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FISHING TECHNOLOGY OF THE "BANDO" HANDLINE AND THE COMPOSITION OF CATCHES IN THE SOUTH WATERS OF ENDE REGENCY OF EAST NUSA TENGGARA PROVINCE, INDONESIA

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ABSTRACT
The use of "Bando" fishing gear technology has contributed to increasing capture fisheries production in Ende Regency. The purpose of this study was to determine the fishing technology, and the composition of Bando catches in the southern waters of Ende Regency. Data collection techniques in this study used observation and interview techniques. The data obtained in this study were analyzed using qualitative and quantitative descriptive analysis. The results of the study found that the construction of bando fishing gear consisted of rollers made of bamboo, fishing line number 1000-2500, reel made of steel, fishing line number 4-6 and bait in the form of live bait such as flying fish, semar bag and mackerel. The fishing vessels used are on average 0.1-0.5 GT in size. Some of these ships use engines and some without engines. Ship engines used on average are 5.5-6 HP. The types of fish caught in bando gear in the waters of the southern part of Ende Regency are yellowfin tuna, marlin, mackerel and shark. The average catch composition for tuna was 58.68%, marlin was 27.44%, mackerel was 3.57%, and shark ranged from 7.14-25.00% with an average of 10.30%. The highest composition value was found in yellow fin tuna, followed by marlin, then the shark and the lowest in mackerel.

KEY WORDS
Fishing technology, bando, handline catches, species composition.

Ende Regency is one of the regencies in East Nusa Tenggara Province which has water areas with abundant potential for fishery products. The value of the potential catch can be seen in 2014 which reached 19.2 tons with details for the northern waters of 6.932 tons and the southern waters reaching 12.367 tons (Pos Kupang, 2014). The potential value of the largest catch comes from the contribution of catches in the southern waters, apart from the fertility of the waters, it is also supported by the activities of coastal communities where the majority of people in this area have a livelihood as fishermen who utilize various fishing technologies to catch fish in the area (Paulus et al., 2019).

The use of fishing technology that makes a major contribution to the acquisition of catches in Ende Regency lies in the use of fishing gear, one of which is the Bando fishing gear. This bando is a fishing gear that is included in the handline classification with a simple design because it only consists of bamboo rollers, fishing line, swivel and hook. In addition, because this fishing gear has a simple design or is still relatively traditional, in terms of information or education regarding fishing technology, it is not widely known by the general public (Yahyah, 2011). Based on this description, obtaining information to provide education to fishing communities in other places as well as related fisheries agencies to take important steps in determining measurable and sustainable fisheries management efforts, it is

important to conduct research related to the study of environmentally friendly "Bando" fishing technology in southern waters of Ende Regency.

METHODS OF RESEARCH

This research was carried out in October-November 2022 and took place in the Southern Waters, Ende Regency, to be precise in IPPI Bay, Ende. Around this area, there are cargo ship port areas, passenger ships, fishing boat anchorage areas, and fisherman settlements. Based on the measurement results, the general characteristics of the water conditions in this area, such as temperature, salinity, pH, and dissolved oxygen, tend to fluctuate, but are still in ideal conditions for the survival of aquatic biota, in this case including fish. For temperatures ranging from 29-33^{o}C, salinity ranged from 30-33 ppt, pH ranged from 7.5-8.3, and dissolved oxygen ranged from 6.40-7.28 mg/l.

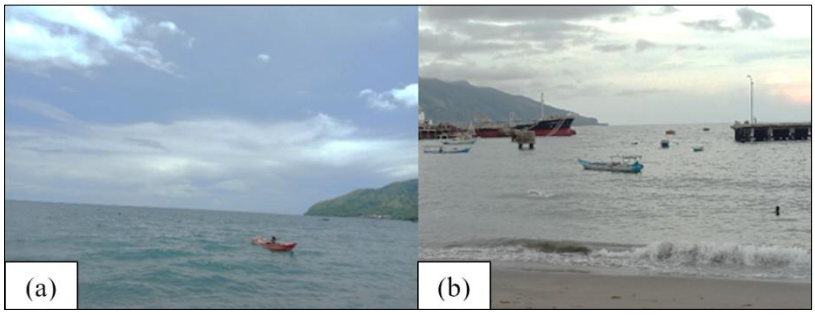

Figure 1 – The overview of research locations: (a) IPPI bay waters, (b) port areas for freight ships, passengers, and fishing boats harbor areas

