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TROPICAL TUNA FISHERIES IN THE INDIAN OCEAN OF INDONESIA

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ABSTRACT

Indonesia lays between two large continents i.e. Asia and Australia as well as two main oceans i.e. the Indian Ocean and Pacific Ocean with a wide coverage of marine waters within its jurisdiction. This strategic location provides various advantages for Indonesia, among those particularly in the tuna fishery is the abundances of tropical tunas surrounding its marine waters. The species of tropical tuna that are commonly found in the area are yellowfin tuna (YFT), bigeye tuna (BET) and skipjack tuna (SKJ). These species are targeted by various fishing gears such as tuna longline (LL), purse seine (PS), pole and line (PL), hand line (HL), and gill net (GN). Among those, long line and purse seine are gears type that mainly contribute a significant catch from the total catch of tuna. In the recent years, hand line also contributes significant catch following the former gears as consequences FADs use in hand line fishery. There are three types of longline operated by Indonesia fishers i.e. surface longline, middle long line and deep long line. Different depth of hooks from these three types of longline showed different catch composition and proportion. Size structure and distributions of YFT and BET caught by longline are also provided in this paper.

Keyword: tuna fisheries, fishing gears, catch composition, size structure

Introduction

Indonesia is an archipelagic nation that located between the continents of Asia and Australia and also surrounded by two oceans, namely Pacific Ocean in the northern part and Indian Ocean in southern part. It consist of 17,508 islands and coast line of 81,000 km. Totally, Indonesia has 5.8 million km^2 of marine waters consisting of 3.1 million km^2 of territorial waters (<12 miles) and 2.7 million km^2 of EEZ (12-200 miles). Economically marine and fisheries sector play a very important role in supporting national income as well as sources of livelihood.

The fisheries production in Indonesia is mainly comes from capture fisheries and aquaculture. Marine capture fisheries contribute of 75 % from the national production of capture fisheries which is contributed from fishing activities. In general, there are three main groups of marine fish resources, i. e., large pelagic fish, small pelagic fish, and demersal fish. Various

fishing gears are operated by fishers to harvest fish resources including tunas as the most attractive and valuable fish. Fishers targeting tunas commonly use long line, purse seine, hand line, gill net and pole and line.

Over exploitation in the shore area making more fishers fishing to offshore and targeting large pelagic fishes including tropical tunas. In the last decade the deployment of FADs have been associated with the operation of hand line of artisanal fisheries (small scale) and making long liner and purse seiners fishers operated by fishing industries have to find more offshore fishing ground.

This paper will describe the fishery of tropical tuna that mainly operated in the Indian Ocean south of Indonesia. Description of the fishery will include fleet structure, type of fishing gears, catch composition, fishing ground, and length size distribution. The data in this report were based from 1) National Capture Fisheries Statistics of Indonesia and Statistics of Marine Capture Fisheries by Fisheries Management Area. 2) Scientific enumerators and observer Report from Research Institute for Tuna Fisheries in Benoa Bali.

Fleet Structure of Tuna Fishing

The number of registered fishing boats as reported to IOTC as per 2011, in the FMAs 572 and 573 was 1278 with breakdown i.e. long line (1256), purse seine (19), gillnet (2) , carrier boat (1). Those fishing boats were vary in size from less than 50 GT to 1025 GT, among them 33 vessels over 200 GT and mostly 100-200 GT. the number of tuna long line fishing in the Indian ocean has slightly increase from 1,188 boats in 2010 to 1256 boats in 2012. Moreover, there are fishing fleets targeting tunas less than LOA 24 m operated in the territorial water up to Indonesian EEZ that not included in the Table 1.

Table 1. Registered Indonesian vessels by size (GT) as reported to IOTC in 2012

size	Longline	Purseseine	Gillnet	Carrier	Total
<50	160	0	1	0	161
51-100	408	6	1	0	415
101-200	659	10	0	0	669
201-300	4	0	0	0	4
301-500	11	0	0	1	12
501-800	14	0	0	0	14
>800	0	3	0	0	3
Total	1256	19	2	1	1278

Source: DGCF (2013)

There are also tuna fishing fleets less than 30 GT operated in the Indian Ocean obtained fishing licensed from provinces or districts and not included in the table 1.

Main Fish Landing Places

Across South Indonesian marine waters from Banda Aceh to NTT (Southeast Timor) there are at least 12 fishing ports as landing site for tuna. Three main landing sites for Indian Ocean tuna industrial fleet are Benoa Fishing Port (Bali), Muara Baru fishing Port (Jakarta), Pelabuhanratu fishing port (West Java) and Cilacap fishing Port (Central Java) (Proctor et al., 2003). There are also several non industrial fishing ports located in Sumatera, Jawa, Bali and NTT Island that known as tuna landing place (Figure 1).

