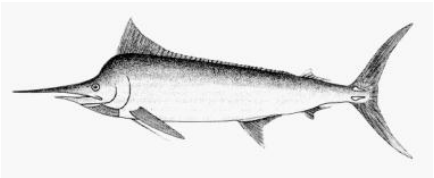
Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



EXECUTIVE SUMMARY: STATUS OF THE INDIAN OCEAN BLACK MARLIN (*MAKAIRA INDICA*) RESOURCE

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

Area[1]	Indicators – 2011 assessment		2011 stock status determination
			2010[2]
Indian Ocean	Catch 2010:	5,018 t	Uncertain
	Average catch 2006–2010:	4,689 t	
	MSY (range):	unknown	
	F_{2009}/F_{MSY} (range):	unknown	
	SB_{2009}/SB_{MSY} (range):	unknown	
	SB_{2009}/SB_0 (range):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence.
[2]The stock status refers to the most recent years' data used for the assessment.

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for black marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore stock status remains *uncertain* (Table 1). However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

Outlook. The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, however there is not sufficient information to evaluate the effect this will have on the resource.

The Scientific Committee considers the following:

- the Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- annual catches of black marlin urgently need to be reviewed.
- improvement in data collection and reporting is required to assess the stock.

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 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area*.
- Resolution 09/02 *On the implementation of a limitation of fishing capacity of contracting parties and cooperating non-contracting parties*.
- Resolution 10/02 *mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*.
- Resolution 10/03 *concerning the recording of catch by fishing vessels in the IOTC area*.
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area.*
- Recommendation 11/06 *Concerning the Recording of Catch by Fishing Vessels in the IOTC Area of Competence*.

FISHERIES INDICATORS

General

Black marlin (*Makaira Indica*) is a large oceanic apex predator that inhabits tropical and subtropical Indo-Pacific oceans. 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.

TABLE 2. 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. Thus, the information detailed here pertains to information from other oceans, primarily the Pacific. Black marlin is a highly migratory, large oceanic apex predator that inhabits tropical and subtropical waters of the Indian and Pacific oceans. 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 is mainly found in oceanic surface waters above the thermocline and typically near land masses, islands and coral reefs; however, they may range to depths of 1000 m. Thought to associate with schools of small tuna, which is one of its primary food sources (also reported to feed on other fishes, squids, cuttlefishes, octopods, 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. However, spatial heterogeneity in stock indicators (catch–per–unit–effort trends) for other billfish species indicates that there is potential for localised depletion.
Longevity	Females: 11–12 years; Males: 5–6 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 or Pacific oceans, but in Australia spawning individuals apparently prefer water temperatures around 27-28°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 4.6 m FL and weigh 800 kg total weight. 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. Females: 326 cm lower-jaw FL, 800 kg total weight; Males: 255 cm lower-jaw FL, 300 kg total weight. Most black marlin larger than 200 kg are female. Recruitment into the fishery: varies by fishing method; ~60 cm lower-jaw FL for artisanal fleets and methods. The average size of black marlin taken in Indian Ocean longline fisheries is not available.

SOURCES: Cry et al. (1990); Froese & Pauly (2009); Nakamura (1985); Speare (2003); Sun et al. (2007)

Catch trends

Black marlin are caught mainly under drifting longlines (44%) and gillnets (49%) with remaining catches recorded under troll and hand lines (Fig. 1). Black marlin are the bycatch of industrial and artisanal fisheries. In recent years, the fleets of Taiwan,China (longline), Sri Lanka (gillnet), Indonesia (gillnets) and India (gillnets) are attributed with the highest catches of black marlin (Fig. 2). The minimum average annual catch estimated for the period 2006 to 2010 is around 4,689 t.

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. 3).

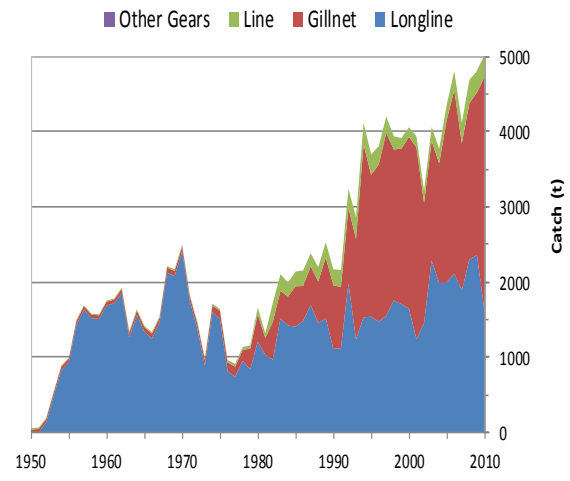


Fig. 1. Catches of black marlin per gear and year recorded in the IOTC Database (1960–2010).

