Chapter 22

Eastern Tuna and Billfish Fishery

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FIGURE 22.1 Relative fishing intensity in the Eastern Tuna and Billfish Fishery, 2013

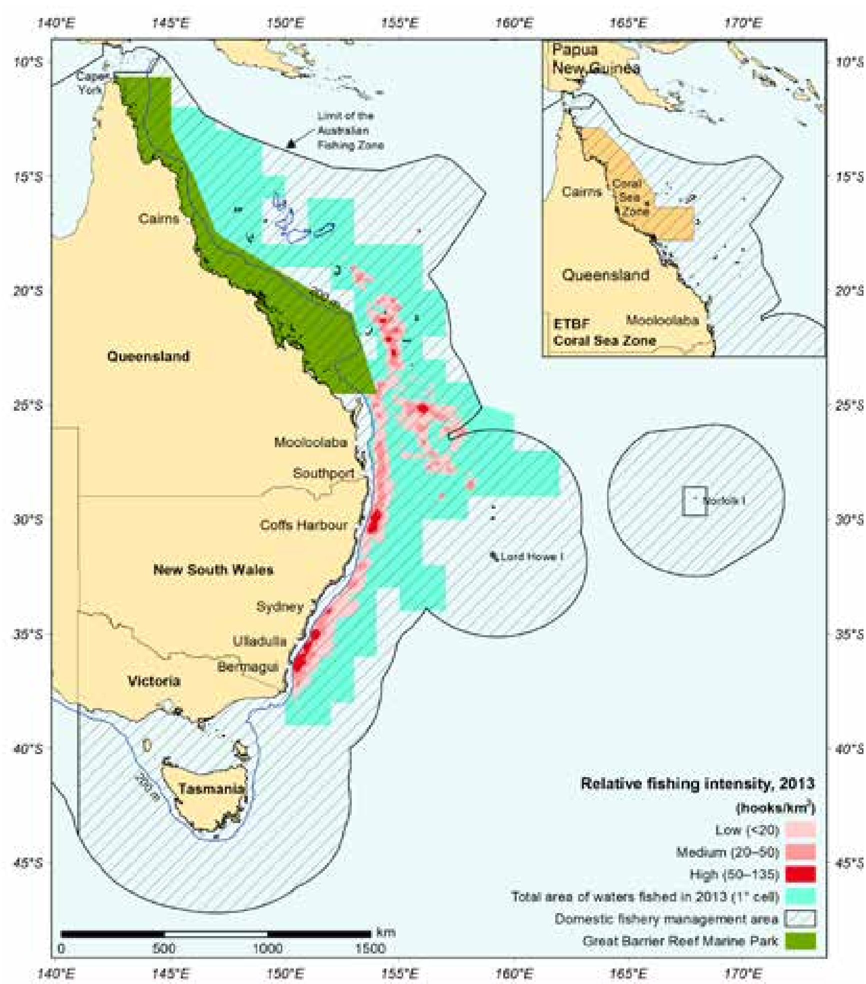


TABLE 22.1 Status of the Eastern Tuna and Billfish Fishery

Status	2012		2013		Comments a
Biological status	Fishing mortality	Biomass	Fishing mortality	Biomass	
Striped marlin (*Tetrapturus audax*), south-west Pacific					Most recent estimate of spawning biomass is above the default limit reference point but below B_{MSY}. Current fishing mortality rate is below that required to achieve MSY.
Swordfish (*Xiphias gladius*), south-west Pacific					Most recent estimates of biomass are above the default limit reference point. Fishing mortality estimates vary depending on uncertain growth schedule.
Albacore (*Thunnus alalunga*), south Pacific					Most recent estimate of spawning biomass is above the default limit reference point. Recent ocean-wide catches and fishing mortality are within MSY levels.
Bigeye tuna (*Thunnus obesus*), western and central Pacific					Most recent estimate of spawning biomass is below the limit reference point. Ocean-wide catches exceed MSY, and current fishing mortality rate exceeds that required to produce MSY.
Yellowfin tuna (*Thunnus albacares*), western and central Pacific					Most recent estimate of biomass is above the limit reference point. Ocean-wide estimates of fishing mortality are low compared with MSY levels.
Economic status	NER were $3.0 million in 2011–12 (preliminary estimates). NER estimates for 2012–13 are not available. The move to ITQs and a new harvest strategy may support improvement.				

a Ocean-wide assessments of species and the default limit reference points from the Commonwealth Fisheries Harvest Strategy Policy (DAFF 2007) are used as the basis for status determination.
Notes: B_{MSY} Biomass at maximum sustainable yield. **ITQ** Individual transferable quota. **MSY** Maximum sustainable yield. **NER** Net economic returns.

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

22.1 Description of the fishery

Area fished

The Eastern Tuna and Billfish Fishery (ETBF) operates in the Exclusive Economic Zone, from Cape York to the Victoria – South Australia border, including waters around Tasmania and high seas of the Pacific Ocean (Figure 22.1). Domestic management arrangements for the ETBF are consistent with Australia's commitments to the Western and Central Pacific Fisheries Commission (WCPFC; see Chapter 21).

Fishing methods and key species

Key species in the ETBF are outlined in Table 22.1 Most of the catch in the ETBF is taken with pelagic longlines, although a small quantity is taken using minor-line methods. Some ETBF longliners target southern bluefin tuna (*Thunnus maccoyii*) off New South Wales during winter, after fishing for tropical tunas and billfish earlier in the year, while others take them incidentally when targeting other tunas. All southern bluefin tuna taken must be covered by quota and landed in accordance with the Southern Bluefin Tuna Fishery Management Plan 1995. Recreational anglers and game fishers also target tuna and marlin in the ETBF. Many game fishers tag and release their catch, especially marlins. The retention of blue marlin (*Makaira nigricans*) and black marlin (*M. indica*) has been banned in commercial fisheries since 1998, and catch limits have been introduced on longtail tuna (*Thunnus tonggol*), in recognition of the importance of these species to recreational anglers.