Figure 1. Primary fishing port/landing sites the industrial (*blue label*) and artisanal (*red label*)
Source: RCCF- ACIAR Report (2003)

Benoa fish landing site is considered as main tuna landing port for Indonesian tuna catch. The most of tuna catch landed in Benoa caught by tuna long line, however, in the recent year some of tuna long liner changed in the fishing method became purse seiner. Those purse seiner are also landed the catch of tuna in Benoa landing site.

Tuna Catch Fluctuation

Various gears are operated targeting yellowfin, bigeye dan skipjack tuna that are tuna long line, purse seine, pole and line, hand line, gill net and others. The tunas production by species by gears from 2007-2011 are estimated and provided in the table 2.

Table 2 . Annual catch estimation by tropical tuna species and by gears during 2007-2011

Gear type	Species	Catch (TON)					
		2007	2008	2009	2010	2011	Average
Long line	Yellowfin	15,837	15,133	13,488	14,572	8,976	13,601
	Bigeye	12,708	11,830	10,002	14,202	6,014	10,951
	Skipjack	1,306	492	585	1463	4666	1,702
	Total	29,851	27,455	24,075	30,237	19,656	26,255

Purse seine	Yellowfin	1,283	3,373	1,718	4,334	8,331	3,808
	Bigeye	1,479	727	2,126	8,226	7,385	3,989
	Skipjack	16,982	13,216	27,210	22,652	36,016	23,215
	Total	19,744	17,316	31,054	35,212	51,732	31,012
Pole and Line	Yellowfin	0	0	359	457	1,639	491
	Bigeye	0	0	0	0	2,506	501
	Skipjack	0	0	3,613	2,255	2,631	1,700
	Total	0	0	3,972	2,712	6,776	2,692
Hand Line	Yellowfin	856	5,256	3,029	3,117	2,133	2,878
	Bigeye	2	59	201	200	239	140
	Skipjack	685	2,947	3,720	3,373	2,743	2,694
	Total	1,543	8,262	6,950	6,690	5,115	5,712
Others	Yellowfin	10,979	10,969	13,664	25,446	17,471	15,706
	Bigeye	2,844		5,848	2,142	10,715	5,387
	Skipjack	28,723	30,223	30,156	38,723	38,545	33,274
	Total	42,546	41,192	49,668	66,311	66,731	53,290
Grand Total	Yellowfin	28,955	34,731	32,258	47,926	38,550	36,484
	Bigeye	17,033	12,616	18,177	24,770	26,859	19,891
	Skipjack	47,696	46,878	65,284	68,466	84,601	62,585
	Total	93,684	94,225	115,719	141,162	150,010	118,960

From the table it was obvious there were three main gears that contribute significant catch of the total catch that is tuna long line, purse seine, and hand line. In the recent years hand line has developed with the deployemnt of FADs and become common to operate this gear associated with FADs, in some places gillnet fishers are shifting to Hand line since the catch are higher in number and beter in quality. Long line and Gillnet mainly caugh Yellowfin and bigeye while purse seine and gill net was skipjack tuna.

In 2007-2010 the tuna longline catch tend to be stable but decrease in 2011, purse seine in the other hand has constantly increased, total catch from all gears has tend to increase. In benoa, commonly the catch landed were from long liners but in recent years there was an increase trend of catches landed from purse seiners.

Long liners hook rate of Yellowfin tuna was decrease from 1.23/1000 hooks in 2006 to just 0.27/1000 hooks in 2010 while hook rate of Bigeye tend to slightly increase up to 2.73 in 2012 (figure 2)

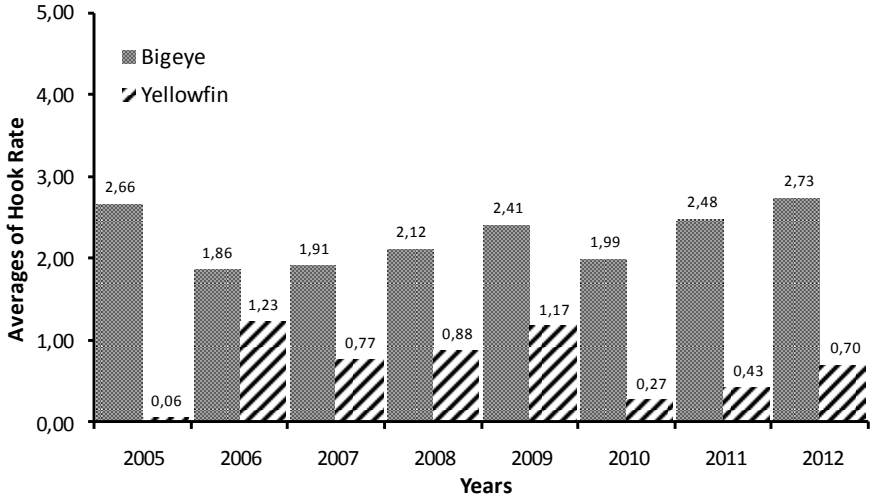


Figure 2. Fluctuation of hook rate (fish/1000 hooks) of bigeye and yellowfin tuna

