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THE EFFECTIVENESS OF USING FAD ON FISHING OPERATION IN WATERS OF MALUKU TENGGARA

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Abstract

Waters of Maluku Tenggara are waters that are rich in natural resources, especially fish (pelagic, demersal and shrimp), especially Kei Kecil waters. It is known by the type of fish landed in PPN Dumar. One of the factors to improve the effectiveness of fishing operations in waters of Maluku Tenggara is the use of FADs. FADs that used are, firstly, deep sea FADs by using fishing gear that is called huhate (pole and line) and purse seine, secondly is shallow sea FADs for purse seine, gillnet and TFR to catch small pelagic fish. The objective of this study are to (1) compare the composition and quantity of the catch of each FAD of fishing unit, (2) compare the effectiveness of fishing operations using FADs, (3) compare the performance of fishing technology in terms of aspects of biology, social, and economy operated around FADs . This research was conducted as many as 14 trips of fishing operations on fishing gear purse seine, gillnet and Trolling Fishing Rod. Total catch of three fishing gears are flying fish (Decaptenus russelli) 57.087 fish (80,57%), tuna (Auxis tharzard) 13.190 fish (18,62%), Spanish mackerel (Scomberomorus commersoni) 573 fish (0,81%). Based on the size as much as 54,9 % flying fish that caught in big size, 80,12 % from tuna that caught is big size and the whole 100 % Spanish mackerel that cathed is in small size. From the two types of FADs are used, there is a dominant catches on FAD bamboo so that FAD bamboo is more effective than plastic drums FADs.

Keywords : *Efektiveness, FAD, in waters of Southest Mollucas*

INTRODUCTION

In general, the waters of Maluku Tenggara are shallow waters. These waters, are part of the waters that are rich biodiversity, especially fish (pelagic, demersal and shrimp). In particular, Kei Kecil waters, dominated by pelagic fish,it is known by the type of fish landed in PPN Dumar. The dominant fish caught include a Indian mackerel (*Rastrelliger kanagurta*), Fringescale sardinella (*Sardinella fimbriata*), The yellowtail scad (*Atule mate*), Scad round mackerel (*Decapterus macrosoma*), Scad

round (*Decapterus russelli*), Frigate Tuna Mackerel (*Auxis thazard*), and Squid (*Loligo sp*). Demersal fish has very few species and number. Demersal fish that are often caught are epinephs grouper and Latex edcaps snapper (*Lutjanus sp*).

Like most fishermen whose living and making a living from marine sources, the fishermen fishing around waters of Kei Kecil are also really depend on marine caught. They are small fishermen (traditional) that fishing only for fulfilled the needs of everyday life. Generally, on fishing operations, fishermen in Kei Kecil are using Gillnet, Purse seine and Trolling Fishing Rod (TFR) as main fishing gear and Fish Aggregating Device (FAD) as fishing gears aids.

Based on the results of several previous researches, it is known that the fish were caught around FADs, generally are pelagic fish, such a flying fish or Scad round mackerel (*Decapterus macrosoma*), Scad round (*Decapterus russelli*), and Indian mackerel (*Rastrelliger kanagurta*), Short fin scads (*Rastrelliger macrosoma*), The yellowtail scad (*Atule mate*), The yellowstripe scad (*Selaroides leptolepis*), The bigeye scad (*Selar crumenophthalmus*), Bali sardinella (*Sardinella lemuru*), Fringescale sardinella (*Sardinella fimbriata*), Smoothbelly sardinella (*Ambligaster sirm*), Frigate Tuna Mackerel (*Auxis thazard*), and much others. Those kinds of fish, its characteristic in cluster, feed plankton, shrimps, small fish and fish eggs (Monintja and Zulkarnain 1995; Monintja et al. 2002). The use of FADs as an effort to improve the effectiveness of fishing operations in waters of Maluku Tenggara can be categorized as two. The first is FADs that used specifically to catch Tuna and Skipjack tuna which known as deep sea FADs by using fishing gear that used is fishing rod called Huhate (Pole and Line) and Purse Seine. The second is FADs that used usually called shallow sea FAD. Common fishing gear that used to catch fish in shallow sea is purse seine, Gillnet and also TFRs to catch small small pelagic fish (Zulkarnain 2002). FAD, specially shallow sea FAD used by fisherman in Kei Kecil.

