Status of neritic tuna fishery and some biological aspects of Kawakawa (*Euthynnus affinis*) in the northern part of Peninsular Malaysia

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ABSTRACT

Neritic tuna species are among the important pelagic fish caught by commercial and traditional fishing gears. The main neritic tuna found in Malaysian waters are longtail (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*). In 2018, neritic tunas contribute about 5% of the total marine catches in Malaysia. Annual catch of neritic tuna in the Malacca Straits is about 32% and had showed a decreasing trend but the opposite was observed in the South China Sea. Purse seiners contributed about 85% of the annual catches of neritic tuna and it is the most important fishing gear for this fishery, especially the 40-69.6 GRT and >70 GRT vessel size. Two type of purse seines operating in Malaysia; using FADs and light luring. This present study will also include information on biological aspects of *E. affinis* such as growth parameters and length distribution.

Keywords : neritic tuna, purse seine, growth parameters

INTRODUCTION

Malaysia fisheries profile

In the year 2014, the fisheries sector had contributed RM12,765.28 million to the nation economy, showing an increase of 11.3% compared to 2013. The Food fish sector which comprises of marine capture fisheries, inland fisheries, and aquaculture include seaweed produced 1,985,163 tonnes worth RM12,335.73 million, signifying a decrease of 1.7% in terms of value compared to 2013.

Marine capture fisheries sub-sector, which includes inshore and deep-sea fisheries, is still the major contributor producing 1,458,128 tonnes (73.45%), valued at RM8,785.39 million (71.22%). This 2014 production indicated a decrease of 1.7% in terms of quantity but increase of 5.4% in value terms as compared to 2013.

Peninsular Malaysia remains the biggest contributor of fish landings in Malaysia. In 2014, it contributes 1,060,465 tonnes or 72.73% of the total fish landed, of which the West Coast contributes a major portion with 748,706 tonnes (70.60%). The state of Perak and Kedah were the two main Coast. For the East Coast region, the East Johor and the states of Pahang were the main provider with 99,591 tonnes (31.94%) and 91,146 tonnes (29.24%) respectively.

A total of 57,927 units of fishing vessels were licensed in 2014 with the majority operating traditional fishing gears. In Peninsular Malaysia, nearly half of the landings were from trawlers amounting to 501,684 tonnes (47.31%) followed by fish and anchovy purse seiners with 275,925 tonnes (26.02%) and 282,856 tonnes (26.67%) from traditional fishing gears.

Fishing areas in Malaysian waters

Malaysia is a maritime nation surrounded by four seas, namely the Malacca Strait, South China Sea, the Andaman Sea and the Sulu Sea. Fishing area in Malaysian waters can be divided into several areas of the West Coast (Malacca Strait) and East Coast (South China Sea) Peninsular Malaysia, Sarawak and Sabah waters including Sulu and Celebes Sea on the east coast of Sabah. Malacca Strait is part of the area included in the Indian Ocean Tuna Commission (IOTC), which includes the states of Perlis, Kedah, Penang, Perak and Selangor. Exclusive Economic Zone (EEZ) in the Malacca Strait is bordered by Indonesia in the west and in the north, it is bordered by Thailand (Andaman Sea) (Figure 1).

Figure 1: Malaysian fishing areas

Annual landings of neritic tuna

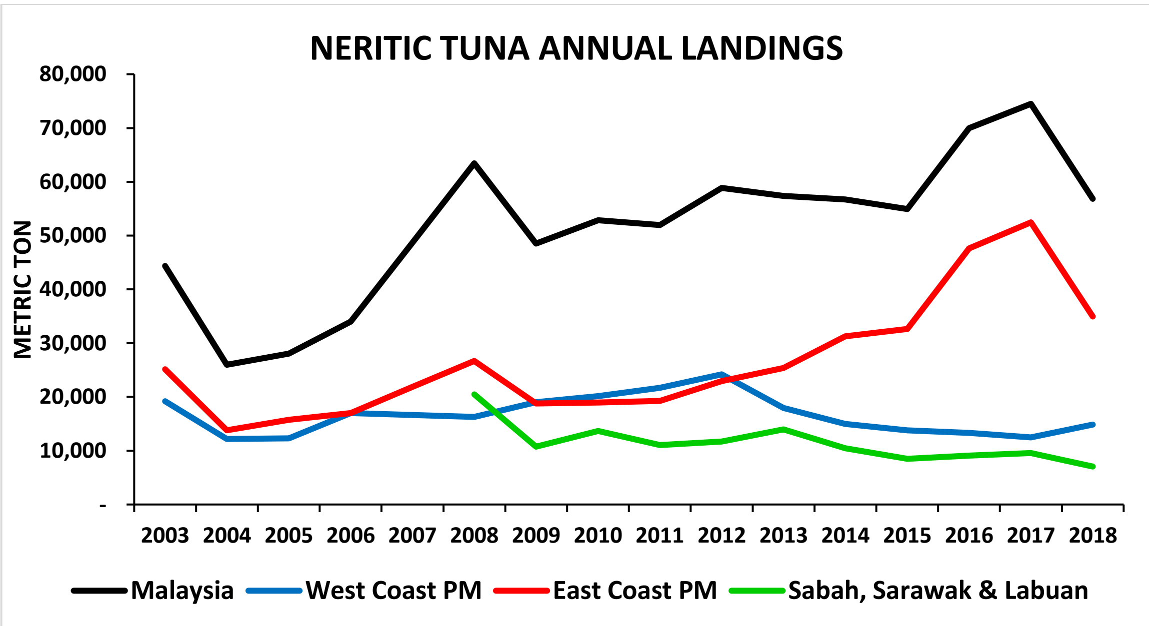

Figure 1 : Neritic tuna annual landings in Malaysia

Neritic tuna species in Malaysia are longtail (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*). It contributed about 5% of the total marine landings in Malaysia. Landings of neritic tuna in Malaysia showed a generally increasing trend from 2003 - 2018 (Figure 1). In the East Coast of Peninsular Malaysia which are facing the South China Sea, the landings are steadily increasing before reaching its highest landing in 2017 (52,455 mt) and then experience a sudden drop in 2018 to about 34,932 mt. Landings in the West

