Improved level of environmentally friendly boat liftnet fishing gear through Underwater Dip Light Technology (UFL +)

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Abstract. Boat Liftnet gear is a fishing gear that requires special attention in the biological, economic, technological and social aspects. Therefore proper management is needed in the development of a liftnet fishery business. This study aims to identify the composition of the boat liftnet catches, identify the level of catch and discard, determine the arrival patterns of fish primarily by catch and discard fish, and provide information on underwater fish lamp design that is expected to reduce the catches by catch and discard. The study was conducted in Mekar Village, Konawe Regency, Southeast Sulawesi Province. In May - July 2019. The research method used was through experimental fishing. The results showed that the boat liftnet is less environmentally friendly, the pattern of arrival of fish in the area around the light source consists of solitary and clustered, there is a pattern of fish behavior as a form of adaptation to light where the fish will stay away after about 40 minutes around the lamp, the device design is needed underwater dip lights are enhanced with the addition of several other supporting devices such as CCTV cameras and monitor screens, hereinafter referred to as UFL + (Underwater Fish Lamp Plus) with the aim of streamlining the capture time and reducing the number of by catch and discard.

1. Introduction
Management and development of capture fisheries businesses currently require a variety of appropriate management methods in accordance with the conditions of the developing biological, economic, technological and social aspects. These four aspects are closely interrelated to support capture fisheries business.

Boat Liftnet gear that requires special attention related to these aspects. This is because of the large contribution of lift net fisheries to the needs of overall capture fisheries production and the dependence of live bait pole and line fishing businesses that are usually obtained from bagan fisheries. In addition, in terms of feasibility, the boat liftnet business is feasible. This is based on the results of research on the feasibility of a boat chart business that has been carried out, showing the fish caught from a boat chart at the Kwandang Archipelago Fishery Port (PPN) seen from the R / C value or ≥ 1, Payback Period (PP) 1.06 years or during 1 year 22 days and NPV + Rp.301,768,360 [1]. Furthermore, from the biological aspect of research on the aspects of lighting and behavior of fish on the chart has been done by several researchers [2], [8], [10], [11]
and several other researchers. Also research on the level of environmentally friendly or in terms of biological aspects of fishing gear charts shows that the percentage of fish that are not worth catching is higher than fish that are worth catching [13]. So that the catch of the chart, including the category of fishing gear is less environmentally friendly. The performance of stepping chart selectivity is very bad, both in terms of size and type of fish caught, with a by catch rate of 22% and a discard catch of 3%. This shows that the boat liftnet is less friendly to the environment [12].

The low level of environmentally friendly fishing gear liftnet is the main problem in this fishing gear, this is because basically this fishing gear is designed to catch anchovies (Stolephorus sp) as the main purpose of fishing. But in the process there are many economically important fish caught both from pelagic and demersal fish. It even becomes the dominant catch. The arrival of these fish is mainly due to the interest in the lights as a tool on the liftnet. Good as a surface lamp even more so as an underwater dip lamp. Research on efforts to improve the level of eco-friendly fishing gear liftnet through improvement of net mesh selectivity has been carried out [11], but detailed technical research related to the review of the use of lamps in order to realize environmentally friendly technology in the process of catching on fishing gear liftnet has never been done until now . The research related to this matter is only limited to giving general recommendations about the impact and solutions of the use of lights in capture fisheries in the form of light intensity regulation [8]. This study aims to identify the composition of boat liftnet, Identify the level of catch and discard, Determine the arrival patterns of fish primarily by catch and discard fish, and Provide expected underwater fish lamp design information can reduce catches by catch and discard.

2. Materials and Methods

2.1 Site and Time

This research was conducted in the waters of Mekar Village, Konawe Regency, Southeast Sulawesi Province, from May to July 2019. With a fishing base at the port or dock, Mekar Village and fishing ground are located at positions 30°95'00" - 30°96'00" LS and 122°41'00" - 122°40'00" East, as in Figure 1.

![Figure 1. Map of a boat liftnet research location](image-url)
2.2 Data Collection
Research methods through experimental fishing. Data collection techniques in this study were (1) experimental data (2) the use of questionnaires (surveys), (3) literature search, (4) observations (observations), (5) interviews.

2.3 Data analysis
2.3.1 The composition of the type of fish caught. The composition of the catch is determined based on the relative abundance of each type of fish with the following equation [10]:
\[ Cr = \frac{Ht \times 100\%}{T} \] ................................................................. (1)

where:
- \( Cr \) = relative abundance of fish to \( T \) (%)
- \( Ht \) = 1st fish catch (kg)
- \( T \) = Total catches (kg)

The frequency with which each type of fish appears
\[ Fr = \frac{Jk \times 100\%}{T} \] ................................................................................ (2)

where:
- \( Fr \) = relative frequency
- \( Jk \) = Number of occurrences for each capture type
- \( T \) = total trip

2.3.2 Bycatch level. Bycatch level is calculated with the following formulations [10]:
\[ \text{Bycatch rate} = \frac{\sum \text{Bycatch} \times 100\%}{\text{Total catches}} \] ........................................... (3)

\[ \text{Discard rate} = \frac{\sum \text{Discard} \times 100\%}{\text{Total catches}} \] .............................................. (4)

\[ \text{Bycatch and Discard Levels} = \frac{\sum \text{Bycatch and Discard} \times 100\%}{\text{Total catches}} \] ........ (5)

Time and pattern of arrival of fish through direct observation with the help of echosounder. The observations were analyzed descriptively and displayed through graphs. Design Plan for Development of underwater dip lights in order to realize environmentally friendly technology in the process of capturing Rambo liftnet. The observations were analyzed descriptively.

