

## Indian Mackerel (*Rastrelliger kanagurta*) Stock Status and Resources in Northern West Coast of Peninsular Malaysia

EFFARINA MOHD FAIZAL ABDULLAH\*, NUR AMALIA SALEH AND FATHUL A'DNNIN ZULPAKAR

*Fisheries Research Institute Kg Acheh, 32000 Sitiawan, Perak, Malaysia*

\*Correspondence Author: [effarina@dof.gov.my](mailto:effarina@dof.gov.my)

**Abstract:** Indian mackerel (*Rastrelliger kanagurta*) is one of the common and economically important pelagic fish in Malaysia. This study was conducted from January 2017 to December 2018. Samples were collected monthly from the commercial purse seines in Kuala Perlis, Perlis landing site. The objective of this study was to assess the resources and stock status of Indian mackerel in the northern area of the West Coast of Peninsular Malaysia. The catches and Catch Per Unit Effort (CPUE) trend in the West Coast Peninsular Malaysia (WCPM) showed fluctuation from 2008 to 2018. The spawning season for the Indian mackerel in WCPM were estimated to be in December to March. The maximum spawning activity occurred in January with the male and female GSI at 4.3 and 3.7 respectively. In WCPM, the highest landing of Indian mackerel comes from purse seines and trawls net. The analysis from Kobe plot showed the stock status of Indian mackerel in WCPM was in the green zone implying it is still safe to be harvested.

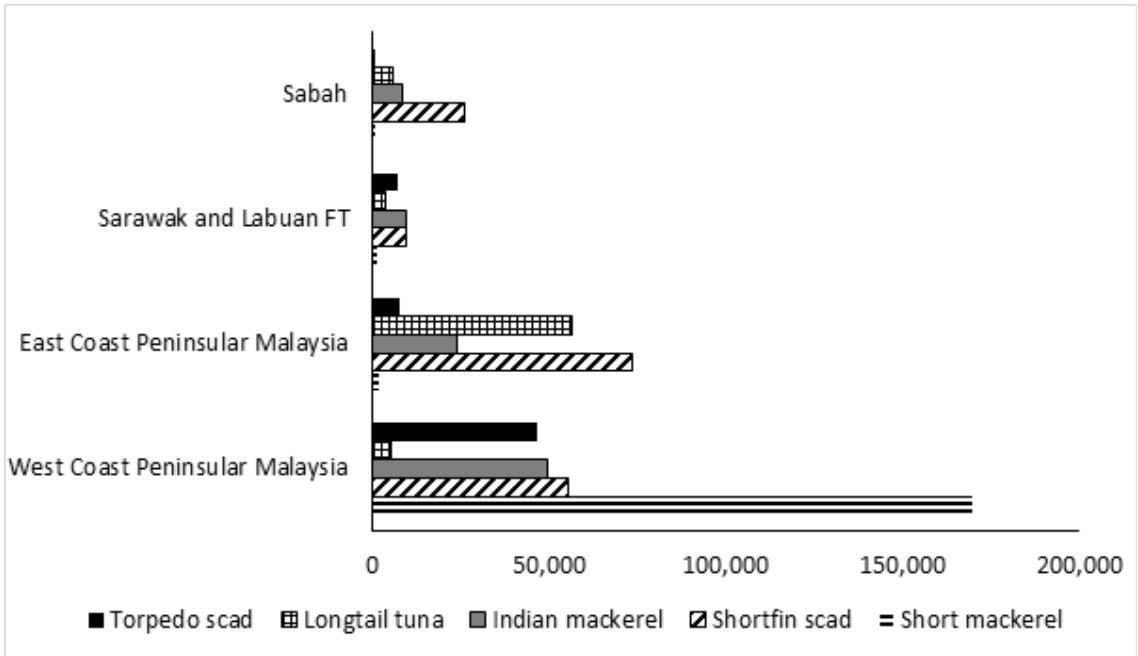
**Keywords:** Indian mackerel, spawning season, stock status, West Coast of Peninsular Malaysia