Management methods

The primary ETBF tuna and billfish species are managed through total allowable catches allocated as individual transferable quotas (ITQs). The Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF 2007) is not prescribed for fisheries managed under international agreements. However, a harvest strategy framework has been developed for the ETBF (Campbell 2012a). The framework does not contain an explicit limit reference point; rather, it is target driven. The framework has been used to set the total allowable commercial catch (TACC) for swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*) since 2011, but is not currently used for tuna species.

Australia's catch in the ETBF as a percentage of the total catch from all nations in the Coral and Tasman seas has been declining across the major target species. This is due primarily to a decline in ETBF catches and, for some species, an increase in the catch of other nations. The Tropical Tuna Resource Assessment Group (TTRAG) noted that the ETBF catch as a proportion of the total catch within the Coral and Tasman seas was relatively high for swordfish and striped marlin and the ETBF harvest strategy would therefore be effective. In 2013, TTRAG made some adjustments to the target reference catch rates used in the ETBF harvest strategy for swordfish and striped marlin. These provide better alignment with the HSP default reference points of 48 per cent of unfished biomass (B_{48}) for the target and 20 per cent of unfished biomass (B_{20}) for the limit.

In 2013, the TTRAG found that the ETBF harvest strategy was not likely to achieve its objectives according to the requirements of the HSP for bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*) and albacore (*T. alalunga*). Australia's catch of these species was low in proportion to total regional catch and, under these circumstances, changes to Australia's catch could not be expected to result in a change in the stock status (due to a lack of feedback to the stock as a whole). The TTRAG considers that this issue will arise with any harvest strategy implemented under the HSP principles for these species and in the circumstances outlined.

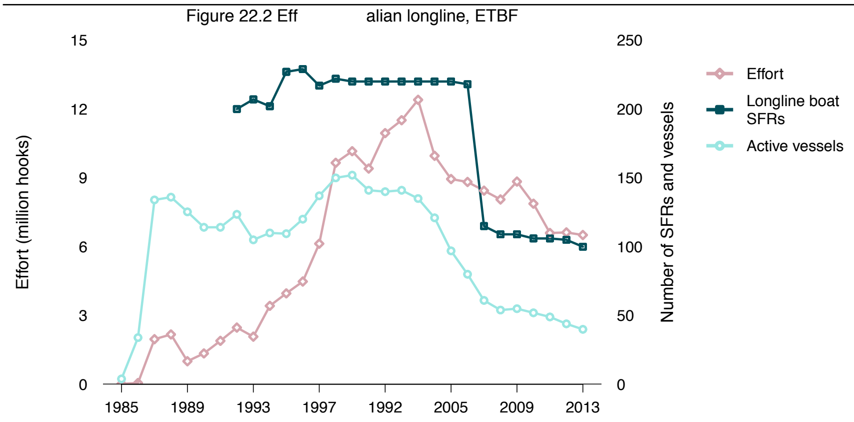
The Australian Fisheries Management Authority (AFMA) Commission subsequently directed TTRAG to cease using the harvest strategy to calculate recommended biological commercial catch levels for bigeye tuna, yellowfin tuna and albacore and to prepare information on stock status of tunas. In the absence of an accepted harvest strategy, and as there has been no allocation of tuna catches by the WCPFC, AFMA have applied TACCs based on historical catch levels in the fishery.

The status of ETBF tuna and billfish is derived from the regional assessments undertaken for the WCPFC. Assessment results over the entire geographic area modelled are used to determine stock status, but supplementary management advice may also be derived from the region most relevant to Australia. In the absence of specified limit reference points for the stocks, status determination is informed by the proxies specified in the HSP.

Fishing effort

The number of active vessels in the fishery (Figure 22.2) has decreased substantially in the past decade (from around 150 in 2002 to 41 in 2013), probably as a result of a decline in economic conditions in the fishery and the removal of vessels through the Securing our Fishing Future structural adjustment package in 2006–07 (Vieira et al. 2010).

FIGURE 22.2 Longline fishing effort, number of permits and active vessels in the ETBF, 1985 to 2013



Note: **SFR** Statutory fishing right.

Catch

Total catch in the ETBF has been declining over the past decade with decreasing effort and this also likely reflects the declining economic conditions in the fishery (Figure 22.3). Swordfish and yellowfin tuna continue to be the main target species.

FIGURE 22.3 Total catch (from logbook data) for all methods, by species, in the ETBF, 1987 to 2013

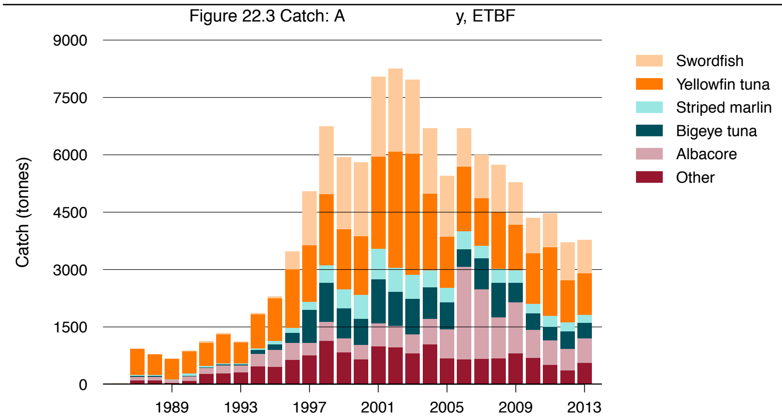


TABLE 22.2 Main features and statistics for the ETBF

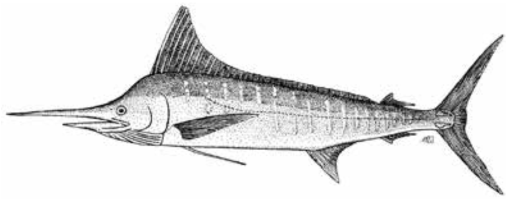
Fishery statistics a	2012			2013		
Stock	**TACC**	**Catch (t)**	**Real value (2011–12)**	**TACC**	**Catch (t)**	**Real value (2012–13)**
Marlin, striped	370	262	$1.5 million	370	250	$1 million
Swordfish	1 396	1 157	$6 million	1 396	1 062	$4.6 million
Albacore	2 500	709	$1.8 million	2 500	773	$1.8 million
Tuna, bigeye	1 056	553	$5.5 million	1 056	489	$5 million
Tuna, yellowfin	2 200	1 259	$12.8 million	2 200	1 341	$11.4 million
Total	**7 522**	**3 940**	**$27.6 million**	**7 522**	**3 915**	**$23.9 million**