3. Results and Discussion
3.1 Boat liftnet catch composition
Based on the results of research conducted during May-July 2019 in Periran Mekar Village, Konawe District, it was found that the size of the most caught fish with boat charting equipment varied for each species at each hauling time. For species of tembang fish (Sardinella fimbriata) is 30 mm-170 mm, anchovies (Stolephorus insularis) 20 mm-70 mm, peperek fish (Leiognathus sp) 30 mm-101 mm, and Parupeneus sp 49mm-132 mm. The composition of fish species most caught at the time of the study can be seen in Figure 2.
Based on Figure 2 above it can be seen that the catch of tembang fish (*Sardinella sp*) which was most obtained during the study was around 323 individuals at or around 15.25%, while other dominant fishes were anchovy and pepperek which had the highest percentage reaching 11% or around 240 individuals every haulingnya. From the catch there are also fish that are laying eggs are in the size of 125 mm to 140 mm. This shows that in terms of the size of the caught song fish, the boat chart is not environmentally friendly to the tembang fish, anchovies and peperek fish and other fish species. This is because about 85% of the caught song fish are small size fish that have never spawned.

### 3.2 Daily Catches on boat liftnet, bycatch and discard levels

The number of daily catches during the study (15 trips) The largest number of catches was on trip 2 which was around 34.2 kg and the lowest on the 14th trip was 3.39 kg where there were variations in the number of daily catches as deep as 15 trips. Daily catches on boat liftnet from three main catches, by catches, and discard catches. Figure 3 below is a histogram comparison of catches during the study (15 trips).

### 3.3 Arrival patterns of fish on a boat chart

Visual observation through an echosounder instrument is to determine the patterns of fish maturity of various types and sizes along with the position of the arrival of fish vertically based on the distance from the transducer on the boat chart. Figure 4 below shows the results of observations of the arrival of fish on the time and depth of the fish swimming to the lights.
The observations showed the fish will come and approach the light source after ± 95 minutes. The ignition of the operating lights on the first hauling precisely at 19.30 and 21.30 at a range of depths from 3.5 to 3.75 meters. But there are things that should be noted that after about 40 minutes the fish back away from lights or light sources. Changes in the position of fish from a light source are thought to be due to the fish's adaptation process to light. In addition, the fish will come to the light in response to the fish's potential phototaxis to light stimulation and the presence of food factors that make the fish move towards food. Besides that naturally a food chain has formed around the lamp. Most large fish will eat small fish, so this is why fish will come to the fishing area of the boat chart unit. Observations also provide information that fish arrival patterns have diversity. Fish according to their respective characteristics come to the light source in groups and solitary. The existence of small fish around the light which is food for large fish. Some fish are predators of other fish [6]. The arrival of fish using an echosounder can be identified through messages sent. However, echosounder technology has so far been limited to giving signals or information about fish.
arrivals but has not been able to detect the types of fish that come and the estimated number of fish that are approaching in the fishing area.

Echosounder technology aims to provide information to users about the presence and arrival of fish around ships and fishing gear through the frequency of sound waves. But until now has not been able to provide clear information about the actual condition of fish in terms of species, size and amount. Though information related to fish species, size and number of arrivals of fish is very necessary in the use of light aids on light fishing fisheries such as chart fishing gear. This is closely related to the amount of bycatch and waste that is a major problem in the fisheries bagan business. So what needs to be addressed in chart fisheries should be how to reduce bycatch and discard.

3.4 Underwater fish lamp design information which is expected to reduce catches by catch and discard to support eco-friendly fishery charts

There is a plan to design a fishing aid for the fishing business of light fishing, namely designing an underwater dip lamp that uses an LED lamp with the addition of a CCTV camera that is assembled in a unit of underwater dipping lights.

This technology relates to a configuration of fish lamps, especially fish lights that are refined as underwater fishing aids equipped with supporting electronic components. The aim is to facilitate fishermen in catching fish that are used as fishing aids, primarily the function of the lamp is as a light source to attract fish's attention while concentrating the presence of fish in the area of capture, there is a framework as the outer protective lamp and its components, as a lamp buffer, and ballast frame buffer and CCTV function are in addition to innovations to monitor the movement of fish from the ship, find out the type, size and number of fish that come, so that at least fishermen have basic information when the right time to lift the net, hereinafter referred to as Underwater Fish Lamp Plus (UFL+)

4. Conclusions

The composition of the number of daily catches of boat liftnet fishing gear during the study consisted of primary catch of 75.5%, by-catch of 21% and discard catch of 3.5%. This provides information that boat charts are less environmentally friendly. The pattern of arrival of fish in the area around the light source consists of solitary and clustered, There is a pattern of fish behavior as a form of adaptation to light where the fish will stay away after about an hour around the lamp, the design of underwater lights aids are enhanced with the addition of several Other supporting devices such as CCTV cameras and monitor screens with the aim of streamlining the capture time and reducing the number of by catch and discard.

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