



EFFECT OF AUTOMATIC LIGHTING FADS (FISH AGGREGATING DEVICES) ON STATIONARY LIFT NET IN KEPULAUAN SERIBU, INDONESIA

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Abstract— Automatic lighting FADs is an innovation for fish aggregating devices and a light attractor that can automatically be activated both day and night. This research is aimed at analyzing the effect of automatic lighting FADs on the composition of fishing capture using stationary lift net in Kepulauan Seribu. The research was conducted from January to February 2018 in Kepulauan Seribu waters in Indonesia using the experimental fishing method. Results show that the use of automatic lighting FADs during the day affects fishing capture (sign. 0.05; P value 0.025), while its use during the night does not affect fishing capture, (sign. 0.05; P value 0.614). The use of automatic lighting FADs affects fishing capture during the day because it serves as both attractor and shelter for schools of fish, yet it does not have the same effect during the night.

Keywords— Automatic lighting FADs; stationary lift net; Kepulauan Seribu;

I. INTRODUCTION

Kepulauan Seribu is a group of islands in Teluk Jakarta and is rich in marine resources as it is surrounded by high waters [1], [2], [3], [4], [5]. Marine resources in Kepulauan Seribu are exploited by local fishermen using gill net trolling line, hand line, trap, boat lift net and stationary lift net. For the stationary lift net, fishing is carried out in Kepulauan Seribu throughout the fishing season both day and night. However, fishing capture during the day using this type of net is not as much as that during the night. One reason is that the device is not equipped with an additional instrument. The additional instrument here is a halogen light that is typically used at night. Fish Aggregating Devices (FADs) is a media to gather fish in certain areas with the help of a rumpon that serves as shelter for the fish. In general, pelagic fish are interested in items floating around their habitat for a few days [6].

This means that the use of FADs can increase fishing capture by attracting the fish and helps with the capturing process [7], [8], [9], [6]. Lighting as a fishing capture instrument in Indonesia has developed over the eras from kerosene pressure lamp, filament light, Tungsten Lamp, and now LED (Light Emitting Diode). LEDs are chosen as they are energy efficient and can easily be modified, especially by artisanal fishermen in Indonesia [10], [11]. Many researches have investigated the use of LEDs as energy efficient additional instrument for fishing capture [12], [13], [14], [15], [16], [17]. Stationary lift net as a combination with automatic lighting FADs as attractor for fish is not yet widely used. A research on automatic lighting FADs was once carried out in Semarang in Central Java. It employed an additional acoustic frequency instrument that has proven to increase the capture of *Stolephorus* sp both day and night [18]. This research combines the use of FADs and automatic LEDs for fish capturing both day and night. The aim is to analyze the effect of automatic lighting FADs on stationary lift net used in the waters of Kepulauan Seribu, in terms of the amount of capture and its biomass.

II. RESEARCH METHODOLOGY

The research method employed is experimental fishing by operating stationary lift nets. It was conducted from November 2017 through February 2018 in the waters of Kepulauan Seribu in Indonesia, mainly in Lancang Besar island (5°55'41" latitude) (Figure 1). There were two stationary lift nets used in the research, one without automatic lighting FADs as control and was set at 5°56'13" latitude and 106°35'14" longitude, and the other one with automatic lighting FADs and was set at 5°56'20" latitude and 106°35'17" longitude. The net area and depth of the stationary lift net is 12 x 12 m² and 40m, respectively. Automatic lighting FADs is placed at the center of the net's area. Construction and specification of automatic lighting FADs and its placement for the research are shown in Figures 2 and 3.

