Updated information on catch and effort of bigeye tuna (*Thunnus obesus*) from Indonesian tuna longline fishery

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Abstract

Bigeye tuna (*Thunnus obesus*) is one of the main targets for Indonesian tuna longline fishery in the Eastern Indian Ocean. The fishery has begun since early 1980's, when deep longline introduced. There were two types of data used in this study; first was the skipper's "logbook" data from the state-owned commercial tuna longline vessels based in Benoa Port (1978-1995), and the later was the scientific observer data conducted by Research Institute for Tuna Fisheries (RITF) from 2005 to 2017. Both datas then combined to produce nominal catch per unit of effort (CPUE) (no. fish/100 hooks). The result showed that the catch rates of bigeye tuna is declining over the years. The highest CPUE recorded was in 1992 (0.62), while the lowest was in 2016 (0.11). Efforts distributed mainly within 0-35 °S and 75 – 130 °E. While high CPUE areas mainly occurred between 5-20 °S and 30-35 °S. We are still in progress of completing the skipper's "logbook" data entry in a hope of presenting the appropriate standardized CPUE in the future.

Keywords: Nominal CPUE; bigeye tuna; longline fishery; Eastern Indian Ocean

Introduction

Bigeye tuna (*Thunnus obesus*) is one of the most important catch in tuna fisheries throughout the Indian Ocean (Nugraha et al., 2010; Polacheck, 2006; Lee et al., 2005). They are widely distributed from tropical to subtropical waters among 3 major oceans, between 45°N and 40°S except the Mediteranian Sea (Collette & Nauen, 1983). It also the most economically valuable (Fonteneau et al., 2004) and principal target species of the large longliners from Japan, China, and Taiwan and smaller longliners based in several Indian Ocean Island countries, especially Indonesia (Nootmorn et al., 2004).

The longline catch of bigeye tuna in the Indian Ocean has increased from approximately 40,000 tonnes in the late–1980s and early–1990s to ~100,000 tonnes in the late–1990s (IOTC Fish stat data set 1950–2000). Tuna production in 2010 reached up to 2.6 million ton and 400,000 ton (15.38%) came from Indian Ocean. Indonesia contributes more than 207,010 ton in 2010, rise up 1.84% from previous year. Port of Benoa contributes more than 60% of tuna production in Indonesia (Setyadji et al., 2012).

Abundance indices (e.g. CPUE) convey important information concerning the status of fisheries stocks because it related to the biomass. Furthermore, those indices are necessary to run simple models and they are also used as auxiliary data in more detailed stock assessment models (Maunder & Punt, 2004). The information nominal CPUE as well as standardized ones have been presented by a number of scientists in recent years (Winker et al., 2017; Zhu, 2016; Jatmiko et al., 2014; Okamoto et al., 2009; Satoh et al., 2009; Hsu, 2006; Nishida et al., 2002; Dai et al., 2002; Hsu & Liu, 2000). However, lack of detailed data has hampered the calculation of standardized CPUE in the recent decades caught by other fleets or in areas where Japanese or Taiwanese longline fleets have not operated in (e.g. eastern Indian Ocean). Therefore, this paper provides new information on nominal CPUE in the east of Indian Ocean based Indonesian tuna longline fleets. We believe the results are valuable in term of fill the research gap and contribute as an auxiliary information to assess the status of BET in the Indian Ocean.

Materials and methods

There were two types of data used in this study; first was the skipper's logbook data from the state-owned commercial tuna longline vessels based in Benoa Port (1978-1995), and the second was the scientific observer data conducted by Research Institute for Tuna Fisheries (RITF) from 2005 to 2017 and National Observer Program, conducted by Directorate General of Capture Fisheries (DGCF) since 2016. The skipper's logbook data contained 35,687 set-by-set data. However, 8.22% of the datasets were excluded due to cleaning process. No data in 1986 was due to the oil price hike, but the operation was resumed the next year. On the other hand, the scientific observer data were collected from October 2005 to December 2017. There were 2897 longline sets recorded by the scientific observer with the fishing areas during 2005-2017 between 0-35^{o}S and 75 – 130^{o}E. These data then plotted on a 5x5-degree square basis.

