Preliminary study of frigate tuna (*Auxis thazard*) CPUE standardization in the Indian Ocean West Sumatera (FMA 572)

Ririk Kartika Sulistyaningsih[1], Prawira ARP Tampubolon[1], Zulkarnaen Fahmi[1]
[1]*Research Institute for Tuna Fisheries, Jl. Mertasari No. 140 Denpasar-Bali*

ABSTRACT

Frigate tuna (*Auxis thazard*) is one of the major commercial tuna species, both by the industrial and small scale fisheries, particularly in West Sumatera. In Indonesia, *A. thazard* is a group of "tongkol" together with *A. rochei*, *Thunnus tonggol* and *Euthynnus affinis*. This study describes a preliminary examination of frigate tuna catch from purse seine in the Indian Ocean West Sumatera (FMA 572). The data were collected daily by enumerators on fish landing site from 2013 to 2017. General Linear Model (GLM) with gamma were applied in this study to standardize the CPUE. The results showed that the variation of CPUE influenced by year and quarter but not the fleet size (GT). In general, the population of frigate in the Indian Ocean West Sumatera (FMA 572) waters were suggested sustainable.

KEYWORDS: *Auxis thazard*; CPUE; frigate tuna; purse seine; standardization

INTRODUCTION

Frigate tuna (*Auxis thazard*) is a pelagic species from the Scombridae family which found in almost all tropical and sub-tropical waters (Tao *etal*. 2012). The habitat is at sea level up to 50 m depth and it has migration pattern at the optimum temperature between 27^0C and 27.9^0C (Herera & Pierre 2009; Maguire *etal*. 2006). In Indonesia, frigate tuna is a group of "tongkol" together with *A. rochei*, *Thunnus tonggol* and *Euthynnus affinis* (Tampubolon *etal*. 2018).

Frigate tuna is one of the major commercial tuna species, both by the industrial and small scale fisheries, particularly in West Sumatera, Fisheries Management Area (FMA) 572 which has the fisheries potential up to 1.353.000 ton per year (Bangun *etal*. 2015). This species is one of the main target of the purse seine in West Sumatera and gathered below Fish Aggregated Devices (FADs). Purse seine fisheries in Indonesia are consisted of two types, which are small pelagic and large pelagic purse seine. The difference of them is on the mesh size and fishing area (Tampubolon *etal*. 2017). The fleet size operated in West Sumatera is between 70 and 100 GT with gear specifications are 1 inch mesh size, 700 m length, and 60 m width (Hariati and Sadhotomo 2017).

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Frigate tuna exploitation is increasing every year. The IOTC (2014) reported that more than 90% of frigate tuna were caught in four countries, including Indonesia (59%), India (14%), Sri Lanka (11%), and Iran (7%). Although there have been many studies dealing with CPUE in Scombrids, only a few have actually addressed the CPUE of frigate tuna. The objective of the present study was to provide an overview of the CPUE standardization of frigate tuna caught by purse seine in the Fisheries Management Area 572.