There was also occur fluctuation of average hook rate for both BET and YFT on monthly basis (figure 3). The highest hook rate (2.88-3.77/1000 hooks) occur between June to August for bigeye and April-June (1.5-1.68/1000 hooks) for Yellowfin. The average of hook rate on monthly basis of Bigeye tuna (BET) are commonly higher compare to Yellowfin tuna (YFT)

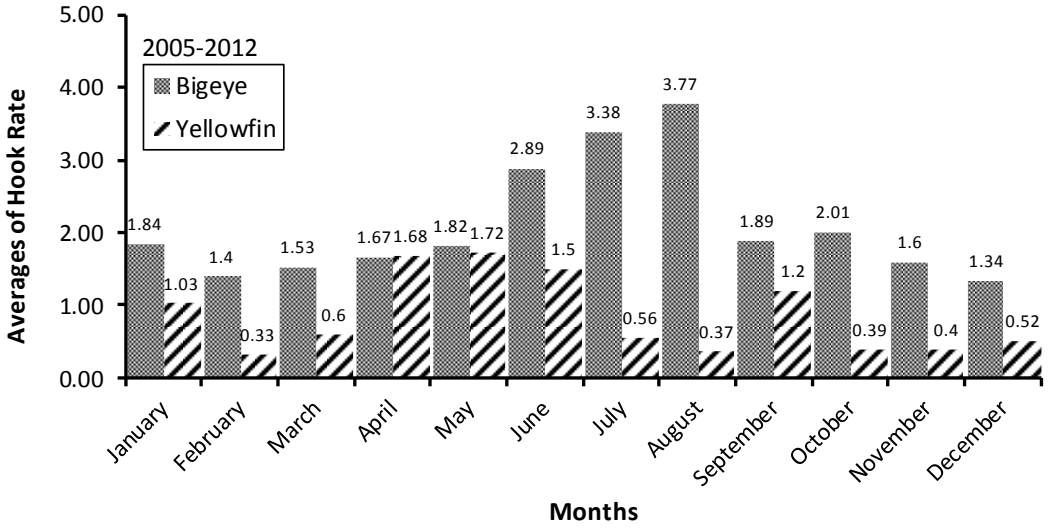


Figure 3. Monthly average of hook rate (fish/1000 hooks) of bigeye and yellowfin tuna, 2005-2012

Catch Composition of Tuna based on Type of Long Line

There are three types of tuna long liners reported by RITF, Benoa observers that is : (1) surface tuna long line with 5 branch lines/basket operated at depth 100-175 m, (2) middle tuna long line with 12 branch lines/basket operated at depth 125-350 m, (3) deep tuna long line with 18 branch line/basket operated at depth around 150-450 m (figure 4).

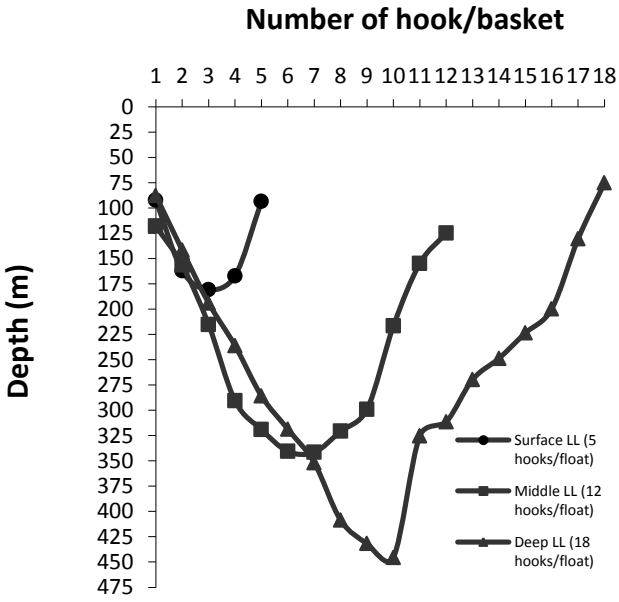


Figure 4. Type of long line based on depth and number of hooks (surface, middle and deep)

When tuna long liners operate different number of branch line as consequences the deep of hooks will also vary in depths hence affect to the catch composition as presented in figure 3, 4 and 5.

