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Utilization of Light Fishing on Ship Hand Line in Kendari, Indonesia

Agus Wahyu Santoso[a*], Mulyono S. Baskoro[b], Budhi H. Iskandar[c],Yopi Novita[d]

[a,b,c,d]*Department of Fishery Resource Utilization, Faculty of Fisheries and Marine Science, Bogor Agricultural University, Bogor 16680, Indonesia*

[a]*Email: agusws@yahoo.com*

[b]*Email: baskoro.mul@gmail.com*

[c]*Email: bhascaryo.iskandar@gmail.com*

[d]*Email: yopi1516@gmail.com*

Abstract

Most hand line fishing vessels in Kendari, Indonesia are operated without fishing equipment. Therefore to increase productivity, fishing equipment is needed such as LED lights. The purpose of this study is to compare the effectiveness of catches of fishing vessels (hand line) equipped with LED lights with catches without using LED lights. The location of the study was carried out around the eastern waters of Kendari, Indonesia. The research method used is the experimental fishing method, where researchers directly conduct fishing experiments in the field to collect data. The results of the study shown that the LED lights on fishing vessels provide more catches of around 22.30% compared to fishing vessels that do not use LED lights. The types of fish caught are Decapterus sp, Rastrelliger sp, Caranx Bartholomaei sp, Selaroides sp, Coryphaenidae sp, Euthynnus affinis, Thunnus albacares, and Katsuwonus pelamis. Thus the fishing vessel (hand line) given to fishermen as an assistance vessel can be maximally beneficial.

Keywords: fishing; LED lights; productivity; types of fish.

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* Corresponding author.

1. Introduction

The use of electric lights to attract the attention of small pelagic fish for fishing purposes in Indonesia has been well developed. However, research with fishing vessels is still very little, because the research of lights as a tool is mostly done on step charts or chart boats. But the use of light technology on the step chart is still simple. In order to improve the technological capabilities of the step-by-step fishing gear, several studies have been carried out by experts. Among them are in conjunction with the use of light illumination with petromax lamps, the use of 4, 6 and 8 lamp units does not show significant differences [1]. On the other hand [2] has reported that the total weight of the catch obtained on the step chart in the Awur Bay waters of Jepara is influenced by the number of lights, where each increase in the number of lights results in an increase in catch, but there is no significant difference between 4 and 5 units lamp. Furthermore it has been reported that based on the descriptive analysis of the catch shows that the composition of the dominant catch for each number of lights is not the same. The use of 2 units of light produces the dominant catch, which is rebon shrimp, 3 units of light produce the dominant catch of anchovies, 4 units of light produce dominant catches of tembang fish and 5 units of light produce the dominant catch of fish. Research into the use of lights for fishing in Indonesia is further developed, not only limited to the tools and catches, but also the mechanism of interest in fish by light or things related to fish behavior to light. How long does the lighting take for the net to be drawn. The results showed that each type of fish had a different response to light. Anchovy responds to light quickly, so it can be removed 4-5 times a night. Furthermore anchovy is more likely to be high in light illumination [3]. Along with the development of technology, especially the use of light in fishing activities, the technology can also be applied to fishing equipment on step charts. A series of trials have been carried out to observe the use of various types of lights (neon, incandescent and mercury) on the step chart in the Makassar Strait. This is because the type of lamp will affect the attractiveness of fish around the fishing gear. So this research focused on fishing vessels equipped with the help of LED lights as a tool to attract fish to approach and then be lured using Hand Line fishing gear.

2. Material and Method

The study was conducted in July 2017 to November 2018 in the eastern waters of Kendari City, Southeast Sulawesi Province, Indonesia. This location is one of the coastal areas in Southeast Sulawesi Province, and is a fishing area that has considerable fisheries potential in Indonesia. Located between 3º54'30 "- 4º3'11" South Latitude and 122º23 ’- 122º39’ East Longitude.

