Chapter 21
Eastern Tuna and Billfish Fishery

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FIGURE 21.1 Relative fishing intensity in the Eastern Tuna and Billfish Fishery, 2016

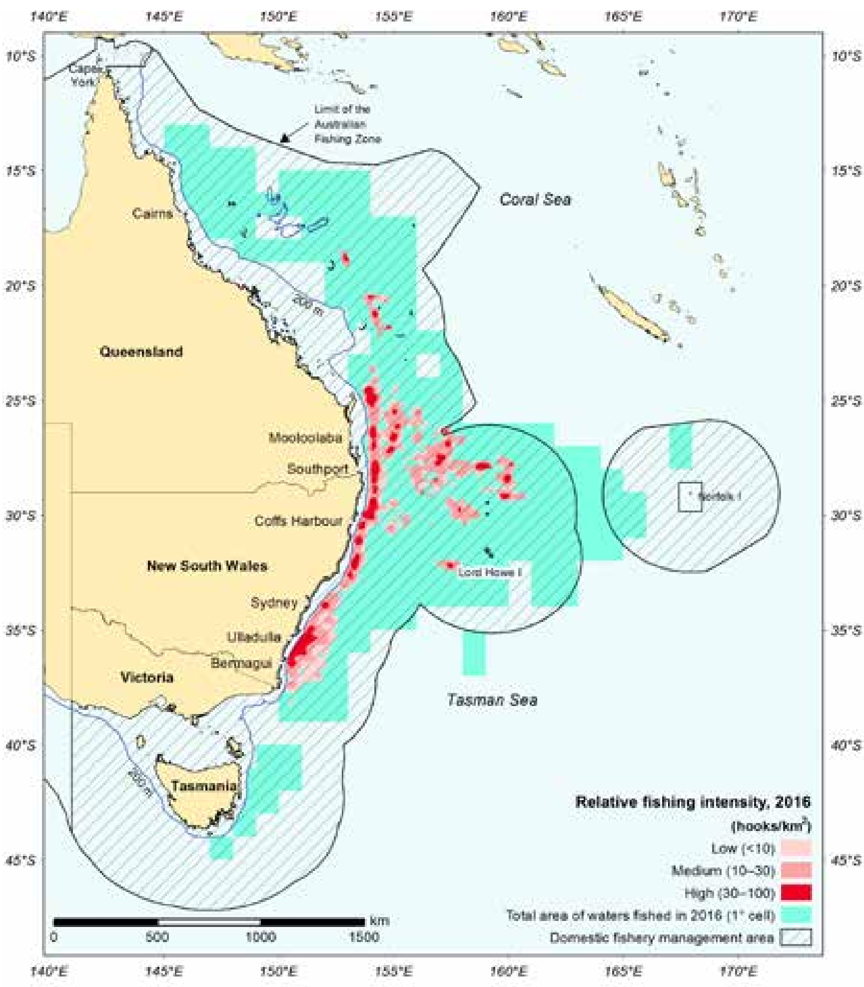


TABLE 21.1 Status of the Eastern Tuna and Billfish Fishery

Status	2015		2016		Comments a
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Striped marlin (*Kajikia audax*), south-west Pacific					Most recent estimate of spawning biomass (2012) is above the default limit reference point of B_{20} but below B_{MSY}. Current fishing mortality rate is below MSY levels.
Swordfish (*Xiphias gladius*), south-west Pacific					Most recent estimates of biomass (2013) are above the default limit reference point of B_{20}. Fishing mortality estimates vary depending on uncertain growth schedule.
Albacore (*Thunnus alalunga*), south Pacific					Most recent estimate of spawning biomass (2015) is above the default limit reference point. Recent ocean-wide catches are at, or slightly less than, MSY, and fishing mortality is below MSY levels.
Bigeye tuna (*Thunnus obesus*), western and central Pacific					Most recent estimate of spawning biomass (2014) 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 (2014) is above the limit reference point. Ocean-wide estimates of fishing mortality are below MSY levels.
Economic status	NER remained positive in 2013–14 (preliminary estimate) and for 2014–15 are likely to have increased as a result of higher GVP, lower fuel prices and reduced latency. In 2015–16, NER are likely to have increased further as prices for all major species increased significantly. The implementation of individual transferable quotas and a harvest strategy for some stocks is likely to be supporting increases in NER; however, neither have been implemented long enough to determine whether there has been a positive effect.				

a Regional 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_{20} 20 per cent of unfished biomass. B_{MSY} Biomass at MSY. **GVP** Gross value of production. **MSY** Maximum sustainable yield. **NER** Net economic returns.

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

21.1 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 the high seas of the Pacific Ocean (Figure 21.1). Domestic management arrangements for the ETBF are consistent with Australia's commitments to the Western and Central Pacific Fisheries Commission (WCPFC; see Chapter 20).

Fishing methods and key species

Key species in the ETBF are shown in Table 21.1. Most of the catch in the fishery is taken with pelagic longlines, although a small quantity is taken using minor-line methods (Table 21.2). Some ETBF longliners catch 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 mazara*) 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 has been used to set the total allowable commercial catch (TACC) for swordfish (*Xiphias gladius*) and striped marlin (*Kajikia 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 an increase in the catch by other nations for some species. 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 that 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, 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 (because of a lack of feedback to the stock as a whole).

