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Analysis of the Use of Attractor Technology in Catching Squid *(Loligo sp.)* in the Makassar Strait

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Abstract

Squid is one of the marine fisheries commodities that is widely liked by the public, causing an increase in demand and making squid production in the country quite large. This study aims to determine the composition, size distribution and productivity of catches in different attractor colors. Sampling was carried out in the waters of the Makassar Strait with 12 repetitions of three attractor treatments. This research is included in quantitative research with the capture experiment method. The data obtained were described descriptively by referring to the treatment of different attractor colors. The results showed that the composition of the catch during 12 trips amounted to 149 fish with details of 16.11% caught in white attractors, 32.21% caught in black attractors and 51.68% caught in blue attractors. The distribution of weight measurements captured based on different attractor colors obtained the highest results in blue attractors, which was in the weight range of 15-95 g (46.62 ± 21.93 g). The distribution of the length of the coat captured based on the color of different attractors obtained the highest results in black attractors, which was in the range of 7.5-20 cm (10.33 ± 2.34 cm) in length. The squid caught is predominantly medium-sized.

Keywords: *catching; attractor technology; Loligo sp.*

Abstrak

Cumi-cumi menjadi salah satu komoditas perikanan laut yang banyak disukai masyarakat sehingga menyebabkan meningkatnya permintaan dan membuat produksi cumi-cumi di dalam negeri cukup besar. Penelitian ini bertujuan untuk mengetahui komposisi, sebaran ukuran dan produktivitas hasil tangkapan pada warna atraktor berbeda. Pengambilan sampel dilakukan di Perairan Selat Makassar dengan 12 kali pengulangan terhadap tiga perlakuan atraktor. Penelitian ini termasuk dalam penelitian kuantitatif dengan metode percobaan penangkapan. Data yang diperoleh diuraikan secara deskriptif dengan mengacu pada perlakuan warna atraktor berbeda. Hasil menunjukkan bahwa komposisi hasil tangkapan selama 12 trip berjumlah 149 ekor dengan rincian 16,11% tertangkap pada atraktor warna putih, 32,21% tertangkap pada atraktor warna hitam dan 51,68% tertangkap pada atraktor warna biru. Sebaran ukuran bobot yang tertangkap berdasarkan warna atraktor berbeda diperoleh hasil tertinggi pada atraktor biru yakni kisaran bobot 15-95 g (46,62 ± 21,93 g). Sebaran ukuran panjang mantel yang tertangkap berdasarkan warna atraktor berbeda diperoleh hasil tertinggi pada atraktor hitam yakni kisaran panjang 7,5-20 cm (10,33 ± 2,34 cm). Cumi-cumi yang tertangkap dominan berukuran sedang.

***Kata Kunci**: penangkapan; teknologi atraktor; Loligo sp.*

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INTRODUCTION

The marine and fisheries sector are one of the main pillars in Indonesia's economic development, especially in coastal areas. As an archipelagic country, Indonesia has enormous potential for fishery resources, including squid *(Loligo sp.)* which is an important commodity for both domestic consumption and export, (Basbeth et al., 2024; Baskoro et al., 2019). However, the challenges in managing these resources are increasingly complex, especially due to unfriendly fishing practices that lead to habitat degradation and declining fish stocks. North Galesong District in Takalar Regency, South Sulawesi, is one of the coastal areas that depends on the fisheries sector, with the main livelihood of its people as fishermen. The productivity of fishermen in this area tends to decrease, especially in squid fishing. This decline is caused by habitat damage, especially coral reefs that are

spawning grounds and shelter for squid, (Angge et al., 2023; Dorval et al., 2013). As a result, the squid population declined, which had a direct impact on fishermen's income, (Baskoro et al., 2019).