Coast of Peninsular Malaysia (Malacca Straits) were quite stable throughout the years. In 2018, about 62% of the total neritic tuna landings comes from the East Coast, 26% from the West Coast and the rest is from Sabah, Sarawak & Labuan.

Landings of longtail tuna from 2008 – 2013 were comparatively higher than kawakawa (Figure 2). However, starting from 2014 the landings plummeted to the lowest landing of 1,543 mt compared to 13,691 mt in 2008. The landings longtail tuna started to double in 2018 by 57% to 3,636 mt. In contrary, landings of kawakawa fluctuates from 2008 and reach it highest landing in 2018 by 10,770 mt.

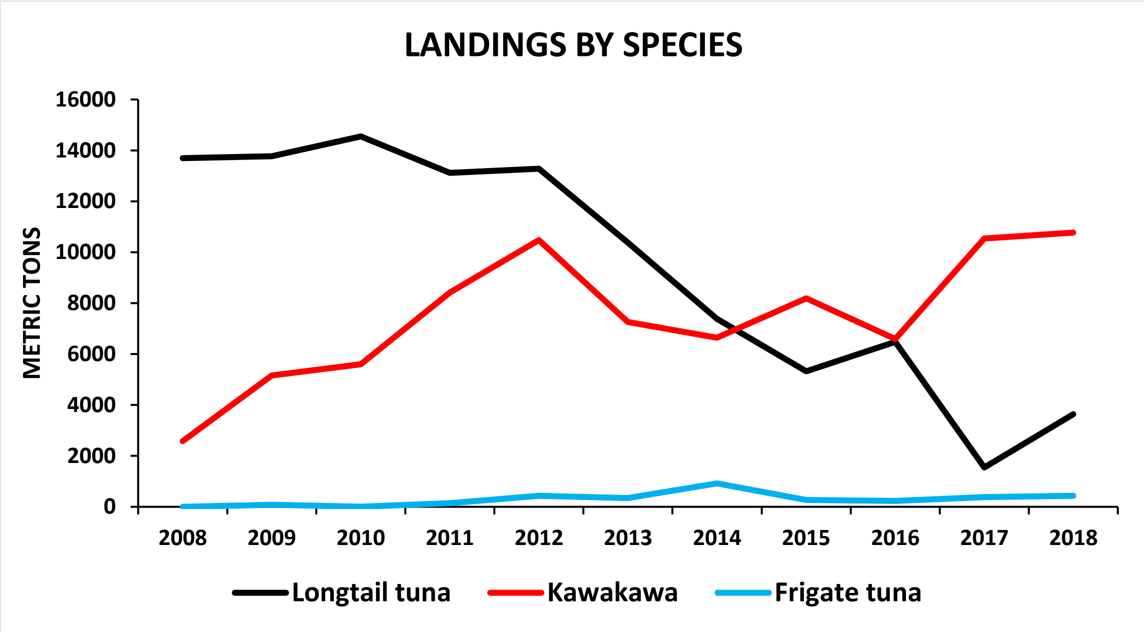

Figure 2 : Annual landings by species on the West Coast of Peninsular Malaysia

Neritic tuna landings by purse seines

Purse seine contributed more than 85% of the annual catches of neritic tuna in Malaysia. There are two types of purse seines operating in Malaysia; using FADs and light luring (Sallehudin, *et al.* 2013). Purse seine in Malaysia is categorized based on GRT, 0-9.9 GRT, 10-24.9 GRT, 25-39.9 GRT, 40-69.9 GRT and 70 GRT and above. Figure 3 showed the landing trend of neritic tunas by fishing gears in the West Coast of Peninsular Malaysia. Neritic tunas are predominantly caught by purse seine. The catches of purse seines range between 40, 764 – 67,268 mt with the highest landing is in 2017. Hook and line are the second most dominant fishing gears followed by trawl and other fishing gears.