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 because there has been no allocation of tuna catches by the WCPFC, AFMA has applied TACCs based on historical catch levels in the fishery, and in accordance with any limits determined by the WCPFC or agreed through regional arrangements, such as the Tokelau Arrangement for the Management of the South Pacific Albacore Fishery.

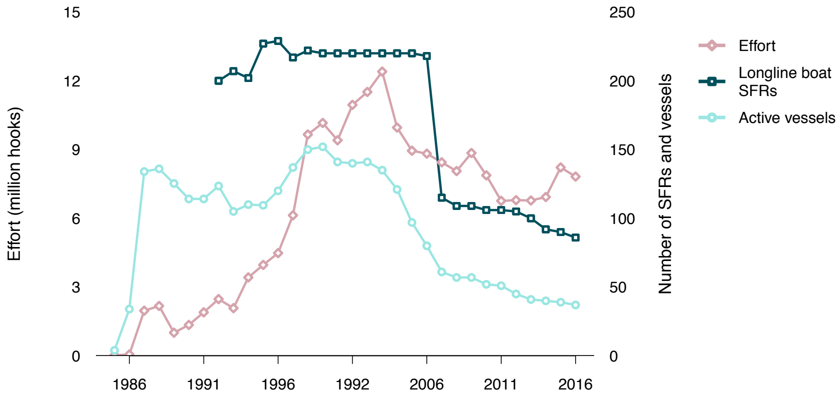
The status of ETBF tuna and billfish is derived from the regional assessments undertaken for the WCPFC. Assessment results over the relevant geographic area modelled are used to determine stock status, but supplementary management advice may also be derived from the region most relevant to Australia.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

From 1 July 2015, electronic monitoring has been mandatory for all full-time pelagic longline vessels in the ETBF and the Western Tuna and Billfish Fishery. At least 10 per cent of video footage of all hauls is reviewed to verify the accuracy of logbooks, which must be completed for 100 per cent of shots.

Fishing effort

The number of active vessels in the fishery (Figure 21.2) has decreased substantially in the past decade (from around 150 in 2002 to 37 in 2016), 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 21.2 Longline fishing effort, number of boat SFRs and active vessels in the ETBF, 1985 to 2016

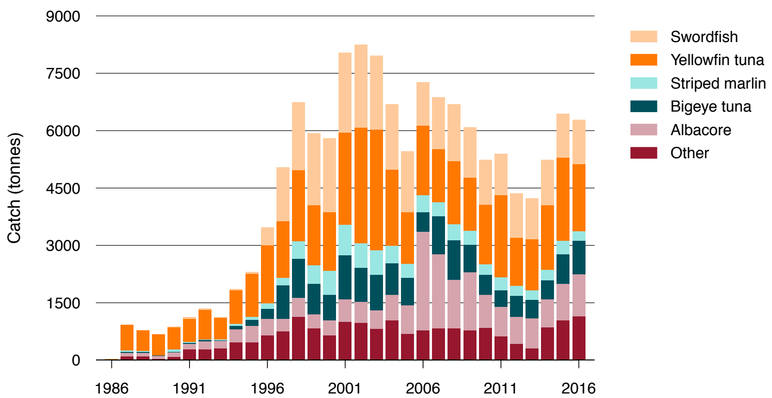


Note: **SFR** Statutory fishing right.
Source: Australian Fisheries Management Authority

Catch

Following a decrease in effort, the total retained catch of all species in the ETBF declined from a high of more than 8,000 t in 2002 to around 4,200 t in 2013, but has since increased to above 6,000 t in 2016 (Figure 21.3). Swordfish and yellowfin tuna continue to be the main target species.

FIGURE 21.3 Total catch (from logbook data) for all methods, by species, in the ETBF, 1987 to 2016



Source: Australian Fisheries Management Authority

TABLE 21.2 Main features and statistics for the ETBF

Fishery statistics a	**2015**			**2016**		
Stock	**TACC (t)**	**Catch (t)**	**Real value (2014–15)**	**TACC (t)**	**Catch (t)**	**Real value (2015–16)**
Striped marlin	351	347	$1.4 million	351	244	$1.4 million
Swordfish	1,381	1,150	$6.8 million	1,373	1,161	$9.1 million
Albacore	2,500	949	$2.0 million	2,500	1,101	$3.9 million
Bigeye tuna	1,056	785	$5.4 million	1,056	870	$8.0 million
Yellowfin tuna	2,200	2,177	$17.4 million	2,200	1,763	$24.7 million
Total fishery	**7,488**	**5,408**	**$33.0 million**	**7,480**	**5,139**	**$48.8 million**