To overcome these problems, an environmentally friendly technological approach is needed to support the sustainability of fishery resources. One of the innovations that has been developed is the use of squid attractors, which are tools designed to attract squid to lay eggs in a place that has been provided, (Basbeth et al., 2024). These attractions serve as artificial habitats that can increase spawning opportunities and enrich squid stocks in nature. Studies show that the effectiveness of squid attractants can reach 60-70%, with a significant success rate of egg attachment. The use of squid attractors not only contributes to the conservation of resources, but also provides economic benefits to fishermen. With the increase in the population of squid, fishermen's catch can increase, which in turn increases their income. In addition, squid attractors can be made from simple and easy-to-obtain materials, such as bamboo, used drums, and PVC pipes, so they can be adopted by small-scale fishermen at an affordable cost, (Angge et al., 2023; Dorval et al., 2013).

Although squid attractant technology has been applied in several regions of Indonesia, such as Bangka Belitung and East Lombok, its application in North Galesong has not yet been carried out. In fact, this region has great potential for the development of such technology, given its favorable water conditions and the urgent need to increase fisheries productivity. Therefore, research on the use of squid attractors in North Galesong is very important to evaluate its effectiveness in the local context. This study aims to analyze the composition and distribution of squid catch size based on the color of the attractant tied to the attractor, as well as the attractor productivity based on the catch and squid capture efforts. By understanding these factors, it is hoped that useful information can be obtained to optimize the design and placement of squid attractions, so as to improve the efficiency of capture and the sustainability of resources. The urgency of this research lies in the urgent need to develop a sustainable and environmentally friendly fisheries management strategy in North Galesung. By introducing squid attractor technology, it is hoped that it can overcome the problem of declining squid stocks due to habitat destruction, as well as improving the welfare of fishermen through increasing catches. In addition, this research can also serve as a model for other coastal regions in adopting similar technologies to support the sustainability of the national fisheries sector.

METHOD

This research was carried out in the waters of the Makassar Strait, precisely in the North Galesong District, Takalar Regency, South Sulawesi Province. This location was chosen based on the potential resources of the squid *(Loligo sp.)* which is quite high and there are reports of a decrease in catch by local fishermen. The type of research used is quantitative with an experimental fishing approach. This approach aims to evaluate the effectiveness of the use of squid attractants with attractant color variations on the increase in catches. This method corresponds to the quantitative paradigm based on positivism, which emphasizes data collection through standardized instruments and statistical analysis to test hypotheses that have been formulatedan, (Sugiyono, 2021). In the context of fisheries, this approach is relevant to identify the causal relationship between the treatment of fishing technology and the catch, (Mulyono et al., 2023; Suharsimi, 2013). The experimental design used in this study is *Randomized Block Design* (RBD), with treatment in the form of different colored squid attractants (red, green, blue, and one colorless control). Each treatment is repeated four times to ensure reliability and replication of the data. The attractor is placed at a uniform depth and distance to minimize interference between treatments. The free variable in this study was the attractant color of the attractor, while the bound variable included the number, weight, and length of the squid coat caught. The observed control variables included environmental conditions such as water temperature, depth, and capture time. Data was collected through direct capture activities using attractors in the field. Each squid caught is recorded in its type, number, coat length, and weight. The composition of the catch is then calculated using a formula adapted from, (Bahari et al., 2019) Data analysis was carried out using descriptive and inferential statistical approaches. All numerical data is pre-processed using Microsoft Excel for initial visualization in the form of a graph. Furthermore, advanced statistical analysis was carried out using IBM SPSS software. *The Analysis of Variance Test* (ANOVA) was used to

determine the significance of the effect of attractant color on squid catches. If significant differences are found, the analysis is followed by a *Least Significant Difference* (LSD) test to find out the groups of treatment that are significantly different, (Angge et al., 2023; Palawe et al., 2021).