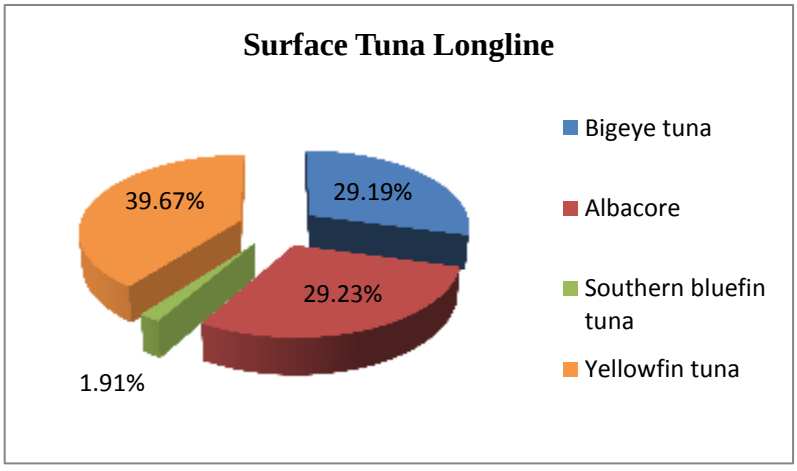


Figure 3. Catch composition of tuna caught by surface tuna long line

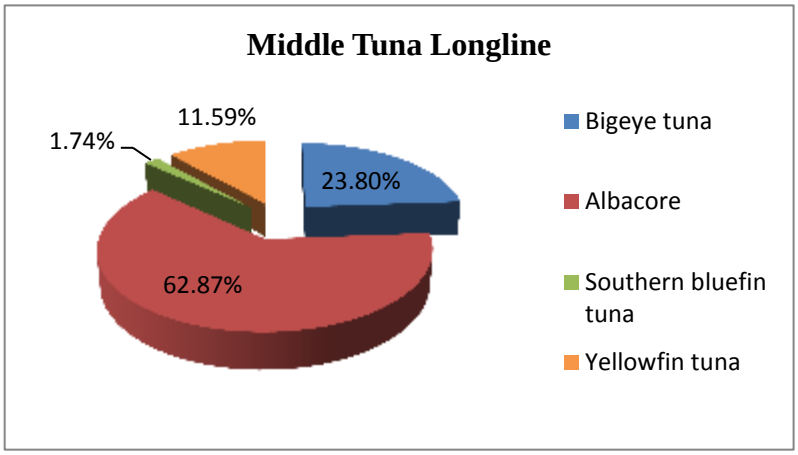


Figure 4. Catch composition of tuna caught by middle tuna long line

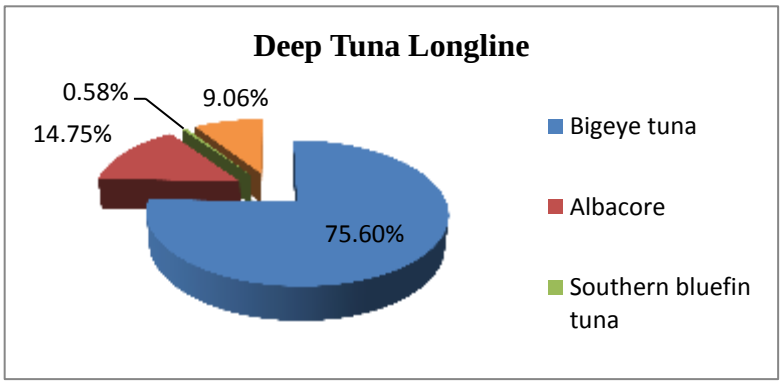


Figure 5. Catch composition of tuna caught by deep tuna long line

Surface tuna long line has dominant catch of YFT (39,7 %) followed by BET (29 %) and ALB (29%), (Figure 3). Middle tuna long line has dominant catch of ALB (83 %) followed by BET (23 %) (figure 4), while dominant catch from deep tuna long line was BET (75 %) (Figure 5).

From mini loggers observation it was revealed that tuna species has depth distribution preference while overlapped area of occurrence among species. BET and ALB have preference in deeper area with lower water temperature compare to YFT that more distribute at surface with higher/warmer water temperature. (figure 6).

