The use of portable fish aggregating devices for pelagic fish in Sunda Strait Water, Indonesia

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Abstract. Portable FADs is a transformation of the conventional FADs which uses the concept of fish responses related to the use of sound frequencies. Portable FADs is a new innovation auxiliary gear in pelagic fishing. The aims of this study are to know the prototype of portable FAD, to know dominant fish compositions of the catches around portable FADs and to analyze total buoyant and sinking force of portable FADs. The study was conducted in laboratory and field experiment in Sunda strait waters. Data analysis were performed by using buoyancy force and sinking force analysis of portable FADs and the composition of the catch. The prototype of portable FADs was made from fiber with dimensions L x W x H = 63 x 43 x 25 cm. The composition of the dominant fish around portable FADs are 83 tails of Rastrelliger sp., 57 tails of Istiophorus platypterus and 51 tails of Euthynnus affinis. Portable FAD has total buoyancy and sinking force of portable FADs are 192.888,2 GS and GS 179.538,19.

Keywords: catch, portable FADs, pelagic fish, Sunda strait

1. Introduction

Application of Fish Aggregating Device (FADs) technology provides certainty regarding to fishing areas and solutions for problems faced in fishing activity regarding to productivity and efficiency of the catch. FADs is a fish aggregating tool which uses different types of solid attractors to lure the fish to gather around it. FADs in Indonesia has been used by fishermen since 1900 until today [1]. Theory and research on the gathering fish around FADs according to scientific papers that have been published in 1967-2007, namely: 1. FADs as an association place; 2. FADs as feeding grounds; 3. FADs as a navigational reference point for certain migrating fish; 4. FADs as shelter from predators; 5. FADs as a shelter; 6. FADs as a cleaning station for certain fish [2].

FADs design, for both deep water and shallow water FADs, generally consists of four main components including (1) buoy or float, (2) rope, (3) attractor, (4) sinker. The rope was used for
connecting the sinker and the buoy, and was attached by coconut leaf fronds. The length of the rope generally is 1.5 times the depth of the ocean where FADs is deployed [1].

Buoy in conventional FADs is made by using natural materials such as bamboo. Attractor is a very important part of the FADs. It is used as a tool to gather fish around conventional FADs which is composed by natural materials namely coconut leaves and palm leaves. These leaves have limited durability in water and limited availability of materials in nature, for example coconut leaves only has a durability of 24 days in the water. The availability of coconut leaves in one region will be out of stock if taken in every 24 days as a natural attractor on FADs [2].

Portable FADs is developed from conventional FADs which uses the concept of fish responses related to the use of plastic ropes as attractor and lights. Portable FADs has several advantages: 1) compact, 2) easily packaged and operated, 3) featured with light, plastic rope and sound frequency, 4) durable and 5) economical. Portable FADs is not permanently deployed in one spot, but the location can be moved according to the desired fishing area. When portable FADs is not in use, it can be taken and transferred to another area or stored until the next fishing operations is performed [3].

The fish that generally gather around FADs are pelagic fish. Pelagic fish are included as fast swimmers and tend to form a huge schooling and have long-migrating route. Pelagic fish are divided into small pelagic fish and large pelagic fish. Large pelagic fish usually gathers around deep-water FADs, while the small pelagic fish usually gathers around shallow water FADs. Small pelagic fish which aggregating in deepwater FADs stimulates large pelagic fish to come and prey on it [4]. Types of large pelagic fish are skipjack tuna (Katsuwonus pelamis), yellowfin tuna (Thunnus albacores), big eye tuna (Thunnus obesus), mackerel tuna (Euthynnus ahlis), marlin (Makaira spp.), wahoos (Scomberomorus spp.), mahi-mahi (Corypaena hippurus) and sailfish (Istiophurus orientalis). Small pelagic fish that generally gather around FADs are mackerel scad (Decapterus spp.), chub mackerel (Rastrelliger spp.), yellowtail scad (Atule mate), yellowstripe scad (Selaroides leptolepis), bigeye scad (Selar crumenophthalmus) and sardinella lemuru (Sardinella spp.).

Research related to sound frequency for fish aggregation in the sea is still very limited, whereas the organ in fish which is most widely used to communicate, spawning, foraging is the organ of hearing when compared with the organ of touch and vision which functioning when the fish touch and see the object. Therefore, the research on portable FADs by using a specific sound frequency to catch pelagic fish is necessary to perform. The purpose of the research (1) To analyze the performance of the prototype of portable FAD, (2) To evaluate dominant fish compositions of the catches around portable FADs.

