Chapter 25
Western Tuna and Billfish Fishery

H Patterson and M Stephan

FIGURE 25.1 Area of the Western Tuna and Billfish Fishery, 2013

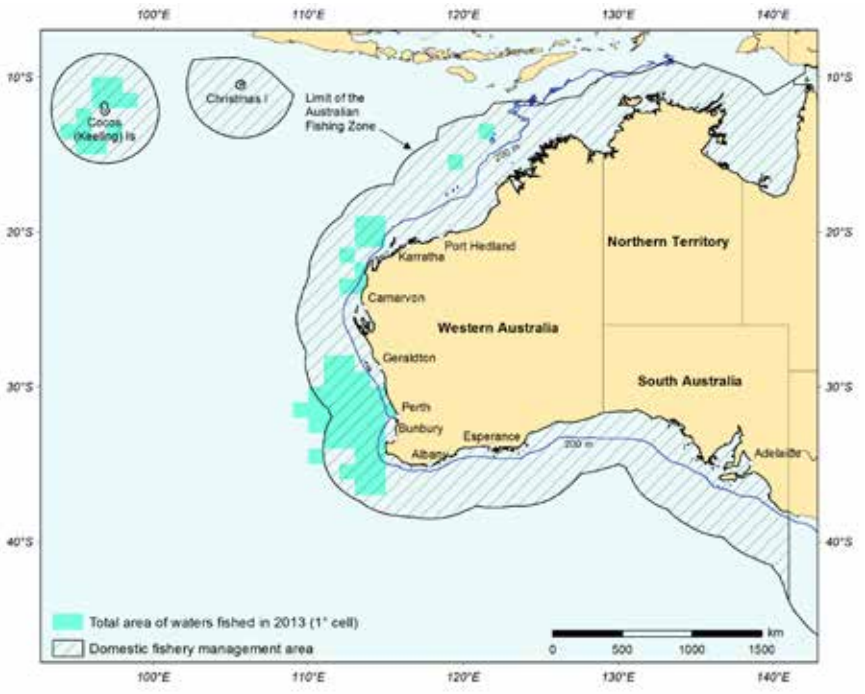


TABLE 25.1 Status of the Western Tuna and Billfish Fishery

Status	2012		2013		Comments a
Biological status a	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Striped marlin (*Tetrapturus audax*)					Current ocean-wide assessments indicate fishing mortality is above F_{MSY} and biomass is below 20% of unfished biomass.
Swordfish (*Xiphias gladius*)					Current ocean-wide assessments indicate fishing mortality is below F_{MSY} and biomass is above 20% of unfished biomass.
Albacore (*Thunnus alalunga*)					Current ocean-wide assessments indicate fishing mortality is above F_{MSY} and biomass is above 20% of unfished biomass.
Bigeye tuna (*Thunnus obesus*)					Current ocean-wide assessments indicate fishing mortality is below F_{MSY} and biomass is above 20% of unfished biomass.
Yellowfin tuna (*Thunnus albacares*)					Current ocean-wide assessments indicate fishing mortality is below F_{MSY} and biomass is above 20% of unfished biomass.
Economic status	Latency remained high in 2013 with only a small proportion of the TACC caught, suggesting low NER.				

a Ocean-wide assessments and the default limit reference points from the Commonwealth Fisheries Harvest Strategy Policy (DAFF 2007) are used as the basis for status determination.
Notes: **CPUE** Catch-per-unit-effort. F_{MSY} Fishing mortality at maximum sustainable yield. **NER** Net economic returns. **TACC** Total allowable commercial catch.

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

25.1 Description of the fishery

Area fished

The Western Tuna and Billfish Fishery (WTBF) operates in the Exclusive Economic Zone and high seas of the Indian Ocean (Figure 25.1). In recent years, effort has concentrated off south-west Western Australia. Domestic management arrangements for the WTBF reflect Australia's commitments to the Indian Ocean Tuna Commission (IOTC; see Chapter 21).

Fishing methods and key species

Fishing in the WTBF mainly uses pelagic longline; some minor-line fishing also occurs. Key species are outlined in Table 25.1. Bycatch is relatively low in the fishery due to the low effort in recent years. Seabird interactions are also relatively rare compared with other longline fisheries, since the overlap with seabird populations is low.