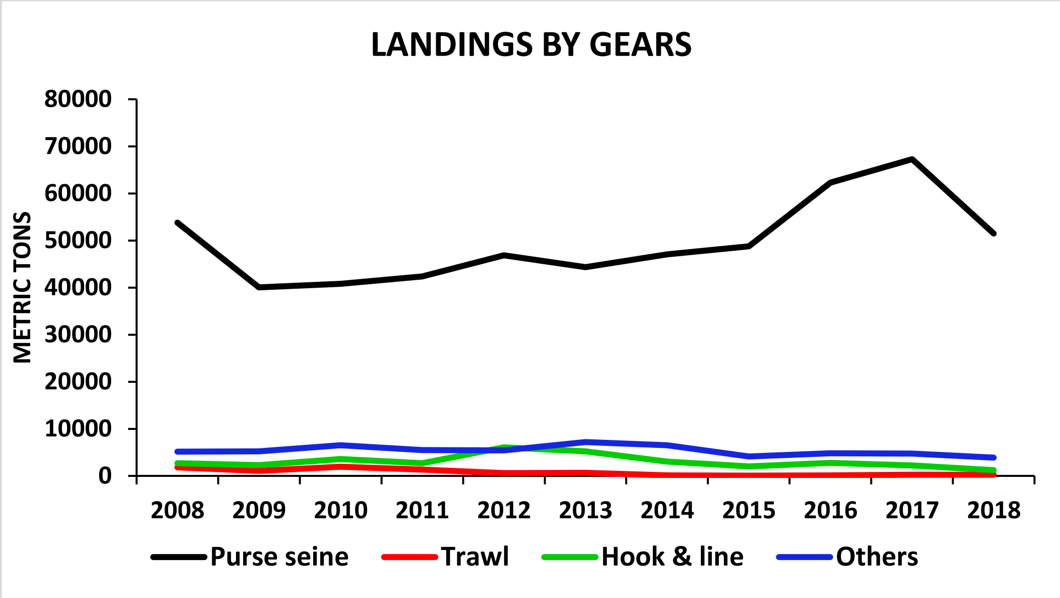

Figure 3 : Landings of neritic tunas by fishing gears on the West Coast of Peninsular Malaysia

Generally, the number of registered purse seines increase by 17% starting from 2010 with 400 vessels to 480 vessels in 2011 and continues to increase until 2017 where the number drop to 411 vessels (Figure 4). This trend coincides with the landing trends of neritic tuna in the West Coast of Peninsular Malaysia (Figure 1)

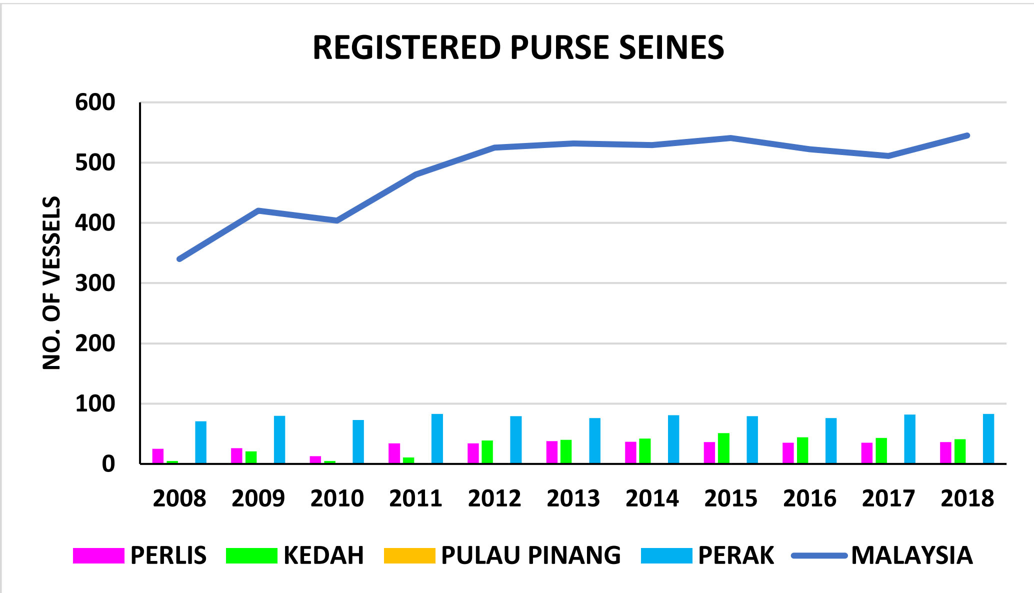

Figure 4 : Number of registered purse seine vessels on the West Coast of Peninsular Malaysia

