DRAFT: EXECUTIVE SUMMARY: BLACK MARLIN

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi

Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource

TABLE 1. Black marlin: Status of black marlin (*Makaira indica*) in the Indian Ocean

Area[1]	**Indicators**		**2013 stock status determination**
Indian Ocean	Catch 2012: Average catch 2008–2012:	8,315 t 9,417 t	**Uncertain**
	MSY (range): F_{2011}/F_{MSY} (range): B_{2011}/B_{MSY} (range): B_{2011}/B_{1950} (range):	8,605 (6,278–11,793) 1.03 (0.15–2.19) 1.17 (0.75–1.55) 0.58 (0.38–0.78)	

[1]Boundaries for the Indian Ocean = IOTC area of competence

Colour key	Stock overfished ($B_{year}/B_{MSY} < 1$)	Stock not overfished ($B_{year}/B_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Data poor methods for stock assessment using Stock reduction analysis (SRA) techniques indicate that the stock is not overfished and close to optimum fishing levels (Table 1). However, as this is the first time that the WPB used such a method on marlin species, further testing of how sensitive this technique is to model assumptions and available time series of catches needs to be undertaken before the WPB uses it to determine stock status. Thus, the stock status remains **uncertain**. Nonetheless in using the SRA method for comparative purposes with other stocks, the WPB considers that the use of the target reference points may be possible for the approach. The stock appears to show an increase in catch rates which is a cause of concern, indicating that fishing mortality levels may be becoming too high (Fig. 1). Aspects of the biology, productivity and fisheries for this species combined with the data poor status on which to base a more formal assessment are a cause for concern. Research emphasis on developing possible CPUE indicators and further exploration of stock assessment approaches for data poor fisheries are warranted. Given the limited data being reported for coastal gillnet fisheries, and the importance of sports fisheries for this species, efforts must be made to rectify these information gaps.

Outlook. Total catch for black marlin in recent years has continued to increase to a total of 8,315 t in 2012 (10,421 in 2011). The following key points should be noted:

- Maximum Sustainable Yield estimate for the whole Indian Ocean is between 6,278 and 11,793 t.
- improvement in data collection and reporting, particularly for coastal gillnet and sports fisheries, is required to further assess the stock.
- research emphasis on improving indicators and further exploration of stock assessment approaches for data poor fisheries are warranted.

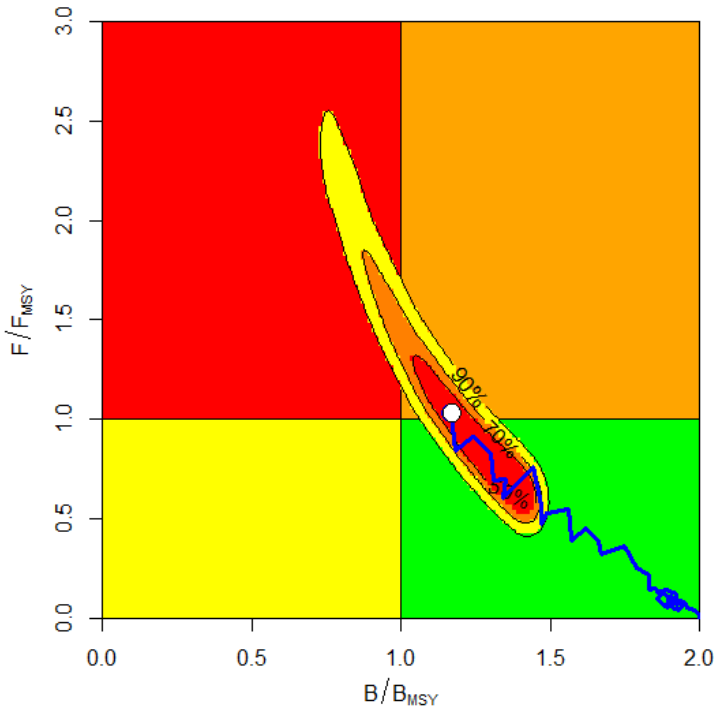

Fig. 1. Black marlin: Stock reduction analysis aggregated Indian Ocean assessment Kobe plots for black marlin (95% confidence surfaces shown around 2011 estimate). Blue line indicates the trajectory of the point estimates for the total biomass (B) ratio and F ratio for each year 1950–2011.