**Abstrak:** Ikan kembong (*Rastrelliger kanagurta*) merupakan spesies yang biasa di jumpai dalam kumpulan ikan pelagik di Malaysia. Kajian status stok dan sumber ikan kembong telah dijalankan dari Januari 2017 hingga Disember 2018. Sampel ikan kembong diperolehi dari tangkapan pukat jerut di jeti pendaratan ikan Kuala Perlis. Objektif kajian ini adalah untuk mentaksir status stok dan sumber ikan kembong di bahagian utara pantai barat Semenanjung Malaysia. Tangkapan per unit usaha (CPUE) di pantai barat menunjukkan corak turun naik dari tahun 2008 hingga 2018. Musim pembiakan ikan kembong di kawasan pantai barat dijangka berlaku pada bulan Disember - Mac. Aktiviti pembiakan yang tinggi dapat dilihat pada bulan Januari dengan nilai gonadosomatik bagi jantan dan betina masing-masing sebanyak 4.3 dan 3.7. Analisis Plot Kobe pula menunjukkan status stok ikan kembong masih berada di zon hijau yang memberi gambaran bahawa spesies ini masih boleh di eksploitasi secara mapan.

### Introduction

The Indian mackerel, (*Rastrelliger kanagurta*) is one of the economically important epipelagic fish species in Malaysia. An epipelagic fish inhabits the epipelagic zone *i.e.*, water from the surface of the sea down to 200 metres (Lønborg et al., 2016) and also referred to as the surface waters or the photic zone. The Indian mackerel belongs to the Scombrid family of the Perciformes Order (Froese and Pauly, 2021). This species is commonly distributed across the Indo-West Pacific from South Africa, the Seychelles and the Red Sea, east of Indonesia and Northern Melanesia, Micronesia, Samoa, China and Ryukyu Islands of Southern Japan (Akib et al., 2015).

The Indian mackerel is abundant across the waters off north-west and east of Peninsular Malaysia, Sabah and Sarawak (Mansor 1997; Chee 1999). They feed mainly on zooplankton, phytoplankton and algae (Hulkoti et al., 2013). It is a highly migratory species with a streamlined fusiform body that make them fast swimmers and habitually found in big schools. In Malaysia, the Indian mackerel contributed about 4.87 % of the total marine fish landings in 2021 (Department of Fisheries Malaysia, 2021). It was also the third highest pelagic species landed after the short mackerel and scads. Figure 1 shows the landing of the important pelagic species according to the fishing areas in 2021.



**Figure 1.** The landings of important pelagic species (tonnes) by fishing areas in 2021

The fishing waters of Malaysia can be mainly divided into four zones, West Coast of Peninsular Malaysia (WCPM), East Coast of Peninsular Malaysia (ECPM), Sabah and Sarawak. The WCPM covers the Strait of Malacca that embraces the north of the Andaman Sea and Indian Ocean. The main fishing gears commonly used to catch the Indian mackerel are purse seine and trawl net. In 2021, about 34.82% out of 40,959.95 tonnes of Indian mackerel landed in the country was contributed by purse seine while 26.34% from trawl net (Department of Fisheries Malaysia, 2021). There is possible usage of other tools by the purse seiners such as fish aggregating devices (FADs) or light to lure the fish into the net.

There are various methods used for stock assessment depending on the types of data, knowledge used and degree of age-structured population dynamics in the models (Cadrin and Collas, 2015). One of the methods, Kobe or phase plot analysis had been utilized to evaluate the status of tuna stock based on the fishing mortality (F) and biomass (B) associated with Maximum Sustainable Yield (MSY; *i.e.*, FMSY and BMSY) (Maunder and Aires-de-Silva, 2011). This method was introduced by the Tuna Regional Fisheries Management Organization (RFMOs), held in Kobe, Japan in January 2007.