Looking from some aspects of its construction, FADs in Kei Kecil is relatively simple, it is also easy to overhaul. The rope used is not too long (less than 50 m) and the placement of FADs are not too far from the beach and fishing objects are pelagic fish. The combination between type of FAD and fishing gear that used to catch fish in Kei Kecil vary widely. However, until now it is not known certainty the level of effectiveness the use of FADs on the fishing gear that used. In relation with those, it is important to do a study about the effectiveness of FADs in increasing the fish caught on a fishing gear.

Studies on FADs technology to improve the caught (production), in relation with the fishing gear used or the construction of FAD itself is mostly done (Sondita 1986; Subani 1986; Subani and Barus 1989; Monintja 1990; Baand Litbang Pertanian 1992; Monintja 1993; and

Mathews et al. 1996; The Assessment Team FAD IPB 1987; Zulkarnain 2002). However, from the few studies that have been done are still very rare studies that particularly examine how the fish living, specifically pelagic fish around FADs.

METHODS Of RESEARCH
Time of Research

This research is done in Waters of Maluku Tenggara subdistrict of Kei Kecil during 6 months, started from preparation suntil writing thesis. Research in the field done during 3 months, from August 2007 until October 2007. The location of research is on 131,850-131,950 BT and 5.250 – 5.450 LS, with the borders: (1) In the north is bordered with South Papua, (2) In the South is bordered with Nerong Strait, (3) In the west is bordered with Banda sea and in the East with Arafura sea.

Method of Research

The Fishing gear that used to collecting the data are adalah Purse Seine, Gillnet, and TFR (Troll) which is operated around FAD. Boat sample is determined by purposif sampling. The number of each those fishing gear is about a unit of Purse Seine, five sheets Gillnet, and a TFRs. After sample of fishing gears determined, then FAD sample determined to represent two kinds of FAD which operates in research' location, namely FADs bamboo rafts and plastic drums FAD with the number of each 2 units of FADs.

The data is gathering by survey method, it follows fishing activities by using Purse Seine, Gillnet and TFR in waters location of FAD installed at the depths of 200 to 300 m for 14 times trip fishing operations. Thecselection of gear types purse seine, gillnet, TFR as sample based on the thinking that those three dominant fishing gears operates around FADs. However, the composition of the caught, the effectiveness is estimated as different.

Fishing activities by using those three fishing gears also done in the waters location that didn't use FAD. Fishing activities by using those three fishing gears as behavior control. The data that gathered includes the data of caught fish. Besides, trough operation fishing activities, data also gathered through interview with fishermen non FAD to get information about (1) composition and size the caught before using FAD. (2) kinds of negative effects that may be experienced after FADs. By gathering the data,it is expected to know the impact on the FADs operation to fishermen around it.

Method of Data Analysis
Composition of the caught fish

Composition Data of the caught fish is analyzed descriptive approach. This approach aims to study the caught fish per trip. The caught

fish served in table or graph. The fish size that caught by using purse seine, gillnet and TFR are grouped based on position of FAD installed (on fishing grounds). Based on the range size of fish that is dominant on each FAD. Fish that caught on each fishing gear, measured by the total length (cm) that divide in two class of size, that is small and big based on the fish caught. (Tabel 1).