Catch is declared in number of fish and effort in total number of hooks/set. Catch rates is define as number of bigeye caught per 100 hooks. The graphs in produced with Microsoft office Excel 2016 and the maps is drawn with QGIS 2.13.

Results

The scientific observer program started in 2005 as an Indonesia-Australia collaboration (Project FIS/2002/074 of Australian Centre for International Agricultural Research), and since 2010 it has been conducted by the Research Institute for Tuna Fisheries (Indonesia) and DGCF since 2016. Scientific observers and national observers recorded catch and operational data at sea following Indonesian tuna longline commercial vessels from 2005-2017 and 2016-2017, respectively. The combined dataset contained 115 trips, 2887 sets, 3499 days-at-sea, and more than 3.5 million hooks deployed, respectively (Table 1).

The effort distribution based on scientific observer data during 2005-2017 distributed within 0-35°S and 75-130°E, with the highest effort occurred within 10-15 °S (Figure 2). High CPUE of bigeye tuna occurred between 5-20 °S and 30-35 °S (Figure 3). Distribution pattern of CPUE of bigeye tuna found in this study were similar to those found based on Taiwanese longliners indicated that bigeye tuna were mainly concentrated in waters between 10°N and 15°S, with the mean CPUE ranged from 0.05-0.81 fish/100 hooks (Lee et al., 2005).

Nominal catch per unit effort of BET during 1978-1985 was relatively low, because most of the fleets were after yellowfin tuna as the main target (Sadiyah et al., 2011). But since early 1980's, the CPUE was climbed up due to the introduction of deep longline technique. Until it reached its peak in 1992 (0.62/100 hooks) then decreased rapidly until 1995 to 0.51 fish/100 hooks (Sadiyah et al., 2011; Gafa et al., 2000). On the other hand, the annual average of CPUE of scientific observer data (2005-2017) was relatively steady over the years, the highest catch was recorded in 2014 with an average of 0.29 fish/100 hooks and the lowest was in 2016 with 0.11 fish/ 100 hooks but slightly increased in 2017 (0.16 fish/100 hooks). The main concern is that the CPUE was declining in the last 4 years (Figure 1).

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Conclusion

CPUE (no. fish/100 hooks) of bigeye tuna showing a declining trend over the years. The highest was recorded in 1992 (0.62), while the lowest was in 2016 (0.11). Effort distributed within 0-35 °S and 75 – 130 °E. High CPUE mainly occurred between 5-20 °S and 30-35 °S. We are still in progress of completing the logbook data entry in a hope of presenting standardized CPUE in the next couple of years.

Future Work

A work on standardized CPUE on BET is expected after the completing and validating the skipper's logbook data. We hope it can be presented at the next WPTT meeting.

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Table 1. Summary of observed fishing effort from Indonesian tuna longline fishery during 2005–2017.

Year	Trips	Sets	Days at Sea	Total Hooks	Hooks per Set		Hooks per Float		Mean Latitude		Mean Longitude	
2005	9	108	117	157,065	1,454.31	(151.8)	18.6	(1.5)	14.3ºS	(1.0º)	111.8ºE	(2.1º)
2006	13	401	401	577,243	1,439.51	(214.9)	11.2	(3.9)	16.9ºS	(6.0º)	113.4ºE	(5.4º)
2007	13	265	258	406,135	1,532.58	(326.5)	14.0	(4.4)	17.0ºS	(6.4º)	103.5ºE	(13.3º)
2008	15	370	404	483,662	1,307.19	(385.9)	13.0	(4.5)	14.2ºS	(2.6º)	107.3ºE	(14.1º)
2009	13	283	288	323,042	1,141.49	(234.7)	12.1	(4.9)	11.4ºS	(3.3º)	113.2ºE	(5.6º)
2010	6	165	152	220,394	1,335.72	(457.5)	13.6	(5.2)	12.0ºS	(3.3º)	113.3ºE	(6.0º)
2011	3	105	111	110,384	1,051.28	(173.9)	12.0	-	13.7ºS	(0.9º)	117.4ºE	(1.3º)
2012	8	198	192	290,265	1,465.98	(559.1)	14.1	(2.3)	18.9ºS	(7.8º)	104.5ºE	(10.8º)
2013	7	225	198	252,919	1,124.08	(210.4)	12.7	(2.1)	12.4ºS	(1.1º)	114.6ºE	(6.6º)
2014	5	167	265	193,740	1,160.12	(176.9)	15.0	(2.0)	11.0ºS	(1.7º)	105.7ºE	(7.5º)
2015	5	148	241	172,463	1,165.29	(145.2)	14.1	(3.2)	10.8ºS	(2.7º)	103.8ºE	(8.1º)
2016	8	244	383	324,068	1,314.89	(146.4)	15.2	(6.4)	10.6ºS	(3.8º)	107.5ºE	(9.4º)
2017	10	218	489	279,204	1.214.04	(395.3)	17.2	(4.8)	11.8ºS	(8.9º)	99.1ºE	(4.4º)