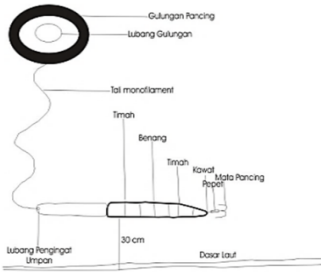
RESULT AND DISCUSSION

The location of this research is on the coast of Aeng Batu-Batu Village, North Galesong District, Takalar Regency. Aeng Batu-batu Village is a coastal area in Takalar Regency with an area of 2.17 km2 or 14.36% of North Galesung. The height of the area above sea level (DPL) is 9 m. People who exploit marine resources are fishermen around the Makassar Strait. Fishermen catch pelagic fish in the Makassar Strait using fishing gear such as drift gill nets, tonda fishing rods, long fishing rods, and ring trawl fishing gear, (Kantun & Amir, 2016). Basically, fishermen catch squid and find lamps as auxiliary tools. Furthermore, traditional fishermen in Takalar Regency often use long fishing rods to catch squid in the waters of the Makassar Strait. This is because the long fishing rod is a passive and environmentally friendly squid fishing tool. To attract the attention of squid, long fishing gear is used inseparably from fishing aids. Squid, known as positive phototacical water organisms, are attracted to light. Lamps such as petromax, incandescent, and carbide are used to catch squid, (Daris et al., 2021).

Fishing Gear Stretcher

Fishing gear for catching squid in North Galesong Waters, Takalar Regency, Makassar Strait, is a fishing gear designed in the way shown in the Figure below:

Figure 1.
Construction of fishing gear used at the research site



Source: (Daris et al., 2021)

The results of interviews with squid fishermen with stretching fishing gear around Aeng Batu-Batu Village, show that he made from used household items such as used toothbrushes (formula), used umbrella wire, tin, glass water straws, thread, monofilament rope, tissues, fishing rods, and rolls. Table 1. shows the role of each material.

Table 1.
Fishing Gear Stretcher

No.	*Material*	*Function*
1.	*Wire*	*Connect the bait head with the fishing rod*
2.	Toothbrush	Feed head
3.	Thread	Binding tissues
4.	kima	*Weighting the bait*
5.	Pipette	*Wrapping the fishing rod handle*
6.	Monofilament	*Fishing rod main line*
7.	*tissue*	*As bait.*
8.	*fishing rod*	*Squid hook*
9.	roll	*Monofilament rope holder.*

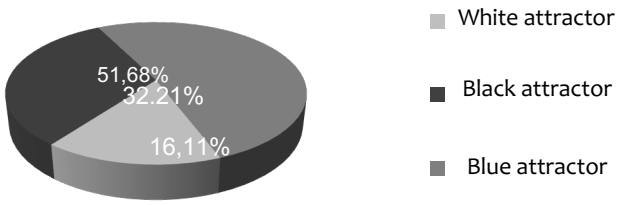
Source: research results

Composition of Catch

The results of the analysis of the composition of squid catches with attractors in different colors during the study obtained results of 149 consisting of 24 fish (16.11%) caught with white attractors, 48

fish (32.21%) caught with black attractors and 77 fish (51.68%) caught with blue attractors (Figure 3). After statistical analysis was carried out using the SPSS output, the Anova Test on the composition of squid catch in different attractor colors was obtained F_{count} > 0,01 (6,846 > 0,003) so it has a very real effect on the catch at a confidence level of 99% so that followed by the *Least Significant Difference* (LSD) test obtained real results on blue and white attractors, namely the difference in average value (4.417) and sig value (0.001). This shows that squid responds to white attractors and blue attractors compared to black attractors.

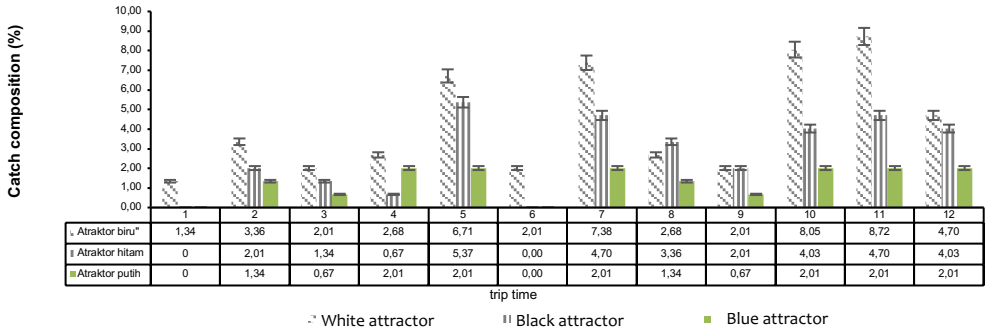
Figure 2.
The composition of squid catch based on the color of the attractor differs