Table 1 frequency Distribution long fish

No	Kinds of fish	Dimension (cm)	Number of fish (Tail)	Note: Source libraries
1	Small			
	Kite	< 25		Murniyati (2004)
	Corn	< 40		Murniyati (2004)
	Wahoo	< 55		Pauly and Martosubroto (1996)
2	Great			
	Kite	Consecutive 25		Murniyati (2004)
	Corn	Consecutive 40		Murniyati (2004)
	Wahoo	Consecutive 55		Pauly and Martosubroto (1996)

Once the fish length distribution obtained from the three fishing gears, it is calculating the proportion of each type of dominant fish caught and fish size classes. The proportion of each type of fish, size composition of the caught is calculated by the formula:

$$P = \frac{n_i}{N_i} x 100\%$$

Note:

N_i = number of certain kinds of fish in size to -i

N_i = total number of catches certain species

Table 2 percentage catches composition size for certain types of fish

No	Class Size	Number of fish	Percent
1	Small		
2	Great		
3			

The FAD Effektiveness

Analyzing the effectiveness of FAD that are tested, is calculated based on the ratio of fish caught by all fishing gear at a type of FADs on the total catch in all other FADs. The level of effectiveness of FADs is calculated with the following formula:

$$Ei = \frac{\sum\limits_{j=1}^{n} hij}{\sum\limits_{i=1}^{n}\sum\limits_{j=1}^{n} hij} \times 100\%$$

Note:

Ei = Effectiveness rumpon i
Hij = Haul rumpon i by fishing equipment j

While the proportion of composition kinds of FAD caught can be calculated the following formula:

$$P = \frac{n_i}{N} \times 100\%$$

Note:

P = Proportion one type of fish that were caught in rumpon
Ni = Total amount of fish to-i
N = Total number of haul

The Effektiveness of Fishing Gear

Analyzing the Effektiveness the caught of a fishing gear, defined as the ratio of the percentage of the total catch of fishing gear from all of the research sites. Can be calculated by the following formula:

$$Ej = \frac{\sum\limits_{j=1}^{n} hij}{\sum\limits_{i=1}^{n}\sum\limits_{j=1}^{n} hij} \times 100\%$$

Note:

Ej Fishing equipment j = effectiveness
Catches Hij   = rumpon i by fishing equipment j

RESULT AND DISCUSSION
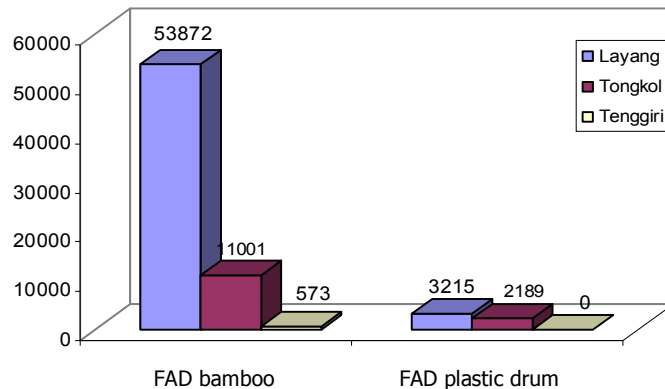### Kinds and Number of Fishing caught

In this research, fishing caught using Purse Seine is flying fih (Decapterus ruselli) as much as 52.957 fish, Tuna (Auxis thazard) 11.144 fish. While fishing caught using Gillnet as much as 5.743 fish consist of 4.130 Flying fish, Tuna (Auxis thazard) 1.040 fish, Spanish mackerel (Scomberomorus commersoni) 573 fish. The total fishing caught using TFR as much as 1006 that all consist of Tuna (Decapterus russelli) (Picture 1). Based on the picture, it can be known that produktivity of Purse Seine is highest, then followed by Gillnet and TFR .
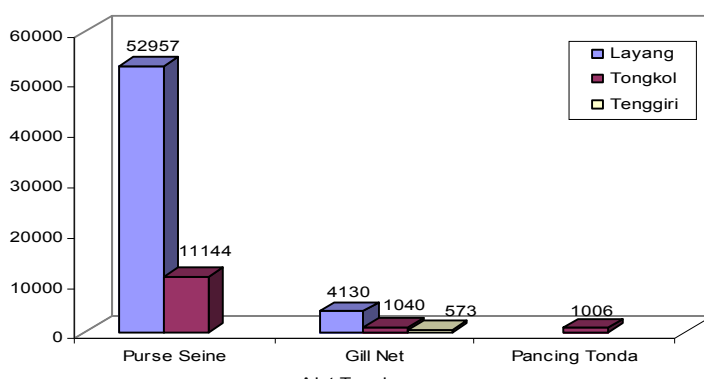
Picture 1 Composition of kinds Fishing caught based on Fishing Gear