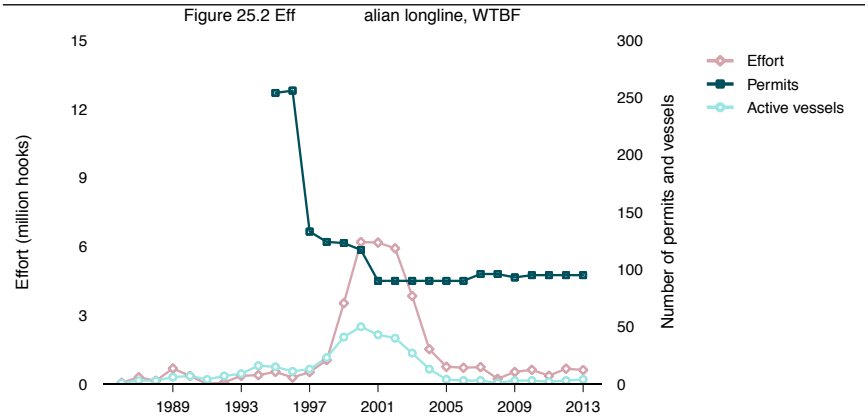
Management methods

The management plan for the fishery began in 2005, although the Australian Fisheries Management Authority (AFMA) first granted statutory fishing rights in 2010. Under the management plan, output controls have been implemented in the fishery through individual transferable quotas (ITQs) for the four key commercial species (bigeye tuna [*Thunnus obesus*], yellowfin tuna [*T. albacares*], striped marlin [*Tetrapturus audax*] and swordfish [*Xiphias gladius*]). Determinations of total allowable commercial catch (TACC) are made in accordance with Australia's domestic policies and apply to the Australian Fishing Zone (AFZ) and the high-seas area of the IOTC area of competence. A harvest strategy has been developed for the WTBF (Davies et al. 2008) and will be implemented if fishing effort increases in the fishery and sufficient data are available for use in the strategy. The framework includes a decision tree that defines rules and subsequent adjustments to the recommended biological catch (or level of fishing mortality). Standardised size-based catch rates will be the main indicators of abundance because robust, region-specific assessments are not available for stocks in the WTBF. In the absence of specified limit reference points for the stocks, status determination is informed by the default limit reference points in the Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF 2007).

Fishing effort

Effort in the WTBF was relatively low from the mid-1980s to the mid-1990s (Figure 25.2). Effort then started to increase, peaking in 2000 with 50 active vessels, but declined steadily after then. Since 2005, fewer than five vessels have been active in the fishery each year.

FIGURE 25.2 Longline fishing effort, permits and active vessels in the WTBF, 1986 to 2013



Catch

The main target species in the WTBF is swordfish, with catches peaking at more than 2000 t in 2001 (Figure 25.3) and declining to a few hundred tonnes in recent years. Bigeye and yellowfin tuna are also valuable target species, although catches of those species have never been as high as swordfish and have been more variable.

FIGURE 25.3 Total annual catch by species in the WTBF, 1986 to 2013

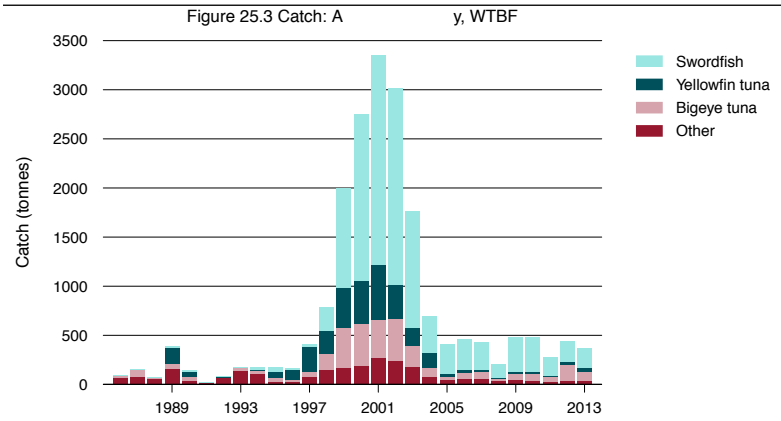


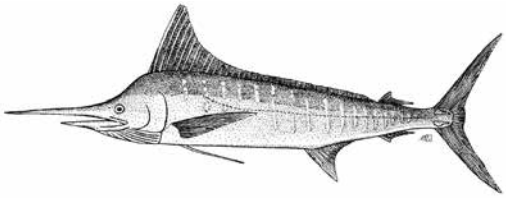
TABLE 25.2 Main features and statistics for the WTBF

Fishery statistics a	2012			2013		
Stock	**TAC**	**Catch (t)**	**Real value (2011–12)**	**TAC**	**Catch (t)**	**Real value (2012–13)**
Marlin, striped	125	2	Confidential	125	2	Confidential
Swordfish	3 000	209	Confidential	3 000	204	Confidential
Albacore	–	13	Confidential	–	15	Confidential
Tuna, bigeye	2 000	167	Confidential	2 000	91	Confidential
Tuna, yellowfin	5 000	23	Confidential	5 000	40	Confidential
Total	**10 125**	**414**	**Confidential**	**10 125**	**352**	**Confidential**
Fishery-level statistics						
Effort	Pelagic longline: 669 198 hooks Minor lines: na			Pelagic longline: 609 995 hooks Minor lines: na		
Fishing permits	95 boat SFRs			95 boat SFRs		
Active vessels	Pelagic longline: 3 Minor lines: 2			Pelagic longline: 4 Minor lines: 3		
Observer coverage	115 117 hooks (17.2%)			0 **b**		
Fishing methods	Pelagic longline (monofilament mainline), minor-line (handline, rod and reel, troll and poling), purse-seine					
Primary landing ports	Fremantle, Geraldton					
Management methods	Input controls: limited entry, gear and area restrictions Output controls: TACCs, ITQs, byproduct restrictions					
Primary markets	International: Japan, United States—fresh, frozen Domestic: fresh, frozen					
Management plan	Western Tuna and Billfish Management Plan 2005 (amended 2012); SFRs issued in 2010					

a Fishery statistics are provided by calendar year to align with international reporting requirements. Real-value statistics are by financial year.
b Although the observer coverage requirements were fulfilled for the 2012–13 and 2013–14 financial years, no observer coverage occurred in the 2013 calendar year. Observer coverage occurred at the end of 2012 and the beginning of 2014 for those two financial years.
Notes: **ITQ** Individual transferable quota. **na** Not available. **SFR** Statutory fishing right. **TACC** Total allowable commercial catch. – Not applicable.