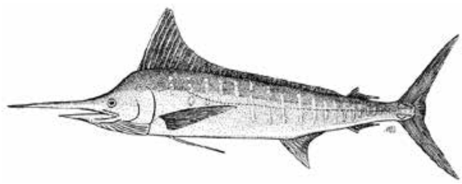
Fishery-level statistics		
Effort	Longline: 8.22 million hooks Minor line: na	Longline: 7.82 million hooks Minor line: na
Fishing permits	Longline boat SFRs: 90 Minor line boat SFRs: 101	Longline boat SFRs: 86 Minor line boat SFRs: 93
Active vessels	Longline: 39 Minor line: 5	Longline: 37 Minor-line: 2
Observer coverage	Longline: 5.87% **b** Minor-line: zero	Longline: 8.7% **b** Minor line: zero
Fishing methods	Pelagic longline, minor line (trolling, rod and reel, handline)	
Primary landing ports	Cairns, Mooloolaba and Southport (Queensland); Bermagui, Coffs Harbour and Ulladulla (New South Wales)	
Management methods	Output controls: limited entry, gear restrictions Input controls: TACC and ITQs	
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 2015–16 dollars. **b** Since 1 July 2015, e-monitoring is mandatory for all full-time pelagic longline vessels in the ETBF. At least 10% of video footage of all hauls is reviewed to verify the accuracy of logbooks, which must be completed for 100% of shots. The percentage of hooks observed is provided.

Notes: **ITQ** Individual transferable quota. **na** Not available. **SFR** Statutory fishing right. **TACC** Total allowable commercial catch.

21.2 Biological status

Striped marlin (*Kajikia audax*)



Line drawing: FAO

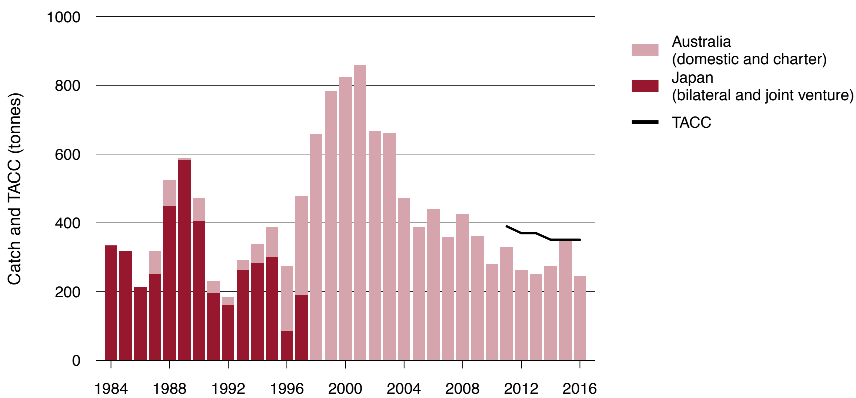
Stock structure

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 (SWPO) stocks are assessed separately (WCPFC 2013). Information for the SWPO stock is reported here.

Catch history

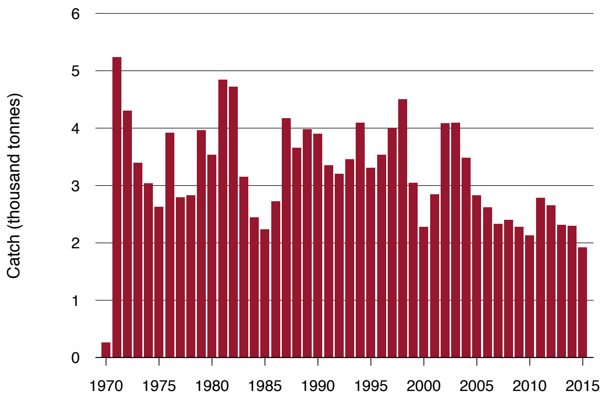
Catch for the ETBF decreased slightly in 2016 to 244 t (Figure 21.4), while catch in the south Pacific decreased from 2,300 t in 2014 to 1,924 t in 2015 (Figure 21.5). An increase in south Pacific catch in 2011–12 was driven in part by increases in catch in the north that are not subject to the current conservation and management measure (CMM) for striped marlin—WCPFC CMM 2006-04—which only applies south of 15°S.

FIGURE 21.4 Striped marlin catch and TACC in the ETBF, 1984 to 2016



Note: **TACC** Total allowable commercial catch.
Source: Australian Fisheries Management Authority

FIGURE 21.5 Striped marlin catch in the south Pacific, 1970 to 2015



Source: Western and Central Pacific Fisheries Commission

Stock assessment

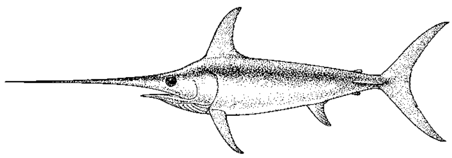
The last stock assessment for striped marlin in the SWPO was conducted in 2012 (Davies et al. 2012). Significant changes in the base case from the previous (2006) assessment included a 50 per cent reduction in Japanese longline catches over the entire model time period (because catches in the previous assessment were erroneously counted twice), faster growth rates, and the steepness of the stock–recruitment relationship being 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 latest (2010) spawning biomass had been reduced to 34 per cent of the levels predicted to occur in the absence of fishing ($SB_{CURRENT}/SB_{F=0}$ = 0.34 for the base case; range 0.32–0.44 across the base case and sensitivities). 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). Fishing mortality (2007 to 2010) was below F_{MSY} ($F_{CURRENT}/F_{MSY}$ = 0.81; range 0.51–1.21), and catches during this period were close to the estimated MSY (2,081 t; range 1,914–2,276 t). Annual catches over the most recent five years since the assessment (2011 to 2014) have averaged around 2,400 t, which exceeds the estimated MSY.