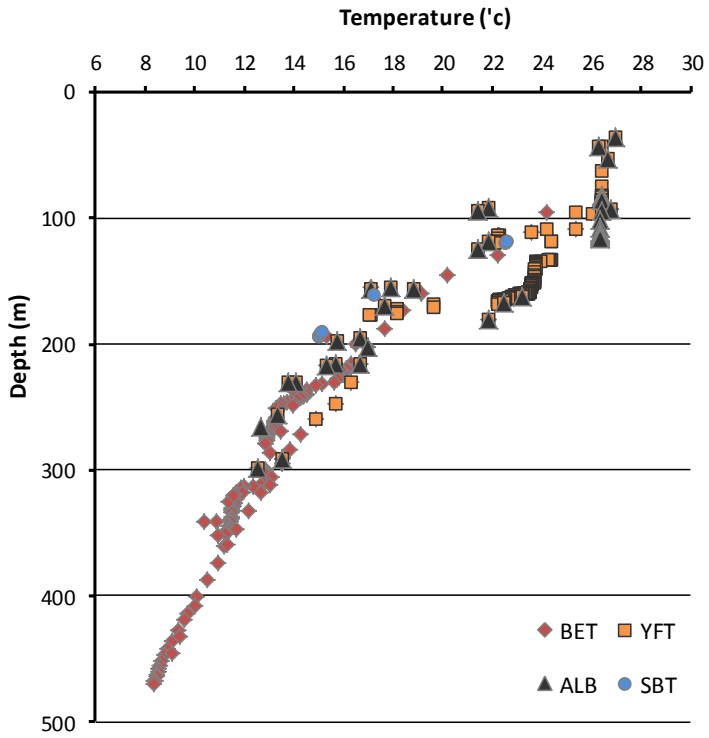


Figure 6. Vertical distribution catch of tuna based on depth and temperature recorded by mini logger (Source: RITF Benoa)

Distribution of Tuna Fishing Ground

The Distribution of Tuna long liners fishing ground based in Benoa fishing port reported by scientific observer from RITF Benoa was presented in figure 7

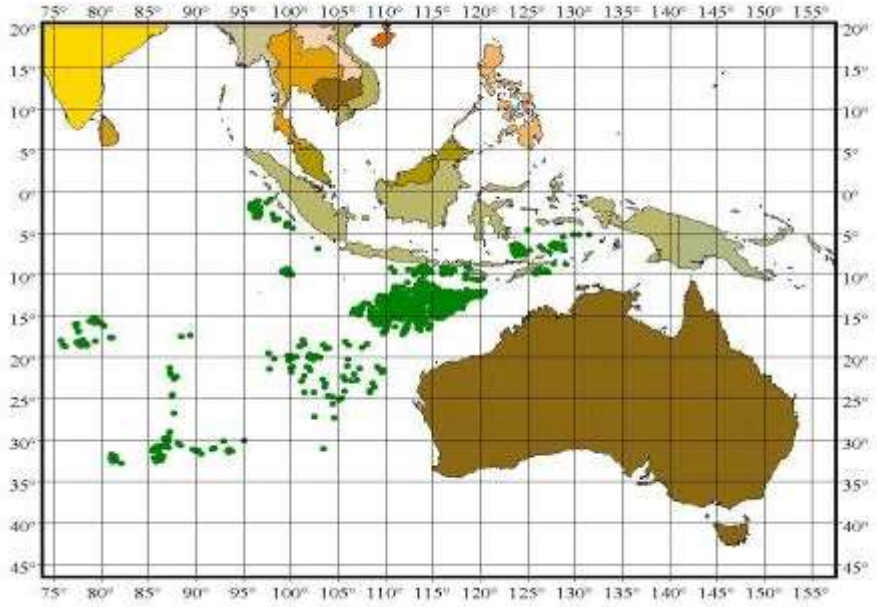


Figure 7. Fishing ground of tuna long line in Indian Ocean, based on observer program (2005-2012)

South Jawa and Bali are main fishing ground for most of Indonesia tuna liners. The fleets also operate to high seas to the south, this wide range of fishing ground gave contribution of number of catch as well as species being caught.

Size Structure of Yellowfin (YFT) and Bigeye Tuna (BET)

(1) Bigeye Tuna (BET)

Size distribution of BET reported by enumerator were range 82-172 cm (figure 8a) while observer reported in different figure 43-178 cm (figure 8b).