The total fishing caught from two kinds of FAD is as much as 70.850 fish from bamboo FAD is 65.446 fish and plastic drum FAD is 5.404 fish (Picture 2). This means that fishing caught obtained from bamboo FAD is higher compared with plastic drum FAD. Based Picture 2, it can be known that flying fish (Decapterus russelli) is the most dominant caught on the two FAD.

Picture 2 Komposisi Jenis Tangkapan Menurut FAD.

The Composition number of fishing caught based on the fishing gear and the type of FAD can be seen at Picture 3. Based on Picture 3 it can be seen that fishing caught of Purse Seine is much more than others, either on bamboo FAD location or drum plastic location. While the lowest fishing caught is obtained from TFR in two kinds of FAD.
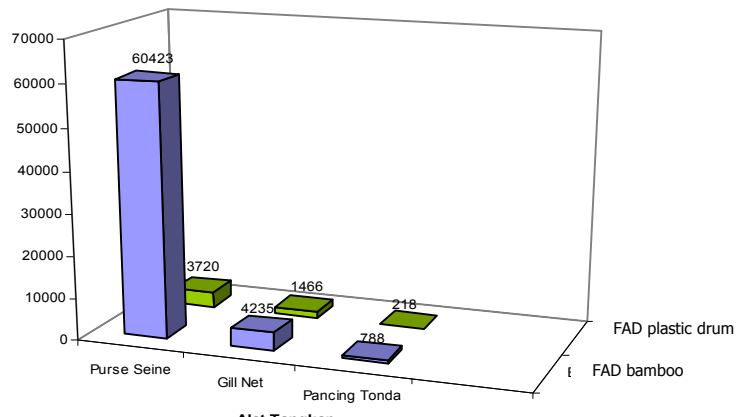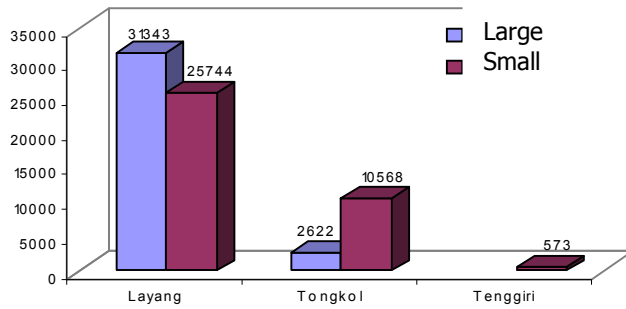

Picture 3 Composition of kinds fishing caught based on Combination of Fishing Gear and FAD.

The Length Size

The number of flying fish in big size is much more than small size. While Tuna and spanish mackerel is dominated by small size. The comparison of big and small of fishing caught for those three konds of fish can be seen in Picture 4.
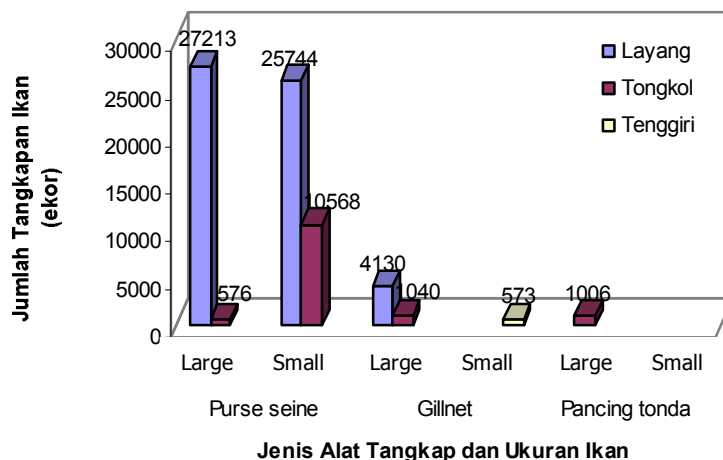
Picture 4 Composition of Length Size Based on kindsss of Fish