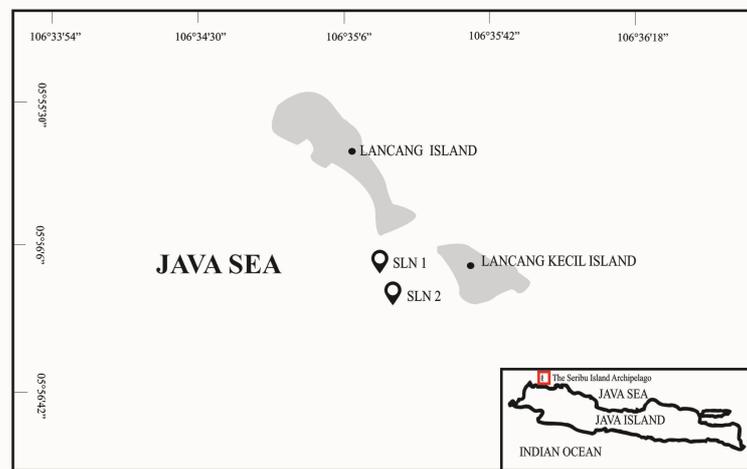
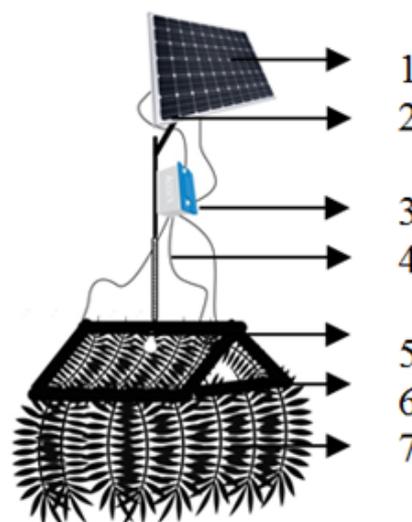
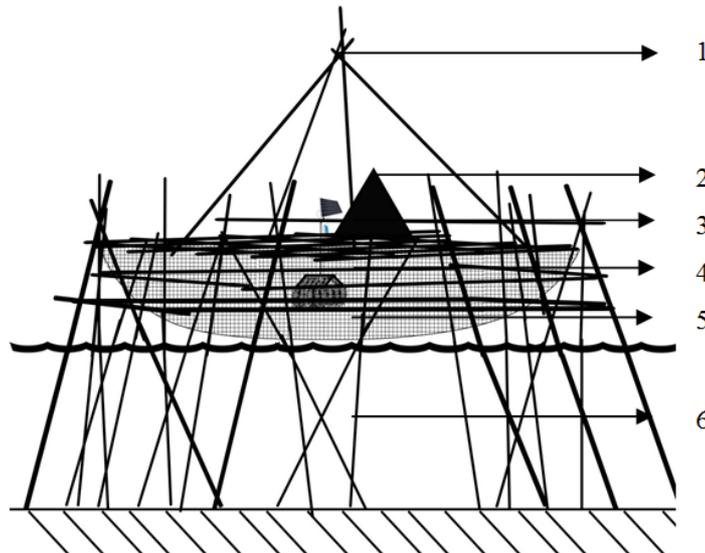


Fig. 1 Research location



(1) 60 wp solar panel; (2) 15 m electronic cable; (3) 12-volt accumulator; (4) 15 m rope; 12-volt light bulb; (5) 1.5 m x 0.5 m rumpon construction; (6) coconut leaves.

Fig. 2 Modified construction of an automatic lighting FADs ([18])



