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THE EFFECT OF RED LED LIGHTS ON POT CATCHES IN PENAAH WATERS, LINGGA RIAU ISLAND

Pengaruh Penggunaan Lampu Led Merah Terhadap Hasil Tangkapan Bubu di Perairan Penaah, Lingga Kepulauan Riau

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ABSTRACT

Fishing using traps is one of the dominant capture fisheries activities in Pena'ah waters, Lingga Riau Islands. Fishermen in Pena'ah still use traps without bait, while its catch continues to decrease. Allegedly, the decrease is due to the reduction of the pots' effectiveness, which is highly affected by baits. This study aims to investigate the use red LEDs as an attractor to increase the catch and the pot's effectiveness in catching grouper and valuable reef fish. This research was conducted in the Pena'ah waters using an experimental method. Data were collected from 18 pots during 18 trips. Three treatments were applied namely traps without bait (control), traps with only red LED, and traps with red LED and bait, each of it consists of six units of traps. Based on the total catch of reef fish, it shows that the third treatment (red LED light with bait) caught 13 families, the second treatment (traps with only red LED) caught 11 families, and the control had 10 families. Furthermore, the 18 groupers were caught by traps with a combination of red LEDs and baits, 9 groupers with only LED and 5 groupers with the control gear. The results showed that traps with a combination of red LEDs and bait had an effectiveness of 50%, traps with red LEDs were 28%, while control traps had an effectiveness of 22%. The red LED attractor is expected to be a solution to increase the effectiveness of traps.

Keywords: *Bait, Effectiveness, Pot, Reef fish, Red LED.*

ABSTRAK

Perikanan bubu merupakan salah satu kegiatan perikanan tangkap yang dominan di Desa Pena'ah, Lingga Kepulauan Riau. Nelayan Bubu di Desa Pena'ah masih menggunakan bubu sederhana tanpa umpan dengan hasil tangkapan yang terus menurun. Diduga, penurunan tersebut disebabkan karena berkurangnya efektivitas alat tangkap bubu yang sangat ditentukan oleh faktor penggunaan umpan. Oleh karena itu penelitian ini bertujuan untuk menguji penggunaan atraktor lampu LED merah sebagai umpan untuk meningkatkan hasil tangkapan serta efektivitas bubu dalam menangkap ikan kerapu serta ikan karang yang bernilai ekonomis. Penelitian ini dilakukan di perairan Desa Pena'ah dengan menggunakan metode eksperimen. Pengambilan data dilakukan dari 18 bubu selama 18 trip. Terdapat 3 perlakuan, yaitu bubu tanpa menggunakan umpan (kontrol), bubu dengan lampu LED merah, dan bubu dengan lampu LED merah serta umpan, dengan jumlah bubu masing-

masing 6 unit. Berdasarkan total hasil tangkapan ikan karang menunjukkan bahwa bubu dengan kombinasi LED merah dan umpan menangkap 13 famili, dengan LED merah menangkap 11 famili, dan bubu kontrol menangkap 10 famili. Hasil tangkapan ikan kerapu selama penelitian berjumlah 18 ekor, di mana 9 ekor ditangkap dengan bubu LED merah dan umpan, kemudian 5 ekor ditangkap dengan bubu LED merah dan 4 ekor ditangkap dengan bubu kontrol. Hasil penelitian menunjukkan bahwa bubu dengan kombinasi LED merah dan umpan memiliki efektivitas 50%, bubu dengan LED merah 28%, sedangkan bubu kontrol memiliki efektivitas sebesar 22%. Atraktor LED merah diharapkan menjadi solusi untuk meningkatkan efektivitas bubu.

Kata kunci: Efektivitas, Bubu, Ikan Karang,LED merah, Umpan.

INTRODUCTION

Pot is one fishing gear used by fishermen in Lingga Regency throughout the year (Fauzi *et al*. 2012). Pena'ah is one of the areas in the Lingga that use pots predominantly as fishing gear, with a total of 2,822 units with CPUE values ranging from 11.28 to 36.7 kg/day, thus contributing to the most significant catch (Dhewani *et al.* 2009). According to Salawita *et al.* (2016), the pot construction in Pena'ah is a hexagon-shaped pot made of wire with a mesh size of 1 inch.

