Modification and Engineering of Portable Fish Aggregating Devices (Fads) With The Addition of Acoustic Sensors

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Abstract. The portable rumpon is a movable fish aggregating device that consists of a float and attractor, without any wood or permanent structures on it. This portable rumpon is commonly used in waters with moderate currents. It is usually equipped with sonar to determine the abundance of fish congregating in the area. Modifications to the shape of the portable rumpon and the engineering addition of acoustic sensors are expected to increase the catch of fish, allowing them to gather around it. The acoustic sensors used have a frequency range of 10,000-15,000 Hz, which is a sound wave favored by fish. The generated sound waves are anticipated to enhance the catch results, as indicated by the number of fish that gather around the rumpon. The operation of the portable rumpon can be conducted alongside fishing gear to achieve optimal results.

Keywords: Portable Rumpon, Modification, Acoustic Sensor

INTRODUCTION

Indonesia's marine waters are among the largest in the world, rich in fish and aquatic plants. Indonesian fish diversity can be observed through snorkeling and diving, and its fisheries support both local consumption and livelihoods. Fishers employ various methods and equipment, classified as either active or passive, and often use fish aggregating devices (FADs) or *rumpon* to attract fish. Originally, *rumpon* were wooden structures floating in the sea, but they have since evolved into portable FADs made with buoys and attractors, suitable for easy relocation.

Portable FADs, often equipped with sonar, help locate fish more efficiently, reducing costs and time. These devices mainly attract pelagic fish, which gather around them at night. Modifications to the portable FADs, such as adding acoustic sensors with frequencies between 10,000-15,000 Hz, aim to increase fish aggregation and catch rates. These acoustic signals are attractive to fish, enhancing the effectiveness of fishing operations

METHODS

This research will be conducted from June to October 2024. The study will take place in the Simulator Laboratory of Capture Fisheries at Politeknik Negeri Lampung, with equipment trials and data collection conducted at the Politeknik Negeri Lampung floating net cage (KJA) and at BBAL Pesawaran, Bandar Lampung.

Table 2. Equipment Used

No.	Name	Amount	Unit	Function
1.	Speaker AUDAX 4 inch	2	Pcs	"To Produce Acoustic Sound as the Main Attractor"
2.	Solder dan timah Listrik	1	Pcs	"To Connect Cables"
3	Saklar On/Of	1	Pcs	"To Turn the Speaker On and Off"
4	Trafo 5 ampere	1	Pcs	"To Transfer Electrical Power"
5	Baut	1	Dozen	"To Position the Speaker in Place"
6	Sekring	1	Pcs	"For Electricity
8	Multitester	1	Pcs	"To Measure Voltage"
9	Obeng	1	Pcs	"To Tighten Nuts"
10	Tang	1	Pcs	"To Strip Cables"
11	Palu	1	Pcs	"To Secure the Mounting"
12	Bor	1	Pcs	"To Drill"
13	Gunting	1	Pcs	"To Cut"
14	DOP PVC	2	Pcs	"As Speaker Cover"
15	Pipa PVC 3 inch	1	Pcs	"As the Frame for the Fish Aggregating Device (Rumpon)"
16	AKI	1	Pcs	"As the Power Source"
17	Kabel	2	Pcs	"As an Electrical Conductor"
18	Kabel Jepit Buaya	2	Pcs	"As a Connector from the Power Source to the Speaker"
19	Pelampung PVC	2	Pcs	"As a Marker for the Fish Aggregating Device (Rumpon)"
20	Tali PE 10 inch	1	Roll	"As the Main Rope for the Fish Aggregating Device (Rumpon)"
21	Tali Rapi	1	Roll	"As the Second Artificial Attractor"
22	Pemberat	1	Pcs	"As a Weight to Prevent the Rumpon from Drifting"
23	Gergaji	1	Pcs	"To Cut PVC Pipe"
24	Satu Set APD	1	Dozen	"As Personal Protective Equipment"
25	Bahan Bakar (Bensin)	10	Liter	"Transportation to the Open Sea for Testing"
26	Lem Paralon	3	Pcs	"As an Adhesive for the Rumpon Frame"

Preparation

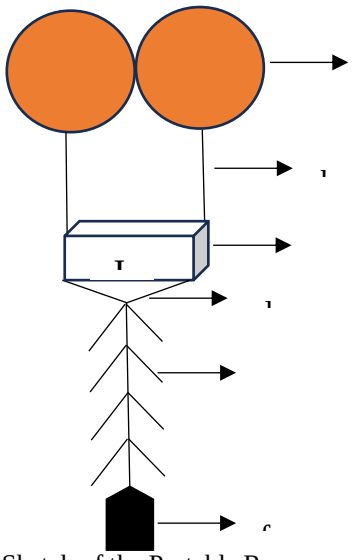
Before the research is conducted, preparations must be made, including designing the portable fish aggregating device (rumpon) with the addition of acoustic sensors according to the existing design. This also involves surveying the prices and availability of materials and equipment that will be used in the research, as well as discussing with team members the possibility of substitute tools and materials.

Modification of the Portable Rumpon with Acoustic Sensor Addition

1) Ensure a suitable location for conducting research on the catamaran owned by Politeknik Negeri Lampung
2) Draw the design according to the layout and its dimensions.
3) Measure the dimensions of the Portable Rumpon and the catamaran that will be used as the research medium.
4) Add the acoustic sensor to the bottom of the rumpon; complete the construction.
5) After construction is complete, check all components to ensure the device is safe to use.
6) Test the acoustic sensor as a fish attractor using sound waves and turn it on.
7) Conduct fish-catching trials using various fishing gear on the rumpon.