Flying fish, in big size or small size are dominant caught on bamboo FAD, that is each about 30.572 fish (53,55 %) and 23.300 fish (40,82 %), while the rest from plastic drum FAD with the composition of big size komposisi about 1873 fish (3,28 %) and small size is about 1.342 fish (2,35 %). For Tuna in big size and small size also much more caught on bamboo FAD like Flying fish (Picture 4). Fishing caught of Spanish mackere is all categorized in small size and caught from bamboo FAD. Data of measured the length of sample fishing caught based on fish size, flying fish (Decapterus russelli) that caught in waters of Maluku Tenggara, the small size are dominant at range class 18-20 cm is about 6.284 fish while big size dominan at range class 30-32. Tuna (Auxis thazard) is most caught in small size at range class 39-40 cm and big size dominant caught at range class 44-46 cm is about 2.237 fish, then spanish mackerel is caught in small size and dominant at range class 76-81 is about 123 fish.
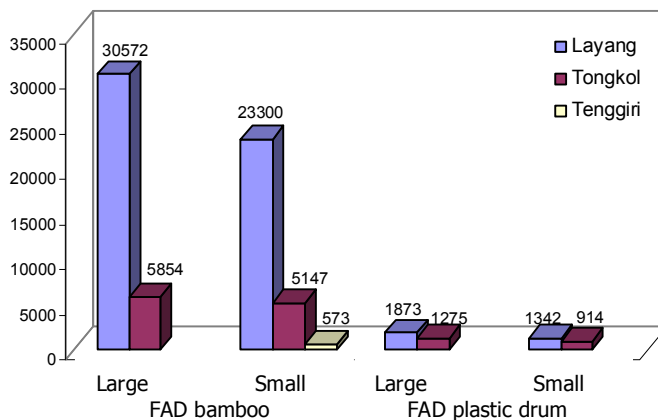

Picture 5. Komposisi ukuran ikan menurut jenis ikan and FAD.

Flying fish in big size is dominan caught by Purse Seine that is about 27.213 fish (47,67 %), and caught by Gillnet is about 4.130 fish (7,23 %). Flying fish small size is much caught by Purse Seine that is about 25.744 fish (45,10 %). For tuna, the caught in big size much more caught by Gillnet is about 1040 fish (7,88 %), while fishing caught in small size which the number is dominant by using Gillnet, that is about 10.568 fish (80,12 %). Moreover, spanish mackerel categorized as small size and caught by Gillnet (Picture 5).