Fishery-level statistics		
Effort	Longline: 6.62 million hooks Minor-line: 73 lines	Longline: 6.51 million hooks Minor-line: 95 lines
Fishing permits	Longline boat SFRs: 105 Minor-line boat SFRs: 131	Longline boat SFRs: 100 Minor-line boat SFRs: 120
Active vessels	Longline: 44 Minor-line: 7	Longline: 41 Minor-line: 7
Observer coverage	Longline: 406 827 hooks (5.9%) Minor-line: zero	Longline: 416 868 (6.2%) Minor-line: zero
Fishing methods	Pelagic longline, minor-line (trolling, rod and reel, handline)	
Primary landing ports	Mooloolaba, Bermagui, Cairns, Coffs Harbour, Southport, Ulladulla	
Management methods	Output controls: TACC and ITQs Input controls: limited entry, gear restrictions	
Primary markets	Domestic: fresh International: Japan, United States—mainly fresh; Europe—frozen; American Samoa, Thailand, Indonesia—albacore mainly for canning	
Management plan	Eastern Tuna and Billfish Fishery Management Plan 2010	

a Fishery statistics are provided by calendar year to align with international reporting requirements. Real-value statistics are by financial year and are expressed in 2012–13 dollars.
Notes: **ITQ** individual transferable quota. **SFR** Statutory fishing right. **TACC** Total allowable commercial catch.

22.2 Biological status

Striped marlin (*Tetrapturus audax*)



Line drawing: FAO

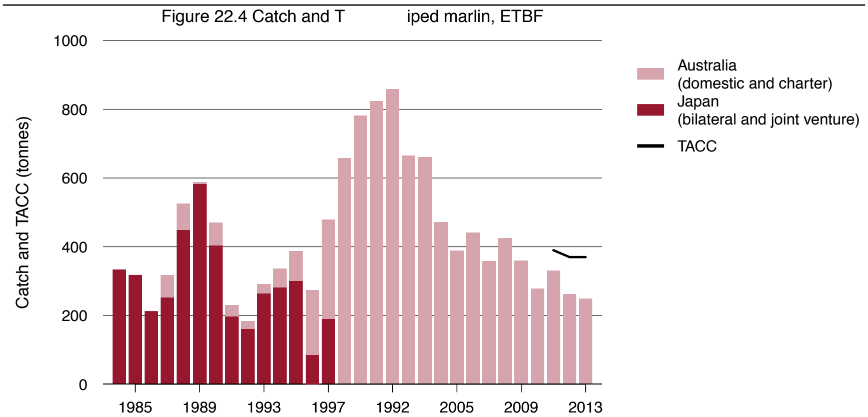
Stock structure

Genetic studies have identified multiple stocks of striped marlin in the Pacific Ocean (for example, McDowell & Graves 2008; Purcell & Edmands 2011). As a result, the north Pacific Ocean and south-west Pacific Ocean stocks (SWPO) are assessed separately (WCPFC 2013). Information for the SWPO stock is reported here.

Catch history

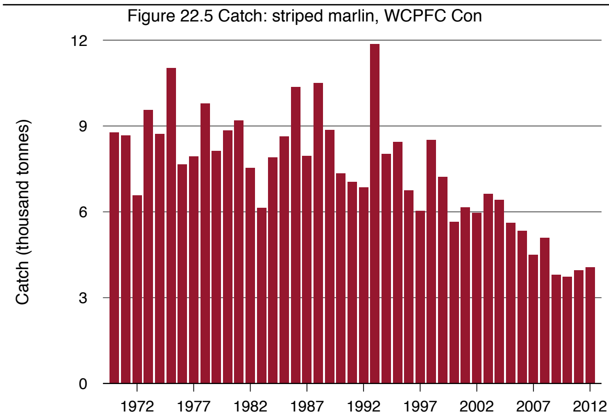
Catch for the ETBF decreased slightly in 2013 (Figure 22.4), while catches in the SWPO increased slightly in 2012 (Figure 22.5). A recent increase in total catch in the SWPO has been driven in part by increases in catch in the northern area that is not subject to the current conservation and management measure (CMM) for striped marlin, which only applies south of 15°S (WCPFC CMM 2006–04).

FIGURE 22.4 Striped marlin catch in the ETBF, 1984 to 2013



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

FIGURE 22.5 Striped marlin catch in the western and central Pacific, 1970 to 2012



Stock assessment

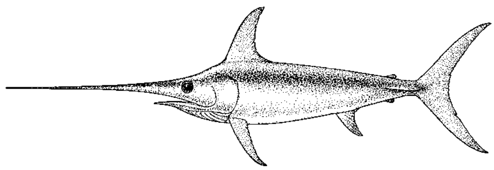
The stock assessment for striped marlin in the SWPO was updated in 2012 (Davies et al. 2012). Significant changes in the base-case from the previous (2006) assessment included a 50 per cent reduction in Japanese longline catches over the entire model time period, faster growth rates and steepness in the stock–recruitment relationship fixed at a higher level (0.8 rather than 0.55). A decreasing trend in recruitment through time was found, particularly from 1950 to 1970. There were conflicts among the standardised catch-per-unit-effort (CPUE) time series, and a series from the Japanese longline fishery was considered to be the most representative. Estimates of equilibrium maximum sustainable yield (MSY) and the associated reference points were highly sensitive to the assumed values of natural mortality and steepness in the stock–recruitment relationship. Estimates of stock status relative to MSY-based reference points, as used by the WCPFC, are therefore uncertain.