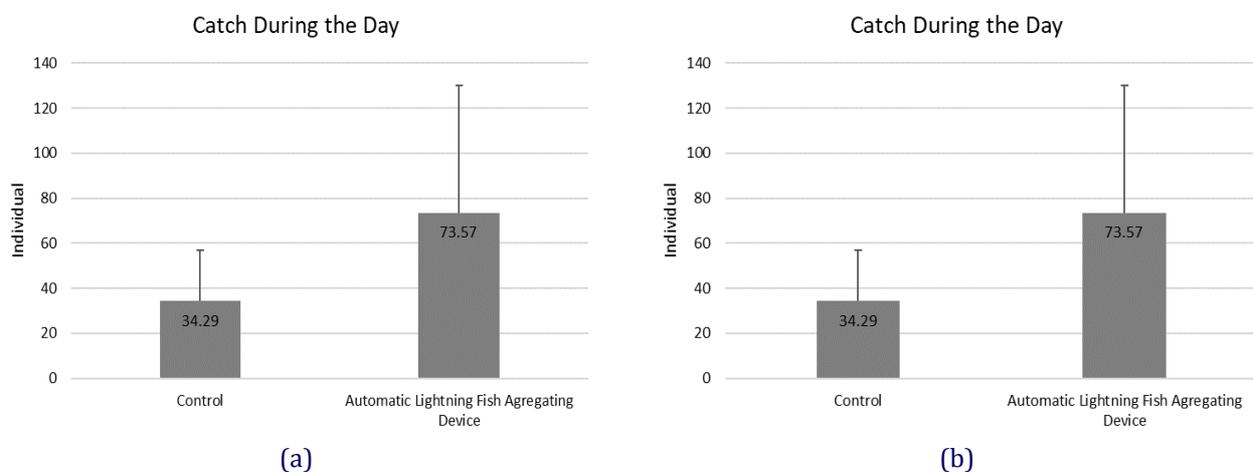
(1) light pole on top of the stationary lift net; (2) frame house; (3) roller; (4) automatic lighting FADs; (5) net of the stationary lift net; (6) waters.

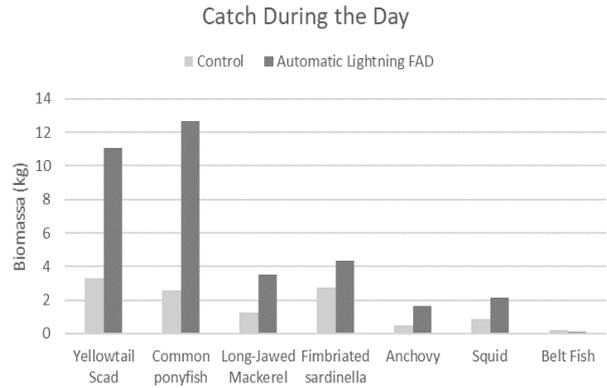
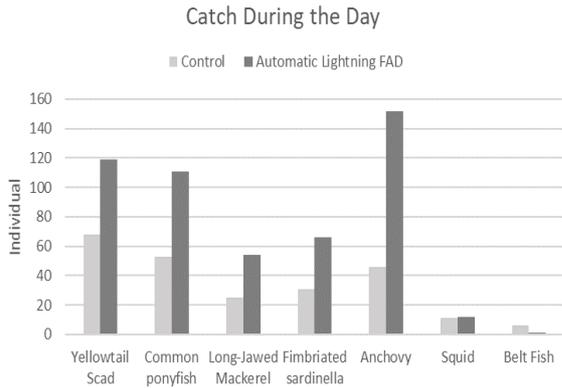
Fig. 3 Placement of automatic lighting FADs on the stationary lift net

The solar cell is used to gather energy from the sun. LED light was chosen as it is energy efficient and matches the 12-volt accumulator capacity [19]. The LED used was white in color, of 12-volt voltage and 5 watts (235 lm) power. While light indicates that positive photo taxis fish love white [20], [21]. Moreover, the light emitted by LED tends to point at certain angles that makes it easy to focus in line with the light design [22]. The frame for the automatic lighting FADs was made of bamboo and was triangular in shape of 1.5 m x 0.5 m dimension. It was equipped with 7-8 coconut leaves to give it a shade. The stationary lift net control was lit with 9-11 tungsten lights. This facility was powered by a 220-volt generator set and one trip of fishing consumed 1-2 liters of diesel fuel. Data of fishing capture were gathered twice during the day (at 09:00 GMT and 12:00 GMT) and twice during the night (at 19:00 GMT and 20:00 GMT), both for the treatment and control stationary lift nets. These four-time data collections are to represent the effect of automatic lighting FADs both day and night. Data were then analyzed using the t-student statistical method.