2. Materials and Methods

The method used was the making of portable FADs design and construction and experimental methods of fishing operation. Fishing operation was conducted in Sunda strait waters. Based on previous trial in the waters, the best prototype of portable FADs is made from fiber. The material used were PE line with a diameter of 5 cm as main line, Electric Fish Attractor and tin as a sinker. The type of fishing gear used in fishing operation was hand line.

The research activities were conducted in May and June 2018. The manufacturing of portable FADs prototype was conducted on May 2018 and the field trials was conducted on June 2018. The research was conducted in two phases, namely:

1. First phase
   - To construct portable FADs prototype and electric fish attractor in laboratory. The first stage was carried out in the workshop and water tank Acoustics Laboratory of Marine Sciences and
Technology Department, Laboratory of Fishing Technology, Faculty of Fisheries and Marine Science, Bogor Agricultural University on May 2018.

2. Second phase
Portable FADs test in the waters of Sunda Straits, Banten. Experimental fishing with three units of handline. The research was conducted on June 10th-14th, 2018 in Sunda Strait waters (figure 1).

![Figure 1. Research location.](image1)

Tools and materials used in this study were divided into equipment used for field trials and tools and materials used in the manufacture of portable FADs. Equipment used for field trials is a fishing boat, plankton net, rope, GPS, hand camera, hand line fishing gear. Design and manufacture of Electric Fish Attractor (EFA) was done in several stages through the assembly of component inside the device, such as the assembly of MP3 component with component amplifier connected to hydrospeaker and battery storage as electric energy supplier, the sound frequency that will be used in data collection was made by using matlab. The main material used in the manufacture of EFA is fibre with a diameter of 5 inches. These size was selected for the electronic components such as 12 volts battery and MP3 player to be fitted inside. The details of EFA can be seen on figure 2.

![Figure 2. Portable FAD design. a) rope (pe); b) raffia rope; c) electric fish attractor; d) buoy (sterofoam).](image2)
2.1. Data collecting method

Data collected was in the form of primary data. Primary data was obtained through fishing activities on portable FADs with electric fish attractor using handline fishing gear. Data was collected in the form of catch composition by fish species and the measurement of the total length (cm) and weight (kg) of fish. Sound frequency were used 1,000-5,000 Hz, 6,000 – 10,000 Hz and 1,000-15,000 Hz in the SD card in MP3 player to compare the appropriate sound frequency according to the time of operation.

This research was conducted by using experimental fishing methods which is directly tested in the field in order to directly find out fish attention toward sound attractor on portable FADs which indicated from the number of catch obtained during fishing operation. Some stages are carried out in field trials, including:

1) Preparation phase
Preparation of portable FADs, electric fish attractor, hand line fishing gear and other equipment are needed for data collection. Portable FADs equipped with plastic-rope attractor, PE line and the sound frequency was ready to be deployed and had been deployed in water.

2) Deploying and Fishing phase
Portable FADs deployment with EFA attractor in the water. Six replications a day was performed due to fish feeding pattern. Inspection related to EFA performance and the change of treatment on handline. Fishing operation using handline was performed after portable FADs equipped with EFA had been deployed so that the fish can be assembled in advance, prior to fishing process. Portable FADs was deployed adjacent to the ship and tied up with a rope so that it will not lost by the current. EFA was attached to a rope tied on portable FADs with a depth of 5 meters to avoid rope breaking due to underwater currents.

Handline is easily operated, mostly fishermen hold the end of the line (usually rolled on rollers), feel the tension with the tip of their fingers when the fish eat the bait, then repositioning the hook so that the fish could not escape and lift the line when a fish has already been hooked [6].

3. Results and Discussion

EFA's dimensions was made with a total length of 23 cm horizontally and 28,1 cm vertically. The electronic components are consist of a 12-volt battery, MP3 player, and 4 inches of Audax speaker covered with a cover made from DOP PVC. These EFA was then inserted into portable FADs. The construction of portable FADs consists of fiber bags, PE line, plastic rope, EFA. Green-colour plastic-rope attractor was vertically attached on FADs line to make it resemble with foliage. Plastic rope was used due to its characteristics which are cheap, durable and attractive toward fish. FADs line was made from PE (Polyethylene). Sinker used in portable PADS was made by tin material. Each of these components plays an important role in supporting the performance of portable FADs itself. Each component of portable FADs was then calculated to see the buoyancy force and sinking force.