SUPPORTING INFORMATION

(Information collated from reports of the Working Party on Billfish and other sources as cited)

CONSERVATION AND MANAGEMENT MEASURES

Black marlin (*Makaira indica*) in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission, although none are species specific:

- Resolution 13/03 on the recording of catch and effort by fishing vessels in the IOTC area of competence
- Resolution 13/07 concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information
- Resolution 12/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*
- Resolution 11/04 *on a regional observer scheme*
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*

FISHERIES INDICATORS

Black marlin: General

Black marlin (*Makaira indica*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans (Fig. 2). Table 2 outlines some key life history parameters relevant for management. There is limited reliable information on the catches of black marlin and no information on the stock structure or growth and mortality in the Indian Ocean.

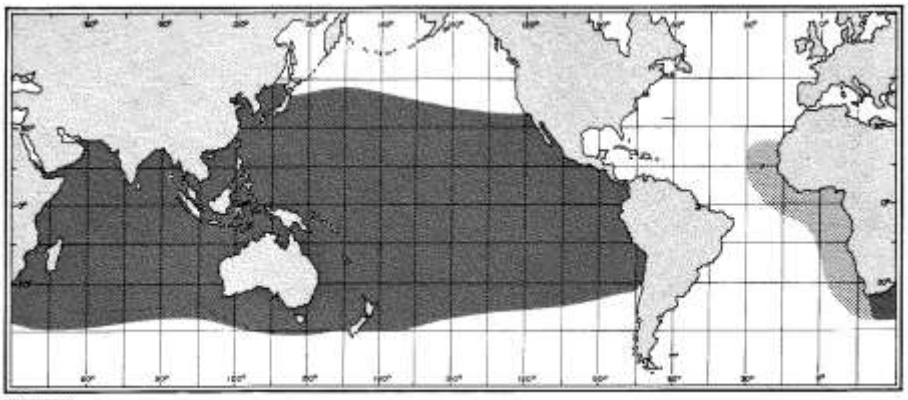

Fig. 2. Black marlin: The worldwide distribution of black marlin (Source: Nakamura 1984)

TABLE 2. Black marlin: Biology of Indian Ocean black marlin (*Makaira indica*)

Parameter	Description
Range and stock structure	Little is known on the biology of the black marlin in the Indian Ocean. Black marlin is a highly migratory, large oceanic apex predator that inhabits tropical and subtropical waters of the Indian and Pacific oceans. Some rare individuals have been reported in the Atlantic Ocean but there is no information to indicate the presence of a breeding stock in this area. Black marlin inhabits oceanic surface waters above the thermocline and typically near land masses, islands and coral reefs; however rare excursions to mesopelagic waters down to depths of 800 m are known. Thought to associate with schools of small tuna, which is one of its primary food sources (also reported to feed on other fishes, squids and other cephalopods, and large decapod crustaceans). No information on stock structure is currently available in the Indian Ocean; thus for the purposes of assessment, one pan-ocean stock is assumed. Long distance migrations at least in the eastern Indian Ocean (two black marlins tagged in Australia were caugh off east Indian coast and Sri Lanka) support a single stock hypothesis. It is known that black marlin forms dense nearshore spawning aggregations, making this species vulnerable to exploitation even by small-scale fisheries. Spatial heterogeneity in stock indicators (catch–per–unit–effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	No data available for the Indian Ocean. In the Pacific (Australia) 11–12 years.
Maturity (50%)	**Age**: unknown **Size**: females around 100 kg; males 50 to 80 kg total weight
Spawning season	No spawning grounds have been identified in the Indian ocean. Spawning hotspot off eastern Australia apparently has no links with Indian Ocean stock. Spawning individuals apparently prefer water temperatures above 26–27°C. Highly fecund batch spawner. Females may produce up to 40 million eggs.
Size (length and weight)	Maximum: In other oceans can grow to more than 460 cm FL and weigh 800 kg total weight. In the Indian Ocean it reach at least 360 cm LJFL. Young fish grow very quickly in length then put on weight later in life. In eastern Australian waters black marlin grows from 13 mm long at 13 days old to 180 cm and around 30 kg after 13 months. Sexual dimorphism in size, growth rates and size and age at maturity - females reach larger sizes, grow faster and mature later than males. In the Indian Ocean documented maximum size for females: 306 cm LJFL, 307 kg total weight; males: 280 cm LJFL, 147 kg total weight. Most black marlin larger than 200 kg are female. Recruitment into the fishery: varies by fishing method; ~60 cm LJFL for artisanal fleets and methods. The average size of black marlin taken in Indian Ocean longline fisheries is not available. L-W relationships for the Indian Ocean are: females TW=0.00000010*LJFL**3.7578, males TW=0.00002661*LJFL**3.7578, both sexes mixed TW=0.00000096*LJFL**3.35727, TW in kg, LJFL in cm. However these relationships were obtained from small sample sizes (n=75), therefore it should be treated with caution.