In general, in fishing operations, fishermen recognize 2 seasons, namely the east season and the west season. The east season lasts from March to October and the west season lasts from November to February. In the east season, with relatively small waves and wave conditions, fishermen tend to be active in fishing activities every day, but in the west season, with unstable weather conditions and big waves, fishermen only carry out fishing activities at certain times and there are even who did not engage in fishing activity at all. In addition, for fishing trips there are fishermen who catch at night and some during the day. Catching at night fishermen start moving towards the fishing area at 16.00 pm in the afternoon and return at 23.00 pm in the evening, while for fishing during the day, fishermen move from the fishing base to the fishing area at 04.00 am in the early morning and return at 11:00 am at noon.

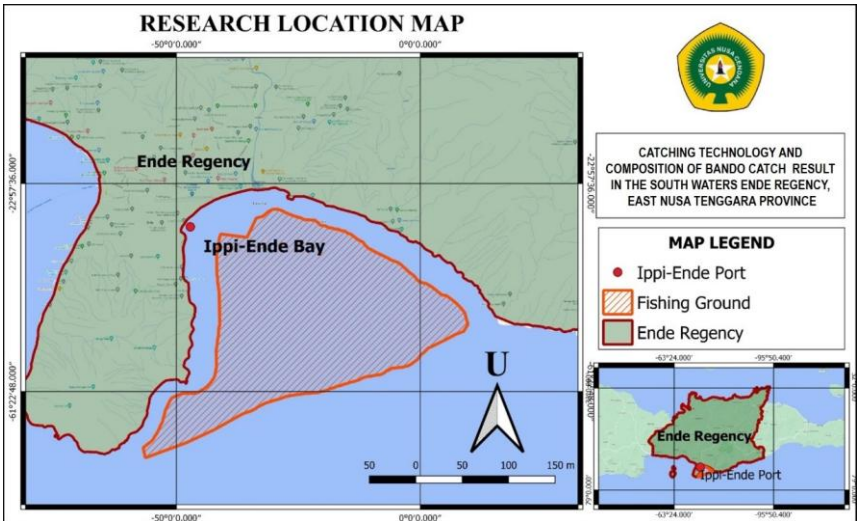

Figure 2 – Research location map

The collecting research data is done using observation and interview techniques. The parameters observed through observation techniques are the construction of fishing gear, fishing vessels, fishing techniques, and types of fish caught. While obtaining data through interview techniques was carried out by filling out questionnaires, the number of Bando fishermen respondents interviewed was 20 people using a purposive sampling technique. The data obtained through interviews is data on the number of catches of fishermen which are then analyzed to determine the composition of the catch by following the instructions of Sudirman and Nesa (2011) as follows:

$$Catch\ Composition = \frac{Number\ \ of\ catc\ hes\ of\ \ fish\ species\ -i}{Total\ \ number\ \ of\ catc\ hes\ of\ \ all\ species\ \ of\ \ fish}\ x\ 100\%$$

RESULTS AND DISCUSSION

"Bando" fishing gear construction. The results of observations show that the construction of Bando fishing gear consists of several components, namely strings or towing lines, reels, hooks, and bait. This is in line with Rahmat's opinion (2007), that the components of fishing gear including Bando consist of reels, fishing lines, hooks, weights, and swivels; But this Bando does not use ballast. The roller itself is in the form of a tube made of bamboo, then the strings or towing ropes that are commonly used number 1000-2500 with a length ranging from 70-210 fathoms or equal to 126-378 meters. The rope or towing rope is basically made of monofilament, and then the reel and hook are made of steel. The size of the hook that is commonly used is numbered 4-6. While the bait usually uses live bait obtained from local waters. According to Syahputra (2009) fishing gear construction is a general form that describes fishing gear with clear components so that the fishing gear can be understood. A detailed description of Bando's construction and components can be seen in Figure 3 and Figure 4.