25.2 Biological status

Marlin, striped (*Tetrapturus audax*)



Line drawing: FAO

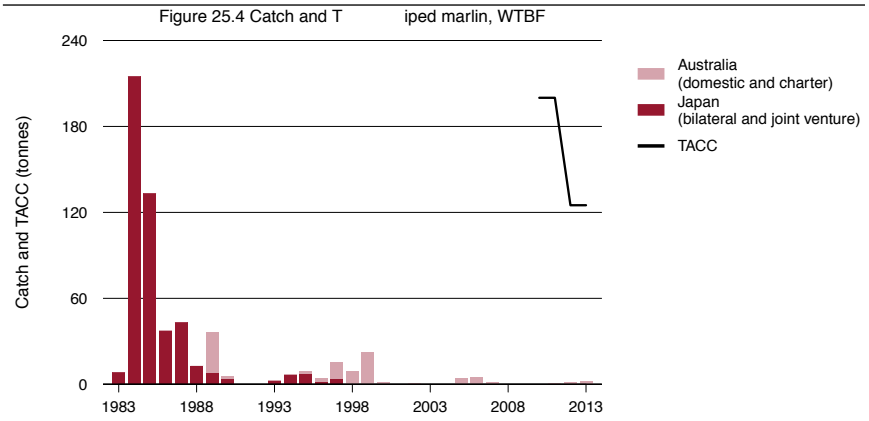
Stock structure

Striped marlin in the Indian Ocean is considered to be a distinct biological stock. Tagging studies have demonstrated large-scale movements of striped marlin in the Indian Ocean that support the assumption of a single biological stock (IOTC 2013).

Catch history

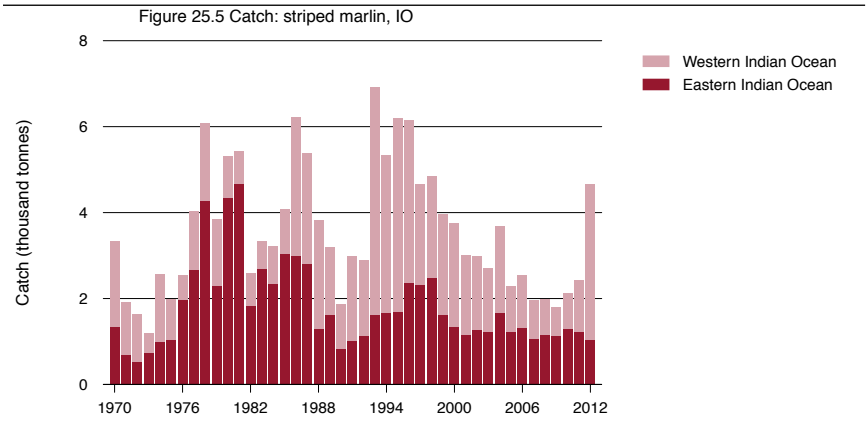
Catches of striped marlin in the WTBF have always been relatively low—less than 60 t since the mid-1980s and very low in recent years, with only 2 t taken in 2012 and 2013 (Figure 25.4). Total international catches in the IOTC area of competence have declined from around 6000 t in 1995, but increased substantially from 2424 t in 2011 to 4666 t in 2012 (Figure 25.5), which is above the estimated maximum sustainable yield (MSY).

FIGURE 25.4 Striped marlin catch and TACC in the WTBF, 1983 to 2013



Note: **TACC** Total allowable commercial catch.

FIGURE 25.5 Striped marlin catch in the IOTC area, 1970 to 2012



Stock assessment

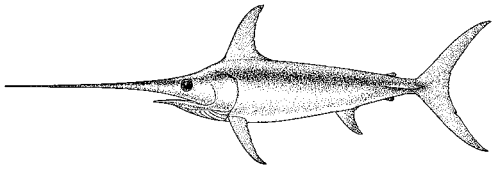
The first stock assessments for striped marlin were undertaken in 2013 at the IOTC Working Party on Billfish. Three models were used: A Stock Production Model Incorporating Covariates (ASPIC), Bayesian state space and stock reduction analysis. The results of the ASPIC model were used for providing management advice, although all the models resulted in similar conclusions regarding stock status. The 2011 biomass for the stock was estimated to be 18 per cent of unfished biomass ($B_{2011}/B_0 = 0.18$) and well below the level that would support MSY ($B_{2011}/B_{MSY} = 0.42$, range 0.20–0.42) (IOTC 2013). Fishing mortality was estimated to be well above the level that would result in MSY ($F_{2011}/F_{MSY} = 1.28$, range 0.95–1.92). Improved data collection and recording and more research on improving methods for data-poor fisheries will improve future assessments of this species.