Picture 6 Composition of fish size based on kinds of fish and Fishing gear

The size of total weight of fish caught at bamboo FAD is about 9.554 kg by Purse Seine is about 85,42 %, by Gillnet 9,66 % and TFR is about 4,91 %. Total weight fish caught at plastic drum FAD is about 4.474 kg, by Purse Seine 90,75 %, by Gillnet and TFR each about 3,93%, and 5,32 %. Total weight fish caught by Purse Seine 12.230 kg caught at bamboo FAD 66,80% and plastic drum FAD 33,20 %. The number of caught at Gillnet is about 1.100 kg of bamboo FAD 84,00 % and plastic drum FAD 16,00 %. Then, total weight fish caught by TFR is about 708 kg of bamboo FAD 66,38 % and plastic drum FAD 33,62 % (Picture 7).
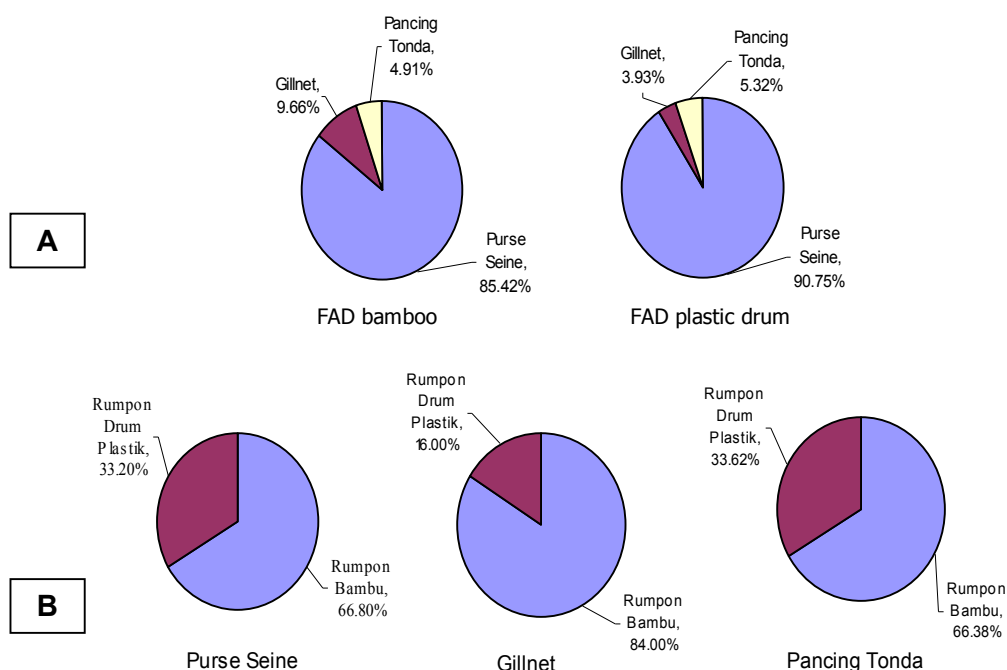
Picture 7 Percentage Fish Weight Based (A) FAD and (B) Fishing gear

Effectiveness of FAD based on the result of effectiveness calculation of FAD to fishing operation shows that effectiveness on two FAD have stricking different. Bamboo FAD has effectiveness that very higher (92,37 %) than effectiveness plastic drum FAD (7,63 %) in Table 3.

Table 3 Effectiveness both FAD based on number of Fishing caught

Types of Rumpon	Catches Total (tail)	Effectiveness Rumpon (%)
Bamboo	65,446	92.37
Plastic Drum	5,404	7.63
Total	70,850	100

Effectiveness Fishing gear

Data of effectiveness each fishing gear obtained by calculate ratio ofi fishing caught of each fishing gear with total fishing caught all fishing gear in research location during time of observation. Based on calculation, Purse Seine has the highest level of effectiveness (90,53 %), than fishing gear gillnet and TFR has lower effectiveness value, that is 8,05 % and 1,42 % (Table 4).

Table 4 fishing equipment effectiveness Catches Based on the Total

Fishing equipment Type	Catches Total (tail)	Fishing equipment (headcount index effectiveness)
Purse Seine	64,143	90.53
Gillnet	5,701	8.05
Fishing Rod Tonda	1,006	1.42
Total	70,850	100

DISCUSSION

The use of biodiversity of pelagic fish sumberdaya ikan pelagis di waters Laut Maluku Tenggara has been a long time. The fishing activities by using purse seine, gillnet and TFR in its development will be rely on technology of fishing gear and its aid as effort in using fishery biodiversity. The development of installation technology of FAD as a gear to gathering fish that giving enough significant contribution to the pelagic fisheres productivity in waters of Maluku Tenggara. Fishing ground, usually not far from fishing base it needs about 20 until 30 minutes. Operation ground of purse seine, gillnet and TFR at research location, generally still around sekitar waters of Maluku Tenggara that isdi waters of Mastur and waters of Kur. Based on fishing operation with fisherman purse seine, gillnet and TFR they still deserve highest fishing caught. Fishing caught by using fishing gear purse seine, gillnet and TFR in this area using FAD, so that operating activities fishermen already know that the clear fishing ground. Fishermen of purse seine, gillnet, and TFR in Maluku Tenggara in doing fishing still based on the fishing before, if the fishing before got much fishing caught,so the next fishing will not be far away from the fishing ground before.