Resistant force in FADs, at sea, was influenced by several factors namely internal and external factors. Internal factor is a factor resulted from the forces generated by FADs itself and external factors are factors from the outside that work on FADs such as upward force of a fluid. The materials used in the manufacture of portable FADs have met the general requirements of FADs materials. The result of the calculation showed that total buoyancy of FADs materials were amounted to 192.888,2 Gs and total sinking force were amounted to 179.538,19 Gs. This means that portable FADs will float on the surface of the water with extra buoyancy of 1,93%. These technical calculations indicated that portable FADs was easily influenced by external force in the form of current. This
influence can result into shifting position of portable FADs. The technical performance of portable FADs on the field was approximately the same with the calculations.

Composition catch data during the study were differentiated per each species catches and catches vary greatly. Fluctuation of fish results catches vary a day, which could have been due to weather and weather movement of fish. Can be seen the most caught fish is the mackerel (Restrelieriger kanagurta), swordfish (Xiphias gladius), mackerel tuna (Euthynnus affinis), barracuda (Sphyraena sp), and yellow trevally (Selaroides leptolepis).

The catch by using high sound frequencies (11,000-15,000 Hz) get the catch as much as 73 heads consisting of fish mackerel, sword fish, barracuda and mackerel tuna fish (figure 5). [5] states that at 1000-20,000 Hz sound frequency is often caught fish with a larger size, that are rarely caught by chart fishermen. So that it was concluded that fish caught with greater sound frequencies get a bigger catch. However, regarding the effect of sound in the process of fishing is still very necessary to do further research that more deeply (figure 3).

![Figure 3](image-url)

**Figure 3.** The number of catch by frequencies.

Daily catch data during the study were differentiated per each species catches and catches vary greatly. Fluctuation of fish results catches vary a day, which could have been due to weather and weather movement of fish. Can be seen the most caught fish is the mackerel (R. kanagurta), swordfish (X. gladius), mackerel tuna (E. affinis), barracuda (Sphyraena sp), and yellow trevally (S. leptolepis).

In this research fish caught by frequency, among other types of fish tuna mackerel (Auxis thazard), mackerel (Restrelliger kanagurta), Sword fish (Xiphias gladius), Barracuda (Sphyraena sp), Yellow traveley (Selaroides leptolepis), The duration of use portable FADs ± 3 hours. The average of the highest percentage of catches from all frequencies contained in the bloated fish, On the whole low frequency, medium, and obtained high mackerel (Restrelliger kanagurta) as much as 83 tails, while Species captured the lowest catch of the three types of frequencies is the type of yellow trevally (Selaroides leptolepis) where only three tails (figure 4).
Based on the size distribution data from several caught species can be seen the variety of species and the size dominance caught below and above from Lm. The result of fish mackerel during the operation of portable FADs as much as 83 tails with a length ranging from 159.5-284.5 mm which is dominated by the size of the hose grade 184.5-209.5 mm. The results of this study also according to what reported in Palabuhanratu Bay stated mature gonad size of 173 mm mackerel for female and 175 mm for males [7]. States in the waters of the Malacca Strait the hose of the bloated fish class obtained by 175-182 mm. Report that fish mackerel female has a size of 164 mm and 170 mm male. In swordfish is obtained as many as 57 tail with a length ranging from 339.5-684.5 mm is dominated by size hose grade 584.5-609.5 mm [8]. On the sword fish obtained as many as 51 tail with a length ranging from 184.5 to 384.5 mm dominated in the 209.5-234.5 mm. The research results in 2015-2016 at PPP Sadeng obtained grade hose for mackerel tuna fish range of 20-35 cm for female and 18-36 cm for male mackerel tuna fish, In the barracuda fish obtained as many as 13 with length ranging from 384.5-609.5 mm is dominated in the class 534.5-559.5 mm. In the selaroides leptolepis fish obtained as many as 3 tails with a length ranging from 209.5-234.5 mm dominated in size hose grade 209.5-234.5 mm. in the table 5 is the Lm data of the fish caught refers to based on the fishbase.

4. Conclusion

The prototype of the portable FADs has a size LxWxH = 63x4x25 cm with total buoyant force and sinking force of portable FADs are 192888.2 GS and 179538.19 GS. The dominant fish compositions of the catches around portable FADs are 83 tails of Rastrelliger sp., 57 tails of Istiophorus platypterus and 51 tails of Euthynnus affinis.

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