Source: research results

The composition of squid catches in this study during 12 trips was obtained with the highest catch of 13 (8.72%) on the 11th trip using a blue attractor and the lowest one (0.67%) on the third and ninth trips using a white attractor, the fourth trip using a black attractor as in (Figure 3). Ramdhani et al (2022) Previous research on how squid caught using long fishing rods consisted of 268 fish (32.1 kg), of which 79 (9.1 kg) were caught with artificial bait in combination orange and white, 57 fish (7.7 kg) were caught with artificial bait in combination green and white, and 132 fish (15.3 kg) were caught with artificial bait in combination with red and white color. Overall, the squid catch was 268 fish consisting of 132 (49.25%) in the red and white bait color combination, 79 (29.74%) in the orange bait color combination and 57 (24.07%) in the green and white bait color combination.

Figure 3.
Composition of squid catch per trip



	1	2	3	4	5	6	7	8	9	10	11	12
Atraktor biru"	1,34	3,36	2,01	2,68	6,71	2,01	7,38	2,68	2,01	8,05	8,72	4,70
Atraktor hitam	0	2,01	1,34	0,67	5,37	0,00	4,70	3,36	2,01	4,03	4,70	4,03
Atraktor putih	0	1,34	0,67	2,01	2,01	0,00	2,01	1,34	0,67	2,01	2,01	2,01

Source: research results

In this study, there was a difference in catch results for different attractor colors where the highest catch was 77 squid in 12 trips on blue attractors. This is due to the emission of blue waves produced higher than white and black colors. Based on the statistical test data, the analysis of Anova squid caught using an attractor aid with three different color treatments gave a very real effect on the composition of the catch, then followed by the *Least Significant Diferent* (LSD) test produced a real effect on the blue attractor with the white attractor. The treatment of blue attractors with black attractors had no noticeable effect, while the treatment of white attractors with black attractors had no noticeable effect on the composition of squid catches.

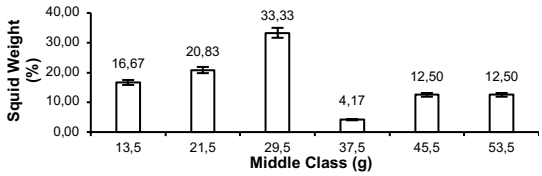
The treatment of blue and white attractors had a real effect due to the acquisition of different squid catches, but descriptively the composition of the highest squid catch was obtained by blue squid

attractors. The treatment of blue squid attractors has the highest squid catches is suspected to be due to the positive phototacosic nature of squid so that the greater the intensity of light emitted by the attractor color, the more concentrated the squid around the attractor.

Squid Size Distribution

The distribution of squid weight measurements obtained during the study on white attractors was in the range of 10-55 g with an average value of 29.75 ± 12.86 standard deviation values. The squid caught is dominated by a medium size of squid. Squid caught in white attractors had the dominant frequency in the middle interval of class 26-33 g amounting to eight (33.33%) and the lowest frequency in the middle interval of class 34-41 g amounting to one head (4.17%) (Figure 4).

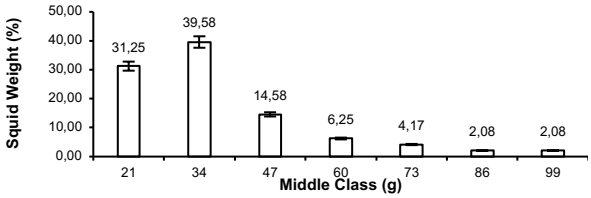
Figure 4.
Distribution of squid weight size in blue attractors



Source: research results

The distribution of squid weight measurements obtained during the study on black attractors was in the range of 15-99 g with an average value of 36.58 ± 17.63 standard deviation values. The squid caught is dominated by a medium size of squid. Squid caught in black attractors had the dominant frequency in the middle interval of 28-40 g amounting to 19 fish (39.58%) and the lowest frequency in the middle interval of 80-92 g and 93-105 g amounting to one fish each (2.08%) (Figure 5).