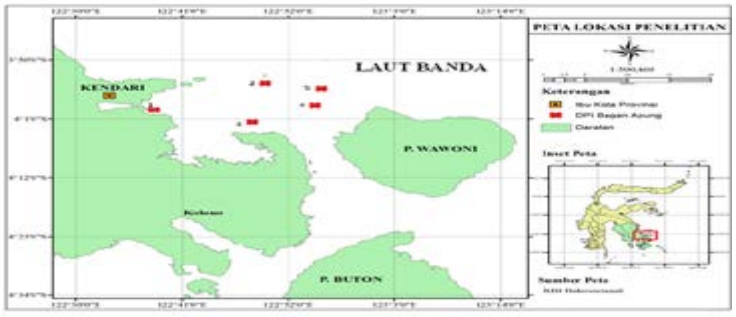

Figure 1: Research location

2. Data collecting method

The research method used is the experimental fishing method, where researchers directly conduct fishing experiments in the field to retrieve data. The object of the research is catch fish on hand line fishing vessels that use light fishing and those that do not use light. Retrieval of primary data is done by identifying the composition of fish species and the number of fish caught on the Hand Line ship. Retrieving data on the species composition of fish caught is done by identifying the type and number of fish caught. Secondary data was collected through literature studies. Secondary data consists of information about the types of fish and plankton. Data related to chlorophyll concentration in the research location was obtained from NASA's level 3 fashionable aqua satellite image data from NASA: http://oceancolor.gsfc.nasa.gov/. Fashionable aqua satellite imagery is a science satellite around the earth owned by NASA (National Aeronautics and Space Administration). Refrence [4] explains the main purpose of fashionable aqua satellite imagery, namely understanding the interconnected processes between the atmosphere, sea and land with changes in weather systems and climate patterns on earth.

2.1. Data analysis

In this study quantitative descriptive analysis was used to describe or illustrate the research object through a predetermined data sample. According to [5] this method can also be used to formulate the type and size composition of fish in fishing areas.

3. Results and Discussion

***Composition of the number of catches*:** The catch of fish species in the five locations of fishing areas using the Hand line consists of 8 species. The most caught fish species is Euthynnus affinis. The most catches of Euthynnus affinis fish are in DPI 2 and 6, namely waters of Wawoni and Saponda Utara islands. Euthynnus affinis fish catches are higher than other species due to the condition of fishing areas in accordance with their habitat. The depth of the waters in the fishing area reaches 50 - 150 m, sea surface temperature 26 ° C – 29 ° C, salinity 32 ‰ - 34 ‰ and chlorophyll-a concentration 0.1 mg / m3–0.4 mg / m3.

Table 1: Fish catches from hand line ships that use LED lights

No	Type of Fish	Fishing Grounds (Kg)							
		1	2	3	4	5	Total	%	Average
1	Decapterus sp	21	24	0	20	29	94	25.20	18.80
2	Rastrelliger sp	0	22	8	10	8	48	12.87	9.60
3	Caranx Bartholomaei sp	0	10	0	6	0	16	4.29	3.20
4	Selaroides sp	12	0	18	0	16	46	12.33	9.20
5	Coryphaenidae sp	0	8	0	14	0	22	5.90	4.40
6	Euthynnus affinis	20	35	22	0	22	99	26.54	19.80
7	Thunnus albacares	5	0	4	0	15	24	6.43	4.80
8	Katsuwonus Pelamis	4	0	2	11	7	24	6.43	4.80
	Total	62	99	54	61	97	373	100.00	9.33

In Table 1 shows that hand line vessels that use LED lights operating in five fishing areas have captured small pelagic fish species such as Decapterus sp with a total weight of 94 kg (25.20%), Rastrelliger sp as much as 48 kg (12.87), Caranx Bartholomaei sp 16 kg (4.29%), Selaroides sp 46 kg (12.33%), Coryphaenidae sp as much as 22 kg (5.90%). Whereas the large pelagic fish caught were 99 kg (26.54%) Euthynnus affinis, 24 kg Thunnus albacares (6.43%), and 24 kg Katsuwonus Pelamis (6.43%). The smallest type of pelagic fish caught was Decapterus sp, while the largest type of pelagic fish most caught was Euthynnus affinis. The total catch of small pelagic fish is 60.59% (226 kg) greater than that of large pelagic fish which is only 39.41% (147 kg). Meanwhile the total of all hand line catches that use LED light aids from the five fishing areas is 373 kg.

