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SPATIAL AND TEMPORAL DISTRIBUTION OF BIGEYE TUNA (*Thunnus obesus*) IN EASTERN INDIAN OCEAN BASED ON SCIENTIFIC OBSERVER DATA FROM 2005 – 2013

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ABSTRACT

Bigeye tuna (Thunnus obesus) is one of the important catch for the fishing industry in Indonesia. The aim of this study is to determine the spatial and temporal distribution of bigeye tuna in the Eastern Indian Ocean. Scientific observers on tuna longline vessels conducted data collection, mainly based in Port of Benoa Bali, from August 2005 to November 2013. Total of 5,340 bigeye tuna were caught and as many as 5,253 of them measured in length. Distribution of bigeye tuna caught by Indonesia tuna longline spreads from 0°-33° S and 76°-128° E. The highest percentage of bigeye tuna > 110 cm (L_m) occurred in the west of West Sumatera and in the South of East Java.There was significant difference in the hook rate by months with the highest hook rate occurred in August with 0.54/100 hooks. This research recommends that fishermen should conduct fishing operations in areas that have a high percentage of bigeye tuna length > 110 cm (L_m), to provide opportunities for the species to spawn at least once throughout their life. It is important to maintain the sustainabilityof bigeye tuna resources in the Eastern Indian Ocean.

KEYWORDS: bigeye tuna, distribution, hook rate, Indian Ocean

1. Introduction

Bigeye (BET) is one of the highly migratory species, which distributed worldwide from tropical to sub-tropical ocean. This species can be found in Atlantic, Indian, and Pacific Ocean (Collette & Nauen, 1983). BET distribution in Indonesia strecthed from western and southern part of Sumatra, Java, Bali and Nusa Tenggara, Banda Sea and its adjacent area, Sulawesi Sea and western part of Papua (Uktolseja *et al.*, 1991). According to Directorate General of Capture Fiheries (DGCF, 2012), total catch of all tuna reached 1,297 mt from 2004 to 2011. BET was the second largest catch (24%) after yellowfin tuna (69%).

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Both IOTC (2013) and ISSF (2013) suggested that the Indian Ocean BET was not overfished and overfishing was not occurring. However, it should be cautious that the BET assessments were associated with many uncertainties according to explorations of extensive sensitivity analysis (Kolody *et al*., 2010). While the demand of tuna from the worldwide market is increasing in the last few years, resulted in expanding of the effort which could threat the sustainability of tuna resources, especially bigeye tuna. Therefore the right and responsible management is a necessity (FA0, 2012). Information on BET distribution related to its environmental factors are important on determining the exploitation level and stock assessment, especially for highly migratory species (Lehodey, 2011). The objective of this paper is to analyze the distribution of BET both spatial and temporal which indicated by the distribution of CPUE (No. fish/1,000 hooks) from the commercial longliners scientific observer data during 2005 – 2013.

2. Material and Methods

Study focused on longline fisheries, the specimens caught on onboard longliner through scientific observer program in which every fish caught was measured. The data were collected from August 2005 to November 2013 comprising of a total of 87 trips with an average of 24 days/trip. These data were plotted according to longitude, latitude, period of fishing, location of deployment, number of operated hooks in daily deployed, catch in number and length (FL). The length frequency was aggregated and the average length was analyzed throughout the period of observation. The nominal fishing effort of tuna longline fishery was described as the number of hooks used on certain area of fishing, while hook rates (CPUE) calculated as number of fishes caught per 1000 hooks. Range of hook rates on each hauls were pooled and plotted according to its geo-reference to describe the geographical distribution of bigeye tuna.

3. Results

The scientific observer program has been deployed for 9 years since its first initiated in August 2005. Of total 5,253 samples of bigeye tuna from 87 trips and 2,121 days at sea have been successfully retrieved (Table 1). The area of fishing operation was between 0°-33° S and 76°-128° E which highly concentrated at the south of Indonesian waters (Figure 1). The average length (FL) of bigeye caught quite steady throughout the years at 110 cm, while the number of fish sampled was fluctuated, the lowest recorded at 2011 (257 samples) and the highest at 2006 (851 samples). The dropping trend of the number of the bigeye sampled was due to the decreasing of the scientific observer deployed.