The aim of fishery management is to ensure sustainability in harvesting fish stocks and to avoid depletion of the resources. A successful or accurate stock assessment is very important so that fishery management for certain species can be developed depending on the estimation on quota and allowable catch regulation. This is applicable to all fish including the Indian mackerel. The resources should be managed at the optimum level since it is an important commercial fish and among 10 most preferred fish in Malaysia (Nurul Izzah et al., 2016).

This study utilizes the Kobe plot analysis to determine the current stock status of the Indian mackerel in the WCPM. The information provided through the biology and stock assessment in this study may be used by the fisheries managers to formulate the best strategy to ensure the sustainable management of this valuable resource in Malaysia.

## Materials and Methods

Biological data were collected from from 2017-2018 for gonad maturity study. Samples of the Indian mackerel were collected monthly from the commercial purse seiners at Kuala Perlis, West Coast of Peninsular Malaysia landing site. In total, 3,318 Indian mackerel samples were collected and measured for gonadosomatic index estimation (GSI). The GSI is a metric that represents the relative weight of the gonad to the fish weight. Next, the length and weight of the fish were measured by using a ruler with 1 mm accuracy and an analytical scale with an accuracy of 0.01 gram. Gonads were observed and removed, then weighted on the analytical scale of 0.01 gram for GSI purpose.

Secondary data was obtained from the Department of Fisheries, Malaysia to elucidate the catch and landing trend of the Indian mackerel in Malaysia. For the stock assessment study of the Indian mackerel, the Kobe plot were used to analyse the data. There are two main visualization tools used in the Kobe Framework; a phase plot and strategy matrix. The phase plot visualized the current stock status and exploitation rate according to the targeting points such as BMSY and FMSY of the Indian mackerel. On the other hand, the strategy matrix represents the probability of catch according to the management objective such as the Total Allowable Catch (TAC). This will be translated according to colours stated such as green (safe zone), yellow (recovery), and red (overfished).

## Results and Discussion

### *Gonad maturation study*

The spawning season for the Indian mackerel in WCPM were estimated to be in December to March based on the highest value of GSI for both sexes (value ranged between 2.7 - 4.3) (Figure 2). The maximum spawning activity occurred in January with the male and female GSI at 4.3 and 3.7 respectively. The size at first maturity was estimated to be 19.6 cm for male and 20.4 cm for female. The fecundity of fish ranged between 25,144 – 151,256 eggs.

Seasonal variations in the values of GSI were reported by different researchers for different areas. Rahman and Hafzath (2012) stated the spawning season of Indian mackerel in Kuantan coastal water falls within the period between end of January and end of May. Furthermore, others studies stated that there are two spawning seasons of *Rastrelliger kanagurta* in Western waters of Aceh, the first from January to March and then from August to October (Arrafi et al., 2016). Spawning season for present study coincides with several studies from adjacent waters (Table 1).