Stock status determination

The most recent estimate of the SWPO spawning biomass of striped marlin is above the WCPFC limit reference point of 20 per cent of the levels predicted to occur in the absence of fishing. The most recent base-case estimates of fishing mortality and most sensitivity analyses are below the level associated with MSY; however, recent catches are somewhat above the estimated MSY level. SWPO striped marlin is classified as **not subject to overfishing** and **not overfished.** The recent catch levels and the age of the stock assessment both contribute to increased uncertainty around the stock status of striped marlin in 2016. This trend is likely to affect future status determination. The Scientific Committee of the WCPFC recommended measures to control overall catch, through expansion of the geographical scope of CMM 2006-04 to cover the distribution of the stock; the WCPFC has not yet adopted this recommendation.

Swordfish (*Xiphias gladius*)



Line drawing: Gavin Ryan

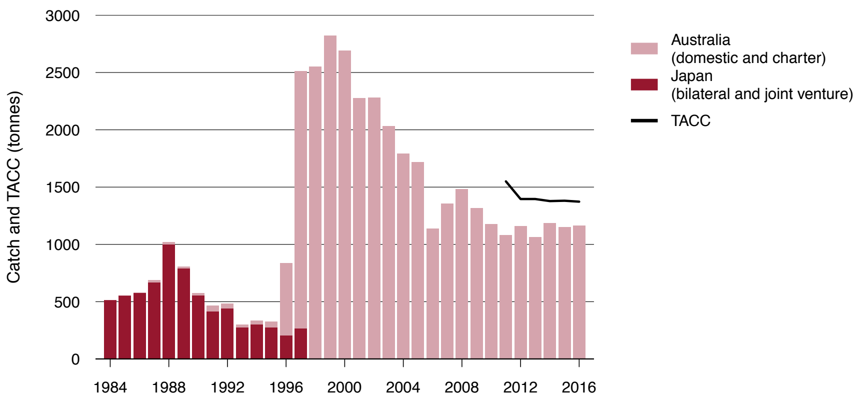
Stock structure

Although 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 an SWPO stock. The information reported here is for the SWPO stock.

Catch history

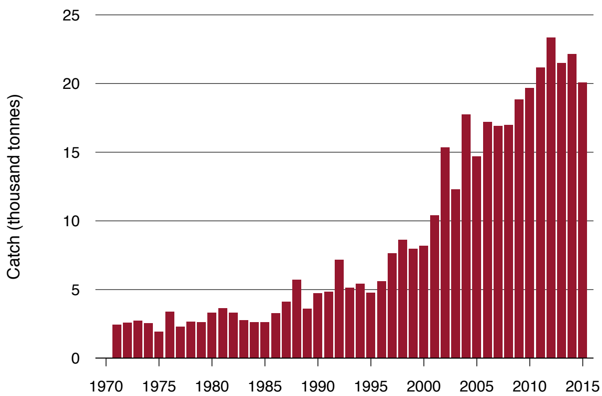
Swordfish catch in the ETBF increased slightly in 2016 (Figure 21.6). Catch in the south Pacific has generally been increasing since 2001, but decreased slightly in 2015 to 20,090 t (Figure 21.7).

FIGURE 21.6 Swordfish catch and TACC in the ETBF, 1984 to 2016



Note: **TACC** Total allowable commercial catch.
Source: Australian Fisheries Management Authority

FIGURE 21.7 Swordfish catch in the south Pacific, 1970 to 2015



Source: Western and Central Pacific Fisheries Commission

Stock assessment

The SWPO stock of swordfish was most recently assessed in 2013 (Davies et al. 2013) using the assessment package MULTIFAN-CL. This 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. Two schedules were used in the assessment: one derived from Hawaiian estimates and the other from Australian estimates. Although the schedule used affected the stock status of swordfish, the WCPFC Scientific Committee was unable to decide which schedule was more reliable (WCPFC 2013).

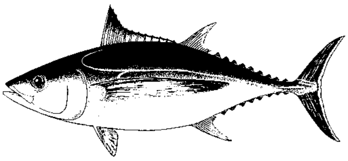
Model runs for both growth schedules indicated that the current (2007 to 2010) level of spawning biomass was above the level that would result in MSY (Australian estimate: $SB_{CURRENT}/SB_{MSY}$ = 1.15–1.80; Hawaiian estimate: $SB_{CURRENT}/SB_{MSY}$ = 1.86–2.54). The range of key model runs also indicated that current spawning biomass was above 20 per cent of the spawning biomass predicted to occur in the absence of fishing ($SB_{CURRENT}/SB_{F=0}$ = 0.26–0.60). However, estimates of fishing mortality relative to F_{MSY} varied under the growth schedules, with the Hawaiian schedule indicating that overfishing was not occurring ($F_{CURRENT}/F_{MSY}$ = 0.40–0.70) and the Australian schedule indicating that 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 the spawning biomass predicted to occur in the absence of fishing. 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 WCPFC Scientific Committee was unable to decide which growth schedule was more reliable, and further research on growth schedules is underway to resolve this issue. The stock is classified as **uncertain** with regard to the level of fishing mortality.