III. RESULT AND DISCUSSION

Composition of fishing capture suggests that the use of automatic lighting FADs on stationary lift net results in more fishing capture during the day, compared to that of the control stationary lift net. It was found that automatic lighting FADs is more effective to improve the ability of stationary lift net to gather fish during the day, compared to its use during the night. This is because the fish are also attracted to the FADs as it can also serve as a shelter for them



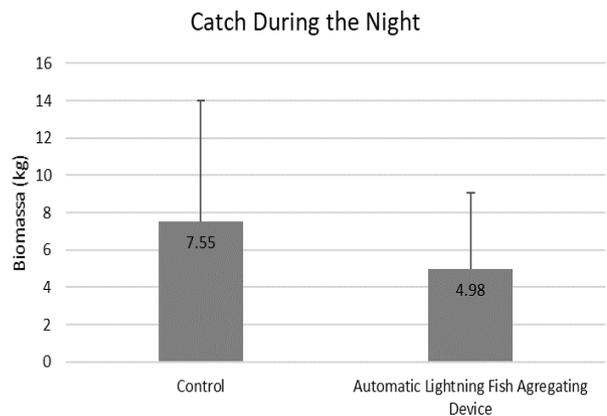
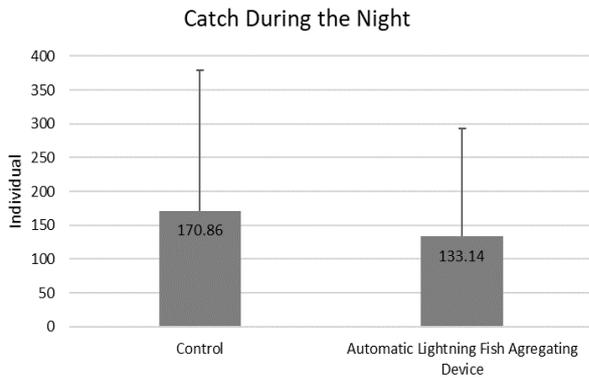


(c)

(d)

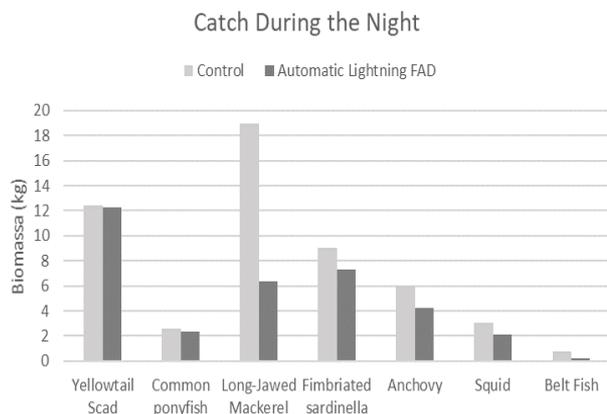
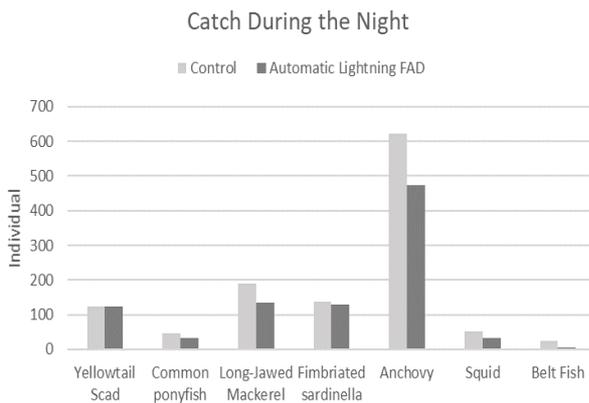
(a) comparison of fishing capture from stationary lift nets with and without automatic lighting FADs (in terms of amount); (b) comparison of fishing capture from stationary lift nets with and without automatic lighting FADs (in terms of biomass); (c) comparison of biota species from stationary lift nets with and without automatic lighting FADs (in terms of amount); (d) comparison of biota species from stationary lift nets with and without automatic lighting FADs (in terms of biomass)