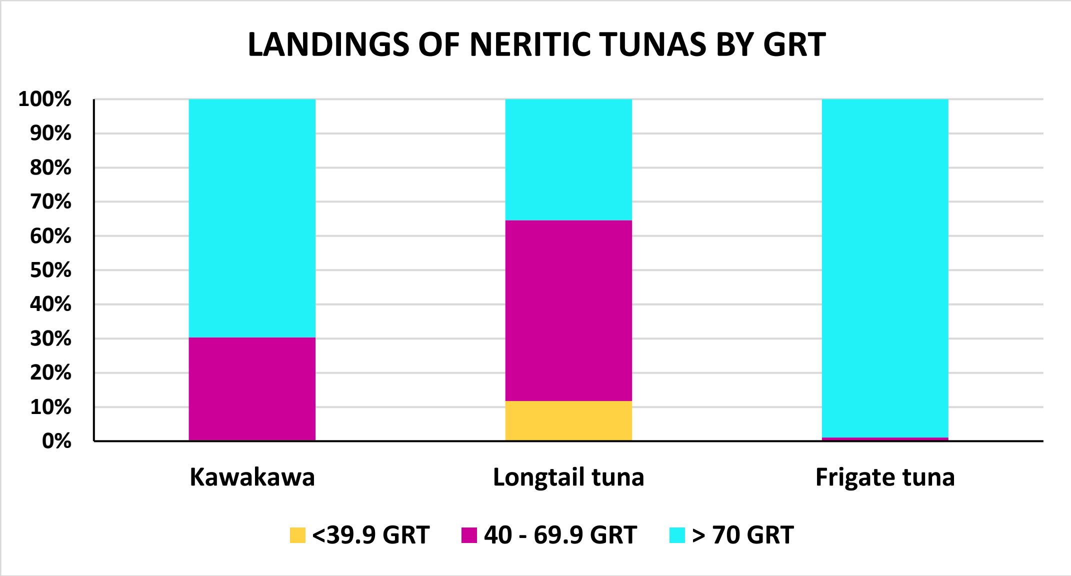

Figure 5 : Landings by species landed by purse seine vessels with different GRT

For purse seines, 96% of the neritic tuna were from the vessels above 25 GRT. Purse seine vessels from category 40-69.9 GRT and >70 GRT contributed 42% and 51% of the neritic tuna landings, respectively. The highest catch of neritic tuna by the vessels 40-69.9 GRT and >70 GRT were parallel to the number of registered vessels from these two categories. For kawakawa, 70% of the catch were from vessels size >70 GRT and the rest in from 40-69.9 GRT (Figure 5). Longtail tuna were caught by all sizes of purse seines vessels with 40-69.6 GRT being the most dominant vessels size. In contrary, frigate tuna is nearly 100% caught by vessels size more than 70 GRT.

Monthly landings of neritic tuna in West Coast of Peninsular Malaysia

The mean monthly landings of neritic tuna on the West Coast of Peninsular Malaysia suggested that this group of species is more abundant from March to August (Figure 6). However, the large standard deviations throughout the year denotes that landings were inconsistent from moth to month. Mean monthly landings of longtail tuna are consistently higher than the other two species (Figure 7). In some months the mean landings of longtail tuna are more than double those of kawakawa. There appears to be two modes, or periods of abundance, for longtail tuna, i.e. in February - May and July - August, but these are not very pronounced. The high standard deviation for August is due to the relatively very high landings in 2010. Kawakawa appears to have one mode of abundance in October. The high standard deviation for October is due to high variations in annual landings for this month. In comparison, landings of frigate tuna are rather low and insignificant, although they appear to be more abundant from March to July.

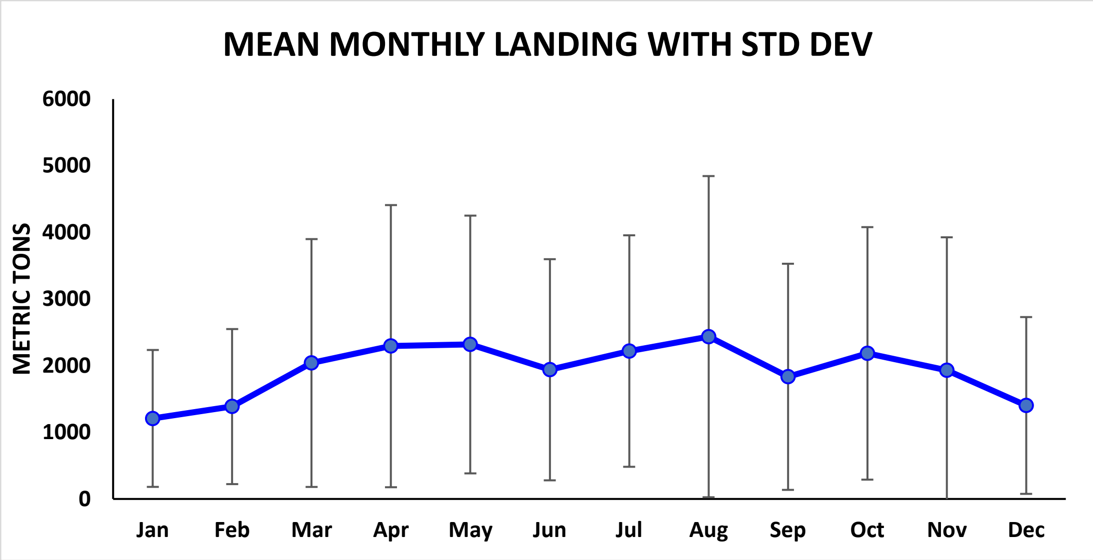

Figure 6 : Mean monthly landings of neritic tuna with standard deviation on the West Coast of Peninsular Malaysia

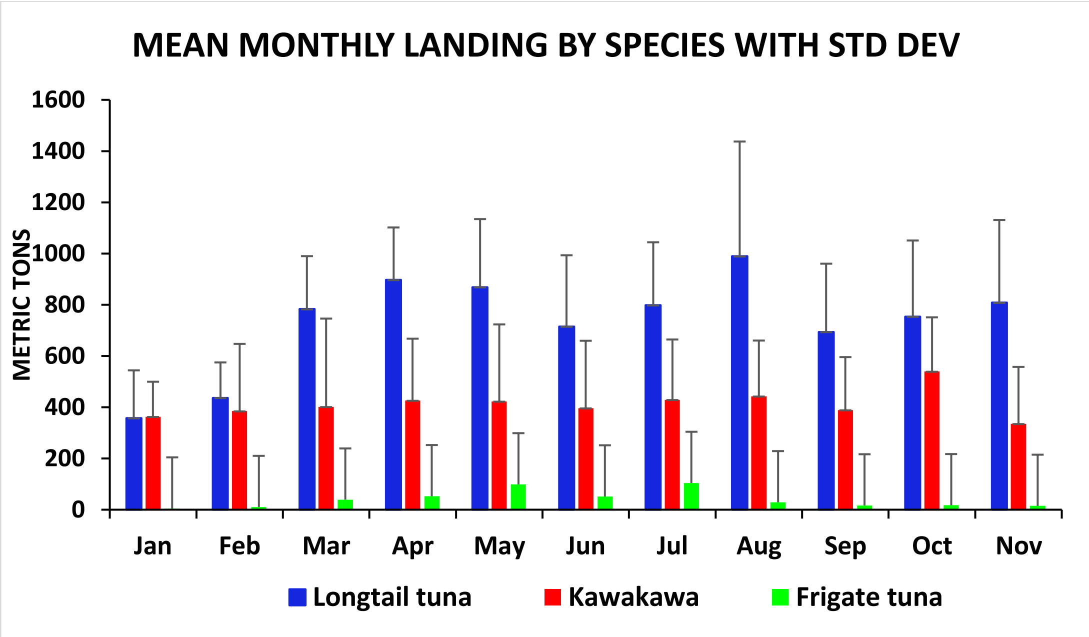

Figure 7 : Mean monthly landings of neritic tuna species on the West Coast of Peninsular Malaysia