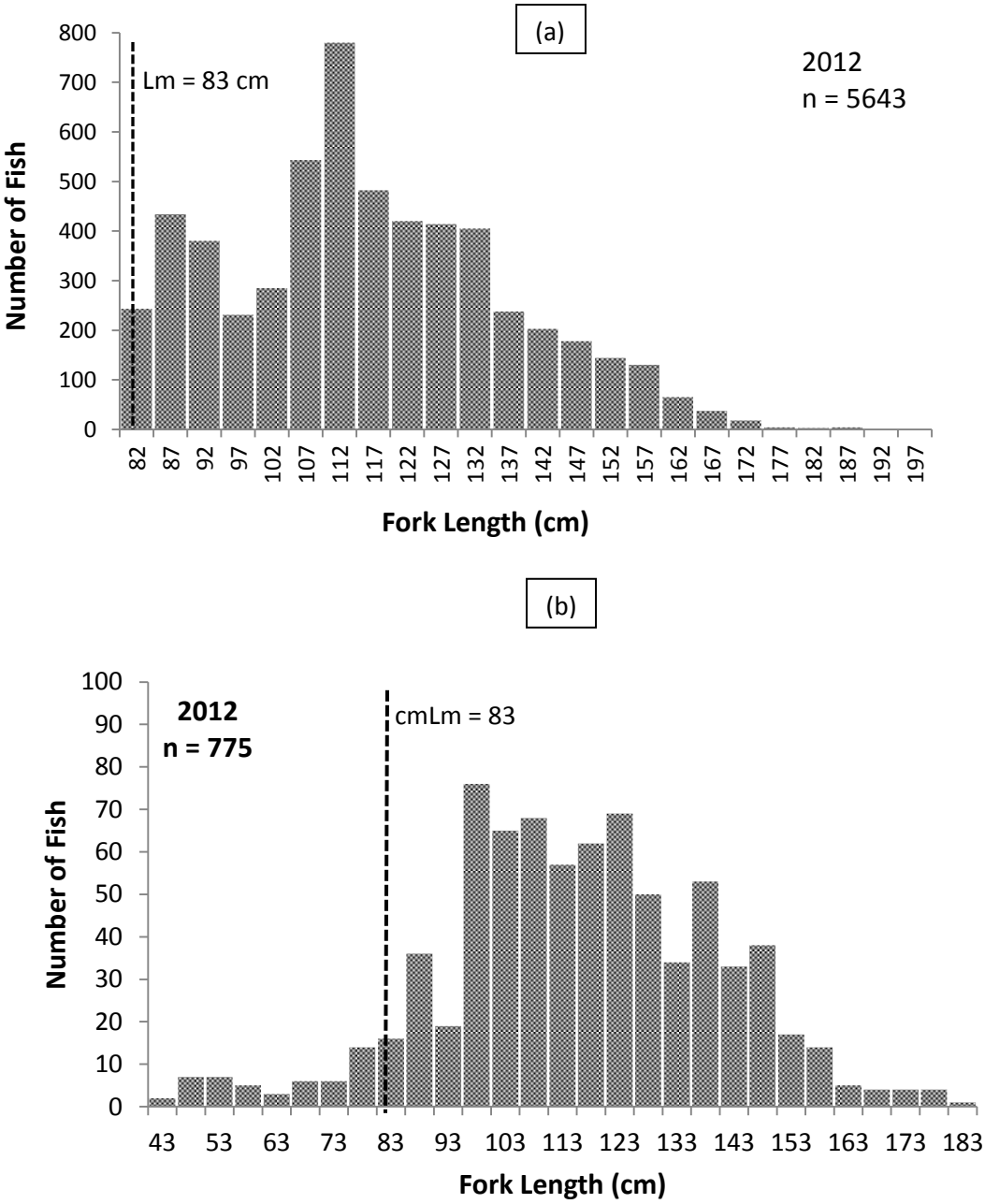


Figure 8. Length frequency distribution of bigeye tuna in 2012 by (a) enumerator and (b) observer program

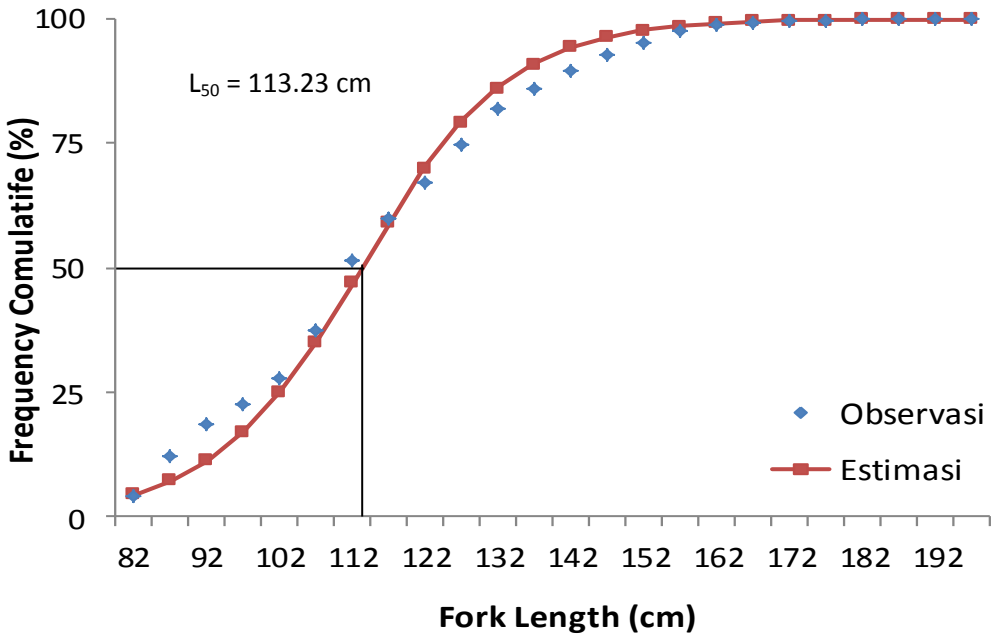
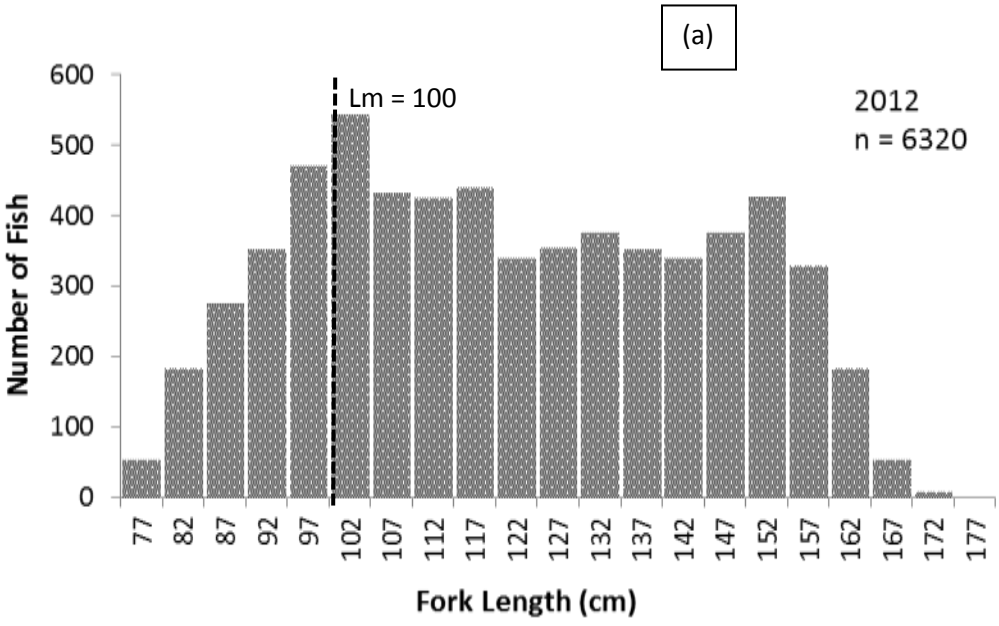