Sources: Nakamura 1985, Cyr et al. 1990, Gunn et al. 2003, Speare 2003; Sun et al. 2007, Froese & Pauly 2009, Romanov & Romanova 2012, Domeier & Speare 2012

Black marlin: Catch trends

Black marlin are caught mainly by drifting longlines (19%) and gillnets (59%) with remaining catches taken by troll and hand lines (Table 3, Fig. 3). Black marlin are not targeted by industrial fisheries, but is targeted by some artisanal and sport/recreational fisheries. Black marlin are also known to be taken in purse seine fisheries, but are not currently being reported.

In recent years (2010–12) the fleets of Sri Lanka (longline and gillnet), Indonesia (troll and hand lines) and India (gillnet and troll) account for around 74% of the catch of black marlin (Fig. 4). Catches of black marlin have increased steadily since the 1990s, from around 2,800 t in 1991 to over 10,400 t in 2011. Current annual catches are estimated at between 8,000 t to 10,000 t (Table 3).

Between the early-1950s and the late-1980s part of the Japanese fleet was licensed to operate within the EEZ of Australia, and reported very high catches of black marlin in that area, in particular in waters off northwest Australia. In recent years, deep-freezing longliners from Japan and Taiwan,China have reported lower catches of black marlin, mostly in waters off the western coast of India and, to a lesser extent, the Mozambique Channel (Fig. 5).

The catches of black marlin in Sri Lanka have risen steadily since the mid-1990's as a result of the development of the fishery using a combination of drifting gillnets and longlines, from around 1,000 t in the early 1990s to over 4,500 t in 2011. In recent years (2009–11) India has reported higher catches of black marlin for its fisheries, amounting to around 1,000 t to 2,000 t, largely from increases in catches from gillnet and troll.

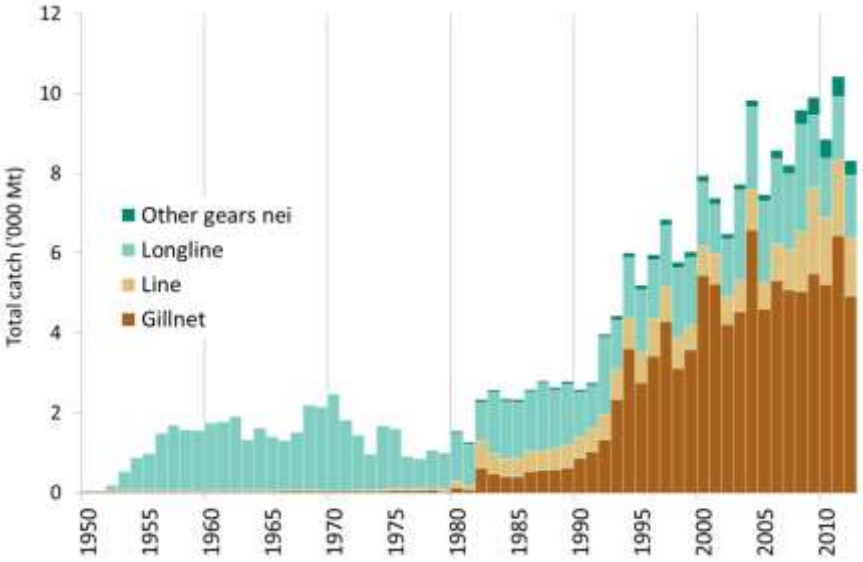

Fig. 3. Black marlin: Catches of black marlin by gear and year recorded in the IOTC Database (1950–2012) (Data as of October 2013).