The nominal CPUE trend was steady from 2005 – 2010, and then rose up in 2011 to 2012 and decline significantly in 2013 (Figure 3). Higher CPUE of bigeye tuna concentrated between 10^0 – 20^0 S and 100^0 – 120^0 E (Figure 4 & 5). The temporal distribution of CPUE was significant throughout the months (One-way Anova; $F_{1,11}$=11,183; p<0,001). The highest CPUE occurred in August (5.45), and the lowest recorded was in January (0.56) (Figure 6). Length frequency distribution showed that in general the bigeye tuna caught during 2005 – 2013 was dominated at size range from 121 – 125 cm (FL). Of total 5,253 samples that could be retrieved and measured, 61.09% of them were above length at first maturity (> 110 cm), which indicated that most of the fish caught were at mature stage (Figure 7).

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6. Appendix

Table 1. Activity summary of scientific observer in Eastern Indian Ocean during 2005 to 2013.

Year	Trip	Days at Sea	Lattitude	Longlitude
2005	9	117	12-16	107-116
2006	13	401	4-31	103-128
2007	13	258	9-33	79-115
2008	16	404	9-18	76-119
2009	13	288	0-14	95-119
2010	5	152	9-15	110-120
2011	4	111	6-30	95-124
2012	8	192	1-32	85-117
2013	6	198	9-13	100-121