Table 2: Fish catches from hand line ships that use LED lights

No	Type of Fish	Fishing Grounds (Kg)							
		1	2	3	4	5	Total	%	Average
1	Decapterus sp	14	10	0	10	19	53	22.36	10.60
2	Rastrelliger sp	0	10	6	7	6	29	12.24	5.80
3	Caranx Bartholomaei sp	0	8	0	4	0	12	5.06	2.40
4	Selaroides sp	8	0	12	0	10	30	12.66	6.00
5	Coryphaenidae sp	0	4	0	10	0	14	5.91	2.80
6	Euthynnus Affinis	12	20	14	0	18	64	27.00	12.80
7	Thunnus Albacares	3	0	1	0	15	19	8.02	3.80
8	Katsuwonus Pelamis	3	0	1	7	5	16	6.75	3.20
	Total	40	52	34	38	73	237	100.00	5.93

In Table 2 shows that hand line ships without using LED lights operating in five fishing areas have captured small pelagic fish species such as Decapterus sp with a total weight of 53 kg (22.36%), Rastrelliger sp as many as 29 kg (12.24), Sardinella sp as much as 12 kg (5.06%), Selaroides sp as much as 30 kg (12.66%), Coryphaenidae sp as much as 14 kg (5.91%). While the large pelagic fish caught were Euthynnus affinis 64 kg (27.00%), Thunnus albacares 19 kg (8.02%), and Katsuwonus Pelamis as much as 6.75 kg (3.20%). Just like the catches with hand line boats that use LED lights, where the smallest pelagic fish caught the most is Decapterus sp while the largest type of pelagic fish caught is Euthynnus affinis. The total yield of small pelagic fishes is 58.24% (138 kg) greater than the catch of large pelagic fish which is only 41.77% (99 kg). Meanwhile the total of all hand line catches using LED light tools from the five fishing areas is 273 kg.

If seen in Figure 2, the number of catches of all types of fish is dominated by catches from ships using LED lights. From the results of the research that has been carried out, it shows that the total catches from hand line vessels that use LED lights are more 22.30% than the total catches from the hand line ships without using LED lights.

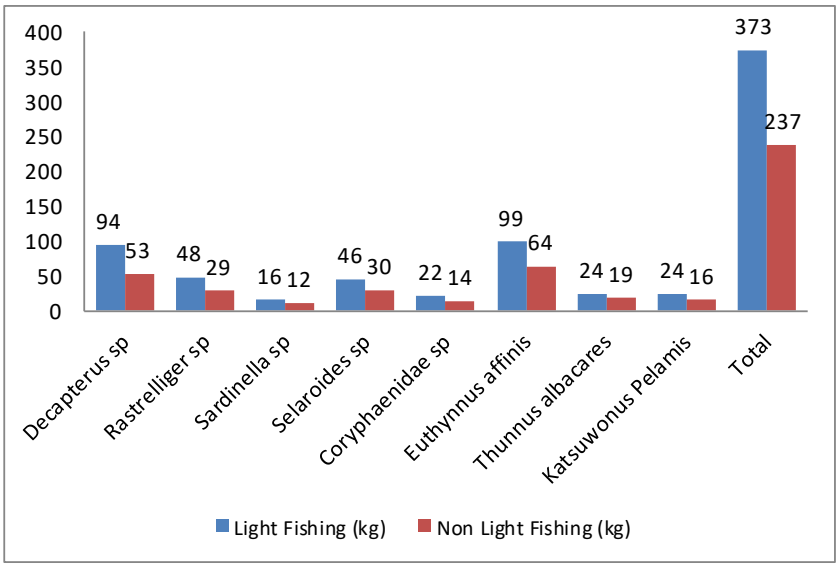

Figure 2: Comparison of catches between hand line ships and LED lights with hand line ships without LED lights