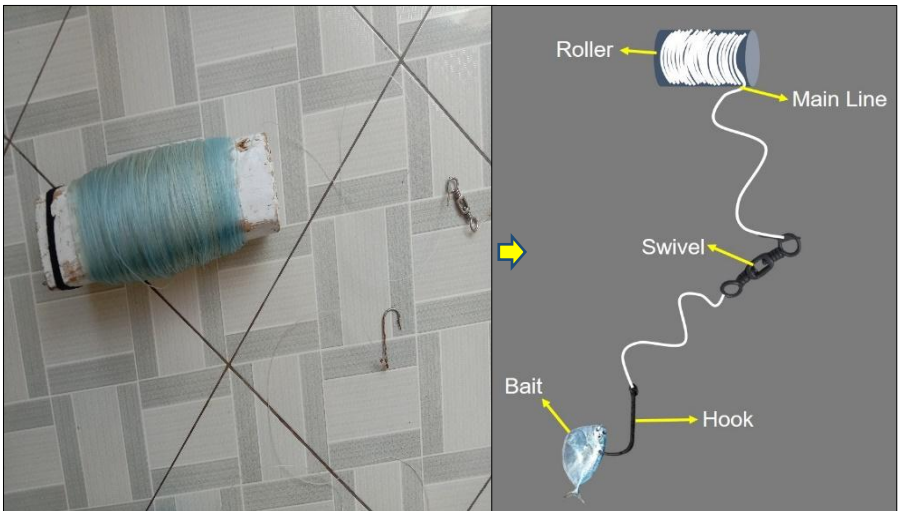

Figure 3 – The construction of Bando fishing gear operated by fishermen in southern waters of Ende

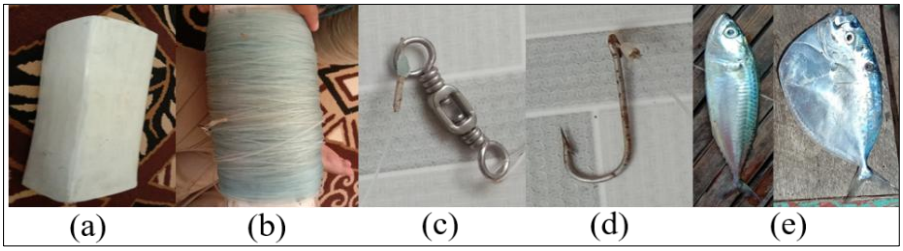

Figure 4 – The components of Bando fishing gear: (a) reel, (b) string/towing line, (c) swivel, (d) hook, (e) bait

The components in the Bando construction have their respective functions, including reels which function to facilitate the operation of the fishing gear so that the ropes do not get tangled and can be rolled up after the fishing operation is complete and then stored for reuse during operation (Tesen and Hutapea, 2020). The string or towing rope functions to move the lure, disguise the bait, and provide a sensation when tugging with the fish. In addition, according to Mudzakir et al., (2014) that the function of this string or towing rope is also the main rope where the swivel, weights, and hooks are attached. The swivel functions to adjust the fishing line so that it doesn't get entangled. The swivel is part of a handline that is useful for connecting and preventing the towing line from getting spun or tangled during the process of operating the fishing gear (Purnomo et al., 2014 in Tesen and Hutapea, 2020). The hook serves to hook the bait and as a place for the fish to be attached when it is caught, so the size of the hook used is one of the main factors in determining the size of the fish caught. This is consistent with what was stated by Maspeke et al., (2018) that the success of fishing operations with fishing rods, including Bando, is highly dependent on the size of the hook and the color of the bait. Bait is an important part of the construction of Bando because the bait determines the fish caught. According to Muhazirin (2016), that bait is one of the determining components of successful fishing, so the requirements for good bait in fishing operations including Bando are durable or not easily damaged when in water, the color of the body is shiny, so it is easily seen by fish that are want to be caught, its body size is in accordance with the size of the mouth of the fish to be caught and is the favorite food of the fish to be caught (Puspito, 2009).