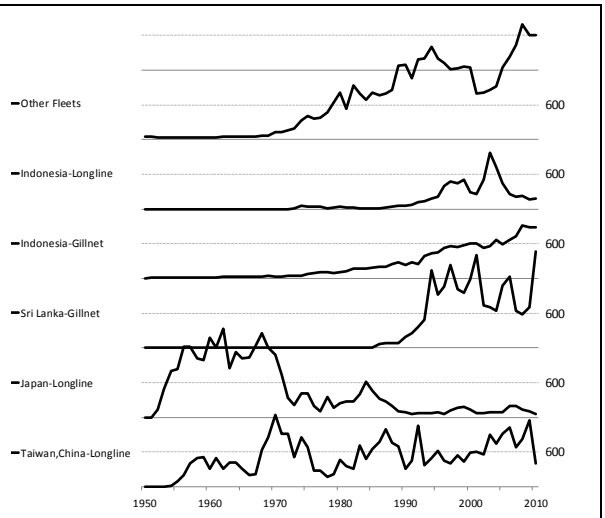


Fig. 2. Catches of black marlin by fleet recorded in the IOTC Database (1960–2010).

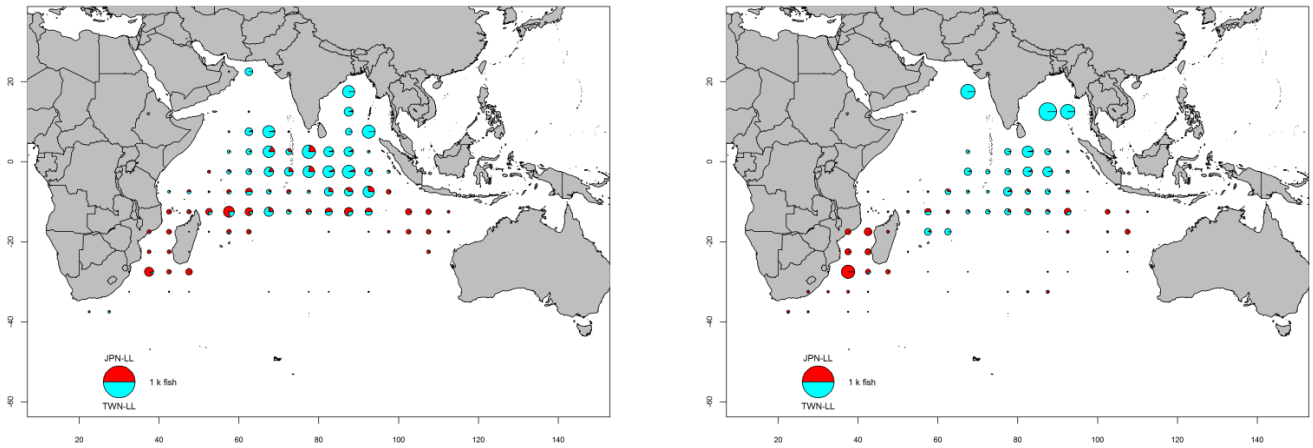


Fig. 4a–b. Time-area catches (in number of fish) of black marlin as reported for the longline fisheries of Japan (JPN) and Taiwan,China (TWN) for 2009 and 2010 by fleet.

TABLE 3. Best scientific estimates of the catches of black marlin by type of fishery for the period 1950–2009 (in metric tonnes). Data as of May 2011.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Longline	846	1,633	1,288	1,370	1,501	1,646	1,243	1,454	2,291	1,985	2,002	2,110	1,894	2,302	2,359	1,612
Gillnet	47	60	115	473	1,680	2,287	2,549	1,600	1,589	1,596	2,157	2,446	1,955	2,080	2,165	3,121
Line	15	19	25	177	231	127	146	162	183	195	201	250	273	310	285	286
Other	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Total	**908**	**1,713**	**1,431**	**2,021**	**3,412**	**4,060**	**3,938**	**3,217**	**4,064**	**3,776**	**4,360**	**4,806**	**4,121**	**4,693**	**4,809**	**5,018**

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 also contribute to the uncertainties of the information available to the Secretariat.