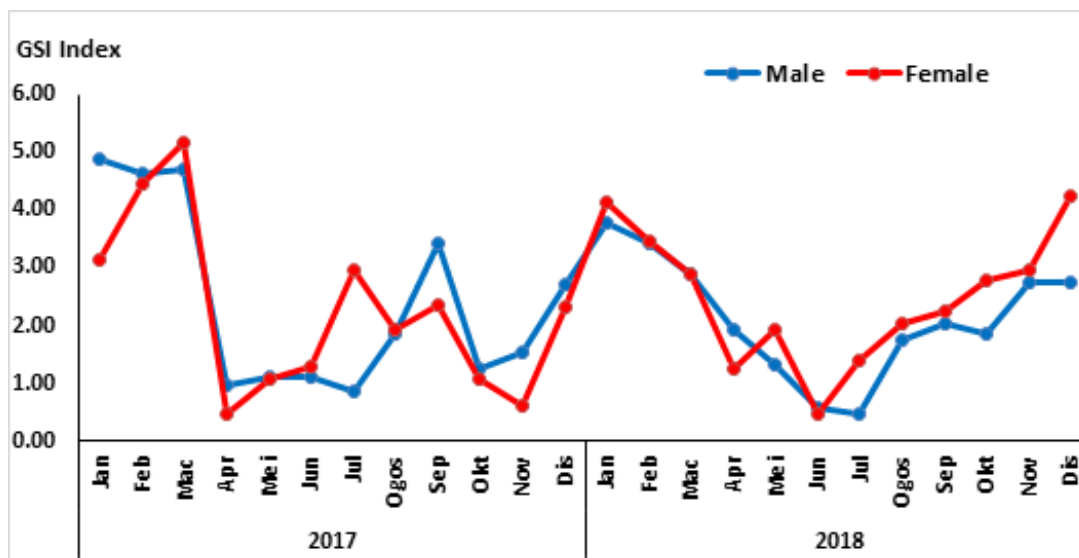


Figure 2. Average gonado-somatic index of the Indian mackerel in the West Coast Peninsular Malaysia, 2017-2018

Table 1. Spawning season of Indian mackerel from adjacent waters

Spawning season	Study area	References
December – January	Kakinada, India	Abdussamad et al., (2006)
June – August	South China Sea	Suwarso et al., (2008)
January – May	Kuantan coastal, Malaysia	Rahman and Hafzath (2012)
January – March August – October	Western waters of Aceh, Indonesia	Arrafi et al., (2016)
October – November	Kwandang waters, north Gorontalo, Indonesia	Faizah et al., (2017)
April and August	West Bengal, India	Das et al., (2016)
December-March	West coast Peninsular Malaysia	Present study

### Catch and landing trend

Figure 3 illustrates catch trends for the Indian mackerel in WCPM from 2008 to 2018. In general, the catch trend shows a gradual increase in catch from 2008 (20,540 tonnes) to 2012 (40,229 tonnes) before dropping slightly in 2013 with catches at 29,000 tonnes with an ascending trend again in 2014 with the highest catch recorded at 44,400 tonnes. The catch however gradually decreased again from 2015 to 2017 and raised again in 2018 at 27,738 tonnes. The catch per unit effort (CPUE) also showed similar trends as the catch.

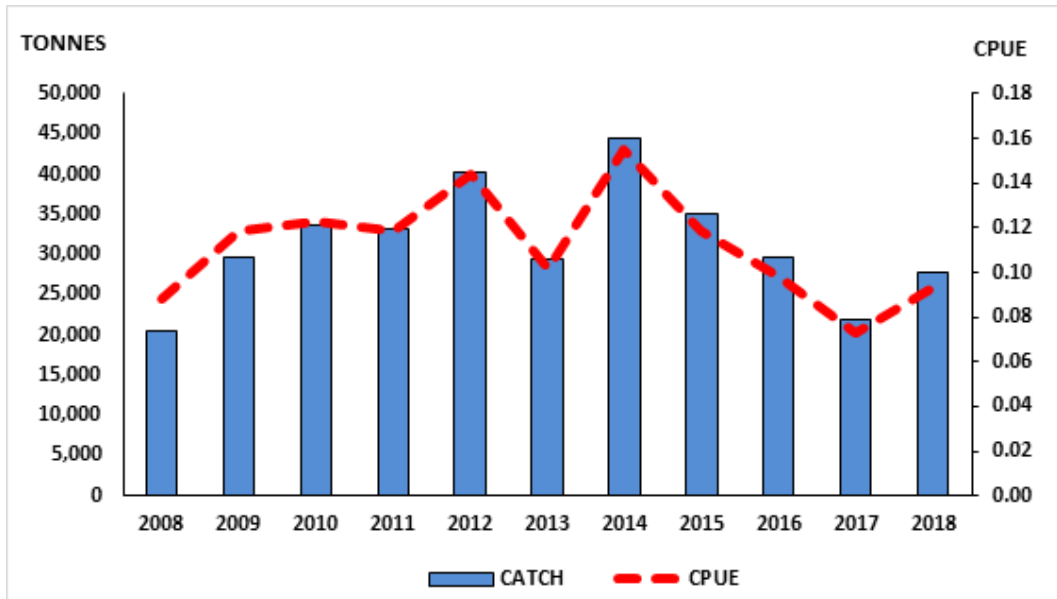


Figure 3. Catch and CPUE of the Indian mackerel in the West Coast of Peninsular Malaysia, 2008 to 2018