The target catches of pot used by fishermen in Pena'ah are demersal fish and reef fish which have been decreased (Salawita *et al.* 2016). The declining catch is due to the lack of effectiveness of the fishing gear used by fishermen. The effectiveness of passive fishing gear, such as pots, is determined by the bait used. Generally, the type of bait used is organic bait which can stimulate the fish's sense of smell. Meanwhile, artificial baits, such as broken white ceramic plates, encourage the fish's sense of sight (Soamole *et al.* 2020).

The visual response of fish is closely related to the light used in the operation of the fishing gear. This light response includes the color and type of light, the color of the light has a different effect on the catch (Loupatty 2012). In

addition, using LEDs as bait for pots has proven that using LED lights with different intensities on pots affects catches (Ammari 2013). The use of constant types of LED lights and clip clips also affects the catch (Aminah and Ahmadi 2017). The research of Yudha *et al*. (2017) stated that using red LEDs increased the catch of Serranidae. Moreover, Reppie *et al*. (2016) show that LED lights have a higher catch than bait. Then, Waris *et al*. (2019) stated that the number of catches using LEDs with bait increases pot catches.

The pots used by fishermen generally have a pot construction without bait, so innovations are needed by adding bait with two approaches: smell-related (natural bait) and vision-related (red LEDs). Installing natural bait attracts fish to the pot because the smell of the bait causes the fish to enter the pot quickly. In contrast, the installation of red LEDs on the pot at night will cause the fish to be attracted to the light and gather in the pot area, which eventually accelerates the fish into the pot. According to Rudiyanto and Haryasakti (2020), catching demersal fish with red lights on passive fishing gear is more effective than white lights and controls weighing 25.60 kg (48.53%).Marine organisms such as Zooplankton (fish larvae, *Juvenile krill*), Meroplankton (mantis larvae), and Phytoplankton (muller larvae) are more attracted to red light than green and blue light colors (Mewengkang *et al*. 2022). Treatment of red LEDs is expected to increase the pot's catch and effectiveness. This research was conducted to determine the composition of the catch and the effect of using a red LED attractor on a pot to catch reef fish and to examine the effectiveness of using a red LED attractor on grouper catches in Pena'ah.

METHODS

The research was conducted using an experimental fishing method, namely field trials, by operating a pot in the three-point sampling around waters of Pena'ah Lingga Riau Islands,from February to March 2022, as presented in Figure 1.

Collecting Data

Field trials using experimental fishing methods in Pena'ah Lingga waters, Riau Islands. Experimental fishing was carried out to determine the effectiveness of pot catches with a red LED light attractor. The pots made of metallic wire and one-door pots totaling 18 units (3 cm mesh size, dimensions 120 cm × 180 cm × 30 cm) were used and illuminated

with Red LED lights 12 units were installed in the pot with the pot in front of the mouth (Figure 2). According to the research of Reppie *et al*. (2016), adding LED lights to the front of the pot mouth can increase the catch. The pots are lifted in the morning with the operating system of the pots in pairs, meaning that a series of pots consist of two units of pot connected by a 16 mm multifilament rope with a length of ± 10 m and one stone to facilitate the picking process.

Set Up of Field Experiment

The treatments on the field consisted of six control pots, six pots with red LEDs, and six pots with a combination of red LEDs and baited with a distance of ± 10 m for each treatment. The distance between the pots is mean to avoid the influence of LED light between the control and treatment pots. According to the research of Waris *et al*. (2019), the distance between pots is ± 10 m effective to apply to the operation of pots in the field. The pot are placed at three different stations, each with three coordinate points of the pot at a depth of ± 10 m with a duration soaking time of 2 days. The placement of the location has been determined based on the habits of fishermen and was determined beforehand so that three areas of pot placement with south latitude specifications (S) are obtained and east longitude (E) with the following details in the Table 1.

Data Analysis

The research was carried out using descriptive and quantitative analysis. Data processing the first aim is to calculate the comparison of catches with catch stages in each treatment arranged based on the type of main catch and bycatch with the weight category of the catch (kg/hauling) and the number of individuals. Meanwhile, for the second aim, calculating the effectiveness of traps is done by separating grouper catch data based on the number of individuals in each treatment per trip. Furthermore, the median test stage was carried out by compiling the catch data for the number of individual grouper fish and then sorting them from the lowest to the highest value to obtain the median value based on each treatment.