The base-case in the assessment estimated that the current (2007 to 2010) spawning biomass has been reduced to 24 per cent of initial levels ($SB_{CURRENT}/SB_0 = 0.24$; sensitivity range 0.21–0.31). It was estimated that the spawning biomass was below the level associated with MSY ($SB_{CURRENT}/SB_{MSY} = 0.87$; range 0.67–1.14). Current fishing mortality is below F_{MSY} ($F_{CURRENT}/F_{MSY} = 0.81$; range 0.51–1.21), and recent catches are close to MSY.

Stock status determination

The most recent estimate of the SWPO spawning biomass of striped marlin is close to but above the HSP default limit reference point of 20 per cent of initial unfished levels. The most recent base-case estimates of fishing mortality and most sensitivity analyses are below the level associated with MSY, and recent catches are close to MSY. As a result, SWPO striped marlin is classified as **not subject to overfishing** and **not overfished**. The Scientific Committee of the WCPFC recommended measures to reduce overall catch, through the expansion of the geographical scope of CMM 2006–04, to cover the distribution range of the stock.

Swordfish (*Xiphias gladius*)



Line drawing: Gavin Ryan

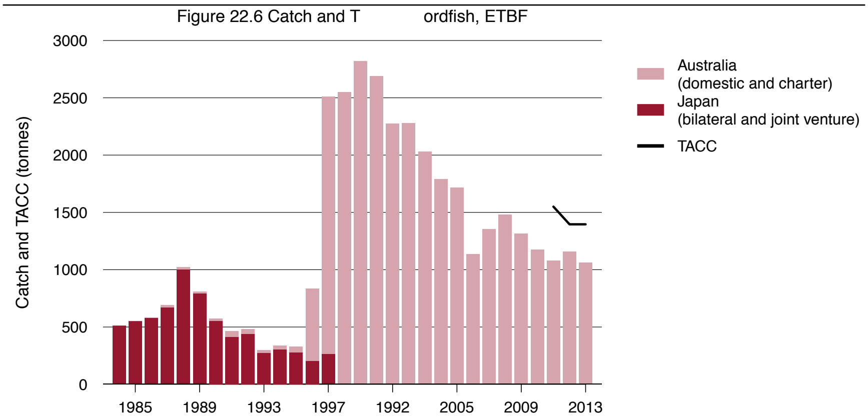
Stock structure

While studies of swordfish have generally indicated a low level of genetic variation in the Pacific Ocean (Kasapidis et al. 2008), the WCPFC assesses two stocks separately: a north Pacific stock and a SWPO stock. The information reported here is for the SWPO stock.

Catch history

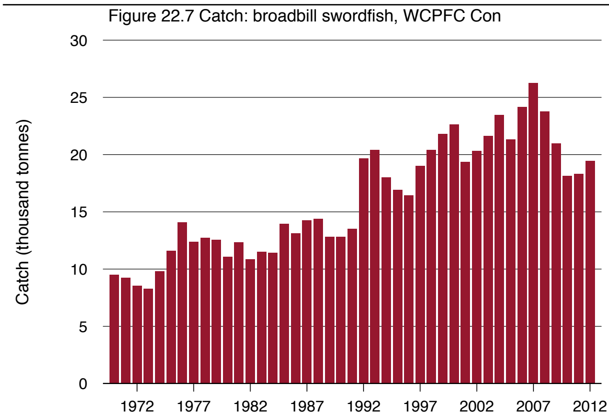
Swordfish catch in the ETBF decreased in 2013 (Figure 22.6). Catches in the SWPO increased to a peak of over 25 000 t in 2007 before declining until 2010 to around 18 000 t. Catch has since increased slightly to just under 20 000 t in 2012 (Figure 22.7).

FIGURE 22.6 Swordfish catch in the ETBF, 1984 to 2013



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

FIGURE 22.7 Swordfish catch in the western and central Pacific, 1970 to 2012



Stock assessment

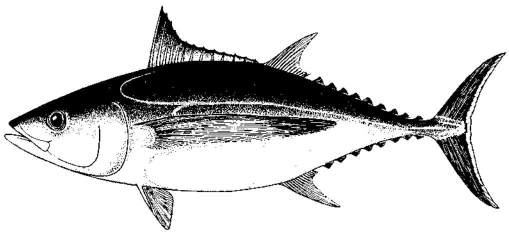
The SWPO stock of swordfish was most recently assessed in 2013 using the assessment model MULTIFAN-CL (Davies et al. 2013). The new assessment builds on the 2008 assessment and is underpinned by several other analyses examining standardised CPUE series (for example, Campbell 2012b; Hoyle et al. 2013). The main uncertainty in the assessment pertains to swordfish growth, maturity and mortality-at-age schedules, with two schedules used in the assessment: one derived from Hawaiian estimates and the other from Australian estimates. Although these two schedules affected the stock status of swordfish, the WCPFC Scientific Committee was unable to decide which schedule was more reliable (WCPFC 2013).

Model runs for both growth schedules indicated that the current (2007–10) level of spawning biomass was above the level that would result in MSY (Australian estimate: $SB_{CURRENT}/SB_{MSY}$ = 1.15–1.80; Hawaiian estimate: $SB_{CURRENT}/SB_{MSY}$ = 1.86–2.54). A range of key model runs also indicated that current spawning biomass was above 20 per cent of initial spawning biomass ($SB_{CURRENT}/SB_0$ = 0.27–0.55). However, estimates of fishing mortality relative F_{MSY} varied under the growth schedules, with the Hawaiian schedule indicating overfishing was not occurring ($F_{CURRENT}/F_{MSY}$ = 0.40–0.70), but with the Australian schedule indicating overfishing was occurring ($F_{CURRENT}/F_{MSY}$ = 1.06–1.77).