MATERIALS AND METHODS

Since 2009, the management of Indonesian fisheries has been based on the Fisheries Management Areas of the Republic of Indonesia (FMA-RI), following the Decree of the Minister of Marine Affairs and Fisheries No. PER.01/MEN/2009. The data were collected daily by enumerators on fish landing site in Sibolga, West Sumatera (FMA 572) (Fig. 1) from 2013 to 2017. The parameters were taken including, the fishing gear, number days at sea, and production of *A. thazard*. To standardized the CPUE, General Linear Model (GLM) was applied using year, quarter, and Gross Tonnage (GT) as fix variables. The application of GLM method in developping CPUE standardization was recommended by Sadiyah *etal.* (2012) using Indonesian tuna longline observer data. Gamma distribution was applied in this study because there were none zero catch in the data. Model goodness-of-fit and model comparison was carried out with the Akaike Informatic Criteria (AIC).
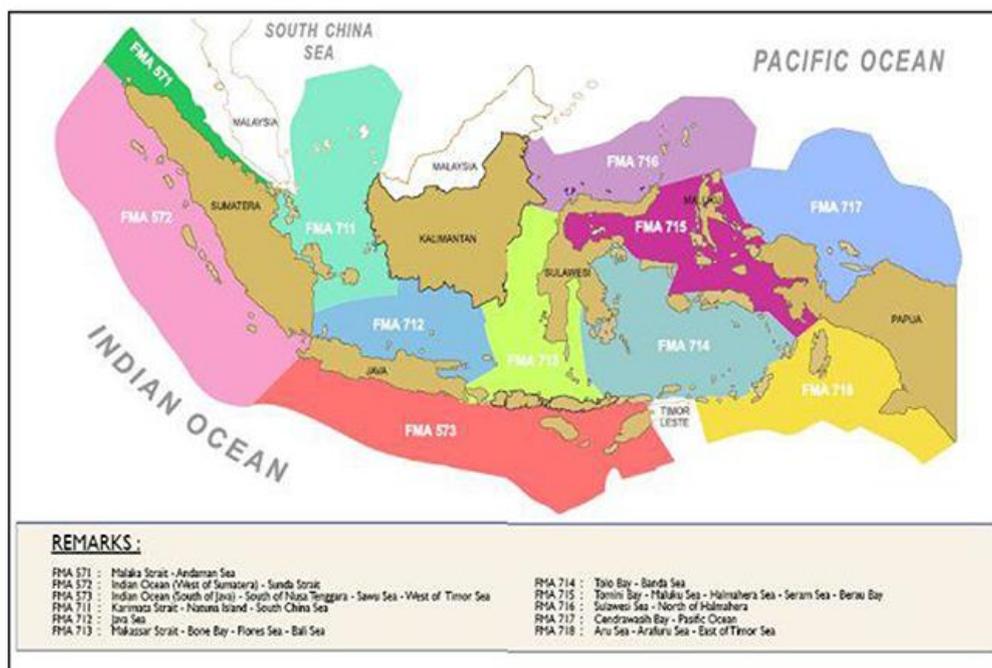
Figure 1. Fisheries Management Areas (FMA) in Indonesia.

RESULTS

Table 1 shows the highest efforts occurred in 2016 with 608 trips and the lowest was in 2013. The fishing season happens every month with the peak on April and the lowest was in January for purse seine fihery in West Sumatera between 2013 and 2017 (Fig. 2). Generally, the catch was increasing from January to April then start decreasing until August. It was slightly rising in September to October but then flat until December.

Table 1. The summary of purse seine trips operated in Sibolga, West Sumatera from 2013 to 2017.

Year	Trips	Total days-at-sea	Mean GT
2013	257	2,934	75.37
2014	311	4,127	79.19
2015	560	7,587	80.28
2016	608	8,909	78.68
2017	445	6,535	78.47
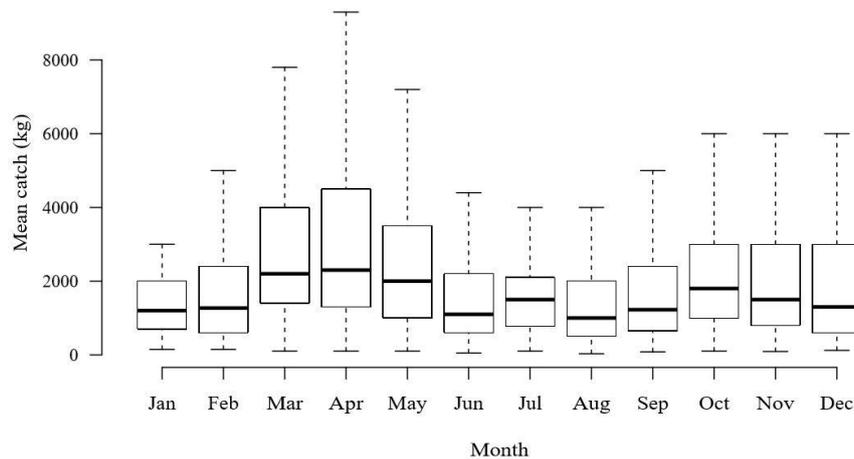
Figure 2. The mean catch of frigate tuna caught by purse seine in West Sumatera during 2013-2017.