Stock status determination

The ASPIC assessment indicates that the current biomass is below the default limit reference point of 20 per cent of initial unfished levels. As a result, the Indian Ocean striped marlin stock is classified as **overfished**. Since the current biomass is below the level that would produce MSY, and fishing mortality is above F_{MSY}, the stock is classified as **subject to overfishing**.

Longline radio beacons
Gavin Kewan, AFMA

Swordfish (*Xiphias gladius*)



Line drawing: Gavin Ryan

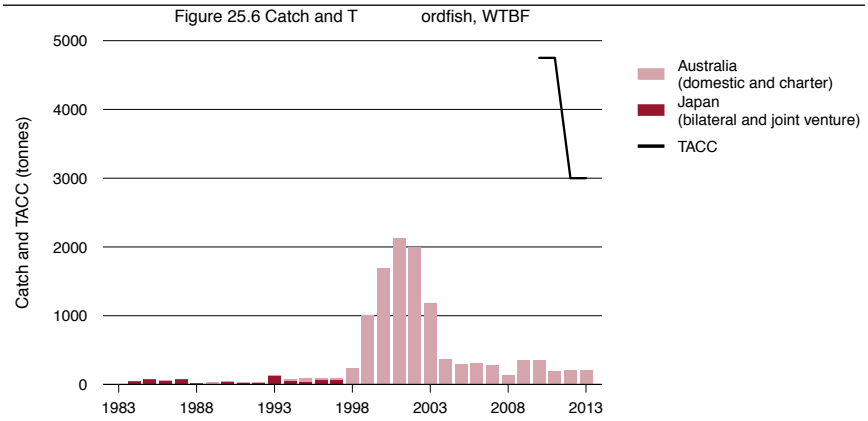
Stock structure

Swordfish in the Indian Ocean is considered to be a distinct biological stock. The possibility of a separate south-west Indian Ocean stock was examined in the Indian Ocean Swordfish Stock Structure project—a genetic study focused on the links between the south-west and other regions. The study found that genetic markers were consistent with a single stock in the Indian Ocean (Muths et al. 2013). Subject to any further research on stock structure, the best information indicates that swordfish in the Indian Ocean should be managed as a single stock.

Catch history

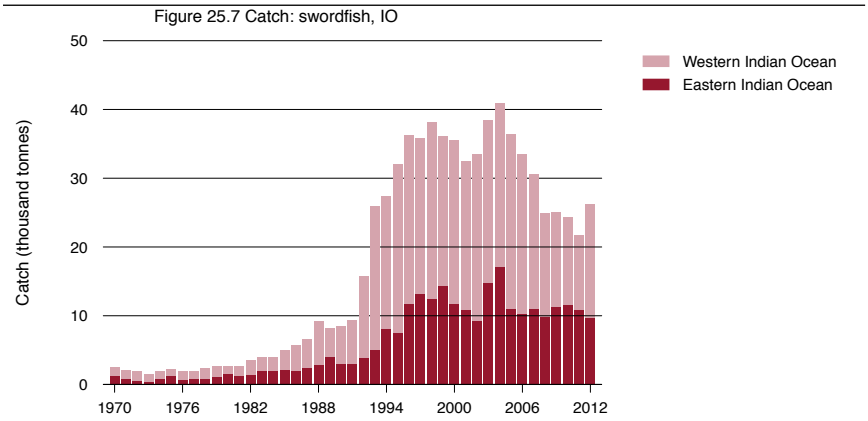
Swordfish catch in the WTBF peaked in the early 2000s but has declined since then with declining effort in the fishery. Catches in the WTBF decreased slightly from 209 t in 2012 to 204 t in 2013 (Figure 25.6). Swordfish catch in the IOTC area of competence peaked in 2004 but has declined since then, likely due to piracy in the western Indian Ocean. Catches in the IOTC increased from 21 681 t in 2011 to 26 187 t in 2012 (Figure 25.7), which remains below the estimated MSY range (29 900 to 34 200 t).

FIGURE 25.6 Swordfish catch and TACC in the WTBF, 1983 to 2013



Note: **TACC** Total allowable commercial catch.

FIGURE 25.7 Swordfish catch in the IOTC area, 1970 to 2012



Stock assessment

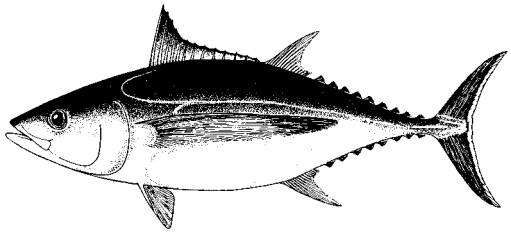
In 2011, a range of ocean-wide stock assessment models (Stock Synthesis 3 [SS3], ASPIC, Bayesian Averaging Method [BMAP], Age-Structured Integrated Analysis [ASIA]) were used to determine the status of the Indian Ocean swordfish stock (IOTC 2013). The 2009 spawning biomass for the Indian Ocean–wide stock was estimated to range between 30 and 53 per cent of unfished biomass, based on the four models (IOTC 2013). The results across the different models suggest that current catches (and associated fishing mortality [F]) are below the level associated with MSY (F_{2009}/F_{MSY} = 0.50–0.63), suggesting that the ocean-wide stock is not subject to overfishing.