Stock status determination

The most recent estimates of spawning biomass, from all models and sensitivities, are above the HSP default limit reference point of 20 per cent of initial unfished levels. As a result, the swordfish stock in the SWPO is classified as **not overfished**. However, the most recent estimates of fishing mortality relative to the F_{MSY} reference point vary greatly, depending on the growth schedule assumed in the model. The Scientific Committee was unable to decide which growth schedule was more reliable and recommended that further research on growth schedules be done. The stock is classified as **uncertain** with regard to the level of fishing mortality.

Albacore (*Thunnus alalunga*)



Line drawing: FAO

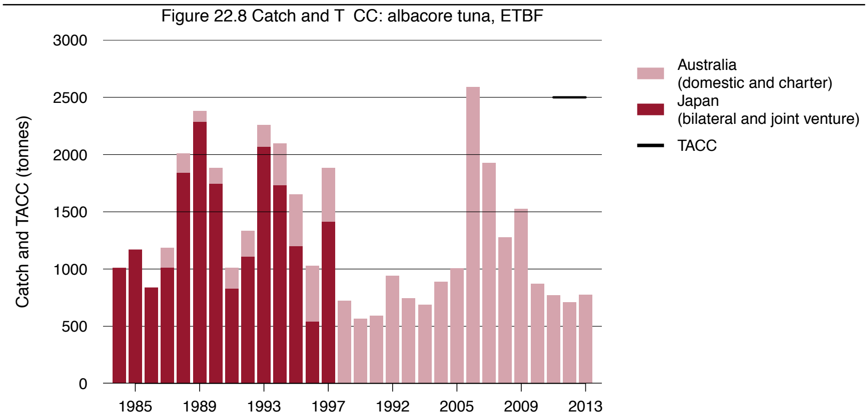
Stock structure

Two distinct stocks of albacore (north Pacific and south Pacific) are found in the Pacific Ocean, generally associated with the two oceanic gyres. These two stocks are assessed separately (WCPFC 2013). Information for the south Pacific albacore stock is reported here.

Catch history

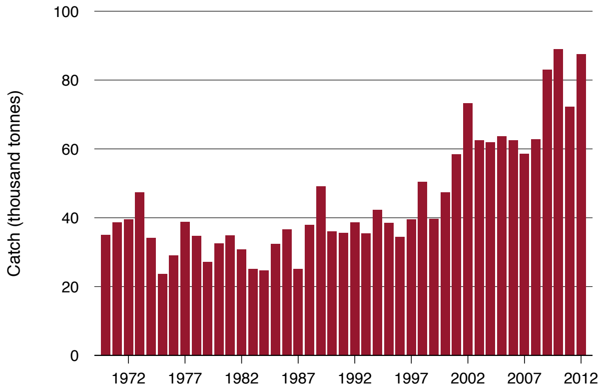
Catches in the ETBF in 2013 increased and were similar to 2011 levels, although remained much lower than catch from 2006 to 2009 (Figure 22.8). Catches and fishing mortality in the south Pacific have increased in recent years, and increased again in 2012 (Figure 22.9). The WCPFC Scientific Committee recommended that longline fishing mortality be reduced if the WCPFC's goal is to maintain economically viable catch rates.

FIGURE 22.8 Albacore catch and TACC in the ETBF, 1984 to 2013



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

FIGURE 22.9 Albacore catch in the western and central Pacific, 1970 to 2012



Stock assessment

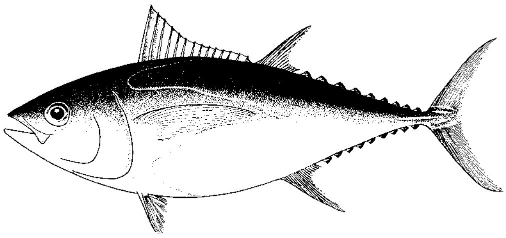
The assessment for albacore in the south Pacific Ocean was updated in 2012 using MULTIFAN-CL. Updates included revised longline CPUE indices, revised catch and size data, and substantial changes to some of the biological parameters (Hoyle et al. 2012). Cumulatively, these revisions resulted in a more optimistic assessment of status.

The base-case in the assessment estimated that the current (2007 to 2010) spawning biomass has been reduced to 59 per cent of initial levels ($SB_{CURRENT}/SB_0$ = 0.59; range 0.41–0.76). It was estimated that the spawning biomass was well above the level associated with MSY ($SB_{CURRENT}/SB_{MSY}$ = 2.56; range 1.46–5.20). Current fishing mortality is well below F_{MSY} ($F_{CURRENT}/F_{MSY}$ = 0.21; range 0.04–1.08), and recent catches are comparable with the estimates of MSY. Reference points based on MSY are quite uncertain for this assessment.

Stock status determination

The most recent estimate of spawning biomass is above the HSP default limit reference point of 20 per cent of initial unfished levels. The most recent estimates of fishing mortality are below the levels associated with MSY, and recent catches are around MSY. As a result, albacore in the south Pacific Ocean is classified as **not subject to overfishing** and **not overfished**.