Catch composition

Mackerels and scads are the most dominant species caught by purse seiners with 30% and 25% of the total catch, respectively (Figure 8). Neritic tuna contributes 13% of the total catch by purse seiners. In trawl net catch composition, neritic tuna makes up a small percentage of 1% from the total catch (Figure 9). Short mackerel and Indian mackerel dominated the trawl net catch by 28% and 17%, respectively.

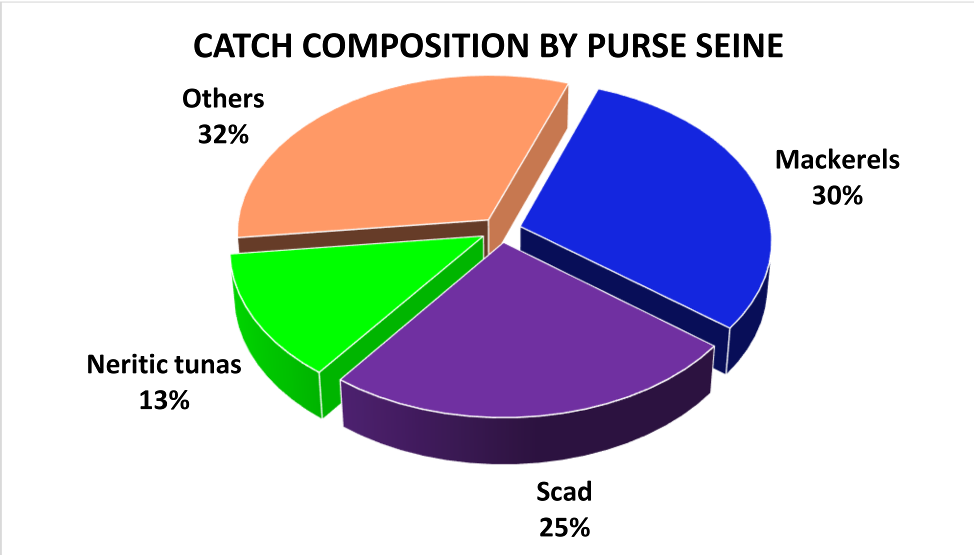

Figure 8: Catch composition by purse seines on the West Coast of Peninsular Malaysia

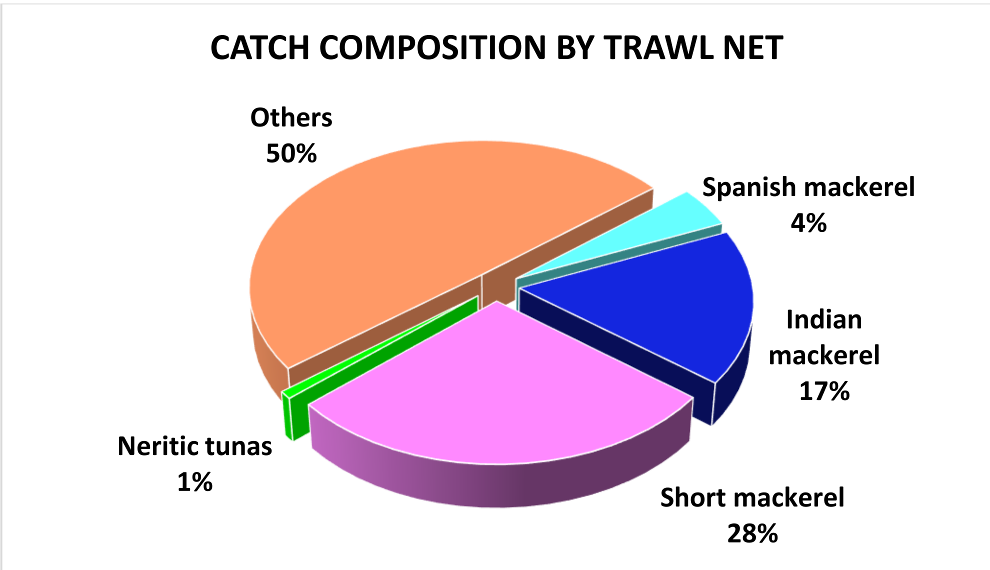

Figure 9: Catch composition by purse seines on the West Coast of Peninsular Malaysia

METHODOLOGY

Sampling at landing jetty

Two enumerators were stationed in Kuala Perlis and Bagan Panchor landing jetty for the purposes of recording data on landings and biological data as required (Figure 5). For each sampled purse seine boats, the information as below must be recorded.

i) Vessel registration number
ii) Name of boat skipper
iii) Fishing day
iv) Catch amount

After the basic information is recorded, the enumerators were then collected data on the biology. A basket of fish was taken as sub sample to obtain the catch composition of the boat. The fish in the basket were sorted into species. Each fish was weighted and measured to be recorded. Specimens were measured to the nearest 10 mm fork length (FL). Enumerators were also recorded the weight and length of 100 selected tuna species for the biological study.