The result of this research shows that number and biodiversity that caught at bamboo FAD is more than plastic drum FAD. Both of this FAD using same attractor that is coconut leaves, but the number of attractor at bamboo FAD is much more (15 cluster of coconut leaves) than the attractor plastic drum FAD (10 cluster of coconut leaves). Density of fish at bamboo FAD probably much more than at plastic drum FAD. By the thicker attractor, so predator will be difficult to detecting the fish around the FAD and the result the fish will be more comfort, moto live around bamboo FAD.

Fishing caught by purse seine in bamboo FAD is more than fishing caught by purse seine in plastic drum FAD. These because of the frequency of fishing operation in bamboo FAD more than in plastic drum FAD. Produktivity (kg/setting) also bigger in bamboo FAD than in plastic

drum FAD, because the fish density in bamboo FAD is estimated more than in plastic drum FAD.

A factor that influence the length size of net is about 200 – 600 m, width between 40 – 70 m. So that, theoretically ,longer purse seine nets, so that greater its circle center line and caused the more chances likely groups of fish are not disturbed attention, because the distance between the schools of fish with purse seine wall is larger so the fish has the greater chances to caught (Fridman and Caroother, 1986).

In the other hand, fishing caught by gillnet and TFR in both FAD not too much different. It is very close relates with the level of selectivity fishing gear. Gillnet with mesh size 5,5 inch only cathhes fish with certain size. The same also happens on TFR, in which the fish caught only certain size based on fish hook size. Based on the composition of fishing caught, flying fish is dominant caught. This relates closely to the information from fishermen that fishing season of flying fish happens on March untili October, and the peak on September.

Fishing caught by gillnet is more vary than fishing gear TFR which the fishing caught by gillnet consists of flying fish, tuna and spanish mackerel, while TFR only catches tuna. This indicates that artficial bait that usedprobably only effective to stimulate tuna. Those condition also close relates with von Brant's opinion (1984) states that artificial bait in blue white colour quite effective to stimulate tuna. Gunarso (1985), states that sparkle fish hook, plaque of sparklecan be effective bait. Those aims to attrack fish by formcolour, and mainly the reflection of certain light. According to von Brandt (1984), artificial bait can made of chicken feather, sheep feather, cloths in interesting colour, plastic or rubber formed miniature like the original one, for instance squid form so that attracted predator fish to caught.

The result of effectiveness comparison of both FAD, bamboo FAD and plastic drum FAD, shows that bamboo FAD more effective than plastic drum FAD, mainly looked from the contribution given by fishing caught production. Due to the analyze, so the effectiveness value that high very real seen on bamboo FAD that has effectiveness value about 92 %, which this result is diffrent with the measure of effektiviteness to plastic drum FAD that has effectiveness value about 8 %. This explanation shows that comparation effectiveness of all fishing gear that used in fishing activities. In partial, the result on analyze totally shows that fishing gear purse seine has high effectiveness value, and very real seen at bamboo FAD that has effectiveness vallue about 94 % by using bamboo FAD, while effectiveness value of purse seine dby using plastic drum FAD 6 %. This result shows that fishing gear Purse Seine has high effectiveness by using bamboo FAD.