Bigeye tuna (*Thunnus obesus*)



Line drawing: FAO

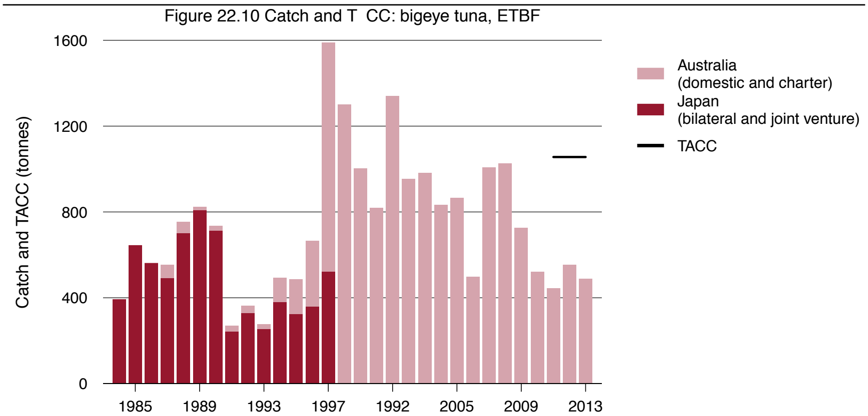
Stock structure

Genetic data has indicated that bigeye tuna in the Pacific Ocean is a single biological stock (Grewe & Hampton 1998).

Catch history

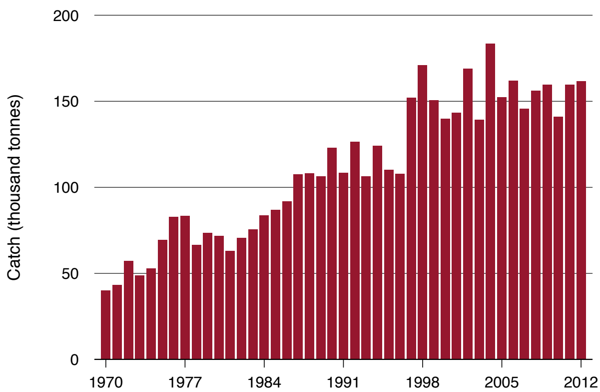
Catches of bigeye tuna decreased in the ETBF in 2013 (Figure 22.10) and increased slightly in the WCPFC area in 2012 (Figure 22.11). Recent bigeye tuna catch in the WCPFC area (161 561 t in 2012) is well above the estimated MSY (108 520 t). Catch has been above this level since around 1987–88 (Figure 22.11).

FIGURE 22.10 Bigeye tuna catch and TACC in the ETBF, 1984 to 2013



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

FIGURE 22.11 Bigeye tuna catch in the WCPFC area, 1970 to 2012



Stock assessment

The bigeye tuna stock in the western and central Pacific Ocean (WCPO) was most recently assessed in 2014 using MULTIFAN-CL (Harley et al. 2014) and was subject to significant changes and improvements following a review conducted in 2012. The assessment indicated that spawning biomass had declined to approximately half of initial levels by the mid-1970s, with spawning biomass continuing to decline since then. The base-case in the assessment estimated that the 2012 spawning biomass has been reduced to 16 per cent of the levels predicted to occur in the absence of fishing ($SB_{LATEST}/SB_{F=0}$ = 0.16 for the base-case and range 0.14–0.18 across the base-case and three sensitivities). The 2012 spawning biomass was also below the level that will support MSY (SB_{LATEST}/SB_{MSY} = 0.77 for the base-case and range 0.62–0.96).

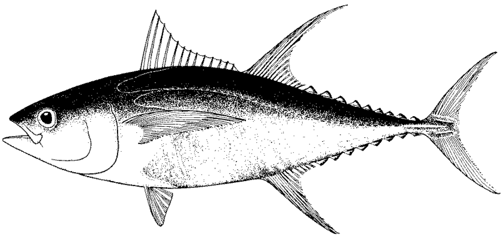
The assessment indicated that current (2008 to 2011 average) fishing mortality is 1.57 times the fishing mortality that will support MSY ($F_{CURRENT}/F_{MSY}$ = 1.57 for the base-case and range 1.27–1.95).

A whole-of-Pacific assessment of bigeye tuna (including the east Pacific) is scheduled to be undertaken in 2015.

Stock status determination

The base-case (and all sensitivities) in the latest assessment (Harley et al. 2014) indicates that bigeye tuna spawning biomass is below the 20 per cent depletion reference point adopted by the WCPFC ($0.2SB_{F=0}$). This reference point corresponds with the limit reference point in the HSP. As a result, the stock is classified as **overfished**. The current fishing mortality across the WCPO is well in excess of levels needed to maintain MSY, and so the stock is classified as **subject to overfishing**. The WCPFC Scientific Committee has recommended a reduction of at least 36 per cent in fishing mortality from the average levels for 2008 to 2011 to reduce the fishing mortality rate to F_{MSY}.

Yellowfin tuna (*Thunnus albacares*)



Line drawing: FAO

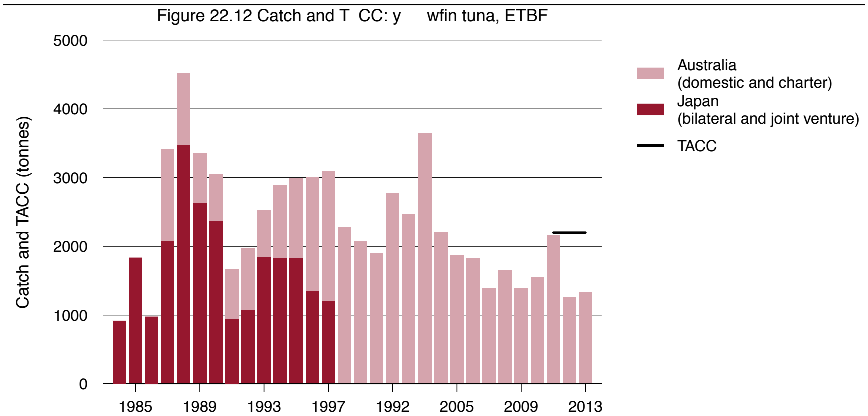
Stock structure

Yellowfin tuna in the western and central Pacific Ocean is considered to be a single biological stock (Langley et al. 2012).