Yellowfin tuna
AFMA

Albacore (*Thunnus alalunga*)



Line drawing: FAO

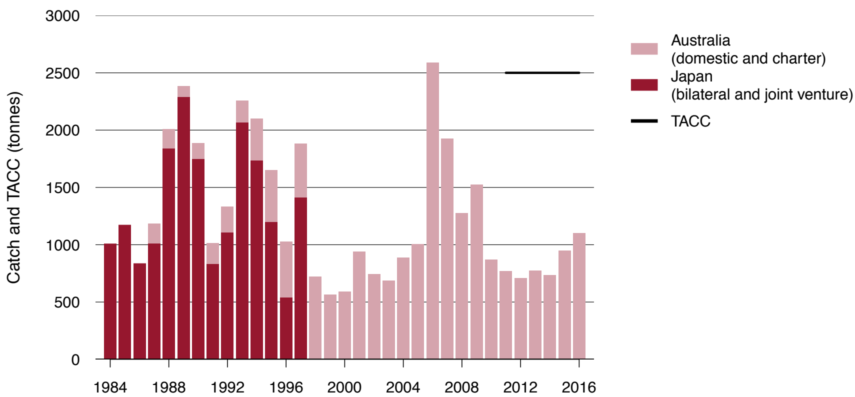
Stock structure

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 2015). Information for the south Pacific albacore stock is reported here.

Catch history

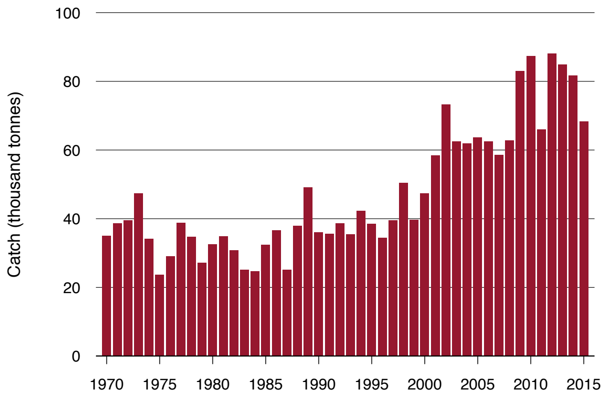
Catches in the ETBF increased to 1,101 t in 2016, the highest since 2009 (Figure 21.8). Catches in the south Pacific have increased in recent years, but decreased in 2015 to 68,306 t (Figure 21.9). The WCPFC Scientific Committee recommended that longline fishing mortality be reduced if the WCPFC's goal is to maintain economically viable catch rates.

FIGURE 21.8 Albacore catch and TACC in the ETBF, 1984 to 2016



Note: **TACC** Total allowable commercial catch.
Source: Australian Fisheries Management Authority

FIGURE 21.9 Albacore catch in the south Pacific, 1970 to 2015



Source: Western and Central Pacific Fisheries Commission

Stock assessment

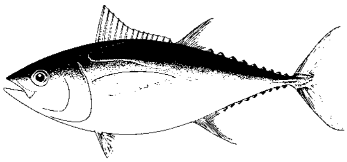
The assessment for albacore in the south Pacific was updated in 2015 using MULTIFAN-CL (Harley et al. 2015). Substantial improvements in the 2015 stock assessment included improvements to the MULTIFAN-CL modelling framework, use of a regional disaggregated framework, use of operational data for construction of CPUE indices and regional weights, changes to some key biological parameters, inclusion of direct age-at-length data to improve growth estimation, and inclusion of additional tagging data (Harley et al. 2015). Two influential changes were a change in the natural mortality assumption (from 0.4 to 0.3 per year) and exclusion of the eastern Pacific from the assessment. Although the results of the assessment are broadly consistent with the 2012 assessment, the changes to the assessment combined with the additional years of fishing resulted in a more pessimistic picture, with substantially lower biomass and higher fishing mortality.

The base-case model in the assessment estimated that the latest (2013) spawning biomass was above the level associated with MSY (SB_{LATEST}/SB_{MSY} = 2.86; range 1.74–7.03) and above the adopted limit reference point ($SB_{LATEST}/SB_{F=0}$ = 0.40; range 0.30–0.60). It should be noted that the estimate of the biomass at MSY (B_{MSY}) for south Pacific albacore is around 14 per cent of unfished levels, which is below the adopted limit reference point of 20 per cent—a target of B_{MSY} would be inconsistent with the adopted limit reference point. Current (2009 to 2012 average) fishing mortality is below F_{MSY} ($F_{CURRENT}/F_{MSY}$ = 0.39; range 0.13–0.62), and recent catches are likely at, or slightly less than, estimates of MSY.