Fishing Vessel. The fishing vessels used in the operation of Bando are on average 0.1-0.5 GT in size. There are ships with engines and some without engines. The ship's engine used an average of 5.5-6 HP and the fuel oil used for one trip is approximately 5 liters. Figure 5 shows an overview of the vessels and machines used in fishing operations by fishermen in the waters of the southern part of the Ende Regency.

Figure 5 – Fishing vessels: (a) ships equipped with engines, (b) vessels without engines, (c) engine vessels

According to the Law of the Republic of Indonesia No. 45 of 2009 that special fishing vessels are only used to catch and collect the catch of aquatic biological resources, including shrimp trawlers, longline vessels, canoes, and others including bando fishing vessels. Furthermore, Sudrajat et al., (2014) also explained that a fishing boat is a means of transportation that carries all fishing units from the fishing base to the fishing ground and brings them back to the mainland along with the catches obtained. Referring to the explanation and description regarding the functions and sizes of fishing vessels including fishing vessels from the Bando fishing gear, if it is associated with vessels operating fishing gear from fishing lines in Indonesian waters, it can be seen that these vessels are in the small size category. However, the local community's statement that they use small boats and some do not even use these machines is because the fishing area is not far from the coast where the boat is anchored which is only less than 1 mile or the equivalent of approximately

500-1000 meters from the ship's berth. This is also reinforced by the results of a study by Gigentika et al., (2017) which reported that fishermen in East Nusa Tenggara in general, including fishermen in Ende, generally carry out fishing activities using small fishing units (< 5 GT).

Bando Operation Technique. The technique of operating bando fishing gear carried out by fishermen in fishing operations in the waters of the southern part of Ende consists of several specific stages including the preparation stage, the lowering of the fishing gear (setting), the waiting period (Immersing) and the withdrawal of fishing gear (hauling). This preparatory stage is carried out by fishermen preparing all the equipment used and checking the condition of the fishing line. Then, after the tools have been prepared, fishermen will determine the fishing area. Determination of the catchment area is based on the experience of local fishermen, then the fishermen carry out fishing activities to obtain live bait to catch the target fish. This fishing process uses fishing gear which the local people call "Rando".

Figure 6 – Fishing gear used to catch bait in fishing operations (from Rando fishing gear)

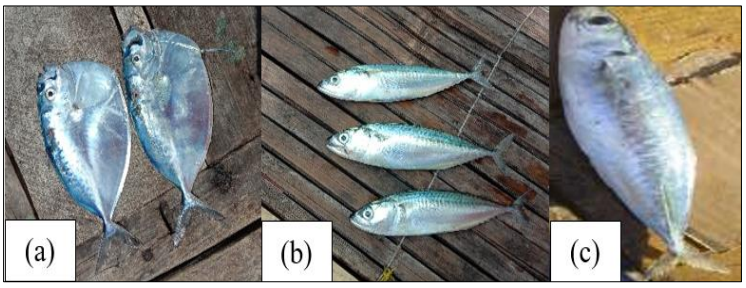

Figure 7 – Types of bait fish: (a) moon fish, (b) mackerel fish, (c) flying fish

Figure – Live fish bait catcher nets

This rando fishing gear is equipped with reels made of bamboo, fishing line/string, swivel, weights, hooks and bait. The fishing ballast used is a 10-millimeter piece of iron, then the fishing line used is number 80 and the hooks used range from number 4 to 5. While the

fishing bait used is bait designed from three-dimensional cloth called sakura cloth which will be used to target mackerel, flying fish, and semar sac fish. These types of fish will be used as bait in Bando operations. The fish are accommodated in a holding net that is tied to the edge of the ship and the nets are allowed to continue to be exposed to water. This effort is made so that the bait fish are kept alive and later taken one by one to be attached to the fishing line in Bando in the fishing operation. Figures 6 to 8 are descriptions of fishing gear for obtaining bait (from Rando) as well as the types of live bait used in Bando fishing and bait catch nets.