Retained catches are uncertain for some fisheries (Fig. 5), 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.

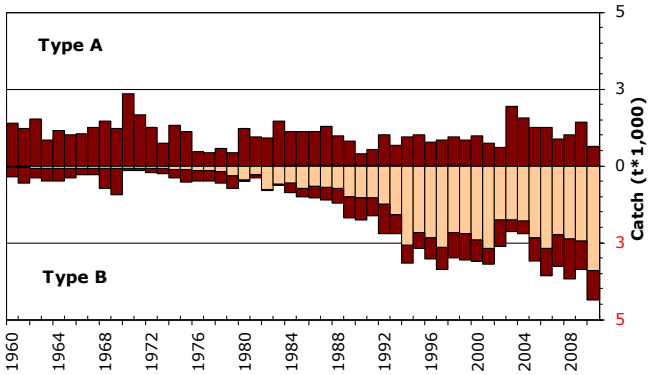


Fig. 5. Uncertainty of time-area catches for black marlin (Data as of October 2011).
Catches below the zero-line (Type B) refer to fleets that do not report catch-and-effort data to the IOTC, do not report catch-and-effort data by gear and/or species or any of the other reasons provided in the document. 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.

Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 6, and total effort from purse seine vessles 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 2007 to 2010 are provided in Fig. 7.

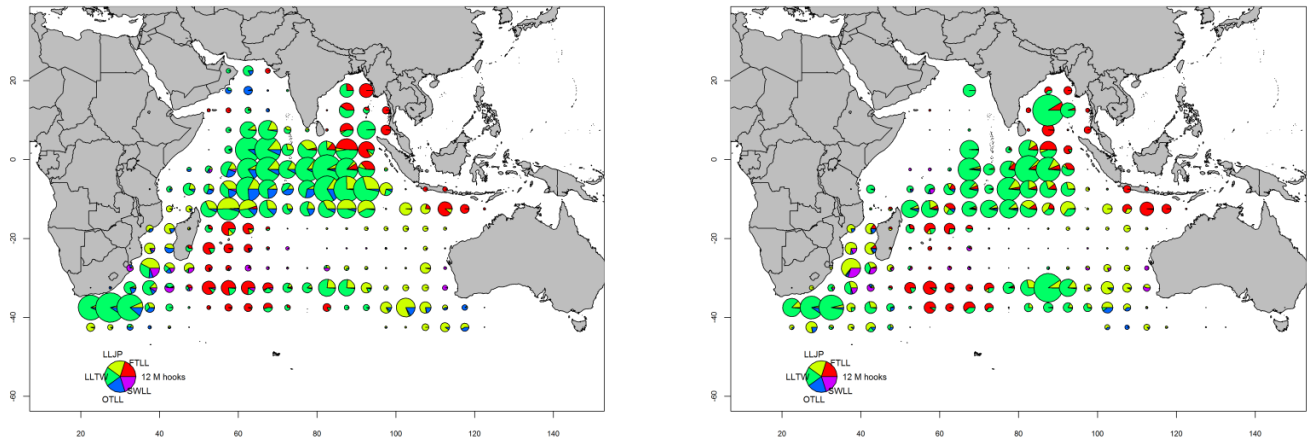


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): 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)