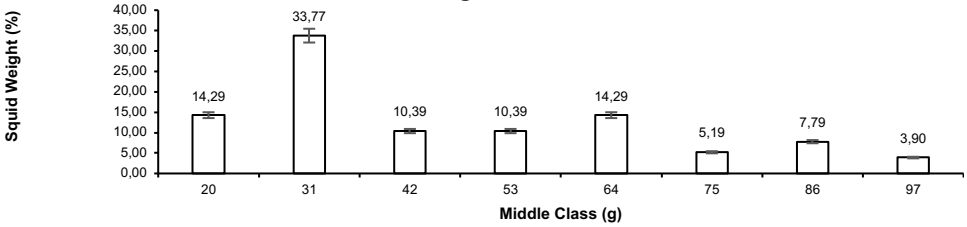
Figure 5.
Distribution of squid weight size in black attractors



Source: research results

The distribution of squid weight measurements obtained during the study on blue attractors was in the range of 15-95 g with an average value of 46.62 ± 21.93 standard deviation values. The captured squid was dominated by a medium size of the squid (Figure 7). Squid caught in blue attractors had the dominant frequency in the middle of the class of 26-36 g amounting to 26 fish (33.77%) and the lowest frequency in the middle interval of 92-102 g amounting to three fish (3.90%) (Figure 6).

Figure 6.
Distribution of squid weight size in blue attractors



Source: research results

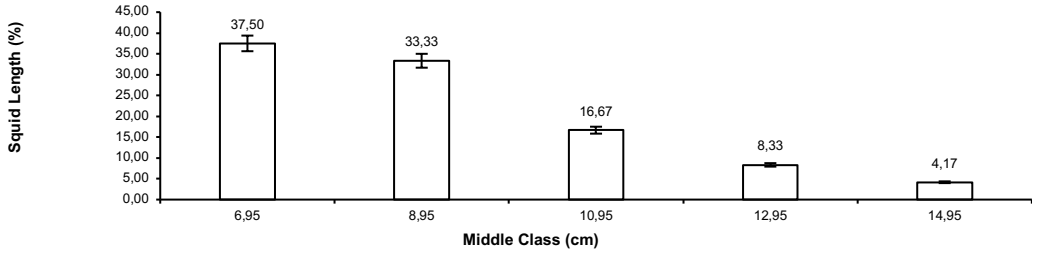
In this study, the distribution of the weight of squid catches with the use of different attractor colors obtained the heaviest catch in black attractors, which is 99 g and the lightest catch in white attractors, which is 10 g. However, for the most catches, it is in blue attractors because it provides high attractiveness compared to white and black. Based on the statistical test of Anova's analysis carried out on the three attractor colors above, it shows that the distribution of weight measurements caught using the attractor shows very real effects, so it is followed by the *Least Significant Deferent* (LSD) test to obtain the catch of blue attractors with white attractors with white attractors with real effect. The treatment of blue attractors with black attractors had a significant effect on the weight distribution, while the treatment of white attractors and black attractors had no significant effect on the distribution of squid weight size. The treatment of blue attractors with white attractors had a noticeable effect due to the acquisition of different catches, but descriptively the highest weight measurements were obtained in black attractors rather than white attractors and blue attractors. It is suspected that there is a difference in the response of squid to the color of the attractor where the sense of sight is more sensitive to white and the emission of blue waves that can attract the attention of squid in the waters of the Makassar Strait.

After statistical analysis was carried out using the SPSS output of the Anova Test on the distribution of the weight of the squid catch in different attractor colors, a value was obtained F_{count} > 0,01 (8,346 > 0,001) then it has a very real effect on the catch at a confidence level of 99% so that followed by the *Least Significant Difference* (LSD) test obtained real results for blue and white attractors, namely the difference in average values (16.873) and sig values (0.001) and in blue and black attractors, namely the difference in average (10.040) and sig values (0.006). This shows that squid responds to white and blue attractors compared to black. The distribution of weight measures is related to the seasons and environment, which impacts the availability of food in nature. Favorable environmental conditions can provide food to the squid thereby helping their weight growth.