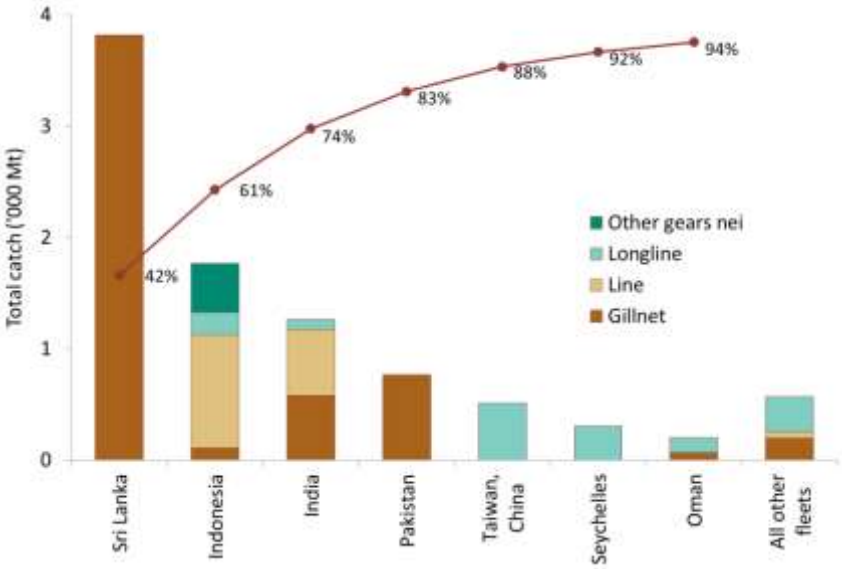

Fig. 4. Black marlin: Average catches in the Indian Ocean over the period 2010–12, by country. Countries are ordered from left to right, according to the importance of catches of black marlin reported. The red line indicates the (cumulative) proportion of catches of black marlin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries (Data as of October 2013).

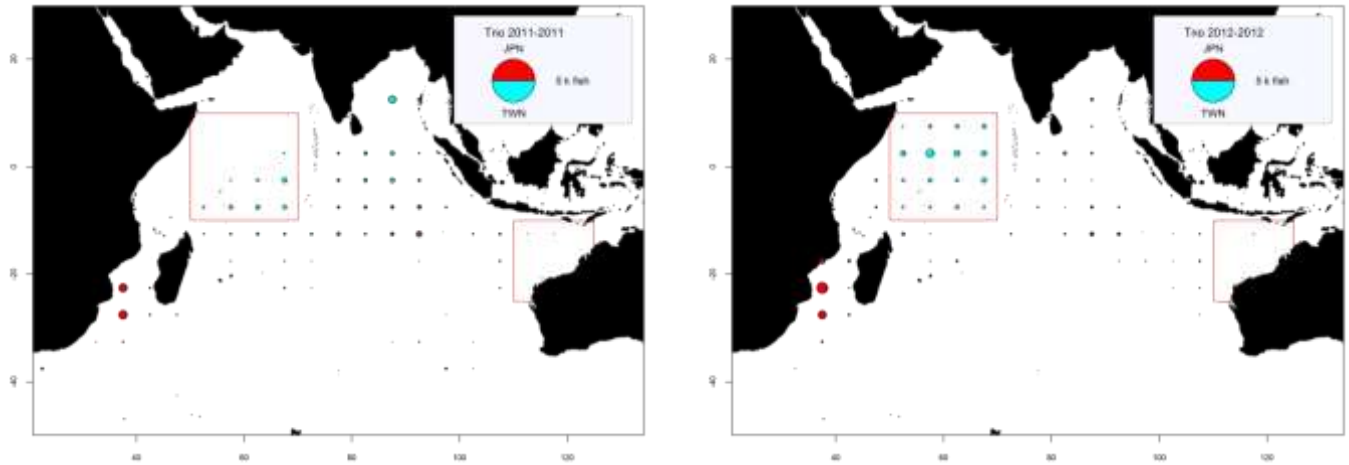

Fig. 5a–b. Black marlin: Time-area catches (in number of fish) of black marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for 2011 and 2012 by fleet. Red lines represent the boundaries of the marlin hot spots identified by the WPB.