Catch history

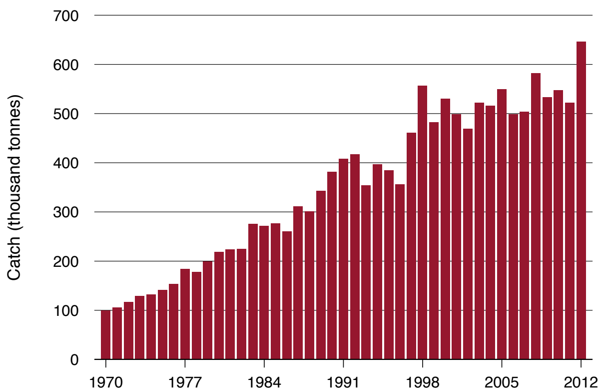
Catch increased slightly in the ETBF in 2013 (Figure 22.12) and increased substantially in the wider WCPFC area in 2012 to its highest reported level (Figure 22.13). The WCPFC 2012 catch (646 165 t) is above the estimated MSY (586 400 t).

FIGURE 22.12 Yellowfin tuna catch and TACC in the ETBF, 1984 to 2013



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

FIGURE 22.13 Yellowfin tuna catch in the WCPFC area, 1970 to 2012



Stock assessment

Yellowfin tuna stock in the WCPO was most recently assessed in 2014 using MULTIFAN-CL, with data up to and including 2012 (Davies et al. 2014). Spawning biomass (2006 to 2009 average) was estimated to be 42 per cent of initial unfished levels ($0.42SB_0$; range 0.40–0.53) and well above the biomass required to achieve MSY ($SB_{CURRENT}/SB_{MSY}$ = 1.47; range 1.34–1.83). Fishing mortality was estimated to be below F_{MSY} ($F_{CURRENT}/F_{MSY}$ = 0.77; range 0.56–0.90).

The base-case in the assessment estimated that the 2012 spawning biomass has been reduced to 38 per cent of the levels predicted to occur in the absence of fishing ($SB_{LATEST}/SB_{F=0}$ = 0.38 for the base-case and range 0.35–0.40 across the base-case and three sensitivities). The 2012 spawning biomass was above the level that will support MSY (SB_{LATEST}/SB_{MSY} = 1.24 for the base-case and range 1.05–1.51).

The assessment indicated that current (2008–11 average) fishing mortality is 0.72 times the fishing mortality that will support MSY ($F_{CURRENT}/F_{MSY}$ = 0.72 for the base-case and range 0.58–0.90).

Stock status determination

The results of the 2014 assessment indicate that the spawning biomass of yellowfin tuna is above the 20 per percent depletion reference point adopted by the WCPFC ($0.2SB_{F=0}$). This reference point corresponds with the limit reference point in the HSP. As a result, the stock is classified as **not overfished**. The 2012 catch is slightly above the base-case MSY; however, the current fishing mortality for the base-case assessment is below that required to achieve MSY. As a result, the stock is classified as **not subject to overfishing**.

22.3 Economic status

Key economic trends

The most recent (2010–11) net economic returns (NER) were positive for the first year since 2000–01 (George & New 2013). This improvement can be attributed to the reduced number of active vessels and lower associated costs. These changes followed the autonomous exit of vessels from the fishery in response to market forces and the Securing our Fishing Future structural adjustment package (Vieira et al. 2010), which removed 99 longline permits and 112 minor-line permits. A change in the production mix (that is, species caught) towards more highly valued tuna species since 2006–07 probably contributed to the revenue increases and positive NER.

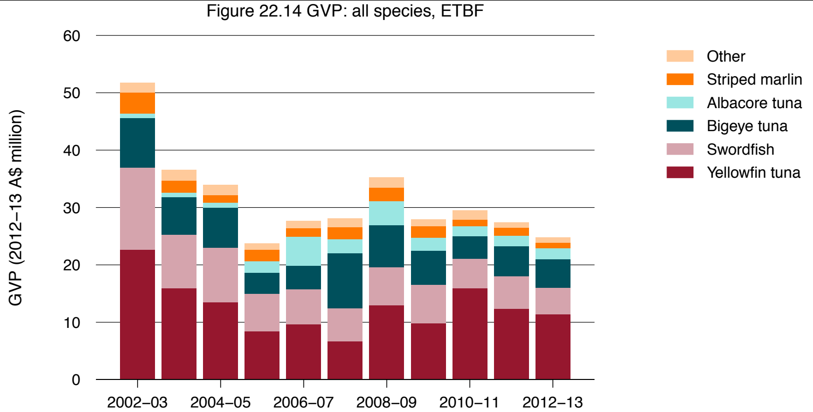
Between 2009–10 and 2010–11, improved economic performance in the fishery was driven primarily by a reduction in operating costs. In 2011–12, NER were estimated to have increased to $3.0 million (preliminary estimate). Revenue and operating costs were both estimated to have declined, with the fall in operating costs proportionately larger than the fall in revenue. The main driver for the reduction in operating costs was a fall in boat numbers, total effort, catch (which affects some key variable costs) and the estimated distance travelled by the ETBF fleet.

Previous improvements in the economic performance of the fishery are consistent with generally increasing productivity since the early 2000s (Stephan & Vieira 2013). Total factor productivity followed a generally increasing trend since 1999–2000, although the rate of growth increased after 2001–02. The increased rate of growth occurred at the same time as the reduction in fleet size, driven primarily by market forces in the early 2000s and, later in that decade, by the Securing Our Fishing Future structural adjustment package. This is likely to have left the more efficient vessels continuing to operate in the fishery, which may be the principal driver for the increasing productivity trend during the latter part of the decade.