Length Size Distribution

The distribution of squid length obtained during the study on white attractors was in the range of 6-15.3 cm with an average value of 8.94 ± 2.35 standard deviation values. The squid caught were dominated by medium squid size. Squid caught in blue attractors had the dominant frequency in the middle interval of class 6-7.9 cm amounting to nine (37.50%) and the lowest frequency in the middle interval of 14-15.9 cm amounting to one (4.17%) (Figure 7).

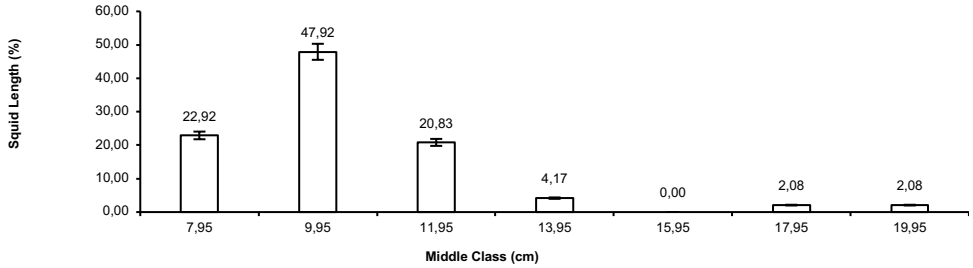
Figure 7.
Distribution of squid length size in white attractors



Source: research results

The distribution of squid length obtained during the study on black attractors was in the range of 7.5-20 cm with an average value of 10.33 ± 2.34 standard deviation values. The squid caught is dominated by a medium size of squid. Squid caught in black attractors had the dominant frequency in the middle interval of the 9-10.9 cm class amounting to 23 heads (47.92%) and the lowest frequency in the middle interval of the 15-16.9 cm class amounting to zero tails (0.00%) (Figure 8).

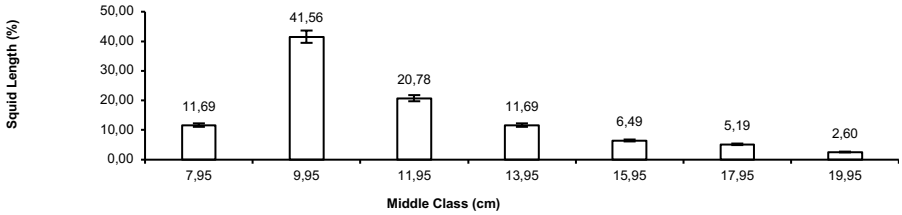
Picture 8.
Distribution of squid length size in black attractors



Source: research results

The distribution of squid length measurements obtained during the study on blue attractors was in the range of 7-19.2 cm with an average value of 11.39 ± 2.84 standard deviation values. The squid caught is dominated by a medium size of squid. Squid caught in blue attractors had the dominant frequency in the middle interval of 9-10.9 cm amounting to 32 heads (41.56%) and the lowest frequency in the middle interval of 19-20.9 cm amounting to two heads (2.60%) (Figure 9).