TABLE 2. Black marlin: Best scientific estimates of the catches of black marlin by type of fishery for the period 1950–2012 (in metric tons) (Data as of October 2013).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
LL	846	1,633	1,287	1,370	1,486	1,920	2,277	2,075	2,057	2,123	1,879	2,704	1,803	1,498	1,598	1,562
GN	26	31	44	438	2,631	5,152	4,533	6,581	4,601	5,319	5,081	5,041	5,488	5,214	6,436	4,924
HL	24	27	42	446	727	1,020	775	1,008	652	913	1,018	1,479	2,159	1,669	1,891	1,477
OT	0	0	4	65	112	216	142	170	155	216	218	370	452	472	496	353
Total	**896**	**1,692**	**1,377**	**2,319**	**4,955**	**8,308**	**7,727**	**9,834**	**7,465**	**8,572**	**8,196**	**9,594**	**9,903**	**8,852**	**10,421**	**8,315**

Fisheries: Gillnet (**GN**); Longline (**LL**); Hook-and-Line (**HL**), including handline, trolling, baitboat, and sport fisheries; Other gears (**OT**)

Uncertainty of time–area catches

Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins (by species) also contribute to the uncertainties of the information available to the Secretariat.

Retained catches are uncertain for some fisheries (Fig. 6), due to the fact that:

- catch reports often refer to total catches of all three marlin species combined; catches by species are estimated by the Secretariat for some artisanal (gillnet/longline fishery of Sri Lanka and artisanal fisheries of India, Iran and Pakistan) and industrial (longliners of Indonesia and Philippines) fisheries.
- catches of non-reporting industrial longliners (India, NEI) and the gillnet fishery of Indonesia are estimated by the Secretariat using alternative information.
- catches are likely to be incomplete for industrial fisheries for which the black marlin is not a target species.
- **conflicting catch reports**: Longline catches from the Republic of Korea are reported as nominal catches, and catch and effort reports are conflicting, with higher catches recorded in the catch and effort table. For this reason, the Secretariat revised the catches of black marlin for the Republic of Korea over the time-series using both datasets. Although the new catches estimated by the Secretariat are thought to be more accurate, catches of black marlin remain uncertain for this fleet.
- a lack of catch data for most sport fisheries.
- **Discards** are unknown for most industrial fisheries, mainly longliners. Discards of black marlin may also occur in the driftnet fishery of I.R. Iran, as this species has no commercial value in this country.
- **Changes to the catch series**: There have been relatively large changes to catches of black marlin since the WPB meeting in 2012, mostly as a result of revisions to catches estimates for Sri Lanka. Catches of marlins (by species) in Sri Lanka have frequently been misidentified, making catches in previous years highly uncertain and subject to sharp fluctuations between years. Estimates of black marlins have subsequently been revised by IOTC from around 1,000 t to over 4,000 t in the last decade in response to inconsistencies identified in the reported data; with most of the increase the result of reallocation of catch previously reported as blue marlin.