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 well 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

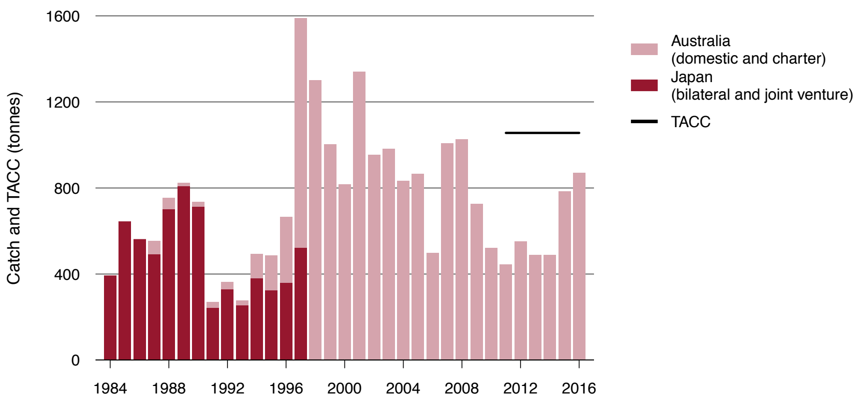
Stock structure

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

Catch history

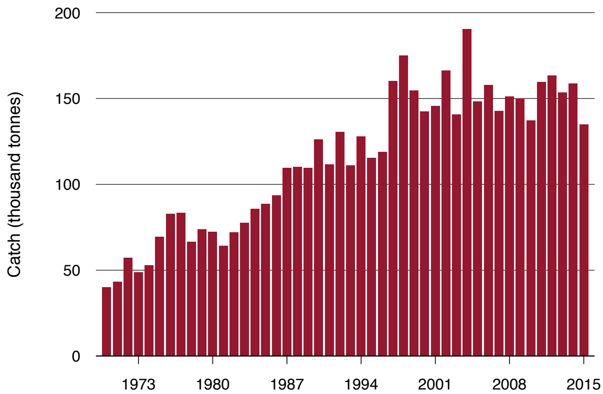
Catches of bigeye tuna increased to 870 t in the ETBF in 2016, the highest levels since 2009 (Figure 21.10). Catches decreased in the WCPFC area in 2015 (Figure 21.11). Recent bigeye tuna catch in the WCPFC area (134,682 t in 2015) is well above the estimated MSY (108,520 t). Catch has been above this level since around 1987–88 (Figure 21.11).

FIGURE 21.10 Bigeye tuna catch and TACC in the ETBF, 1984 to 2016



Note: **TACC** Total allowable commercial catch.
Source: Australian Fisheries Management Authority

FIGURE 21.11 Bigeye tuna catch in the south Pacific, 1970 to 2015



Source: Western and Central Pacific Fisheries Commission

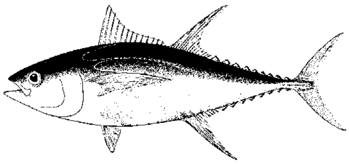
Stock assessment

The bigeye tuna stock in the western and central Pacific Ocean (WCPO) was most recently assessed in 2014 (Harley et al. 2014) using MULTIFAN-CL. The assessment was subject to significant changes and improvements following a review in 2012. It indicated that spawning biomass had declined to approximately half of initial levels by the mid 1970s and continued to decline after that. The base case in the assessment estimated that the 2012 spawning biomass had 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; 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; 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; range 1.27–1.95). Repeated runs of the assessment model resulted in inconsistencies in the parameter estimates, which were most likely due to conflicts in the input data (relating to growth, regional recruitment distributions and movement parameters). However, the stock status outcomes were consistent among model runs.

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 has driven the stock to below the limit reference point (B_{20}); consequently, 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

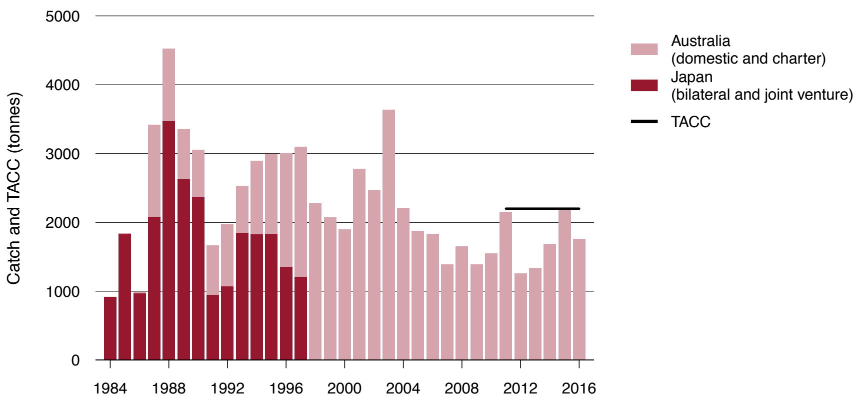
Stock structure

Yellowfin tuna in the WCPO is currently considered to be a single biological stock (Langley et al. 2012). However, a recent study using newer genomic techniques provided strong evidence of genetically distinct populations of yellowfin tuna at three sites (Coral Sea, Tokelau and California) across the Pacific Ocean (Grewe et al. 2015). Further work is underway to confirm and expand on this initial study.