Concerns about historical overfishing in the south-west Indian Ocean region led to a separate assessment for that area (IOTC 2013). The results indicated spawning biomass depletion levels of 16 to 58 per cent of the initial unfished level. This is more optimistic than previous assessments of the south-west region and suggests that the state of the stock in the south-west is not as poor as previously believed.

Stock status determination

Assessments of the ocean-wide stock indicate that swordfish biomass is above the HSP proxy limit reference point and that fishing mortality is below F_{MSY}. As a result, the stock is classified as **not overfished** and **not subject to overfishing**. However, monitoring of the level of localised depletion in the south-west region should continue.

Albacore (*Thunnus alalunga*)



Line drawing: FAO

Stock structure

Albacore in the Indian Ocean is considered to be a distinct biological stock. Two distinct stocks of albacore have been noted in the Atlantic and Pacific oceans due to the presence of northern and southern ocean gyres. Because no northern gyre exists in the Indian Ocean, it is likely that only a single stock exists (IOTC 2013). A genetic study of albacore found that the Atlantic Ocean and Indian Ocean populations were not distinguishable (Montes et al. 2012). This homogeneity may be driven by albacore migrating between the Indian and southern Atlantic oceans off South Africa.

Catch history

Historically, albacore catches in the WTBF have been low, and since 2004 annual catches have been below 30 t. Catches increased slightly from 14 t in 2012 to 15 t in 2013 (Figure 25.8). Catches in the IOTC area of competence have increased slightly in recent years, increasing from 33 595 t in 2011 to 33 961 t in 2012 (Figure 25.9). The average IOTC catches from 2008 to 2012 were about 11 per cent higher than MSY.

FIGURE 25.8 Albacore catch in the WTBF, 1983 to 2013

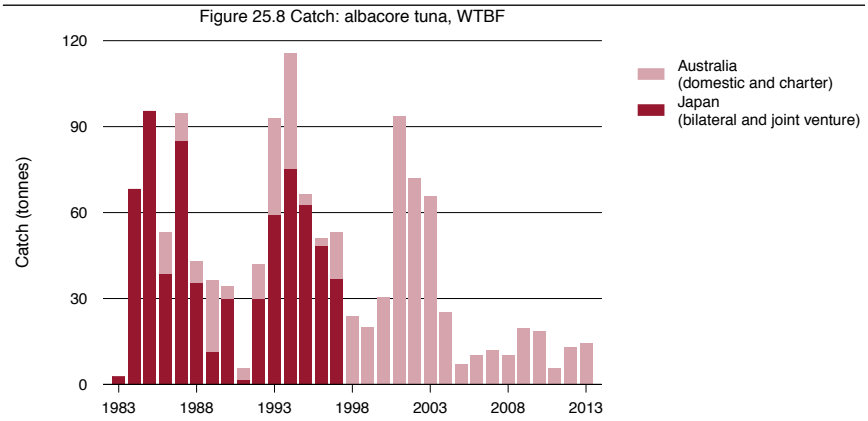
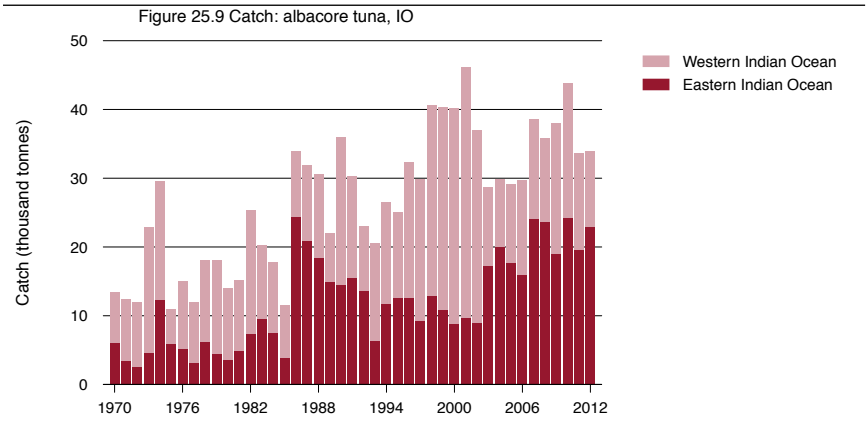


FIGURE 25.9 Albacore catch in the IOTC area, 1970 to 2012



Stock assessment

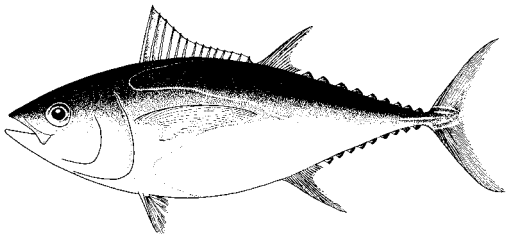
There was no new assessment for albacore in 2013. Several assessment models were used for albacore in 2012, including ASPIC, ASPM and SS3. The results from the ASPM (age-structured population model) were used by the IOTC (2013) to represent the current status of albacore, but all findings from all models were treated as equally informative. Considerable uncertainty exists about the relationship between abundance and the standardised catch-per-unit-effort (CPUE) series for albacore. For this reason, all the 2012 assessments used either the Taiwanese CPUE series (as the Taiwanese fleet has consistently targeted albacore) or a combined CPUE (weighted average of the Japanese and Taiwanese series; IOTC 2013).