Sketch of the Portable Rumpon Modification

The process of creating the portable rumpon begins with drawing a sketch of the constructed device. The drawn sketch is then built directly. The rumpon is modified into a round shape to facilitate movement in the flowing seawater. Acoustic sensors are added to the rope strands, with two sensors installed to attract more schools of fish to the area around the rumpon. The sound waves used are specifically within the range of 10,000 Hz to 15,000 Hz, which is broader to enable various schools of pelagic fish to approach the rumpon more easily



Keterangan:
a= PVC Float
b= 12 mm PE Rope
c= Electric Fish Attractor
d= Synthetic Rope as an Attractor
f= Weight

Figure 2. Sketch of the Portable Rumpon with Acoustic Sensors

RESULTS AND DISCUSSION

CONSTRUCTION OF THE PORTABLE RUMPON

Before the construction of the Portable Rumpon begins, the following materials must be prepared: 20 mm diameter PE rope, 2 floats, a measuring tape, a roll of raffia rope for the fringes, concrete weights, an AUDAX 4-inch speaker, cables, a soldering iron, a mini amplifier, a battery, and personal protective equipment (PPE). Once the materials are prepared, the first step is to create a knot with the rope that will be tied to the float, serving as a marker for the rumpon when in operation.

Figure 4.1 Knotting the Rope to the Float

Figure 4.2 Installation of Raffia Rope Fringes

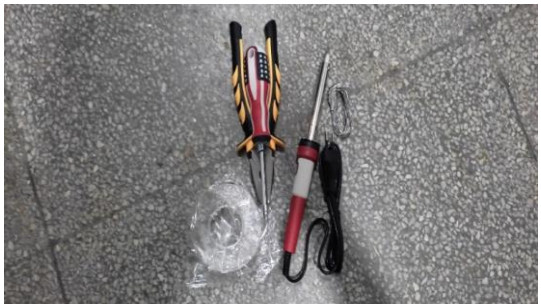


Figure 4.3 Soldering Iron, Pliers, and Screwdriver

Figure 4.4 AUDAX 4-Inch Speaker

Figure 4.5 PVC Pipe as Speaker Cover

After all the equipment is prepared, the steps for constructing the Portable Rumpon are as follows:

1. Prepare all necessary equipment, starting from personal protective equipment (PPE) to the tools used in making the Portable Rumpon.
2. Once all equipment is ready, begin by measuring the length of the main rope as previously determined.
3. Next, connect the main rope to the float by tying a secure knot to ensure it doesn't easily come loose.
4. After knotting the main rope and the float, the next step is to create fringes using the torn raffia rope. The raffia is installed on the main rope with a distance of approximately 2 meters between each fringe, with each fringe measuring 1.5 meters in length. This installation serves as an attractor to draw fish closer to the rumpon.
5. Once the fringes are installed, attach a weight to the end of the main rope to ensure the rumpon remains stable. The weight is made using a concrete mold.
6. After this is completed, proceed to create the electrical component of the rumpon using a speaker that can be controlled via an Android device.
7. The speaker is installed on the main rope, positioned 2 meters away from the float

   The trials of the portable rumpon were conducted at the floating net cage (KJA) of Politeknik Negeri Lampung in September. The trials were carried out twice over a period of 2 weeks. Each trial lasted for 4 hours, from 08:00 to 12:00. Pelagic fish began to gather around the rumpon approximately 2 hours after it was deployed. The fish that gathered included mackerel, flying fish, and scad. This demonstrates that the portable rumpon, enhanced with acoustic sensors, functions effectively, as evidenced by the gathering of fish around the rumpon.

In addition, the water quality in the pond was measured to determine whether temperature, salinity, and pH changed drastically during the trials. Measurements of water quality parameters were taken every 2 hours with two repetitions. In the first trial on September 5, 2024, the temperature ranged from 26-29 °C, salinity was between 32-35 ppt, and pH levels were between 6.8-7.2. On September 10, the temperature ranged from 23-27 °C, salinity was between 30-32 ppt, and pH levels ranged from 6.5-6.9. Measurements taken on September 15 showed a temperature range of 27-32 °C, salinity levels between 35-37 ppt, and pH levels of 7.4-7.6. The final water quality measurements on September 20, 2024, recorded a temperature range of 29-33 °C, salinity between 34-39 ppt, and pH levels between 7.5-7.8.

The results of the water quality measurements indicate that the temperature remained relatively stable, except during the second week when the temperature dropped to 23-27 °C due to heavy rainfall at night and drizzles continuing into the morning. Salinity also remained stable throughout the four weeks of research, ranging from 27-37 ppt. The salinity results are considered good, as they fall within the typical range for seawater salinity, which is between 25-45 ppt (Supono, 2004). The pH levels of the water are also classified as good, ranging from 6.5-7.8, which is still acceptable for seawater pH, typically ranging from 6.0-8.5 (Supono, 2004).

The water quality results indicate that the presence of the portable rumpon moving around did not affect the water quality. Instead, the water quality was more influenced by natural phenomena such as rain or heat.

CONCLUSIONS

The portable rumpon is a compact and easy-to-carry device, allowing fishermen to utilize it after completing their fishing activities. The portable rumpon can be retrieved from the water and taken home after use. It is equipped with a frequency transmitter, and its system is technically electronic. The portable rumpon includes a rechargeable 12V battery. The effective operational time for the portable rumpon is 8 hours. After this period, the rumpon must be recharged.

The prototype of the electric fish attractor, as observed in the field, is shown in. Measurements of sound intensity at three frequency ranges (1,000-5,000 Hz, 6,000-10,000 Hz, and 11,000-15,000 Hz) were conducted at a distance of 50 cm from the portable rumpon. The water quality parameters measured during the installation of the portable rumpon included temperature, salinity, and pH. The presence of the portable rumpon did not have an impact on the water quality in the vicinity of the floating net cage (KJA).

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