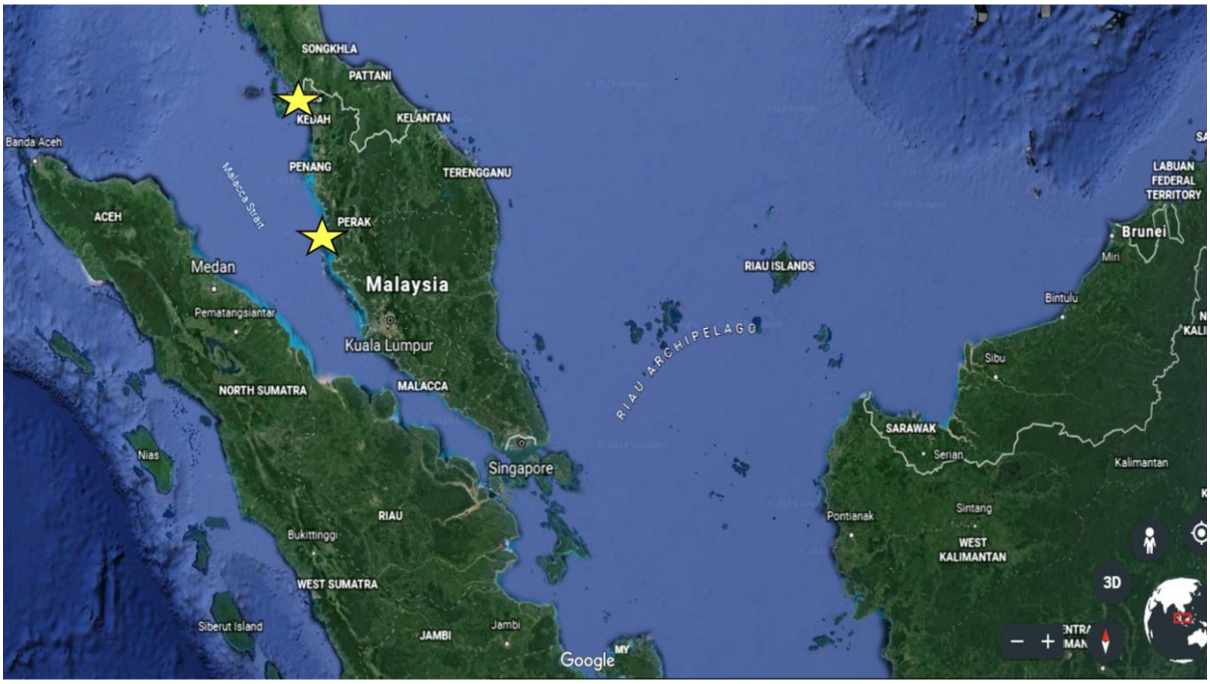

Figure 10 : Sampling station located in the West Coast of Peninsular Malaysia

Procedures in the laboratory

A total of 100 fish were sampled and brought back to the laboratory. Each individual fish was weighed and measured the length and recorded in the forms provided.

Data analysis

Population parameters were estimated from the length frequency data using computer program ELEFAN 1 of FiSAT II software and the Powell Wetherall plot (Gayanilo et al. 2005). The VBGF model was used to evaluate age and growth. Growth was investigated from length frequency data using the von Bertalanffy growth function:

$$Lt = L\infty \, (1 - \exp\,[-K\ 9t - t0])$$

Where Lt is the length at age t, L∞ is the theoretical maximum (or asymptotic) length that the species would reach if it lived indefinitely, K is the growth coefficient and t0 is the theoretical age at zero length (Sparre and Venema, 1998). FiSAT II program only provided estimates of L∞ and K, t0 was estimated using Pauly's equation (Pauly, 1980) :

$$\text{Log}\,(-t0) = -0.3922 - 0.2752\ \text{Log}\ L\infty - 1.038\ \text{Log}\ K$$

Length-converted catch curves were developed from the length frequencies to estimate the total mortality (Z) (Gayanilo et al., 2005). Natural mortality (M) was determined using Pauly's equation by taking the mean water temperature as 30°C (Pauly, 1983):

$$\text{Log}\ M = -0.0066 - 0.279\ \text{Log}\ L\infty + 0.6543\ \text{Log}\ K + 0.4634T$$