3.1. Species composition of catch fish

Catch fish obtained from hand line vessels should be identified according to their type so that fishing methods can continue to be developed in accordance with the dominance of the type of fish caught [6]. From the results of identification, eight species of fish were caught, namely five types of fish from the small pelagic group Decapterus sp, Rastrelliger sp, Sardinella sp, Selaroides sp, and Coryphaenidae) and three fish species from the large pelagic group (Euthynnus affinis, Thunnus albacares and Katsuwonus Pelamis). The composition of species caught on the Hand Line is relatively small, this is influenced by the condition of the fishing area generally located at a depth of 50 m. Refrence [7] explain the ability of light mercury vertically to reach a depth of 27 m and horizontally at a distance of 50 m. Pelagic fish at night are generally at a depth of 20-30 m. This causes species that are at a depth of more than 27 m cannot capture light originating from the Hand Line, so the number of species in the catchable area is relatively small. The most dominantly cumulative species in the hand line fishing area is Euthynnus affinis. This species spreads evenly throughout the fishing area. The biggest catches of tuna on DPI 2 and 5 are Wawoni and Saponda Utara waters. The catch of tuna is higher than other species due to the condition of the fishing area according to their habitat. Refrence [8] explained that Euthynnus affinis at the age of immature was able to adapt to the water temperature range of 27 ° C - 29 ° C. Sea surface temperatures on DPI 2 and 5 range from 26 ° C – 27 ° C. Refrence [9] explained that the sea surface temperature of the eastern waters of Southeast Sulawesi in the western transition season was warmer, ranging from 25 ° C – 26 ° C. The event of direct attraction of fish by light causes fish to gather in the catcable area. The gathering of fish in a catchable area indirectly forms a fishing area and forms a structural pattern in the food chain called the tropic level [10,4].

3.2. Trophic level

The relatively high diversity of species in light fishing causes interactions between one species and other biota

in fishing areas generally due to the predation process. The predation process that occurs describes the energy transfer sequentially. Refrence [11] explains that tropic levels describe the stages of material or energy transfer from each level or group to the next level, starting with primary producers, primary consumers (herbivores), secondary, tertiary, and so on and ending with predators at the top of the net. Tropical levels formed in the capture unit, namely the Carangidae species, Scomberoides commersonnianus have preyed on 50% -90% of small-sized crustaceans, mollusks and nektons. Some other types of fish such as Rastrelliger kanagurta, Sardinella gibbosa, Sardinella lemuru, Leptojulis cyanopleura, Loligo sp have preyed on phytoplankton, zooplankton, juvenile fish and juvenile crustaceans. The type of Stolephorus sp takes up 100% zooplankton. Penaeus indicus eats 77% of zooplankton and more is phytoplankton. According to that tropical levels formed in light fishing are tropical levels from 3.2 to 4.2 up. Tropical levels formed on purse seine capture units, typically Coryphaena hippurus, Thunnus albacares, Euthynnus affinis and Katsuwonus pelamis are prey on 95% - 100% nekton, and only 0.4% eat zooplankton and mollusks. Rastrelliger kanagurta types prey on zooplankton groups by 55%, the rest are nekton, phytoplankton, detritus and juvenile crustaceans. The Selar crumenophthalmus species eats almost all the small biota found in the fishing area. Squid prey on small fish such as anchovies and some shrimp. Refrence [12] explain that the capture of Thunnus albacares with pole and line can use bait such as Selaroides sp, Decapterus sp, Euthynnus sp, Cypsilurus sp and Loligo sp. Refrence [9] stated that the arrest of Katsuwonus Pelamis can use Sardinella sp, Stolephorus sp, and Decapterus sp. This predation process can occur between one species with another species and can also occur in one species known as predator. Generally, the size of smaller fish falls prey to larger fish. In the tropical predatory structure these levels are in the position of carnivorous and predatory species. The types of biota that are consumed are generally from small-sized groups of biota such as juvenile fish, juvenile crustaceans, anchovy, mollusks and some plankton.