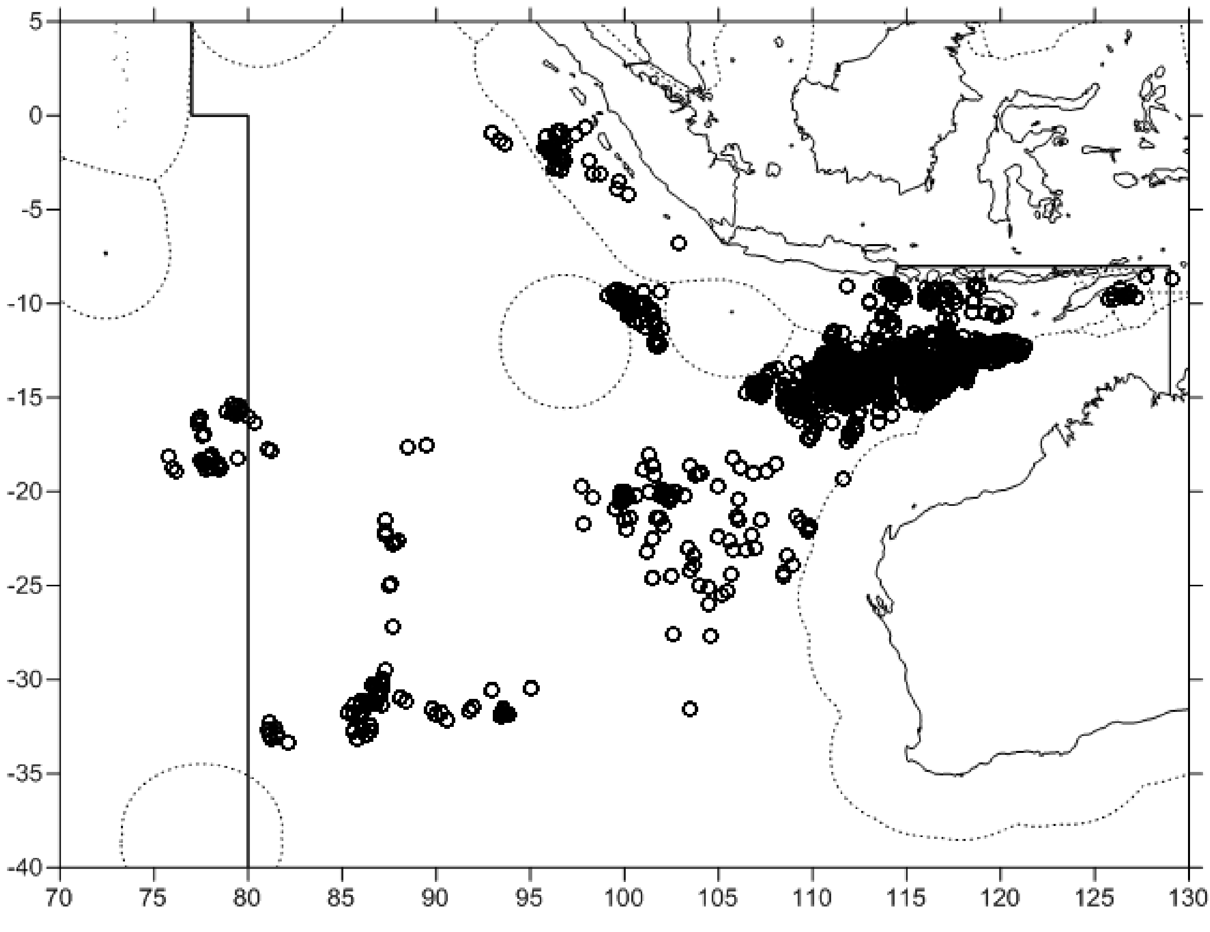

Figure 1. Location of the Indonesia tuna longliners fishing ground of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

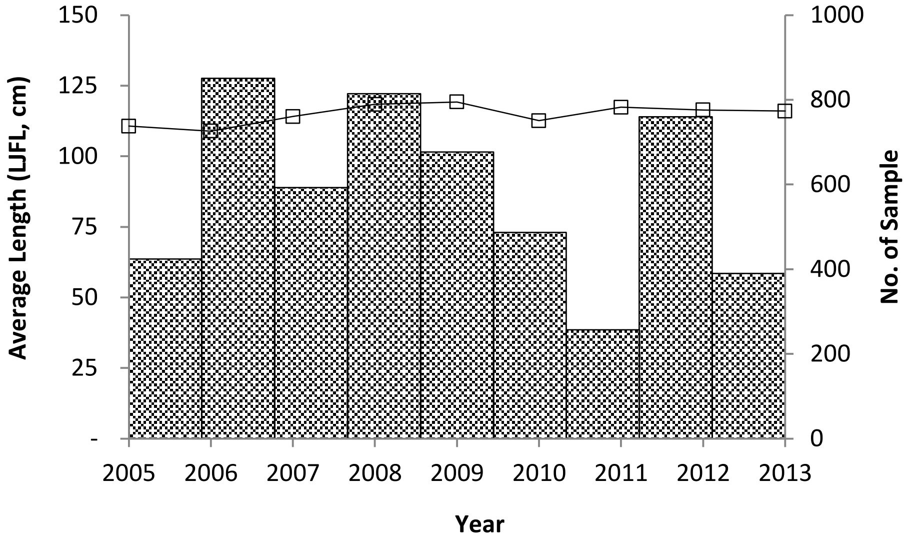

Figure 2. Average length versus number of sample of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