Picture 9.
Distribution of squid length size in blue attractors



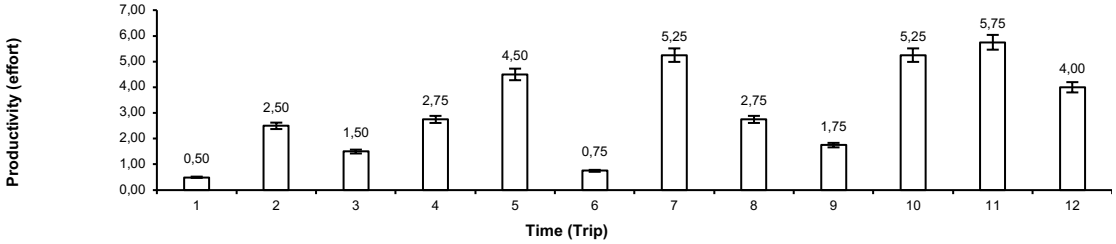
Source: research results

In this study, 149 squids were collected, 24 in white attractors, 48 in black attractors, and 77 in blue attractors, with a length range between 6-20 cm. Most squid caught are small. After statistical analysis was carried out using the SPSS output of the Anova Test on the distribution of the length of squid catches in different attractor colors, a value was obtained F_{count} > 0,01 (8,406 > 0,001) then it has a very real effect on the catch at a confidence level of 99% so that followed by the *Least Significant Difference* (LSD) test obtained real results on blue and white attractors, namely the difference in average values (2.44794) and GIS values (0.001). This shows that squid responds to white and blue attractors compared to black. The distribution of weight measures is related to the season and environment that impact food stocks in nature. Then a good environment can provide food availability to squid to help the weight growth of the squid. The treatment of blue attractors with white attractors had a real effect due to the acquisition of different catch production, but descriptively the highest coat length size was obtained by black attractors. The length of the squid coat was measured using a meter with an accuracy of 0.1 cm for all the catches in this study. The distribution of the length size captured based on different attractor colors of the total squid catch production was indicated by the squid's response to the attractor color used in the study.

Attractor Productivity

The productivity of the catch in this study is based on the number of trips caught per fishing attempt, namely the highest catch on the 11th trip which amounted to 23 fish (5.75%) and the lowest catch on the first trip which amounted to two fish (0.50%) (Figure 10).

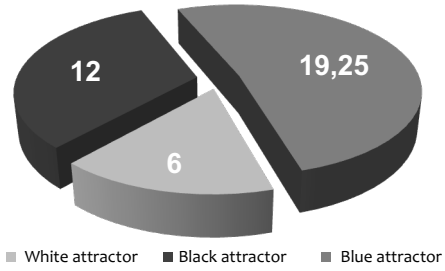
Picture 10.
Squid catch productivity per trip



Source: research results

The productivity of the catch in this study was based on the color of the attractor, which was obtained the highest result in blue attractors amounting to 77 fish with a catch effort rate (19.25) and the lowest in white attractors amounting to 24 fish with a catch effort rate (6) (Figure 11). According to Elbadiansyah (2019)In general, productivity is a comparison between the results achieved (*output*) and the total resources required (*inputs*)).

Picture 11.
Squid catch productivity per attractor



Source: research results

The productivity of catches per effort in this study showed that the most productive attractor for fishermen to use to catch squid was the blue attractor. This is due to the resulting blue attractor wave emission being higher than that of white attractors and black attractors. Based on the analysis of statistical data, the Anova test of squid catch using an attractor aid with three different color treatments had a very real effect on the productivity of squid catches, then followed by the LSD test obtained the highest productivity in blue attractors and the difference in the three attractor colors had a real effect.

The color treatment of blue attractors with white attractors had a significant effect on different captures, but descriptively the highest productivity was obtained by blue attractors rather than black attractors and white attractors. The productivity of squid catches in this study is that the three attractors have attractor color treatment due to the difference in the total squid catch, namely blue attractors are better than white attractors and black attractors, because blue attractors are brighter than white attractors and black attractors so that squid gathers around brighter attractors. The squid's attraction to dimly lit light is influenced by the light factor. The squid catch is also influenced by the time of the installation of the attraction and the capture of the squid as well as the expertise in squid fishing. Squid catch production can be affected by the squid's response to light color and weather conditions during the squid capture process. This is proven when the waters are not calm due to bad weather such as (strong winds that cause wave height) can affect the squid catch. Catch production is a measure of the production capacity of a fishing gear. This is measured by comparing production with capture efforts.

CONCLUSION

Based on the results of the study, it can be concluded that 1) The composition of squid catches with different attractor aids during the study obtained results amounting to 149 fish with details of 16.11% caught in white attractors, 32.21% caught in black attractors and 51.68% caught in blue attractors; 2) The distribution of the weight size captured based on different attractor colors obtained the highest results in blue attractors, namely the weight range of 15-95 g with an average value of 46.62 ± 21.93 standard deviation values. The distribution of length measurements captured based on different attractor colors obtained the highest results in black attractors, namely the length range of 7.5-20 cm with an average value of 10.33 ± 2.34 standard deviation values.; and 3) Squid fishing productivity in this study is that of the three most productive attractor colors, the most productive is blue attractors.

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