The descriptive analysis describes the treatment of red LED light on the catch in each treatment. Quantitative analysis tests the hypothesis using the median test using Software analysis. According to Sugiyono (2011), the median test is used theory by comparing two samples with nominal or ordinal data with the hypothesis being rejected or accepted. H0 is accepted if the significant value is > 0.05, while if the significant value is < 0.05, H1 is accepted with a significant level or an alpha value of 5%. Then calculate the effectiveness of the pot catches for grouper fishing based on the formula Riyanto (2008) show that the effectiveness of catching grouper with bait can be calculated based on the number of pots that catch grouper fish divided by the total pots used, with the following equation:

$$Ef = \frac{Ku}{TB} x\ 100\% \text{... .....} \quad (1)$$

With:
Ef: Effectiveness of pot
Ku: Pot that catches grouper
TB: Total pot used.

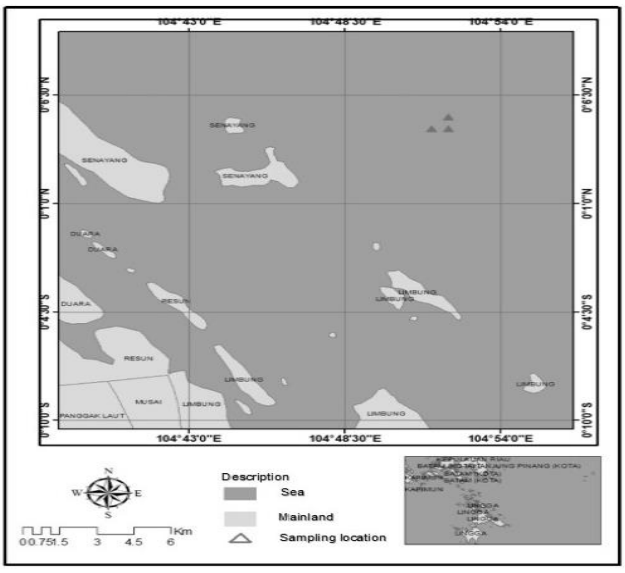

Figure 1 Map of Research Locations

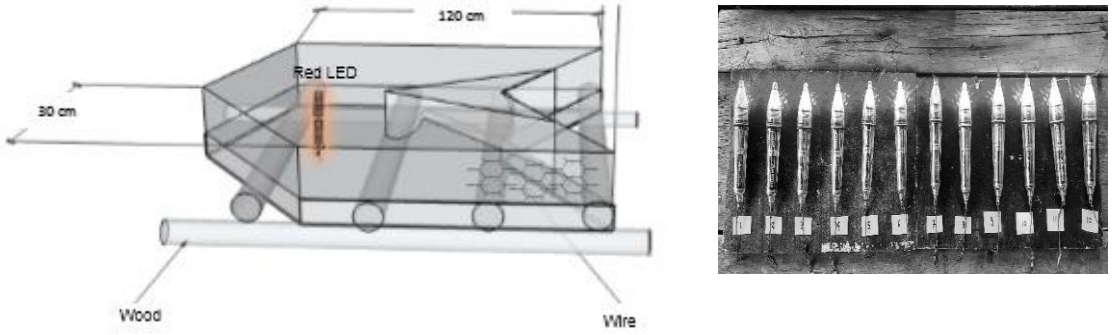

Figure 2 Placement of red LED lights on the pots and and Construction Red Led

Table 1 Study sites in different station in the field

Study site	Coordinate Point	South Latitude	East Longitude	Soaking Time	Long of Priod of Operation Pot
Station I	1	S 00.05.233	E 104.51.776	2 days	18 trips
	2	S 00.05.198	E 104.51.901		
	3	S 00.05.227	E 104.51.978		
Station II	1	S 00.05.259	E 104.52.023	2 days	18 trips
	2	S 00.05.309	E 104.52.051		
	3	S 00.05.396	E 104.52.074		
Station III	1	S 00.05.475	E 104.51.929	2 days	18 trips
	2	S 00.05.456	E 104.51.895		
	3	S 00.05.039	E 104.51.744		

RESULTS

The composition of the total catch during the study, as much as 51.87 kg consisting of 23 families and 43 species, is presented in Figure 3. Latidae is the family that has the highest total catch during the study compared to other families, 5.82 kg. However, each treatment gave different catches; control pots caught 10 families dominated by Latidae 3.24 kg, red LED pots caught 13 families dominated by Lujtanidae 1.73 kg, and bait combination red LED pots caught 11 families dominated by Haemulidae 1.97 kg.