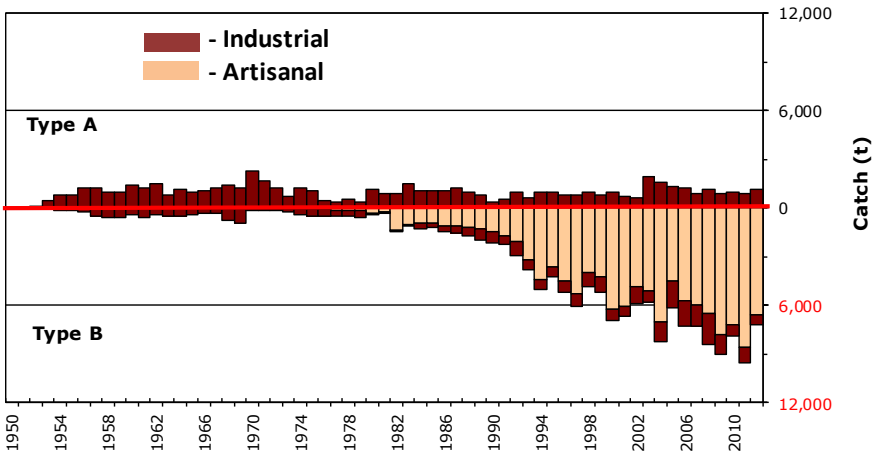

Fig. 6. Black marlin: Uncertainty of annual catch estimates for black marlin (Data as of October 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Black marlin: Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid in 2011 and 2012 are provided in Fig. 8, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2011 and 2012are provided in Fig. 9.

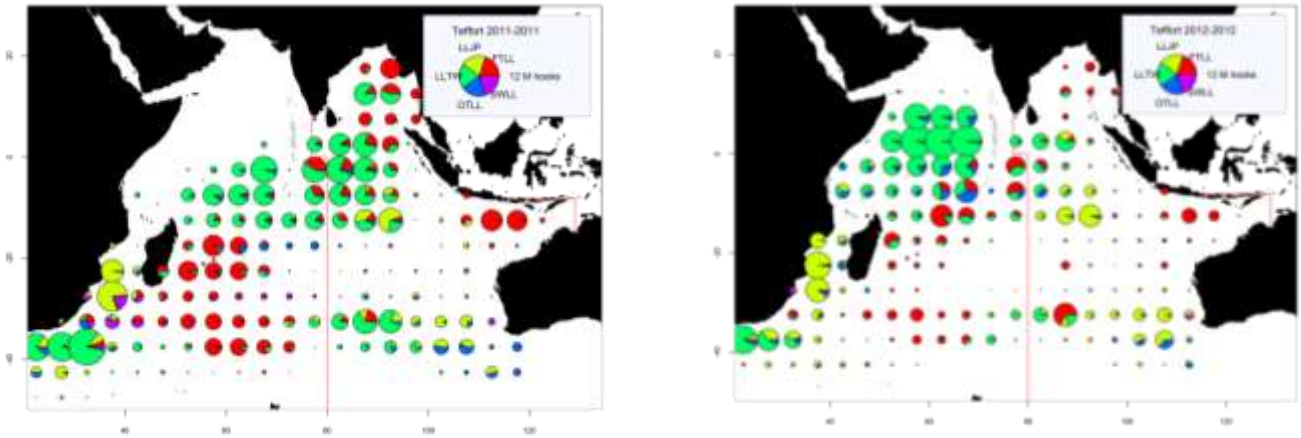

Fig. 8. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2011 (left) and 2012 (right) (Data as of Ocotber 2013).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