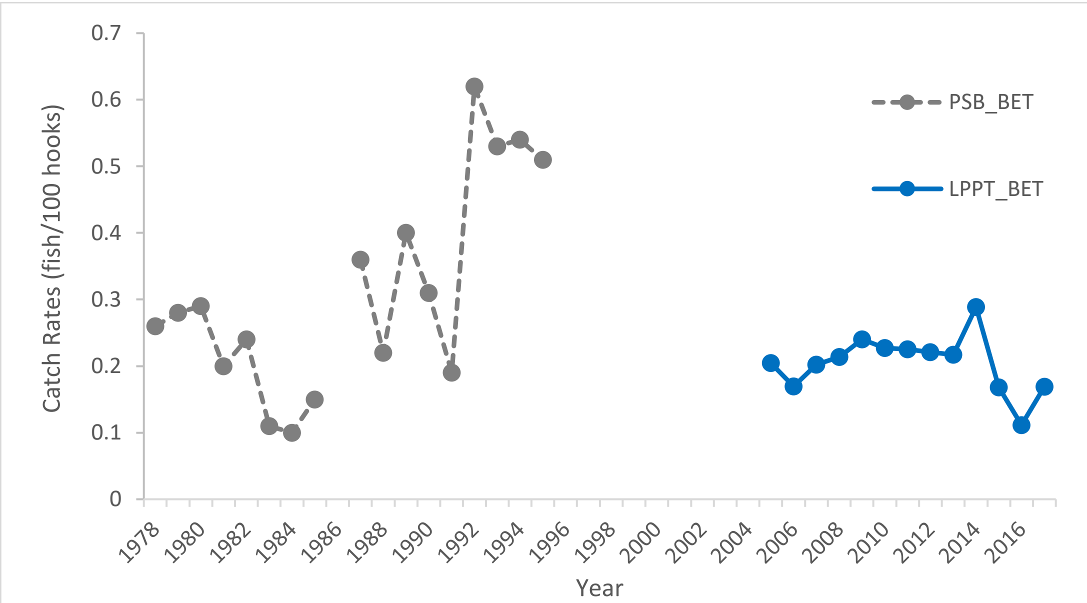

Figure 1. Average nominal catch per unit effort (no. fish/100 hooks) of bigeye tuna (remarks: the early nominal CPUE data was reproduced from Sadiyah *et al.*, 2011).