The total catch based on individuals from the three treatments was 306 individuals. Each treatment gave other catches, including control pots dominated by the Latidae family (22.22%) and red LED pots dominated by the Lutjanidae family (17.82%). In comparison, the combination bait red LED pots were dominated by the Nemipteridae family (18.22%) (Figure 4).

The dominant individual catches were different in each pot treatment, indicating that the Latidae family was the species that caught the most, as many as 22 individuals. The least was the Caesionidae family of four individuals, while in the red LED treatment, the most caught from the Lutjanidae family were 18 individuals, and the least was in the family of Caesionidae, family Ephippidae, family Mobulanidae and Cephalopoda with the same number of one individual. In the red LED treatment, the bait combination was dominated by the family Nemipteridae totaling 20 individuals and at least two individuals in the family Carangidae. The difference in the type of family in the red LED combination bait treatment on weight was dominated by the Haemulidae. In the individual of the Nemipteridae, the fish caught were small, while the Haemulidae were quite large.

Grouper catches are based on treatment.

The number of groupers caught during the study was 18, with details of 15 individuals *Plectropomus maculatus* and three *Epinephelus coioides*. Judging from the number of individuals in each treatment, it showed that the highest catch came from the red LED treatment with a combination of the bait for as many as nine individuals (8.33%), and the second most were five individuals with red Led pots (4.95%), and the least control pots. Namely, four individuals (4.04%) is presented in Figure 5.

Grouper catches have different lengths in each treatment. Control pots had a *Plectropomus maculatus* size range of 20-46 cm, pots with red LED *Plectropomus maculatus* size ranged from 20-25 cm, while red LEDs with bait combination had *Epinephelus coioides* size ranges of 40-46 cm, as can be seen in Figure 6.

The catch based on the sale ability of grouper has a minimum size range of 35 cm; based on research by Salawita *et al*. (2016), the size suitable for selling grouper in Pena'ah is 35 cm. The grouper catches in the control pot showed that two individuals were worth selling and two were unfit for sale. At the same time, the red LED pot caught five groupers that were not worth selling, and the red LED pot combined bait caught six individuals that did not worth selling and three individuals worth selling.