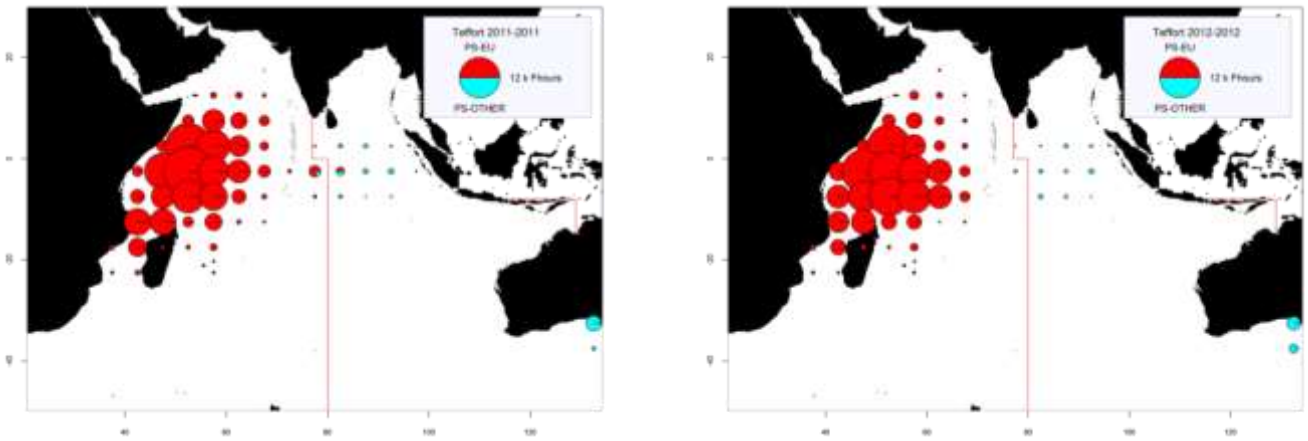

Fig. 9. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2011 (left) and 2012 (right) (Data as of October 2013)
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

Black marlin: Catch–per–unit–effort (CPUE) trends

Catch rate time series for the longline fleets of Japan and Taiwan,China (Fig. 10) show a similar decreasing trend from 1960's until the end of 2000's. There is no available data for the longline fleet of Taiwan,China for the 1950's and part of the 1960's. Catch rates as calculated based on Japanese dataset show a strong decreasing trend in the early 1950's, in the very beginning of the commercial fisheries. Nevertheless it is important to highlight the doubts on the reliability of the results based on aggregated data sets not fully reviewed by experts on Japanese longline fisheries. The sharp decline between 1952 and 1958 in the Japanese black marlin CPUE series does not reflect the trend in abundance.

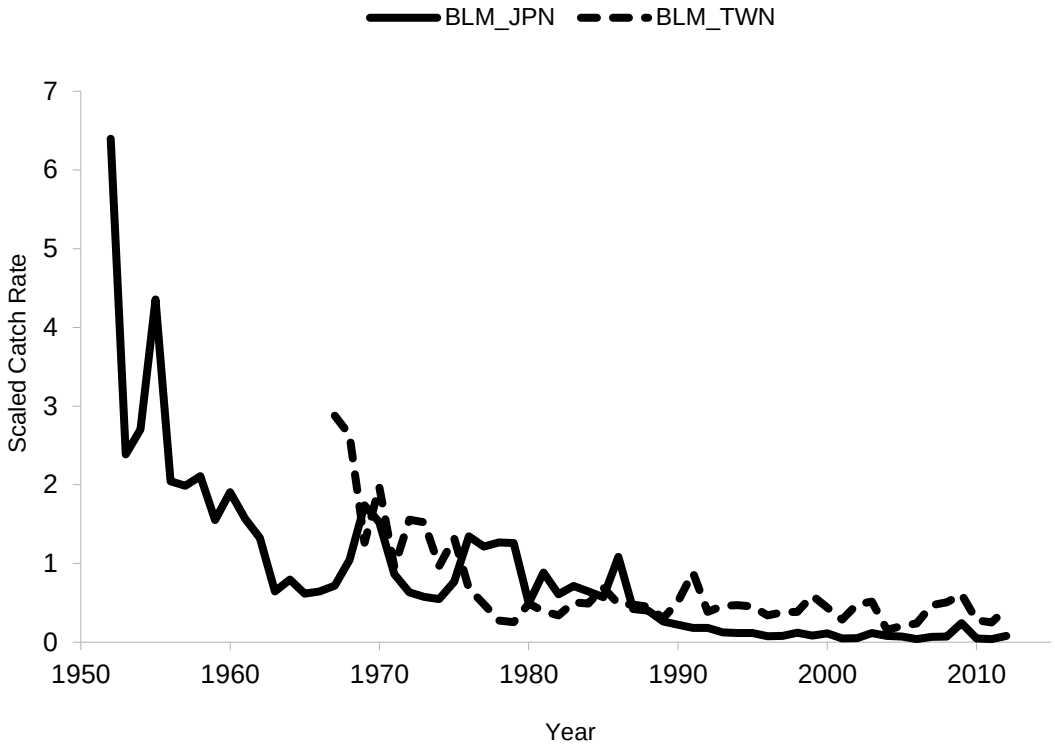

Fig. 10. Black marlin: Standardised catch rates of black marlin for Japan (JPN) and Taiwan,China (TWN) as calculated based on the IOTC catch and effort aggregated dataset. Values were scaled with respect to the mean of 1970–1979 period.