RESULT

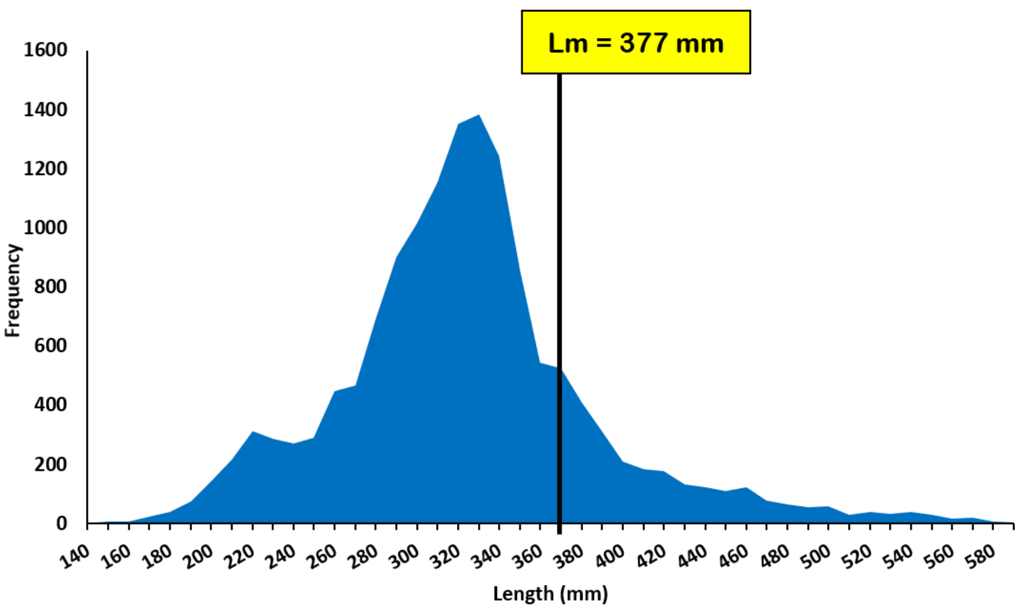

Figure 11 : Length at first maturity (Lm = 377 mm) and length frequency distribution of kawakawa (E. affinis) caught in northern part of Peninsular Malaysia

Length frequency

The length frequency distribution of kawakawa is 140 – 580 mm with major modes were at 330 mm. Length at first maturity for kawakawa is 377 mm (Figure 11). From the graph, it can be interpreted that 85% of kawakawa landed in the area was caught before reaching its first maturity.

Length weight relationship

The length-weight relationship of kawakawa was estimated as W = 0.000025 L $^{2.9335}$, where 'W' is the weight of the fish in g and 'L' is fork length in mm. (Figure 12).

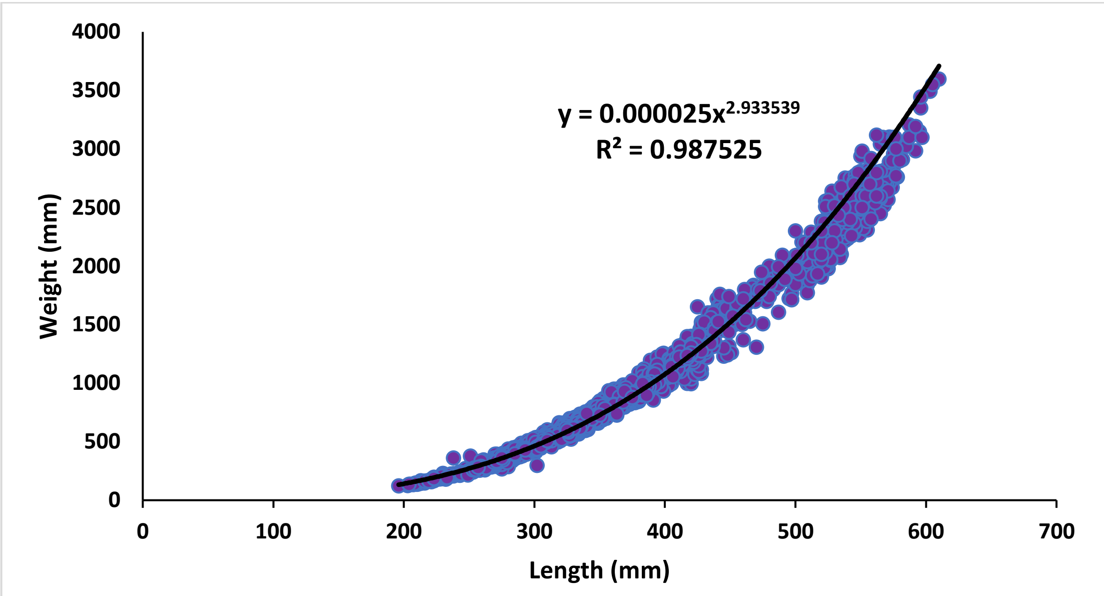

Figure 12 : Length weight relationship of kawakawa (E. affinis)

Growth parameters

The estimated von Bertalanffy growth parameter of kawakawa are L∞ = 613.73 mm, and K = 0.22. The majority of captured fish was within the size of 150 - 575 Mm (Figure 13). The estimated growth performance index (ø) for kawakawa were 4.68, which gave indication that the parameters estimated confirmed the von Bertalanffy condition. The L∞ and K found using this process were within the ranges estimated in FiSAT II.

Table 1 showed the growth parameters of kawakawa in the northern part of Peninsular Malaysia. The natural mortality rate (M), fishing mortality rate (F) and total mortality rate (Z) of kawakawa were 0.30, 0.46 and 0.75 respectively (Figure 14). The exploitation rate of kawakawa is E = 0.61 was considered moderate indicating the resources can still be further exploited.