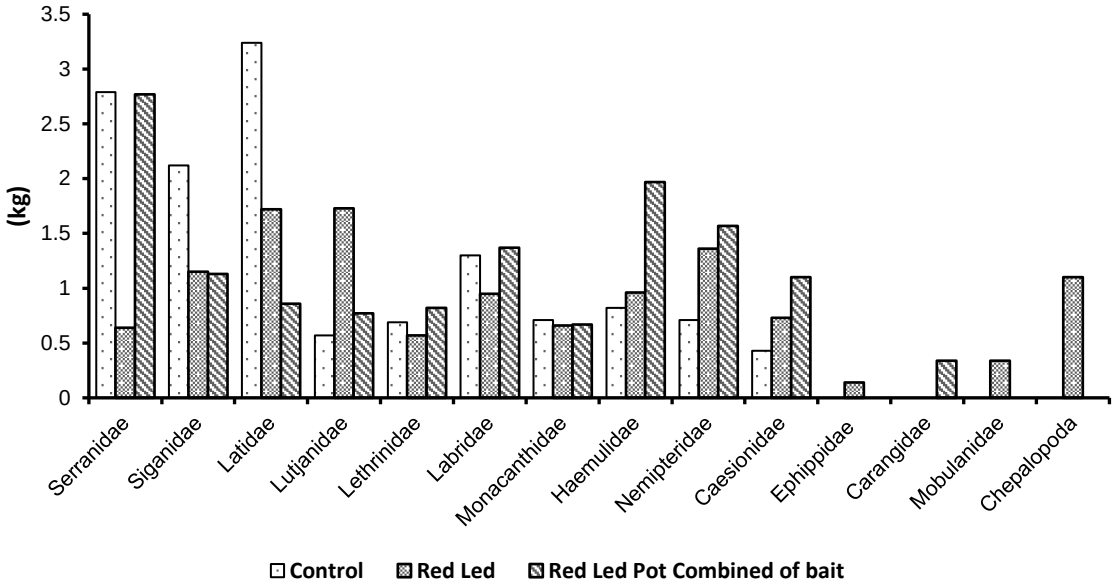

Figure 3 The economic value of catch weight in three different treatments

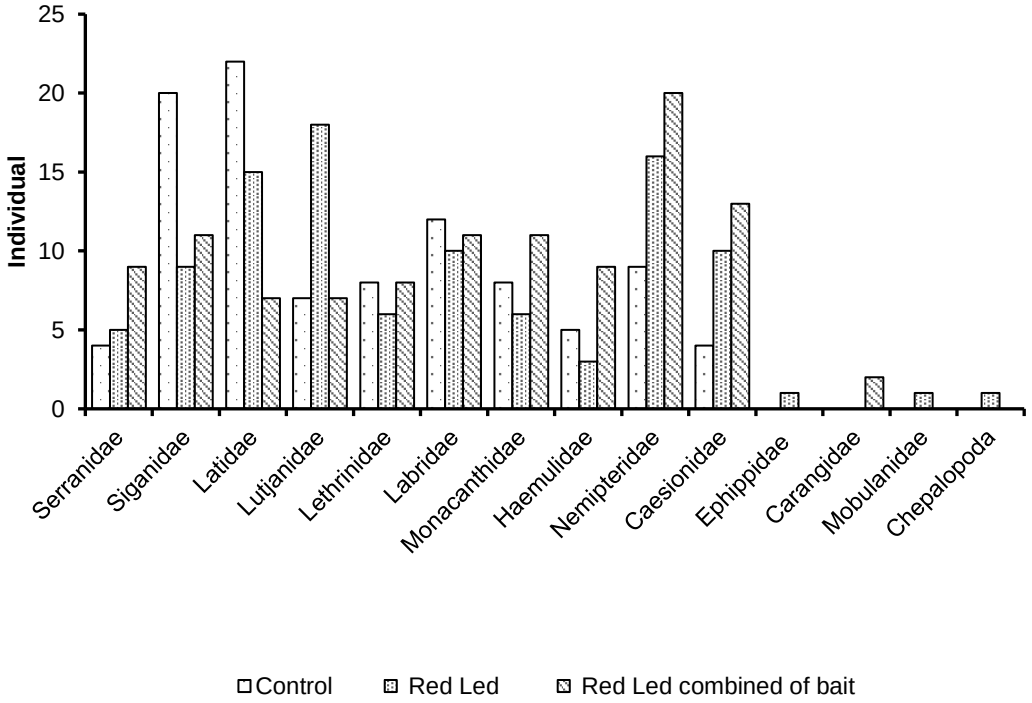

Figure 4 Economic value catches based on individuals in three different treatments.

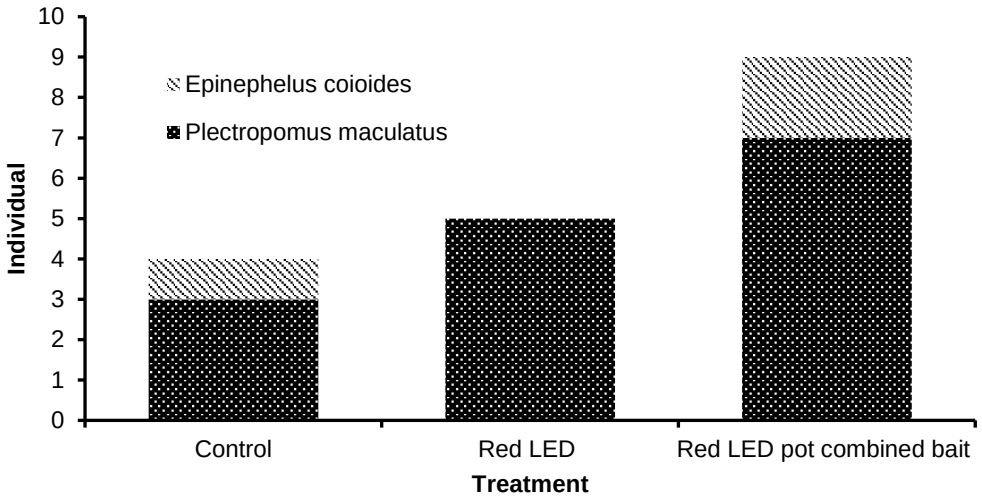

Figure 5 Grouper catches individuals in three treatments.

