., Fuah, R.W., Pesiwarissa, L.F., Haryono, S., Ahmadi., Budiarti, S., Imamia, T.L., Darnawati., Rusmayani, N.G.A.L., Sakti, D.P.B., Santoso, F.I., & Safitri, J. (2024). *Pengantar Metodologi Penelitian: Strategi dan Teknik*. Badung: CV. Intelektual Manifes Media.

Muna, Z., Fuah, R. W., Khobir, M. L., Purwangka, F., & Marbun, A. S. (2023). Analisis Kondisi Sosial Ekonomi Nelayan Bagan Tancap di Tapanuli Tengah, Sumatera Utara. *ALBACORE Jurnal Penelitian Perikanan Laut*, *7*(3), 359-369.

Muna, Z., Sarumaha, H., Huda, M. A., Fuah, R. W., & Dariansyah, M. (2024). Status Pengelolaan Ikan Teri dengan Pendekatan Ekosistem di Perairan Pantai Barat Sumatera Utara Berbasis Pendaratan Bagan Tancap. *ALBACORE: Jurnal Penelitian Perikanan Laut*, *8*(3), 303-311.

Nguyen, K. V., Luong, T. T., & Hoang, H. D. (2018). Effects of Underwater LED Lights on Gillnet Fishery Performance. *Journal of Fisheries Science, 14*(4): 355-362.

Puspito, G., Hartono, S., Kurniawan, F., & Mawardi, W. (2020). Introduksi Lampu Celup pada Pengoperasian Jaring Insang Hanyut. *ALBACORE: Jurnal Penelitian Perikanan laut, 4*(3), 283-293.

Rahayu, R., Arif, M., Masykur, M., & Fuah, R. W. (2024a). Introducing Underwater Light Emitting Diode (LED) Technology to Increase the Catches on Tradisional Gillnets, Aceh Barat Regency. *Mattawang: Jurnal Pengabdian Masyarakat*, *5*(3), 145-148.

Rahayu, R., Fuah, R.W., Muna, Z., Karyanto., Andhini, N., Fazri, K., Akbardiansyah., & Rahmawati. (2024). *Alat dan Teknologi Penangkapan Ikan*. Badung: CV. Intelektual Manifes Media.

Reppie, E., Patty, W., Sopie, M., & Taine, K. (2016). Pengaruh Pemikat Cahaya Berkedip pada Bubu terhadap Hasil Tangkapan Ikan Karang. *Marine Fisheries, 7*(1). 25-32.

Rosalina, D., Rombe, K.H., Nurulludin., Reza, M., Julian, D., Pane, A.R.P., Muna, Z., Efendi, D.S., Tahapary, J., & Fuah, R.W. (2024). *Teknologi Penangkapan Ikan.* Ternate: PT. Kamiya Jaya Aquatic.

Sintia, I., Pasarella, M.D., & Nohe, D.A. (2022). Perbandingan Tingkat Konsistensi Uji Distribusi Normalitas pada Kasus Tingkat Pengangguran di Jawa. *Prosiding Seminar Nasional Matematika, Statistika, dan Aplikasinya*, hal. 322–333.

Usmadi, U. (2020). Pengujian Persyaratan Analisis (Uji Homogenitas dan Uji Normalitas). *Jurnal Inovasi Pendidik, 7*(1). 50–62.

Winger, P. D., Eayrs, S., & Glass, C. W. (2010). Fish Behavior Near Gillnets and the Effect on Selectivity. *Marine Fisheries Review, 72*(3): 45-57.