The current (2010) biomass was estimated to be 29 per cent of the unfished (1950) biomass and close to the level that supports MSY (SB_{2010}/SB_{MSY} = 1.05, range 0.54–1.56). However, fishing mortality was estimated to be well above the level that results in MSY (F_{2010}/F_{MSY} = 1.33, range 0.90–1.76) (IOTC 2013). This high fishing mortality is likely to be related to piracy activities that have displaced longline effort towards traditional albacore areas in the southern and eastern Indian Ocean. This pattern of fishing appears to have diminished from 2011, as longliners have begun to move back to the traditional fishing grounds in the western Indian Ocean. Recent catches (average 37 802 t over the last five years) have exceeded the median MSY (33 300 t); however, the 2012 catch (33 961 t) was close to MSY.

Stock status determination

The assessment indicates the spawning biomass is above the HSP default limit reference point (SB_{20}), and so the stock is classified as **not overfished**. However, fishing mortality across the entire IOTC area is well above F_{MSY}, and so the stock is classified as **subject to overfishing**.

Tuna, bigeye (*Thunnus obesus*)



Line drawing: FAO

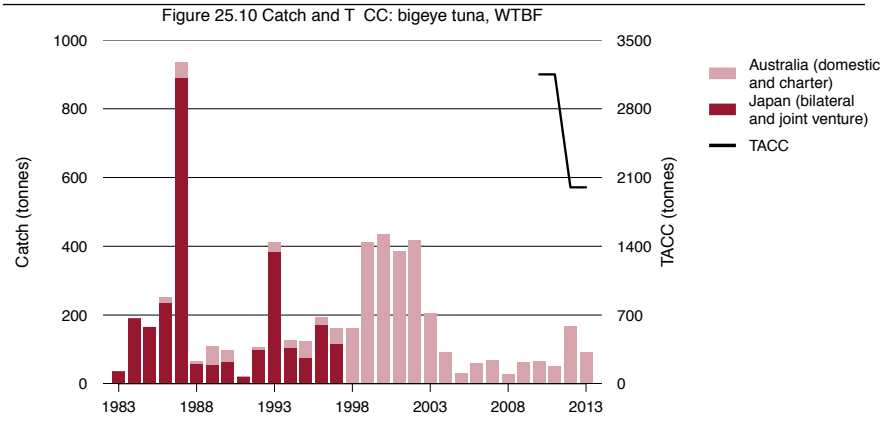
Stock structure

Bigeye tuna in the Indian Ocean is considered to be a distinct biological stock, based on a genetic study that indicated the presence of a single panmictic stock (Chiang et al. 2008) and tagging studies that have demonstrated large-scale movements of bigeye tuna (IOTC 2013).

Catch history

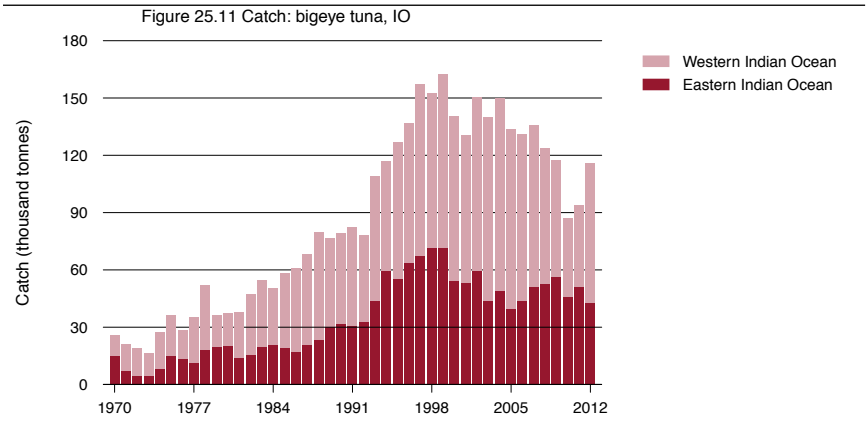
Catches of bigeye tuna in the WTBF have been relatively stable since 2003, although the catch decreased substantially from 167 t in 2012 to 91 t in 2013 (Figure 25.10). Total catches in the IOTC area of competence have been slowly declining as a result of piracy in the western Indian Ocean, which has deterred fishing effort. However, bigeye catch increased from 93 707 t in 2011 to 115 794 t in 2012 (Figure 25.11). The catch in 2012 is below the estimated MSY of 132 000 t, as is the five-year average catch.