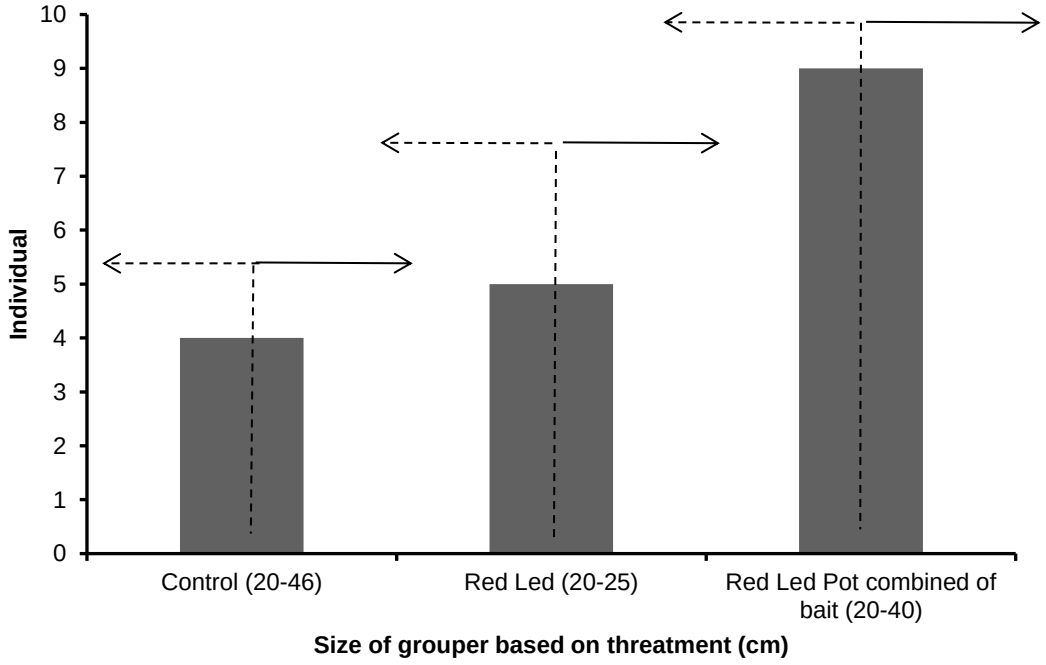

Figure 6 Number of grouper worth selling.

Effectiveness of The Pots in Catching Grouper

Pot with sufficient effectiveness in the study, namely the red LED pot with bait and the lowest on the control and red LED pot. The effectiveness value of the control pot was 22%, the red LED with 28%, while the pot using a red LED combination with bait was 50%. The percentage of grouper catches during the study is presented in Figure 7.

Types of grouper caught during the study were 18 individuals with the most catches in the LED combination bait pot with a total of nine individuals with details of seven *Plectropomus maculatus* and two *Epinephelus coioides*, followed by red LEDs with details of five individuals of *Plectropomus maculatus* and controlled as many as four individuals consisting of three *Plectropomus maculatus* and one *Epinephelus coioides*.

Result of Statictical Analysis Use Median Test

Experiment at Pena'ah water data individuals of grouper was compared between treatment periods using mediant test. Individual values were used for each treatment within each block as dependent variables in the analysis (Table 2).

The four families recorded were within the individual range of five individuals compared with the grouper. However, this ignores the individual's range of each size.There was statistical evidence for Red Led capture greater numbers of grouper (chi-squared = 6.667, df = 2, p-value = 0.036;)(Table 3). The mediant tested were checked by table of analsys indicated significant differences between the main effects without interaction, so differences between light treatments. In preliminary data analysis showed that the red LED attractor affected the grouper catches based on the individuals—the Asymp sig value evidenced this < 0.05, which is 0.036.