It is different with fishing gear gillnet, its effectiveness value about 74 % by using bamboo FAD, while effectiveness value of purse seine by using plastic drum FAD about 26 %. Besides, effectiveness value of fishing

gear TFR about 78 % by using bamboo FAD, while efektiveness value of this fishing gear by using plastic drum FAD about 22 %. This result shows is a comparation that done for each fishing gear to kinds of FAD that used. The result which is mentioned, didn't showed that fishing gear TFR more efektive than fishing gear purse seine. Because if it is made a comparation between fishing gear, so that the contribution of fishing caught that going higher is showed by fishing gear purse seine with contribute about 91 % from the total fishing caught. Fishing gear gillnet and TFR, each only giving contribution about 8 % and 1 % to the total fishing caught. If it is compared with effektiveness value that showed by fishing gear purse seine, value fishing gear gillnet with using FAD still under the effectiveness value of fishing gear purse seine. While effectiveness value of TFR with using bamboo FAD still in under effektiveness fishing gear purse seine and fishing gear gillnet. So that, if it made a rank for the existence of the three fishing gear, purse seine is in the first rank, second rank fishing gear gillnet and the third rank fishing gear TFR.

Based on this discussion, it can be given two main statements as the result of discussion in this section, as follows:

(1) FAD that effectively used in support operational fishing gear, mainly in aspect of production fishing caught is bamboo FAD.
(2) Fishing gear that is very effektive to develop in relates with development bamboo FAD is Purse Seine.

Productivity of fishing gear purse seine in this research is about 12.230 kg/months or same with 146.760 kg/years while in the research of Djabaludin (2006), in waters Tidore is smaller, that is 11.103,36 kg per year. Whereas the size of mini purse seine in Tidore longer than 200-600 m and the operation way using out board machine is about 4 machines while the size of purse seine that used by fishermen in Maluku Tenggara berkisar antara 200-400 m only used 2 machines out board. This, probly caused of fish stock that became the destination of fishing used purse seine in waters Maluku Tenggara still much more than in waters of Tidore. This information is important for managing fisheries so that a kind os research necessary o done perlu dilakukan di waters of Maluku Tenggara in order to answered fishermen needs that using fishing gear purse seine.

The size of fishing caught by gillnet on research in waters of Maluku Tenggara is dominated by big size (Picture 24). These are because probably relates with mesh size that used (5,5 inch). Differ with the research of Burhanudin (2004), operating gillnet in waters of District region Alor Nusa Teggara Timur by using mesh size 2,5", 3,0", and 3,5", fishing caught that most dominant caught is small size so that the productivity is in average between antara 62% higher than productivity di waters Maluku Tenggara. The size of fish hook that used in TFR in waters Maluku Tenggara number 4, 5 and 6. From the result of this research is

showed that fish hook number 6 giving fishing caught much more 62 % than fish hook number 4 and 5 with the percentage each about 15 % and 23 %. Differ with the research of Umar Alatas (2004), TFR in waters of west coast in Kabupaten Donggala Province of Sulawesi Tengah in April until September. In general size of fishhook number 5 giving fishing caught higher thanfishhook number 4 and number 6. The size of fishhook number 5 can be said more effective for TFR that opearted in waters of west coast in Kabupaten Donggala Province of Sulawesi Tengah this size is more suitable for group of fish.

CONCLUSSION

Composition of fishing caught total from the whole fishing gear at the two FAD consists of flying fish (Decapterus russelli) is about 57.087 fish (80,57 %), tuna (Auxis tharzard) 13.190 fish (18.62 %) and spanish mackerel (Scomberomorus commersoni 573 fish (0.81 %). Based on size so that is about 54,9% flying fish caught in big size, is about 80,12 % tuna caught is in big size and all (100 %) spanish mackerel caught is in small size. The type of bamboo FADs is more effective compared to other types of plastic drums FADs, in terms of the number of fishing caught, when viewed from the gear efiktiviteness so that purse seine is more effektif compared to gillnet and TFR. Purse seine is worthy to develop than gillnet and TFR.

SUGGESTION

In order increasing the effectiveness of FADs in the waters of Maluku Tenggara there should be a further research about the use of attraktor on FADs and the use of fishhook size on fishing trolling gear. Besides, it is necessary to structuring the placement of FADs in the settings fishing grounds of purse seine in order to avoid the possibility of conflict between fishermen.

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