Figure 9. Length capture (L_{50}) for bigeye tuna by tuna long line

According to selectivity analysis the L50 BET was 113.23 cm that much higher to the Lm BET for 83 cm.

(2) Yellowfin Tuna (BET)

Length size of Yellowfin tuna (YFT) reported by enumerators was range from 77 to 167 cm (figure 10a) while observer gave wider range from 63 cm to 178 cm (figure 10b).



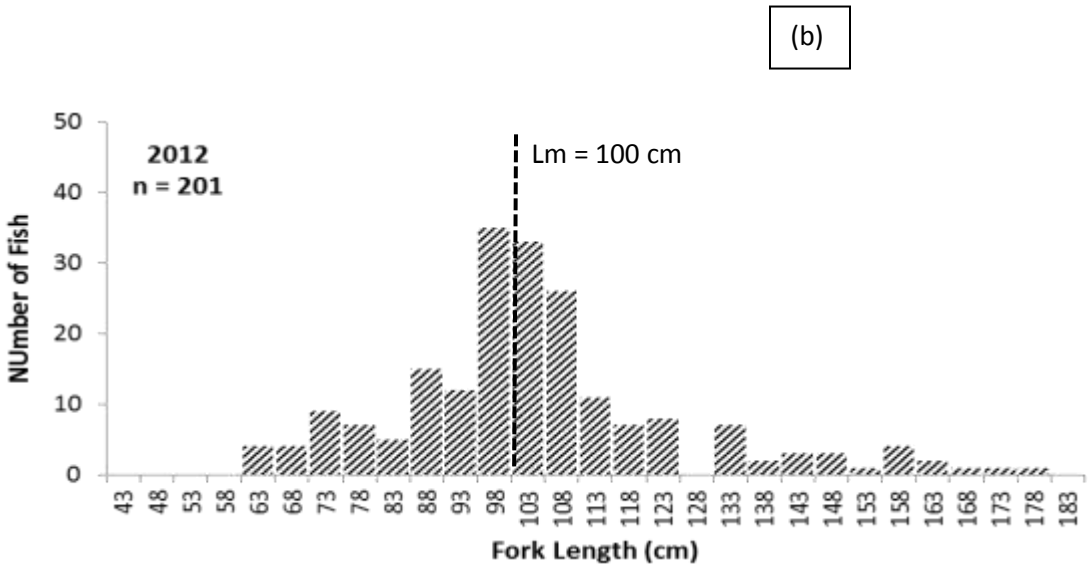


Figure 10. Length frequency distribution of yellowfin tuna in 2012 (a) enumerator and (b) observer

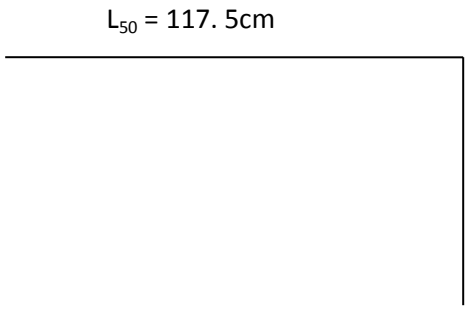


Figure 11. Length capture (L_{50}) for yellowfin tuna by tuna long line

According to selectivity analysis the L_{50} YFT was 117.5 cm that higher to the Lm YFT for 100 cm. It is indicated that tuna longline mostly catch yellowfin tuna in big size.