FIGURE 25.10 Bigeye tuna catch and TACC in the WTBF, 1983 to 2013



Note: **TACC** Total allowable commercial catch.

FIGURE 25.11 Bigeye tuna catch in the IOTC area, 1970 to 2012



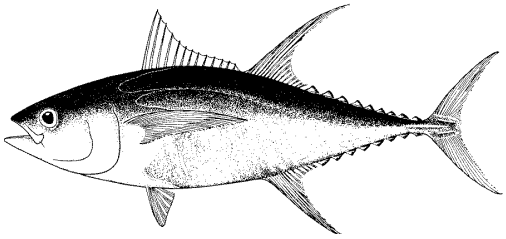
Stock assessment

The stock assessment for bigeye tuna was updated in 2013. Three models were used for the assessment (SS3, Age-Structured Assessment Program [ASAP] and ASPM), using data up to 2012 (IOTC 2013). The results are similar to previous assessments, although a revised catch history and CPUE series were used. The IOTC Working Party on Tropical Tunas agreed that management advice for bigeye tuna be based on the SS3 model because the results examined a range of options and demonstrated a relatively good fit to the data. The results from the SS3 assessment indicate that the current spawning stock biomass is above the level that would produce MSY (SB_{2012}/SB_{MSY} = 1.44, range 0.87–2.22). Similarly, the assessment indicated that spawning biomass is above 20 per cent of initial unfished biomass (SB_{2012}/SB_{0} = 0.40, range 0.27–0.54). Fishing mortality was below the level associated with MSY (F_{2012}/F_{MSY} = 0.42, range 0.21–0.83).

Stock status determination

The updated SS3 assessment indicates that bigeye tuna spawning stock biomass is above the HSP default limit reference point of 20 per cent of initial unfished levels. As a result, the Indian Ocean bigeye tuna stock is classified as **not overfished**. Since the current spawning biomass is above the level that would produce MSY, and fishing mortality is below F_{MSY}, the stock is classified as **not subject to overfishing**.

Tuna, yellowfin (*Thunnus albacares*)



Line drawing: FAO

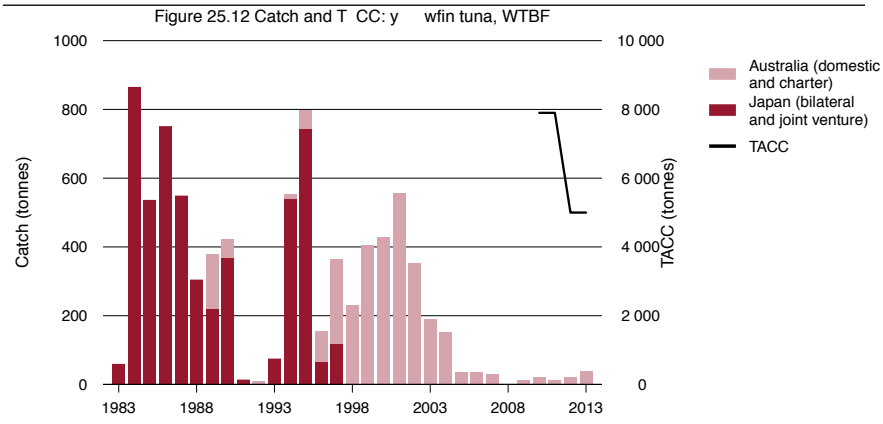
Stock structure

Yellowfin tuna in the Indian Ocean is considered to be a distinct biological stock. Tagging studies have demonstrated large-scale movements of yellowfin tuna that support this assumption (Langley et al. 2012).

Catch history

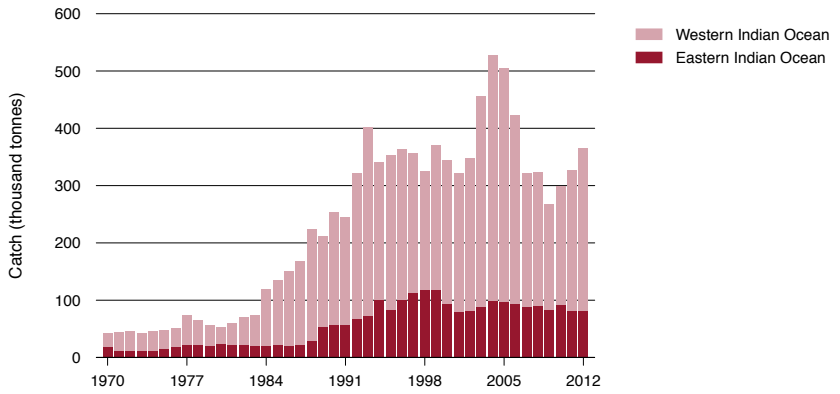
Since the early 2000s, declining effort in the WTBF has resulted in reduced catches, but catches increased from 23 t in 2012 to 40 t in 2013 (Figure 25.12). Catches in the IOTC area of competence have generally increased with increasing demand, but declined over the past several years due to piracy. Catches increased from 327 098 t in 2011 to 365 826 t in 2012 (Figure 25.13) and remain within, or slightly above, the range of MSY values (MULTIFAN-CL: 344 000 t, range 290 000–453 000 t; ASPM: 320 000 t, range 283 000–358 000 t).