Regarding the use of bait in Bando fishing operations, based on the description and appearance of the previous picture, the conditions for good bait must be considered. According to Puspito (2009), the requirements for good bait in fishing operations are the bait that is durable and not easily damaged during fishing operations in water, the color of the body is shiny so that it is easily seen by the target fish, the size of the body matches the size of the mouth of the fish you want. caught and the bait must be the target fish's favorite food. From this explanation, it can be concluded that the type of bait used by local fishermen meets the requirements for good bait, because the bait used is live bait so it can last a long time, then the color of the type of bait fish is also shiny which can then attract target fish.

The process of lowering Bando is done by dropping or throwing Bando into the waters. This throwing process must be done properly in order to avoid getting entangled or entangled in the fishing line. The Bando lowering technique carried out by local fishermen is by throwing the fishing gear which is first attached to the bait as far as approximately 10-15 meters from the ship, then released to enter the water column, after release, then the fishing gear is tied to the side of the ship using a fine raffia rope with the aim of knowing whether the target fish caught has grabbed the bait or not. If the bait has been eaten by the target fish, the raffia rope tied to the side of the boat will break due to the jolt of the target fish caught. Then, the last stage is checking the fishing gear. This checking process will begin when 30 minutes to 1 hour after the fishing gear is lowered into the water column. Figure 9 presents the process of lowering Bando into the water column by fishermen during fishing operations in the southern waters of Ende Regency.

Figure 9 – The setting process of lowering the Bando

The process of setting Bando reduction carried out by fishermen during fishing is similar to that carried out by fishermen using other fishing gear in Indonesia, this is in accordance with what was reported by Wirayuda (2017), the stages of setting fishing gear include placing bait on the hook, then lower the fishing line equipped with bait to a predetermined depth and leave it until the target fish eats the bait and hooks on the hook.

The Immersing stage is one of the stages in the Bando fishing operation by Ende fishermen which is also known as the waiting period for the fish to eat the bait. According to Tesen and Hutapea (2020), the waiting period for fish to eat the bait is uncertain, because not all fishing areas obtain target fish, so the determination of the fishing area depends on

the fishermen's ability or experience in reading/knowing the fishing area. Furthermore, according to Kantun and Mallawa (2015), a good fishing area for getting target fish is an area that easily gets bait or the type of fish the target fish likes. This is similar to the statement of the Bando fishing community that based on their experience in fishing operations when bait fish such as flying fish, semar sac, and mackerel are found, there are also target fish. Likewise with the waiting period, according to local fishermen, the fastest waiting time they have experienced so far is around 30 minutes, while the longest waiting period is around 8-10 hours or even up to 12 hours. The stages of withdrawing the Bando fishing gear (hauling) by local fishermen are carried out by rolling the fishing line to raise the catch target onto the boat. Figure 10 shows the process of withdrawing the Bando fishing gear carried out by Bando fishermen.

Figure 10 – The setting process of withdrawing the Bando

The process of reeling the fishing line is done when the fish eats the bait or when the fish is hooked on the hook. This is in accordance with Wirayuda's statement (2017) that after the fish eats the bait, the fish will be tied to the fishing line, then the rope is pulled onto the boat. The Bando line winding process takes about 30 to 60 minutes, depending on the weight and size of the target fish. If the target fish you get is large, the rolling process will take a long time and likewise, for small fish, the rolling process will be faster. In the process of getting the fish onto the boat it is also important and must be considered, if the fish are caught in large sizes and after approaching the boat are still in active moving condition, then the fish must be killed first using a tool in the form of a spear, after that, the fish is lifted to be put into the ship using a tool in the form of Gancu. Figure 11 shows the fishing aids during hauling in the form of spears and gancu in the Bando fishing operation.

Figure 11 – Auxiliary tools for hauling: (a) spear, (b) gancu

A spear is a fishing aid designed to use a rod or stick with a sharpened iron attached to the end. Its use in the Bando fishing operation is to kill large fish that are too active when

they are about to be loaded onto the ship (Supriatna, 2015). The gancu tool is a tool shaped like a hook, only it is bigger and the stem is longer. The main use of gancu is as an aid in lifting large fish which is impossible to do using only a fishing line (Irwan, 2014). The length of the spear tool used by local fishermen is approximately 3 meters, with a spear hook size of 0.3 meters, and spear handles measuring approximately 2.7 meters long. The length of the gancu tool is approximately 1 meter with the hook size of the gancu 0.3 meters, and the handle measures approximately 0.7 meters.