Catch history

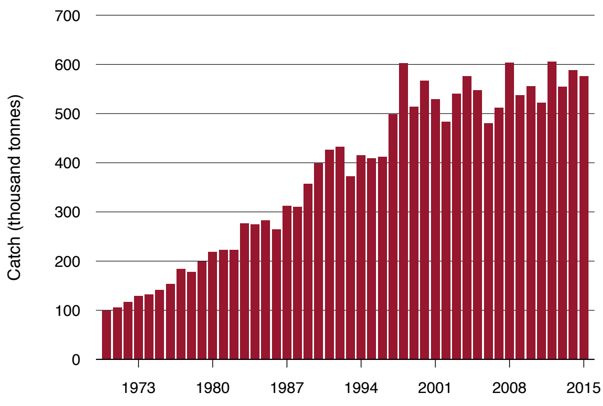
Catch decreased in the ETBF in 2016 (Figure 21.12). In the wider WCPFC area, the 2015 catch was slightly lower than the 2014 catch, at 575,901 t (Figure 21.13), which is below the estimated MSY (586,400 t).

FIGURE 21.12 Yellowfin tuna catch and TACC in the ETBF, 1984 to 2016



Note: **TACC** Total allowable commercial catch.
Source: Australian Fisheries Management Authority

FIGURE 21.13 Yellowfin tuna catch in the south Pacific, 1970 to 2015



Source: Western and Central Pacific Fisheries Commission

Stock assessment

The yellowfin tuna stock in the WCPO was most recently assessed in 2014 (Davies et al. 2014) using MULTIFAN-CL, with data up to and including 2012. The base case in the assessment estimated that the 2012 spawning biomass had 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; 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; range 1.05–1.51). The assessment indicated that current (2008 to 2011 average) fishing mortality is 0.72 times the fishing mortality that will support MSY ($F_{CURRENT}/F_{MSY}$ = 0.72 for the base case; 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 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 **not overfished.** The 2014 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.**

21.3 Economic status

Key economic trends

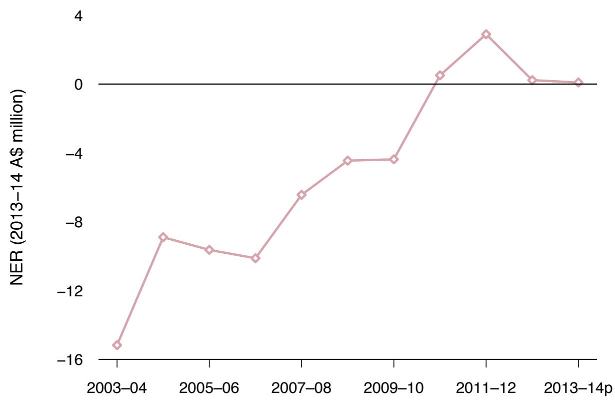
ABARES has conducted economic surveys of the ETBF since the early 1990s. The survey data are used to estimate the level of net economic returns (NER) earned in the fishery. The most recent survey results for the ETBF cover the 2011–12 and 2012–13 financial years. Non–survey based estimates for economic performance are available for 2013–14. Survey results show that NER were positive from 2010–11 to 2012–13; 2010–11 was the first year with positive NER since 2000–01 (Bath et al. 2016; Figure 21.14). This improvement was attributed to a reduced number of active vessels and lower associated costs. These changes followed the 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.

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. 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 drivers for the reduction in operating costs were falls in boat numbers, total effort, catch (which affects some key variable costs) and the estimated distance travelled by the ETBF fleet. From 2011–12 to 2012–13, NER remained positive but slightly lower as a result of higher fuel prices. Preliminary estimates for 2013–14 are that NER fell further to $0.1 million, a reduction mostly driven by higher operating costs and a relatively small increase in fishing income.

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 has 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.

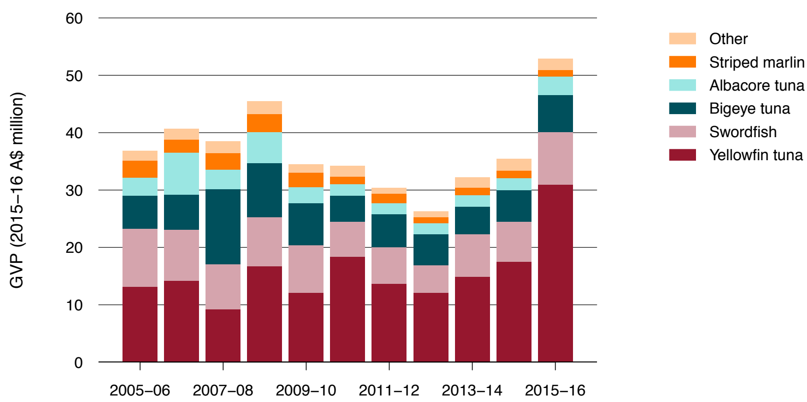
Cost and NER estimates are not yet available for 2014–15 or 2015–16. Between 2014–15 and 2015–16, effort fell (from 8.22 million hooks to 7.82 million hooks), and the number of active vessels in the fishery fell from 39 to 37. Consistent with the decrease in effort, the total retained catch in the fishery decreased from 5,408 t to 5,139 t in 2015–16, indicating marginal improvements in productivity in terms of quantity of fish caught per hook deployed. Prices for all major species in the fishery increased significantly in 2015–16, leading to a strong increase in gross value of production despite falls in catch. The gross value of production increased in 2015–16 by 35 per cent (Figure 21.15). NER in 2015–16 are still uncertain; however, the available economic information indicates that NER in the fishery increased in 2015–16.