3.4. Establishment of a fishing area (light fishing)

In fish species that are positive for light phototoxis generally are pelagic fish species such as Decapterus sp, Rastrelliger sp, Sardinella sp, Selaroides sp, Coryphaenidae sp, Euthynnus affinis, Thunnus albacares, and Katsuwonus Pelamis. Physical interactions between species and light fishing can attract several species originating from the bottom of the waters coming near the light. Physical interaction between species and light in the fishing unit (light fishing) has an indirect influence on the biological interactions between species and other species [13]. Species diversity in fishing areas is determined by the behavior of fish in the waters against their environmental conditions. The level of chlorophyll-a concentration in waters can be used as an indicator of aquatic fertility that affects the diversity of fish catch composition. Phytoplankton as a source of chlorophyll-a becomes the first chain in the food chain in marine ecosystems. The higher the concentration of chlorophyll-a in the waters, the more composition of fish catches [4]. The amount of phytoplankton biomass in the waters produces the main food source for zooplankton and juvenile in the waters. This condition is an attraction for plankton-eating species to be around fishing grounds. The results of the study of water samples indicate that in fishing areas with a lot of help there are plankton which are food sources for fish. This condition is one of the factors that attracts the attention of fish to gather around the light because there are many prey to eat. Physical interaction between species and light in fishing units (light fishing) has an indirect influence on the biological interactions between species and other species in the predation process. Some studies on fish behavior on light

suggest that pelagic fish, crustaceans and mollusks mostly have strong positive phototactic properties of light with high illumination [14,15,16,17]. Field observations show that fish species began to be in the fishing area at 00.00 WITA before sunrise and at sunrise at 04.00 WITA it was not seen around the fishing area. The intensity of the light at the time of sunrise becomes lower due to the appearance of sunlight. Based on this, it can be said that fish species belong to a group of species that like light with low illumination. The formation of fishing areas in fishing traps with light fishing is due to physical interactions between species and light sourced from mercury lamps in light fishing capture units. Fish behavior towards light in fishing areas is moving around the light and tends to form a circle. Refrence [18] explain that there are fish groups that go directly to light and some that do not, groups of fish come from various depths according to the depth of swimming of each species. Refrence [10] explain that groups of fish that directly approach light are generally fish species that are positive photopotax to light and which do not directly approach light generally species that forage around light. Refrence [4] explained that the level of fish hordes and fish attraction in light sources varied between types of fish. Differences are generally caused by phylogenetic factors, ecology and physical characteristics of light sources. The wavelength of light that can be received by the sense of sight in fish from 400 to 700 nanometers. For the purpose of attracting fish in the widest area, it can use blue light, because the light has a short wavelength of 450 to 500 nanometers, but the farthest frequency, so that it can attract fish vertically and horizontally widely. After the fish have accumulated in the cathchability area, red light can be used to draw fish closer to the light source, because the wavelength is longer than other lights, 650 to 700 nanometers but the frequency is short so the fish is more focused on red light and the movement of fish becomes narrower. This condition can be used by fishermen to start operating their fishing gear so that fishing activities are more effective. Species that like light with low illumination and are in fishing grounds because there are prey to eat, are classified as species that interact biologically with their environment. The combination of physical and biological interactions is common in all species in fishing areas with the help of light fishing. However, species with strong positive phototaxis to light are more dominant in this combination of interactions. This is because these species are attracted by high light illumination and these species interact with each other in the process of predation. The species consists of pelagic and demersal fish. The process of establishing fishing areas with light fishing creates compositions of various species and sizes of fish. Refrence [19] explain the food chain is a network of one species with other species in predatory interactions. Interactions between species in the feeding chain cause energy transfer and the relationship of metabolic size causes the community to have certain tropical structures. Refrence [11] explains that in predation in marine ecosystems, all adult nektons are carnivores which prey on smaller plankton or other nektons. The predation process by large nektons is a predator for other nektons. One of the most consistent traits of how to eat nectonic fish is that it is not selective in preying because all the sizes of food available in the waters become food. The combination of the physical interactions of species with their environment and biological interactions between species and other species has formed the optimal fishing area at night.

4. Conclusions

LED lights on fishing vessels provide more catches of around 22.30% compared to fishing vessels without LED lights. Thus fishing vessels that are given to fishermen as aid vessels will be maximally utilized by fishermen both making arrests during the day or night. At the beginning of the light starts, the fish comes to the light source. But the fish only lasts a while then disappears again. 00.00 to 04.00 is a good time to catch fish using

light stimulation on water. The movement of fish occurs irregularly during foraging but at its appearance, fish appear to remain under the light source. By considering the number of catches and the operational technical aspects of utilizing electric lights on fishing vessels, especially LED lights are feasible to be developed in the context of developing capture fisheries. The right light power and color of LED lights, to be used as a fishing aid, still need further investigation.

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