No catch and effort data are available from sports fisheries, other than for partial data from the sports fisheries of Kenya; or other artisanal (gillnet fisheries of Iran and Pakistan, gillnet/longlines of Sri Lanka, gillnets of Indonesia) or industrial fisheries (NEI longliners and all purse seiners).

Black marlin: Fish size or age trends (e.g. by length, weight, sex and/or maturity)

Fish size: Average fish weight can only be assessed for the longline fishery of Japan since 1970 and Taiwan,China since 1980. The number of specimens measured on Japanese longliners in recent years is, however, very low (Fig. 11).

Catch-at-Size(Age) tables have not been built for black marlin due to a lack of information reported by CPCs. Fish size is derived from various length and weight information, however the reliability of the size data is reduced when relatively few fish out of the total catch are measured.

Sex ratio data have not been provided to the Secretariat by CPCs.

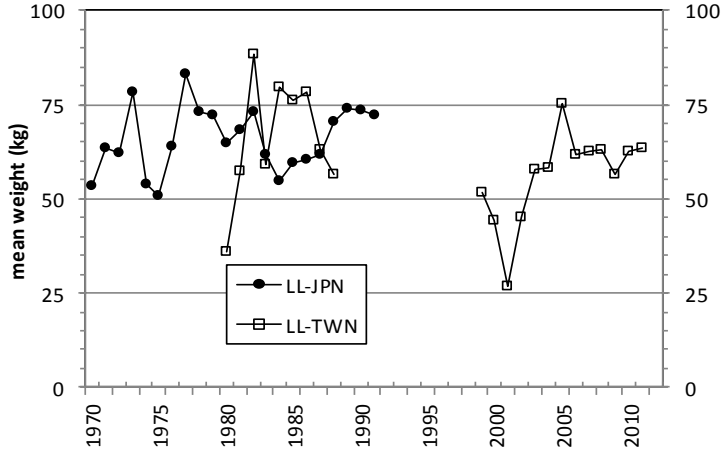

Fig. 11. Black marlin: Average weight of black marlin (kg) estimated from the size samples available for longliners of Japan (JPN:1970–2012) and Taiwan,China (TWN:1980–2012). Note: Average weights are shown only for years in which 300 or more specimens were sampled for length.

STOCK ASSESSMENT

Data poor methods for stock assessment using Stock reduction analysis (SRA) techniques indicate that the stock is not overfished and close to optimum fishing levels (Tables 1, 3). However, as this is the first time that the WPB used such a method on marlin species, further testing of how sensitive this technique is to model assumptions and available time series of catches needs to be undertaken before the WPB uses it to determine stock status. Thus, the stock status remains **uncertain**. Nonetheless in using the SRA method for comparative purposes with other stocks, the WPB considers that the use of the target reference points may be possible for the approach. The stock appears to show an increase in catch rates which is a cause of concern, indicating that fishing mortality levels may be becoming too high (Fig. 1). Aspects of the biology, productivity and fisheries for this species combined with the data poor status on which to base a more formal assessment are a cause for concern. Research emphasis on developing possible CPUE indicators and further exploration of stock assessment approaches for data poor fisheries are warranted. Given the limited data being reported for coastal gillnet fisheries, and the importance of sports fisheries for this species, efforts must be made to rectify these information gaps.

TABLE 3. Black marlin (*Makaira indica*) stock status summary

Management Quantity	Aggregate Indian Ocean
2012 catch estimate	8,315 t
Mean catch from 2008–2012	9,417 t
MSY (80% CI)	8,605 (6,278–11,793)
Data period used in assessment	1950–2011
F_{2012}/F_{MSY} (80% CI)	1.17 (0.15–2.19)
B_{2012}/B_{MSY} (80% CI)	1.03 (0.75–1.55)
SB_{2012}/SB_{MSY}	–
B_{2012}/B_{1950} (80% CI)	–
SB_{2012}/SB_{1950}	–
$B_{2012}/B_{1950, F=0}$	–
$SB_{2012}/SB_{1950, F=0}$	–

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