FIGURE 21.14 NER for the ETBF, 2003–04 to 2013–14



Note: **NER** Net economic returns. Data for 2013–14 are preliminary.
Source: Bath et al. 2016

FIGURE 21.15 Real GVP for the ETBF, 2005–06 to 2015–16



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 2000–01 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 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 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 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.

Performance against economic objective

International sharing of stocks complicates both the selection of economic-based targets and the assessment of economic status against the 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 may be 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 some internationally shared stocks, a reduction in the Australian catch may not necessarily lead to response in stock abundance and, therefore, profitability in the long term. For two stocks in the ETBF—swordfish and striped marlin—Australia's share of the catch is considered to be high enough for domestic action to have a more direct influence on stock abundance. These two stocks are managed under a harvest strategy designed to achieve a catch rate target biomass for prime-size fish consistent with the HSP economic target proxy of 48 per cent of unfished levels. Recent implementation of the harvest strategy indicates that since 2008 swordfish stock levels have been close to, but just below, the target reference point (Campbell 2016). For striped marlin, catch rates have been between the target and limit reference points for more than a decade, but have approached the target since 2013 (Campbell 2016). As a result, these two species have increased their contribution to overall NER from the fishery. The potential lack of association between domestic management actions and changes in stock biomass for the tuna species in the ETBF means that stock-wide B_{MEY} may not be relevant.

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 been positive. However, it is unclear to what extent the targets are responsible for this. NER were improving in the fishery before the harvest strategy was implemented, and many factors other than the harvest strategy may have influenced the fishery's economic performance.

21.4 Environmental status

Product from the ETBF currently has export approval under inclusion on the List of Exempt Native Specimens under the *Environment Protection and Biodiversity Conservation Act 1999* until 22 August 2019. Conditions under this approval, in addition to standard conditions of reporting and monitoring, include updating the ecological risk assessment for the ETBF, developing and implementing a framework for the management of non-quota and bycatch species, and continuing to determine the impact of fishing in the ETBF on shark species.

Under the level 3 Sustainability Assessment for Fishing Effects (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 sunfish species 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 protected species can be easily removed from fishing gear, should they become hooked or entangled. Results from a new ecological risk assessment in the ETBF in 2017 will be reported in *Fishery status reports 2018*.

The introduction of electronic monitoring in the ETBF from mid 2015 has improved the accuracy of logbooks, particularly in the reporting of discarded or released catch. This improved reporting may be reflected in apparent higher levels of interaction for 2016, reported below.

In 2016, logbooks indicated that 2,005 shortfin mako sharks (*Isurus oxyrinchus*) were hooked in the ETBF. Of these, 744 were dead and 1,261 were released in unknown condition. Eight longfin mako sharks (*I. paucus*) were also hooked; two were dead and six were in unknown condition. Nine porbeagle sharks (*Lamna nasus*) were hooked and released, with eight in unknown condition. Forty-one silky sharks (*Carcharhinus falciformis*) were hooked and released in unknown condition. Thirty-nine green turtles (*Chelonia mydas*) were hooked; 30 were released alive and 9 were dead. Thirty-two leatherback turtles (*Dermochelys coriacea*) and nine loggerhead turtles (*Caretta caretta*) were also hooked; all were released alive except for three loggerheads that were dead. Two hawksbill turtles (*Eretmochelys imbricate*) were hooked, with one dead and one released alive; and one flatback turtle (*Natator depressus*) was caught and was dead. Seventeen unidentified turtles were hooked, with 12 alive and 5 dead.

Five black-browed albatrosses (*Thalassarche melanophris*) were caught, with one released alive and four dead, and one wandering albatross (*Diomedea exulans*) was released alive. Twenty unidentified albatrosses were hooked, with 4 released alive and 16 dead. Two flesh-footed shearwaters (*Ardenna carneipes*) and four unidentified shearwaters were hooked, with all being dead except one flesh-footed shearwater. One Australian gannett (*Morus serrator*) was released alive, and one unidentified bird was dead.

Several interactions with marine mammals were also recorded; these comprised three unidentified dolphins (released alive), one unidentified whale (released alive), two toothed whales (Parvorder Odontoceti; released alive), five short-finned pilot whales (*Globicephala macrorhynchus*; released alive), one long-finned pilot whale (*G. melas*; released alive), one unidentified seal (released alive) and one Australian fur seal (*Arctocephalus pusillus*; released alive).

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