Fig. 4 Comparisons of amount and biomass from day time capture



(a)

(b)



(c)

(d)

(a) comparison of fishing capture from stationary lift nets with and without automatic lighting FADs (in terms of amount); (b) comparison of fishing capture from stationary lift nets with and without automatic lighting FADs (in terms of biomass); (c) comparison of biota species from stationary lift nets with and without automatic lighting FADs (in terms of amount); (d) comparison of biota species from stationary lift nets with and without automatic lighting FADs (in terms of biomass)

Fig. 5 Comparisons of amount and biomass from night time capture

Rumpon is one of the technologies that function to gather and concentrate fish in certain waters as to help ease their capture with proper equipment, as the fish composition of those waters are known [24], [25], [26], [27]. Gathering fish passively requires the use of a helping instrument in the form of FADs as they come with certain designs that can be customized for different fishing needs [18], [9].

During the night, the helping instrument for fishing with stationary lift net is light. The lights in this research were of low power of 9 watts and 10 of them were utilized. The stationary lift net itself employed automatic lighting with 2 units of 5 watt LEDs. Light intensity used at the stationary lift net control was brighter to that of the automatic lighting with a voltage comparison of 1: 9, that more fish were caught on the stationary lift net with brighter lights. Other than being more superior in numbers, the lights used by present fishermen are held above the water that they attract more fish, compared to the automatic lighting that is placed under the rumpon [28]. Positive photo taxis fish are attracted to fluorescent light. Photo taxis fish are attracted to more dominant lights, as visual experience affects the way fish behave around this or stuff that gets to their attention such as light [29], [15], Yamashita *et al*, 2012). The lumen of the lights used in the control stationary lift net are greater than fishing capture with the use of automatic lighting FADs on treatment fishing net at night is less that of the former. According to [30], [31], light affects fish distribution as its wavelength influences behavior patterns of fish. Different light intensity and color attracts different types of fishes depending on the type and wavelength certain species of fishes can take White light quickly attracts fish as it neutralizes the waters. One of the most influential factors affecting fish behavior is the eye. Fish sensitive to bright lights tend to be more active during the day and are known as diurnals, while those more sensitive to darkness are known as nocturnal and hence, are more active during the night [14], [11].

T-student analysis results show that the use of automatic lighting FADs during the day affects results of fishing capture more during the day than at night (*sign.* 0.05) with P-value 0.008 for amount and P-value 0.025 for biomass (Table 1). Meanwhile, the use of automatic lighting FADs during the does not have significant effect (*sign.* 0.05) both for amount (P-value 0.23) and biomass (P-value 0.61) of fishing capture (Table 2).

TABLE I - T-STUDENT ANALYSIS RESULTS OF DAY TIME FISHING CAPTURE
 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total_Catch	Equal variances assumed	6.521	.025	-1.710	12	.113	-39.286	22.979	-89.352	10.781
	Equal variances not assumed			-1.710	7.875	.126	-39.286	22.979	-92.422	13.850

TABLE III - T-STUDENT ANALYSIS RESULTS OF NIGHT TIME FISHING CAPTURE
 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total_Catch	Equal variances assumed	.268	.614	.381	12	.710	37.714	98.956	-177.893	253.321
	Equal variances not assumed			.381	11.236	.710	37.714	98.956	-179.530	254.958

IV. CONCLUSION

The use of automatic lighting FADs affects fishing capture during the day, but does not show significant effect during the night. There is an indication of the effect of the use of automatic lighting FADs on fishing capture compared to the use of lights. Effectiveness of the use of automatic lighting FADs is influenced by the other function of FADs as a shelter for some biota. It is also known that light intensity of LEDs used in automatic lighting FADs is less than that of tungsten lights used by fishermen, that fishing capture from the control stationary lift net in this experiment is more than that of the treatment stationary lift net with LEDs.

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