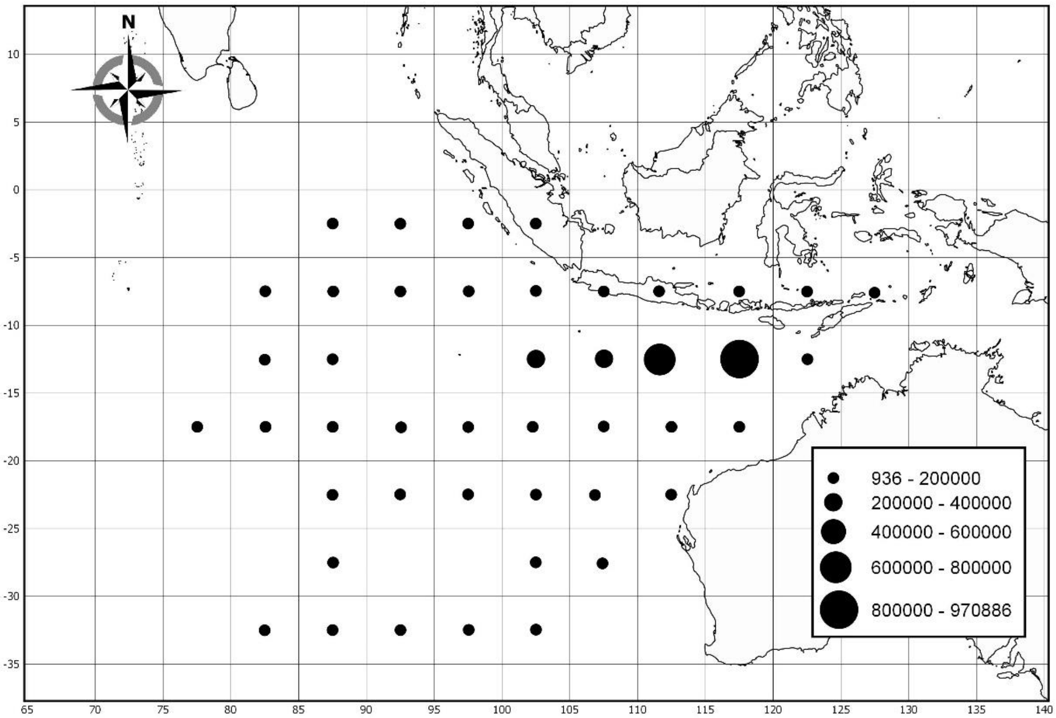

Figure 2. The distribution of effort (number of hooks) based on observer data collected from longline fishery in Indian Ocean (2005 – 2017).

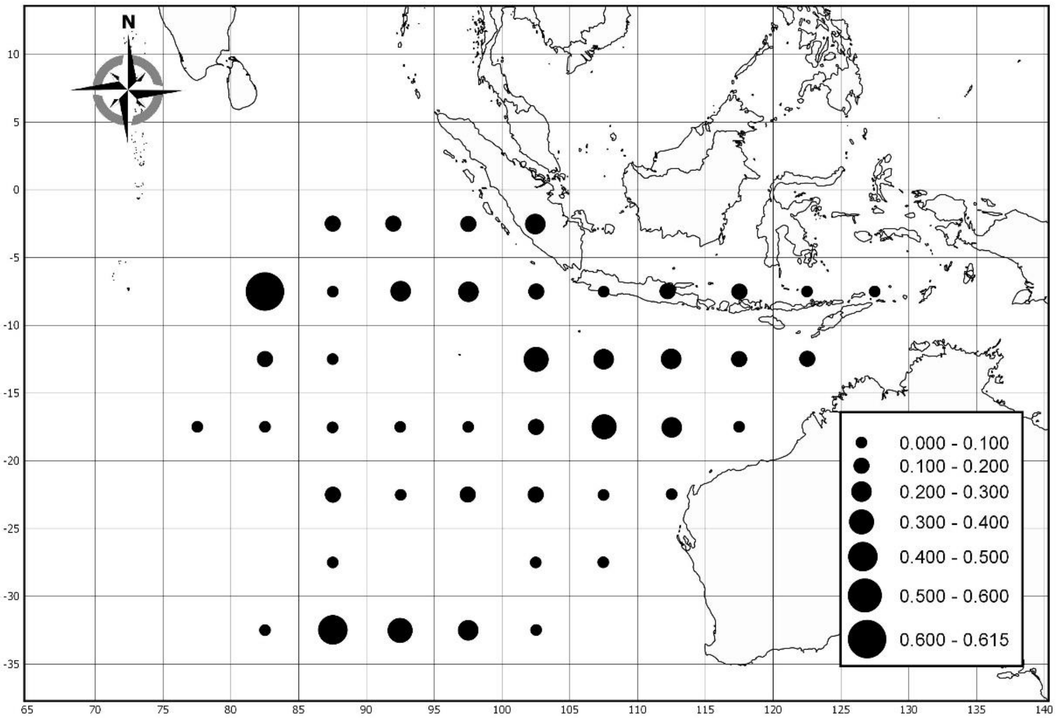

Figure 3. The distribution of CPUE of bigeye tuna based on observer data collected from Indonesian longline fishery in Indian Ocean (2005 – 2017).