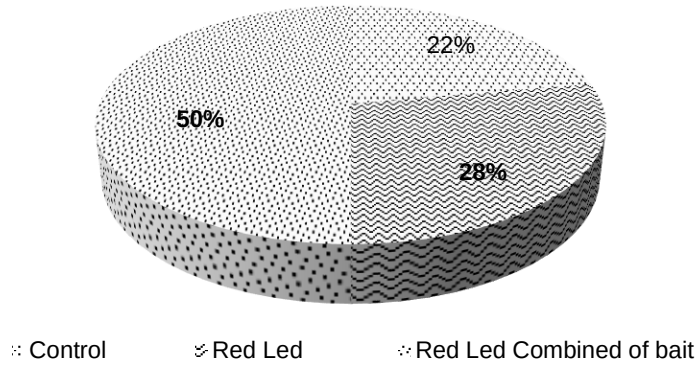

Figure 7 Percentage of grouper catches based on treatment during the study.

Table 2 Frequencies of data

Description of Family		Treatment types		
		Control	Red LED	Red LED Combined of Bait
Caseonidae (individuals)	> Median	1	1	3
	<= Median	4	4	2
Hemulidae (individuals)	> Median	1	0	2
	<= Median	4	5	3
Monacanthidae (individuals)	> Median	1	0	2
	<= Median	4	5	3
Serranidae (individuals)	> Median	0	2	4
	<= Median	5	3	1

Table 3 Result of Median Test

Description	Family Caseonidae (individuals)	Family Hemulidae (individuals)	Family Monacanthidae (individuals)	Family Serranidae (individuals)
N	15	15	15	15
Median	1.0000	1.0000	2.0000	1.0000
Chi-Square	2.400[b]	2.500[c]	2.500[c]	6.667[d]
df	2	2	2	2
Asymp. Sig.	.301	.287	.287	.036

DISCUSSION

The total catch during the study from the three treatments found that the family Latidae was the most dominating catch. According to research by Mariappan *et al*. (2016), the Latidae family is the catch that dominates up to 53% in pot treatment with two different types of bait. Meanwhile, the total catch shows that the red LED attractor has a direct impact, namely by affecting the fish's vision so that the fish enter the pot, but on the other hand, the red LED also has an indirect impact. It is due to schools of other fish in the pot, making the fish finally enter the pot. The light factor causes direct and indirect effects on the swimming behavior of fish (Syam and Hendra 2009).

The control pot treatment captured more Latidae families than other families based on weight and individual. In comparison, the red LED treatment was able to capture more Lutjanidae family both based on weight and individual this was due to Lutjanidae's visual ability to see a specific object around it, according to the results. According to research by Fitri and Asriyanto (2009), the Lutjanidae family fish's visual acuity level is relatively high in distinguishing the color of an object. According to Juliana *et al*. (2020), many families of Lutjanidae were caught with the addition of LED attractors to pots. On the other hand, several families were only caught in red LED pots, including Cephalopoda, Mobulidae*, and* Epipphidae. Cephalopods (*Sepia pharaonis*) were caught because they saw the presence of prey in the form of fish around the light. According to Brauckhoff *et al*. (2020), in the dark, Sepia sp. cannot catch prey as long as there is no light, especially at night. Mobulidae, with the type of elasmobranch caught, was thought to be attracted by the presence of light in the pot. According to McComb (2009), the surrounding environment's light dramatically affects the Elasmobranch eye's visual function. The small Ephippidae caught are thought to be due to the swimming behavior of the fish and their eating habits. Small Ephippidae swims close to corals at the bottom of the water and feeds on mosses (Leis *et al*. 2013).

The treatment of red LED combination bait has its differences where based weight is dominated by the Haemulidae family while based on individual catches is dominated by the Nemiptritidae family. The difference in catches in the combination bait red LED treatment occurs because the Haemulidae family has a large body size that affects fish weight based on weight. In contrast, the fish from the Nemipteridae family is smaller, so there is a high number of individuals. Haemulidae are fish with extensive body weights and solitaire but sometimes in groups (Burhanuddin and Iwatsuki 2012). Haemulidae were caught because they considered the pot as a shelter. Haemulidae enter the pot because they are attracted to schools of fish in the pot, which are their prey targets (Widana *et al*. 2015).