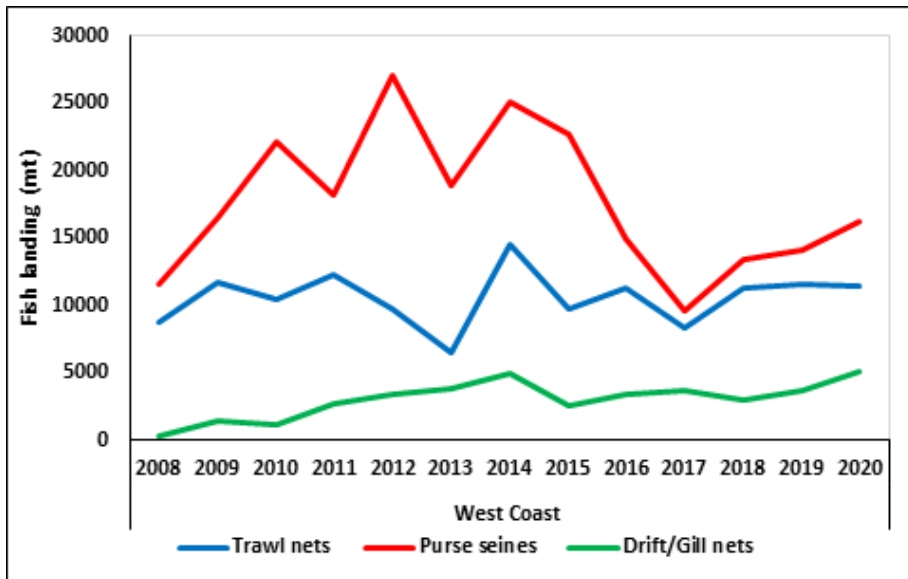
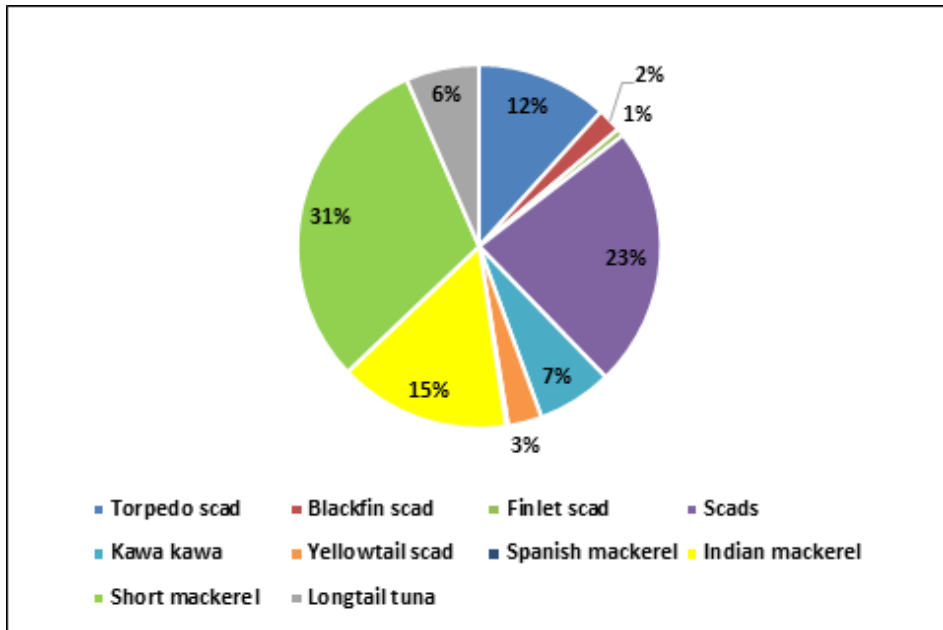