Landing a yellowfin tuna
Gavin Kewan, AFMA

Cost and NER estimates are not yet available for 2012–13. However, a 2 per cent decline in effort (from 6.62 million hooks to 6.51 million hooks) between 2011–12 and 2012–13 and a 9 per cent reduction in the number of active vessels (from 44 to 40) are likely to have put downward pressure on fishery-level costs in 2012–13. Off-road prices for diesel increased by 1 per cent in 2012–13, but this increase is unlikely to have counteracted the entire reduction in fishery-level costs. The gross value of production (GVP) declined by 16 per cent in 2012–13 (Figure 22.14). The economic information available suggest that fishery-level NER could have increased, stayed the same or declined. As such, NER for 2012–13 is uncertain.

FIGURE 22.14 Real GVP for the ETBF by financial year, 2002–03 to 2012–13



Note: **GVP** Gross value of production.

Management arrangements

Despite being a managed fishery, the ETBF has previously exhibited some of the economic characteristics of an unmanaged, open-access fishery (Kompas et al. 2009). Estimates suggest that the fishery earned negative NER between 2001–02 and 2009–10. Low NER are likely to have been a major reason for a large proportion of the fishery's permits being inactive. This is a sign that the fishery was overcapitalised. The structural adjustment under the Securing our Fishing Future package addressed these issues to a degree—it left fewer vessels sharing a similar amount of catch and revenue.

In March 2011, output controls were introduced for five key target species in the form of TACCs, allocated as ITQs. The removal of some input controls under ITQs can provide fishers with more flexibility to fish with a more efficient combination of inputs (Elliston & Cao 2004). The transferability of statutory fishing rights among fishers also allows for more efficient allocation of these rights. This is likely to result in the catch being taken by the most efficient operators in the fishery.

The move to ITQs may have benefits for some species, but since they were only introduced in 2011 it is too early to assess their impact on NER. The setting of TACCs in the ETBF is complicated by uncertainty around what level of TACC is consistent with maximising NER from an internationally shared stock (see 'Performance against economic objective'). If TACCs are set too high so that they do not constrain a species' catch, the incentive for quota trade and the associated positive impacts for fishery-level efficiency from trade are reduced (Elliston et al. 2004). If TACCs are set too low (based on a stock's biological and economic status) some level of NER will be foregone as a result.

Performance against economic objective

The harvest of stocks that are internationally shared complicates both the selection of economic-based targets and the assessment of economic status against the economic objective of maximum economic yield (MEY), intended to maximise NER to the Australian community. Stock assessment is particularly complicated for the ETBF because the catch taken is a relatively small proportion of the total WCPFC catch, and the degree of connectivity between the Australian population and that in the wider region remains uncertain for some species. For these species, a reduction in the Australian catch may not necessarily lead to an increase in stock and, therefore, profitability in the long term. The potential lack of association between domestic management actions and changes in stock biomass means that stock-wide B_{MEY} may not be relevant. Recent increases in international catches near the Australian border have further complicated matters, as these vessels are more likely to be interacting with a separate Australian stock, if one exists.

The species-specific biomass targets in this fishery are based on the expected catch rates and the size proportion that is expected to occur when the level of mean spawners per recruit is at 48 per cent of initial unfished levels. This is assumed to be consistent with the MEY target recommended by the HSP. It is unclear how accurately the target reflects MEY. Since the harvest strategy for the fishery was implemented in 2010, NER have turned positive. However, it is unclear to what extent the targets are responsible for this. NER were improving in the fishery before the implementation of the harvest strategy, and many factors other than the harvest strategy may have influenced the fishery's economic performance.

22.4 Environmental status

Product from the ETBF currently has export approval under inclusion on the List of Exempt Native Specimens until 2019. Several conditions were imposed as part of the previous approval (which expired on 28 August 2014), including AFMA ensuring that the catch of bigeye tuna is sustainable and implementing measures to ensure that the take of sharks in the fishery is sustainable. To meet these conditions, AFMA, through the TTRAG, undertook research into the consequences of different bigeye stock structures for the harvest strategy. For sharks, operators must not take more sharks than the number of fish of the quota species retained, up to a maximum of 20 sharks per trip. This excludes species that are subject to other catch limits (for example, white shark [*Carcharodon carcharias*] and other shark species that are no-take in the ETBF). AFMA has implemented a ban on retaining oceanic whitetip sharks (*Carcharhinus longimanus*) that was agreed by the WCPFC in early 2012. The use of wire trace leader is prohibited in the ETBF.

Under the Level 3 Sustainability Assessment for Fishing Effects (carried out for fish only), two species of sunfish and three species of shark were identified as being at high risk from the effects of fishing in the ETBF (Zhou et al. 2007). A 2012 review of the ecological risk assessment, using new information on sunfish, has reclassified both species of sunfish as medium risk. The priorities of the ecological risk management response are to reduce interactions with marine turtles, seabirds and whales because of their protected status (AFMA 2012), and to reduce the capture and mortality of sharks by implementing the 20-shark trip limit. The ecological risk management report also lists specific actions for the priority groups—for example, all vessels in the ETBF are required to carry line cutters and de-hookers so that sharks, turtles and other threatened, endangered or protected species can be easily removed from fishing gear, should they become hooked or entangled.

In 2013, logbooks indicated that 1988 shortfin mako sharks (*Isurus oxyrinchus*) were hooked in the ETBF. Of these, 1540 were dead and 448 were released in unknown condition. Ten longfin mako sharks (*I. paucus*) were also hooked; two were dead and eight were in unknown condition. Fifteen porbeagle sharks (*Lamna nasus*) were hooked, with 12 dead and 3 released in unknown condition. Six green turtles (*Chelonia mydas*) were hooked with three released alive and three dead. Seven leatherback turtles (*Dermochelys coriacea*) and three loggerhead turtles (*Caretta caretta*) were also hooked and all were released alive except for one leatherback that was in unknown condition. Finally, an unidentified dolphin became entangled and one New Zealand fur seal (*Arctocephalus forsteri*) was hooked; both were released alive.

Deck of longliner
Tristan New, AFMA

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