The nominal CPUE of frigate tuna reached it maximum in 2010 and minimum in 2014 (Fig. 3). In general, it decreased at the second of the observation year (2014) but then increased in 2015 until 2017. The CPUE values are very important information in explaining the stock status (Setyadji *etal*. 2016). Various factors associated with environmental condition and

fishing practice were possible to generate the effect on the temporal trends of nominal CPUE (Sadiyah *etal*. 2012).
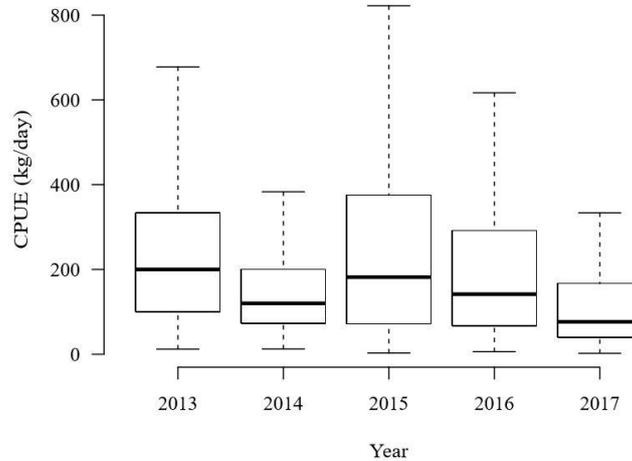

Figure 3. CPUE nominal series (kg/day) of frigate tuna from purse seine between 2013 and 2017.

The result from frigate tuna CPUE standardization using GLM with gamma shows that the most accounted variables are year and quarter (Table 2). Whereas, the fleet size (GT) did not provide a significant effect on the catch. Overall, the final examination result shows the declining trend of frigate tuna CPUE's over the five year observations (Fig. 4). The external factors, for example environmental condition, government policies, social and religious affairs were likely driving the change for CPUE values (Mira *etal*. 2014; Setyadji *etal*. 2018; Setiawan *etal*. 2013; Teliandi *etal*. 2013).

Table 2. The parameters used for frigate tuna CPUE standardization using GLM with gamma distribution.

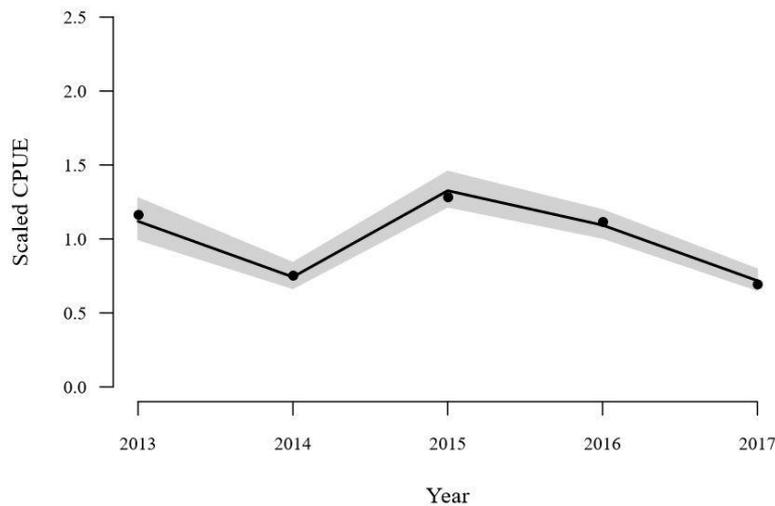| Parameter	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)
(intercept only)			1905	1889.4	
Year	4	112.386	1901	1777	< 0.001 ***
Quarter	3	69.208	1898	1707.8	< 0.001 ***
GT	1	5.033	1897	1702.7	0.02946 *

Figure 4. Scaled standardized CPUE series for frigate tuna from purse seine using gamma model from 2013 to 2017.

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