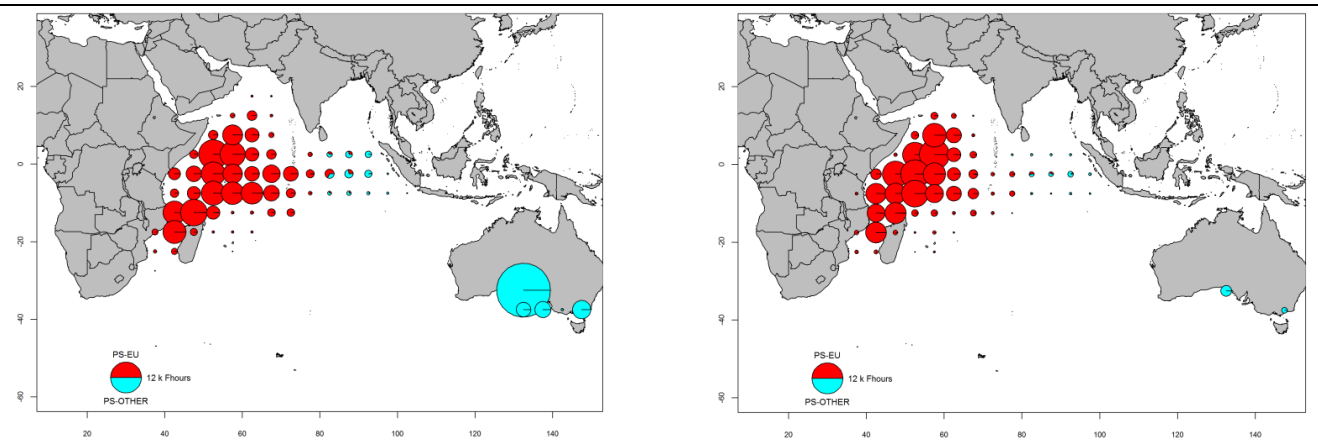


Fig. 7. Number of hours of fishing (Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles 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

Catch–per–unit–effort (CPUE) trends

Standardised CPUE series have not yet been developed. Nominal CPUE series are however available from some industrial longline fisheries (primarily the Japanese longline fleet; Figs. 8, 9) although catches are thought to be incomplete (catches of non-target species are not always recorded in logbooks). 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).

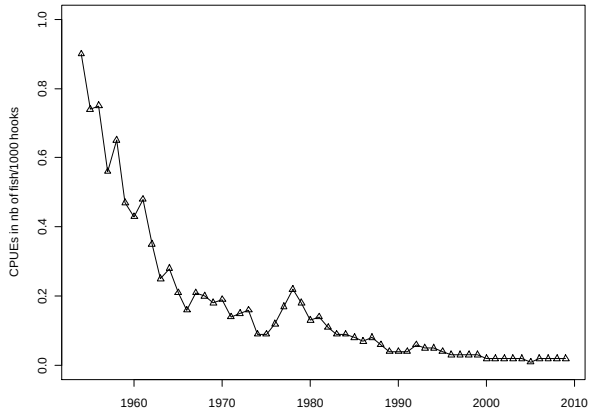


Fig. 8. Nominal CPUE (number of fish by 1,000 hooks) of black marlin caught by Japanese longliners off-Somalia.

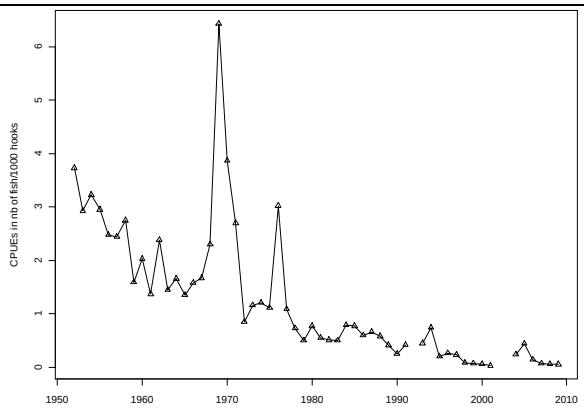


Fig. 9. Nominal CPUE (number of fish by 1,000 hooks) of black marlin caught by Japanese longliners northwest Australia.

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

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.

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.

STOCK ASSESSMENT

No quantitative stock assessment for black marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan, China that represent the best available information. Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major fishing grounds (West Equatorial and north-west Australia) (Figs. 8 and 9) and catches in the initial core areas have also decreased substantially. However, there is considerable uncertainty about the degree to which these indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

TABLE 4. Black marlin (*Makaira Indica*) stock status summary.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate (1000 t)	5.0
Mean catch from 2006–2010 (1000 t)	4.7
MSY (1000 t) (80% CI)	unknown
Data period used in assessment	–
F_{2010}/F_{MSY} (80% CI)	–
B_{2010}/B_{MSY} (80% CI)	–
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	–
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980,\ F=0}$	–
$SB_{2010}/SB_{1980,\ F=0}$	–

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