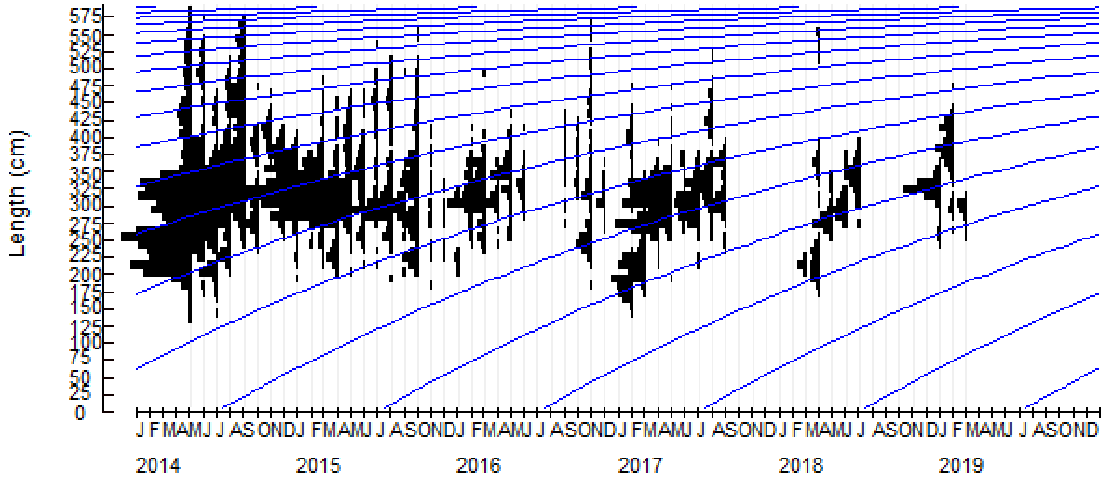

Figure 13 : The Von Bertalanffy graph plot of kawakawa (*Euthynnus affinis*) in the northern part of Peninsular Malaysia

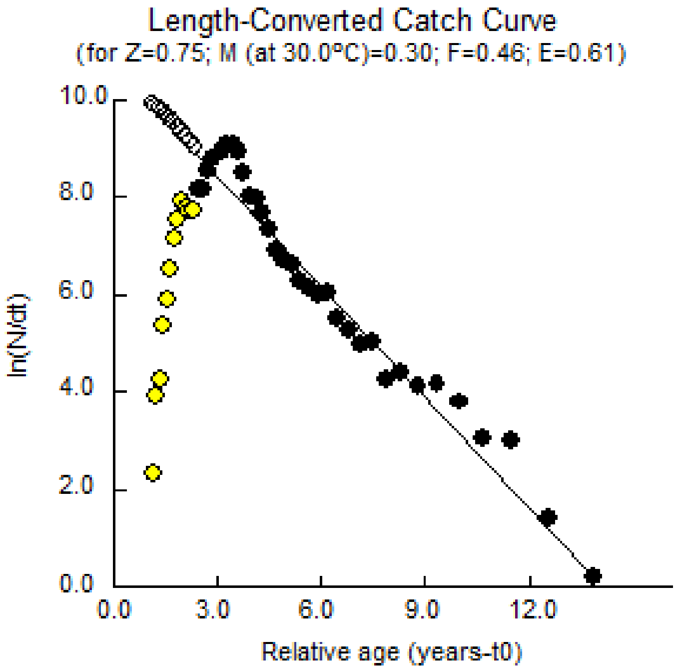

Figure 14 : Mortalities and exploitation rate of kawakawa (*Euthynnus affinis*) estimated using length converted catch curve

Table 1 : Growth parameters of kawakawa

Species name	Common name	L∞ (mm)	K	Z	M	F	E

Euthynnus affinis	Kawakawa	613.73	0.72	0.75	0.30	0.46	0.61

DISCUSSION

Neritic tuna in Malaysia is considered as a bycatch of commercial fishing gears, purse seiners and trawlers. This species group is distributed almost throughout the continental shelf of Malaysia waters. These species have traditionally been caught in Malaysia at subsistence levels by fisherman using a variety of fishing gears (Chee, 1995). Purse seine is the most important fishing gear in neritic tuna fisheries and contributed more than 82% of the annual catches of neritic tuna in Malaysia (Ahmad Adnan, et. al. 2015).

The length weight relationship of kawakawa caught from different regions has been estimated by several earlier studies and the values of 'a' and 'b' obtained are as in Table 2. For the present study, kawakawa in Kuala Perlis exhibit isometric growth with the 'b' value close to 3 (Figure 12). Growth parameters in the von Bertalanffy equation as estimated by earlier studies and present study are given in Table 3. Kawakawa is a fast-growing fish attaining a maximum length of around 580 mm. However, the $L\infty$ estimated from other regions are much higher which ranged from 810 – 890 mm, than the estimated value obtained in the present study. The 'K' value obtained from this study also revealed a much bigger value than earlier studies in other regions.

Table 2 : estimated value of 'a' and 'b' of kawakawa in the length-weight relationship

Region	a' value	b' value	Reference
Philippines waters	0.0334	2.838	Ronquillo, 1963
South China Sea	0.0885	2.565	Williamson, 1970
Indian waters	0.0254	2.889	Pratibha et al. 2012
West Coast of Peninsular Malaysia	0.000026	2.933	Present study

Table 3 : Estimates of growth parameters of kawakawa from earlier and present studies in the regions

Region	$L\infty$ (mm)	K	Reference
Maharashtra, India	817	0.79	Khan, 2004
Persian Sea of Oman	877	0.51	Taghvai, 2010
Veraval, India	725	0.56	Ghosh et al. 2010
Indian waters	819	0.56	Pratibha et al. 2012
West Coast of Peninsular Malaysia	614	0.72	Present study

In northern part of Peninsular Malaysia, kawakawa of size range 150 – 575 mm fork length represented the catches throughout the year. Common size in commercial catches ranged from 230 – 400 mm FL. Peak period of occurrence of commercial size is March to June. In sampling areas, kawakawa were mostly caught below the size of first maturity (Lm = 377 mm), thus indicating that the fish did not have the chance to spawn for the first time in their life.

Data collection and recording system for neritic tuna species need improvement as they are important for future stock assessment analysis that will provide the scientific information for sustainable management of the neritic tuna species in Malaysian waters. As neritic tuna are shared stocks, thus managing it need a regional management. To manage the shared stocks, it needs systematic cooperation and shared management between the bordering countries such as Malaysia, Thailand and Indonesia.

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