Catch Composition. Types of fish caught in bando gear based on identification results according to the identification manual Allen and Stenee (2002), ISA et al., (1998), Matsuura, et al., (2000), and Prestasidy (2006) referred to by Risamasu et al., (2013), it was found that there were four main types of fish caught. The types of fish are yellowfin tuna, marlin, shark, mahi-mahi, and mackerel. The types of fish caught by Bando can be shown in Figure 12. The types of fish caught by Bando fishermen based on an analysis of the composition of the number of catches in the last six months from March to August 2022 are presented in Table 1, while the average value of the composition of the catch can be shown in Figure 13.

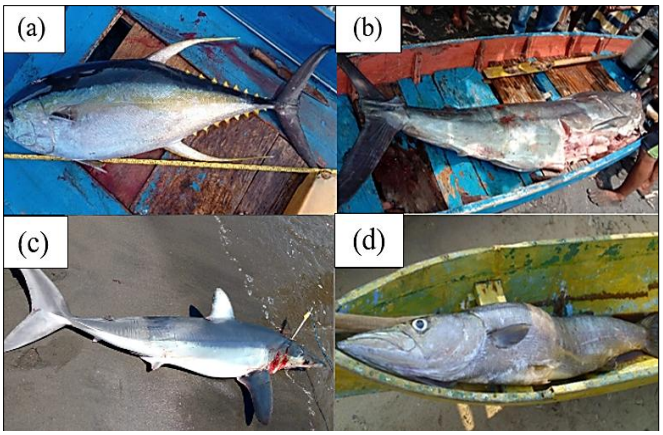

Figure 12 – Types of fish main catch from bando: (a) yellowfin tuna fish), (b) marlin fish, (c) shark, (d) barracuda fish

Table 1 – The composition of bando catches in the southern waters of Ende Regency

Fish Type	Composition of Catch (%)						Range (%)	Average (%)
	March	April	May	June	July	August		
Yellowfin Tuna	46.15	28.57	60.71	100	66.67	50.00	28.57-100	3.68
Marlin	38.46	50.00	17.86	0.00	33.33	25.00	17.86-50.00	7.44
Barracuda	0.00	7.14	14.29	0.00	0.00	0.00	7.14-14.29	57
Shark	15.38	14.29	7.14	0.00	0.00	25.00	7.14-25.00	0.30

Source: Primary Data of 2022.

The average value of Bando catch composition operated in the waters south of Ende shows that the highest catch composition was found in tuna, followed by marlin, then shark, and the lowest catch composition was found in mackerel. The high and low values of the composition of the number of catches of each type of fish in Bando are certainly influenced by certain factors. These factors can be explained by the first, Akbar et al., (2018) that the large and small composition of the number of fish catches in Indonesian waters is very dependent on several things, including those related to the nature of fisheries in tropical areas which are multispecies, namely inhabited by a variety of fish species. Furthermore, the type of fishing gear used for the Bando fishing operation has different hook sizes making it possible to catch fish of varying sizes.

The second factor that influences the composition of fish catches is explained by Darondo et al., (2014) which states that differences in the total composition of fish caught in an area are absolute or common. Weather fluctuations every year in an area have an impact on the number of fishing fleets used, then another triggering factor is the occurrence of

damage to the fleet so that only a portion of the number of fleets carry out fishing operations and some even do not carry out fishing operations. This condition can certainly trigger a high and low number of existing catches (Kaplan et al., 2014). Referring to this description, it can be indicated that the cause of the high and low differences in the composition of Bando's catch could have been the result of unstable weather changes which caused damage to fishing gear and fleet which resulted in delays in fishing operations by fishermen in the local area.