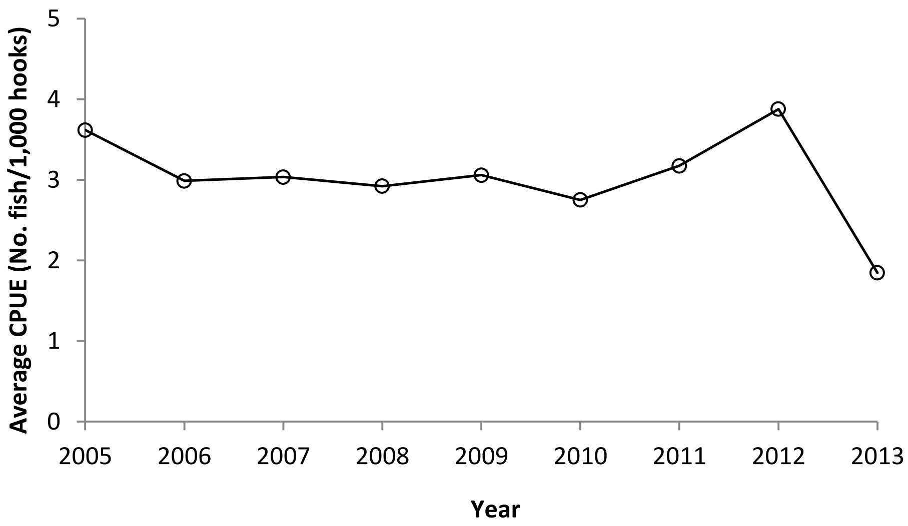

Figure 3. Average of annual nominal CPUE (No. of fish/100 hooks) of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

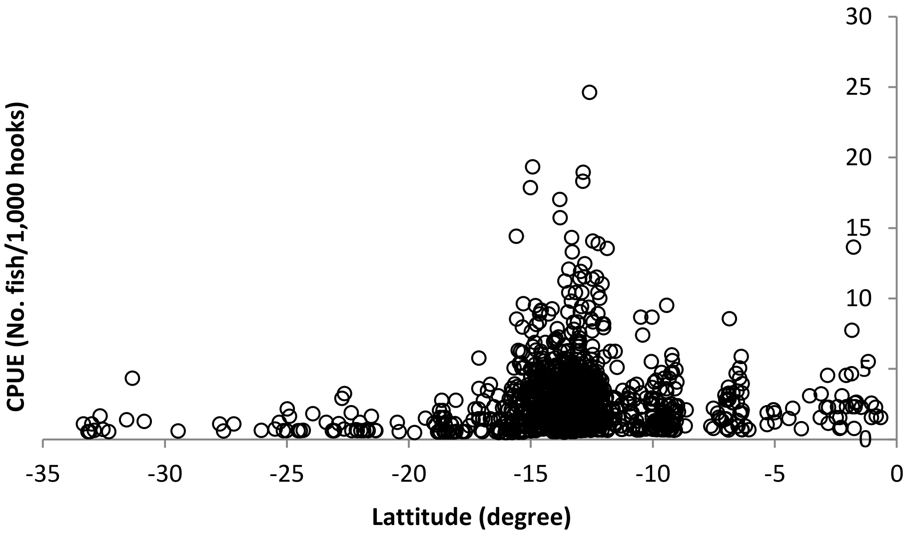

Figure 4. Average of annual nominal CPUE (No. of fish/100 hooks) of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

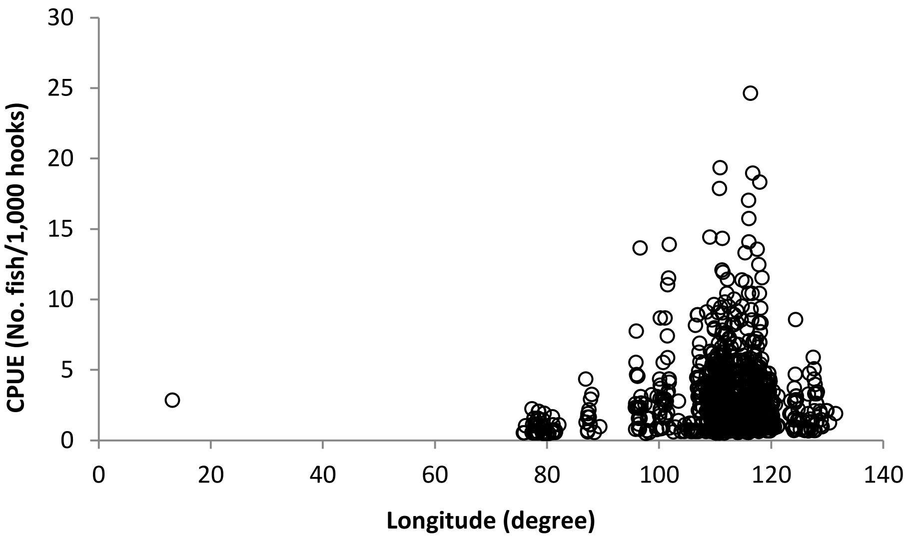

Figure 5. Average of annual nominal CPUE (No. of fish/100 hooks) of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