FIGURE 25.12 Yellowfin tuna catch and TACC in the WTBF, 1983 to 2013



Note: **TACC** Total allowable commercial catch.

FIGURE 25.13 Yellowfin tuna catch in the IOTC area, 1970 to 2012



Stock assessment

There was no new assessment for yellowfin tuna in 2013. In 2012, yellowfin tuna was assessed using three quantitative methods: MULTIFAN-CL, ASPM and SS3. It was agreed that management advice for the stock would be based on the MULTIFAN-CL base-case (using short-term recruitment and alternative steepness scenarios: 0.7, 0.8 and 0.9) and the ASPM base-case with a steepness of 0.9 (IOTC 2013). The results indicate that current (2010 for MULTIFAN-CL and 2011 for ASPM) levels of fishing mortality have declined and are below the level that would achieve MSY (MULTIFAN-CL: F_{2010}/F_{MSY} = 0.69, range 0.59–0.90; ASPM: F_{2011}/F_{MSY} = 0.61, range 0.31–0.91). The assessments also indicate that current spawning biomass is above the level associated with MSY (MULTIFAN-CL: SB_{2010}/SB_{MSY} = 1.24, range 0.91–1.40; ASPM: SB_{2011}/SB_{MSY} = 1.35, range 0.96–1.74). The MULTIFAN-CL analysis indicated that 2010 spawning biomass was 38 per cent of initial levels ($0.38SB_0$, range $0.28–0.38SB_0$).

Stock status determination

The assessments indicate that fishing mortality has substantially declined and is now below the level associated with MSY. As a result, the yellowfin tuna stock is classified as **not subject to overfishing**. The biomass is above the default HSP limit reference point of 20 per cent initial unfished biomass, and as a result the stock is classified as **not overfished**.

25.3 Economic status

Key economic trends

Economic surveys have not been conducted in the WTBF since 2001–02 because of the low fishing activity. In 2012–13, 95 fishing permits were issued, but only four longline vessels operated. Since 2004–05, an average of three Australian vessels have operated annually. The high level of latent quota in the fishery (the extent to which the TACC is not fully caught) indicates that permit holders expect low or negative profitability from operating in the fishery, suggesting that net economic returns are low to negative.

Management arrangements

Before 2010, the WTBF was managed solely under an input control regime in which entry was limited, and gear and operating areas were restricted. In 2010, output controls were introduced in the form of a TACC, allocated as individual transferable quotas (ITQs). The impact of the move to ITQs has not been measured because of the low participation in the WTBF in recent years. In general, ITQs allow fishers to use input combinations that are more efficient, particularly after any unnecessary input controls are relaxed. The transferability of fishing rights between fishers can also allow more efficient allocation of fishing rights so that catch is taken by the most efficient operators in the fishery. However, the very low levels of catch relative to TACC in the WTBF are unlikely to provide any incentive for such trade to occur, minimising any efficiency gains.

Performance against economic objective

A harvest strategy is yet to be implemented because of low levels of effort in the fishery. It is therefore not possible to assess the performance of the harvest strategy against the economic objective of the HSP. Furthermore, since the WTBF accesses a relatively small component of broader, internationally managed ocean-wide stocks, domestic management actions to control catch are likely to have limited impact on the biomass of these stocks and, therefore, on future profitability. This means that domestic management actions pursuing a biomass-based maximum economic yield target may not be appropriate and that an alternative approach to maximising net economic returns may be necessary.

25.4 Environmental status

The WTBF has been granted continued export approval under the *Environment Protection and Biodiversity Conservation Act 1999*, expiring on 1 December 2014. Conditions of export approval include a requirement to develop and implement a harvest strategy in the WTBF. Because of the very low effort in the fishery, the harvest strategy has not been implemented. A revised harvest strategy that takes different levels of effort into account is currently being developed.

AFMA's ecological risk assessment examined 187 fish species in the WTBF (38 chondrichthyans and 149 teleosts), all of which were classified as being at low risk of potential overfishing, based on the Level 3 Sustainability Assessment for Fishing Effects analysis (Zhou et al. 2009). Although no shark species were identified as high risk, an increase in effort could move some species to a higher risk category. A priority action identified in the WTBF ecological risk management report is to monitor the catch and level of interaction with sharks. Management of shark interactions in this fishery will be reviewed if the landed amount of any one shark species exceeds 50 t within a year (AFMA 2010). There is a limit of 20 sharks per trip when operating in the AFZ.

AFMA publishes quarterly reports of logbook interactions with threatened, endangered and protected species on its website. In 2013, 324 shortfin mako sharks (*Isurus oxyrinchus*) were hooked in the WTBF; of these, 34 were dead and 290 were released in an unknown condition. One loggerhead turtle (*Dermochelys coriacea*) and one leatherback turtle (*Caretta caretta*) were also hooked and released alive. One longfin mako (*I. paucus*) was hooked and released in an unknown condition.

25.5 Literature cited

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