FISHERIES MANAGEMENT ARRANGEMENTS

For fisheries management purpose, Indonesian waters is divided into eleven Fisheries Management Areas (FMA) that are Malacca Strait, South China Sea, Java Sea, Makasar Strait, Banda Sea, Tomini Bay and Seram Sea, Celebes Sea, Pacific Ocean, Arafura Sea, and Indian Ocean (Figure 5). FMAs 572 (Indian Ocean – west Sumatera) and 573 (South of Java – east Nusa Tenggara), are located within the IOTC area of competence, whereas FMA 716 (Sulawesi Sea) and 717 (Pacific Ocean) are located in WCPFC area (Figure 5). The type of fisheries activities for those fishing areas are slightly different that is depend on their fish resources and water characteristics.

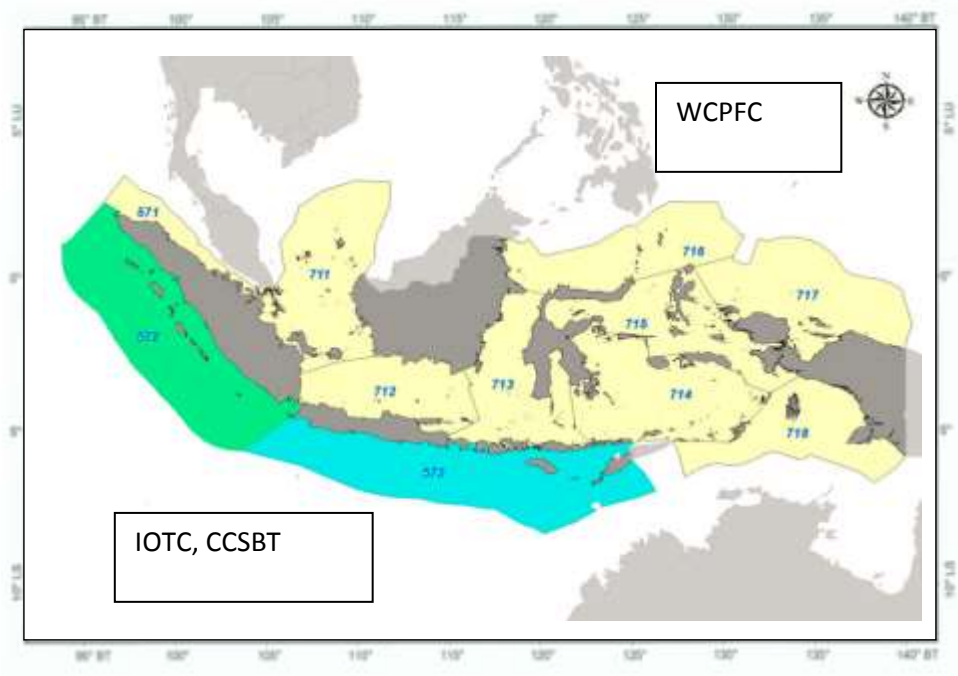


Figure 12. Map showing the nine of fisheries management area in Indonesian waters and Regional Fisheries Management Organization (RFMO).

In the central level, the main agency which responsible for the administration, development and management of capture fisheries is the Directorate General of Capture Fisheries, Ministry of Marine Affairs and Fisheries. In the provincial level the fisheries activities is under controlled by Provincial Fisheries Service. For the license of fishing boat with size of more than 30 GT is authorized by Directorate General of Capture Fisheries in central state, however, the fishing boat with size of less than 30 GT is licensed by Provincial Fisheries Service.

A national program for Monitoring Control and Surveillance (MCS) have been adopted by Ministry of Marine Affairs and Fisheries since 2006 which focus on program using VMS (Vessel Monitoring System) on fishing vessel with size of more than 30 GT. The government

will not issue authorization to fish unless the fishing vessel sends the VMS data needed and that the last fishing ground of the vessel was within the area permitted under its license (Merta, 2005).

For fisheries management in the high seas especially tuna fisheries, Indonesia has actively involved in the regional/international fisheries management in line with existing Regional Fisheries Management Organization (RFMO). It is also mandated by the Indonesian Law on Fisheries, the Government shall participate actively in the membership of anybody/institution/organization at the regional or international levels in the cooperation for regional or international fisheries management. Since 2007 Indonesia had been become as a full member of Indian Ocean Tuna Commission (IOTC).

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