Meanwhile, Nemipteridae is attracted by the presence of light in the pot. According to Ammari (2013), the Nemipteridae family is very interested in or likes LED light, so it enters the pot. More Nemipteridae were caught in pots with red LEDs than in control pots (Yudha 2005). On the other hand, the red LED combination of bait can catch the *Carangidae* family with the type of Blue runner fish (*Carangoides praeustus*). Blue runner fish has different swimming patterns concerning the color of the given light with a response towards or away from the light source (Susanto *et al*. 2018).

The Effectiveness of The Pot

According to Baskoro *et al*. (2006), the value of the effectiveness of a pot can be categorized into three, namely: if the value is less than 50%, it can be classified that a fishing gear has low effectiveness, the value of 50% - 80% is classified as a relatively good, and the value of 80%-100% of fishing gear has high effectiveness. The results of the grouper fishing trial showed that the red LED pot with the bait combination had sufficient effectiveness, while the red LED pot and control pot had less effectiveness. The effectiveness of pot fishing with bait affects the weight and type of fish that enter the pot (Mahulette 2005). Many groupers were caught in the combination of bait and red LED treatment due to their sense of sight and smell. The *Plectropomus maculatus* has greater visibility of an object (Fitri and Asriyanto 2009). Natural baits overall have better effectiveness for grouper fishing (Riyanto *et al*. 2011a).

The grouper caught was dominated by unsold size due to the pot operating area being at a depth of 10 m or around the coast, a nursery for grouper-sized fry. According to Nuraini and Hartati (2006), the operation of pots at coastal water fewer than 15 m catches 60% of the size of the fry. Grouper in immature

gonad conditions caught in *fishing ground* pots of 62.5% is influenced by the depth of the waters because, in general, young groupers live in coral coastal waters with a depth of 0.5-3 m while stepping on adults migrate to the waters, which is 7-40 m deep (Tadjuddah *et al.* 2013). Catching with pot fishing gear or pot contributes quite a lot to catching the average grouper a size below the adult (Agustina *et al.* 2018). The sight of tiger grouper on bait with a larger size is the type of bait that is most visited and seen (Riyanto *et al.* 2011b).

The value of the median test shows that the treatment of the red LED attractor on the pot affects the type of catch based on the grouper catches. Pot with red LED treatment had a significant difference by individuals between Caesionidae, Haemulidae, and those compared to Serranidae. According to Siebeck and Marshall (2001), the corneas of reef fish such as Caesionidae and Haemulidae show that 52% can absorb light in water.The selection of this family is based on MSY(*Maximum Sustainable Yield*) and indicators of the health of the water. *Caeseonidae* in Riau Islands can still be increased to get optimal yield (Desiani *et al.* 2019). Based on observation Camera underwater with red light in the afternoon, family Caesionidae was found wandering in schools of 20-30 individuals (Yoshida *et al*. 2010). Family *Haemulidae* in Riau Islands can still be improved for a more optimal yield (Jupitar *et al.* 2014). Monacanthidae is a family that can indicate the health of an aquatic or coral ecosystem in water. According to research by Gilby *et al.* (2016), Monacanthidae is an omnivorous family with an essential role in the food chain.

The treatment of the red LED attractor on the pot affects the type of catch based on the individuals. The different treatment types of bait on the pot affect the effectiveness of grouper catches (Saputri *et al*. 2021). LED light treatment on pot significantly affected yields, with a ratio of 66% pot with LED treatment and 34% pot without LEDs (Banurea and Manurung 2021). The effectiveness of the pot increases when the trap uses bait compared to without bait (Firdaus *et al.* 2019).

CONCLUSION

The pots in this study showed that the types of catches treated with red LEDs had more efectively than control pots. The composition of the total catch during the study was as much as 51.87 kg consisting of 23 families and 43 species consist of red LED combination bait caught 13 families, red LED caught 11 families, and control caught ten families, which Latidae families dominate.The catch of grouper based on individuals consist of two kinds are *Plectropomus maculatus* and *Epinephelus coioides which are dominated by Plectropomus maculatus.* To the effectiveness of the pots on the red LED pots with a combination of 50% bait, 28% red LED pots, and 22% control pots.

RECOMMENDATIONS

Fishermen in Pena'ah are advised to use red LEDs with bait because it increases catch and can catch more groupers. Research is needed on how the behavior of *Plectropomus maculatus* and other demersal fish enter the pot using an underwater camera. Research is required to be related to trapping catches.

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