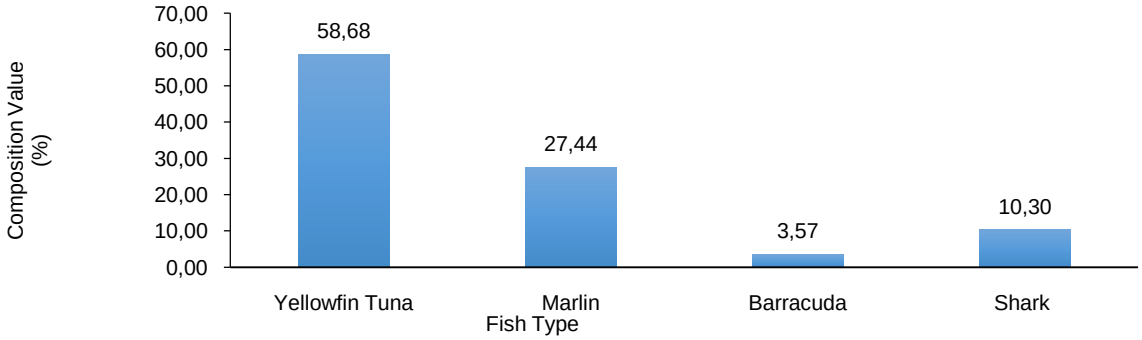

Figure 13 – The Average value of Bando's catch composition in the last six months period (March-August) in 2022

The third factor explained by Okamura et al., (2017) is that the cause of high and low variations in the composition of the catch is possibly caused by fishing operations carried out by fishermen not always getting the same results every time. Where the number of catches this month is certainly different from the previous month, even though fishing operations are carried out with the same effort and in the same fishing area so the difference in the composition of the number of catches is also thought to have something to do with the presence of fish in water. To maintain its survival, fish always move from one place to another to find areas where these fish can survive. Fish will like areas where water conditions are in accordance with their body's adaptability, lots of food, and safe from predators. This statement is reinforced by the findings of Saba et al., (2011) and Ekayana et al., (2017) that differences in the amount composition of fish catches are closely related to the fertility of an aquatic environment that has sufficient food for fish.

Another factor was explained by Sadiyah et al., (2014), that the high and low composition of the number of catches of fish species is very dependent on the amount of stock of fish resources that exist in an aquatic environment. This is reinforced by the explanations of Masrshal et al., (2019) and Sambah et al., (2021) that an increase in resource stocks in waters is strongly influenced by growth, and individual recruitment, as well as a decrease in resource stocks in waters, is influenced by mortality, experience and capture. Furthermore, Wiryawan et al., (2020), also reported that a decrease in fish resource stocks in waters was caused by fishing activities that were greater than the ability to recruit resource stocks. Recruitment of fish stocks occurs due to the presence of fish stocks that are allowed to spawn, and vice versa if there is a decrease in fish stocks in water, it is caused by no fish being allowed to spawn or the fish being caught continuously.

Referring to the various descriptions above, the possible reasons for the high and low composition of fish catches in Bando operated by Ende fishermen are a result of fisheries conditions in the tropics which have multispecies characteristics, water conditions, and seasons in fishing areas that tend to be different, the number of stocks for each type of fish, the number of fishing trips, differences in hook size, and also as the result of damage to fishing vessels. Various indications such as the multi-species nature of the fishery, the number of fishing trips, differences in hook size, and fishing vessel damage are of course factors that are found at the research location, but the factors of stock availability and fishing season are still conjectural so that further research is needed to find out in detail. certainly, the information to support this conjecture.

CONCLUSION

Local fishing gear also known as "Bando" is an environmentally friendly fishing gear that is included in the category of handline fishing gear and is made from bamboo. Bando uses live bait such as flying fish, mackerel, etc. The Bando operation technique is carried out through several stages, including preparation, the stage of setting the lowering of fishing gear, the stage of Immersing, and the stage of hauling. The types of fish caught in Bando are yellowfin tuna, marlin, mackerel, and shark. The highest composition value was found in yellowfin tuna, followed by marlin, then shark and the lowest was mackerel.

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