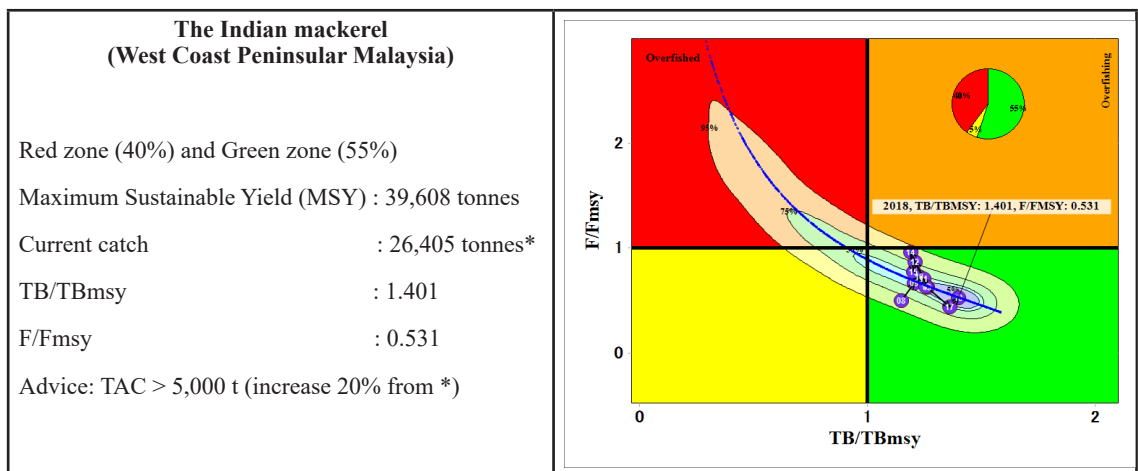
Figure 5. Landing by gears of Indian mackerel in West Coast Peninsular Malaysia, 2008 to 2020

In West Coast of Peninsular Malaysia, the highest landing of Indian mackerel from 2008 to 2020 was by purse seines (214,124 mt) then followed by trawl nets (126,184 mt) and drift/gill nets (33,845 mt) (figure 5). The highest landing of Indian mackerel by purse seines was in 2012. Figure 7 showed catch composition percentage of pelagic fish by purse seines in 2008 to 2020. In West Coast of Peninsular Malaysia, the Indian mackerel (15%) was among the highest catch percentage after short mackerel (31%) and Scads (23%) which are also deemed as '*Ikan Rakyat*'. Thus, it showed that Indian mackerel were one of the targeted species by major fishing gears in the WCPM as it serves as cheap and reliable source of protein for Malaysian.



**Figure 7.** Catch composition of pelagic fish by purse seines in West Coast Peninsular Malaysia from 2008 to 2020.

Based from the stock and risk assessment of the Indian mackerel using Kobe plot analysis showed that the status of this species in WCPM was in the green zone implying that the stock was still safe to be harvested (Figure 5). The current catch level was 26,405 tonnes whereas the risk of exceeding the TBmsy and Fmsy was 30 %. Thus, the total catch of the Indian mackerel in the WCPM could be increase by additional 20 % (31,686 tonnes) while reserving 10 % as a buffer to overexploitation to ensure that the stock can be sustained for the next 10 years.



**Figure 5.** Stock status (2018) and management advices (Total Allowable Catch/TAC) based on stock assessment by Kobe Plot Analysis

## Conclusion

The stock status of the Indian mackerel in Malaysia as of 2018, being in the green zone for West Coast Peninsular Malaysia implies that the stock is still safe to be harvested. Hence, based on the current catch level, a proper management should be taken into consideration to ensure that the stock of the Indian mackerel lies within its safe zone or can be sustained for the next decade.

The collaboration with neighbouring countries such as Thailand and Indonesia should also be considered due to the migratory-epipelagic nature of this species. Through the establishment of Technical Working Group, activities such as information exchange can be developed. Skills development through capacity building or training program can be developed and upgraded. A cooperation between scientist and managers also could be facilitated so the development of information, education and communication programs on sustainable use of resources can be supported thus management measures to control fishing effort and capacity at national or even regional level can be established.

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