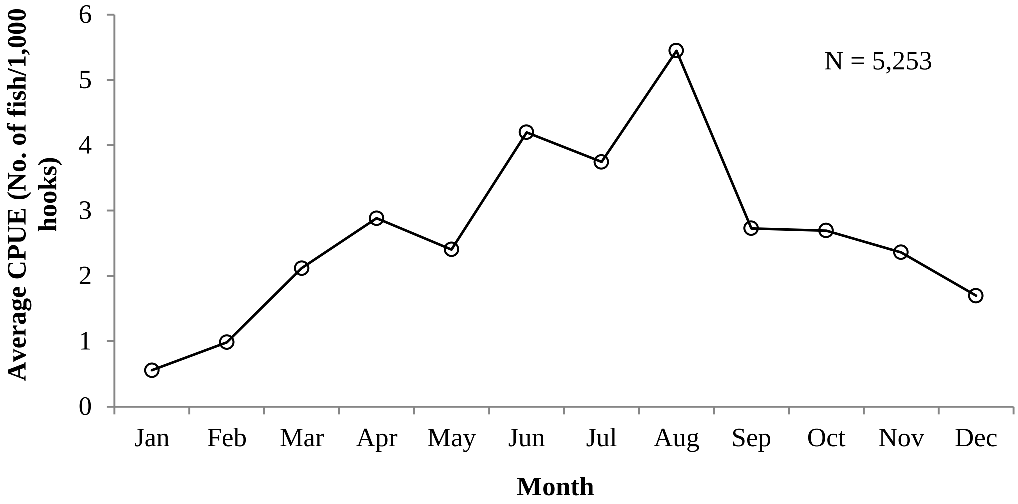

Figure 6. Average of monthly nominal CPUE (No. of fish/100 hooks) of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013.

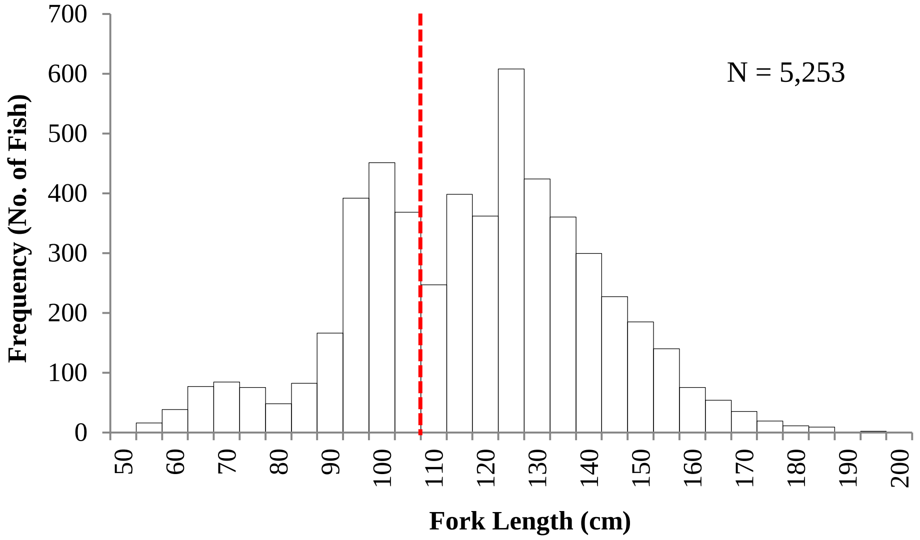

Figure 7. Length frequency distribution of bigeye tuna in eastern Indian Ocean based on observer data from 2005 to 2013. Dashed lines was the length at first maturity.