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Ecologically Related Species in the Australian Southern Bluefin Tuna Fishery 2015–16 and 2016–17

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Contents

Summary

Purpose

This report includes information and data on ecologically related species (ERS) from Australia's southern bluefin tuna (SBT) fishery, updated for the 2015–16 and the 2016–17 fishing seasons.

Catch and effort

Australian SBT catches for the 2016 and 2017 calendar years were 5962 t and 5221 t, respectively. The 2015–16 quota year catch was 5633 t, and the 2016–17 quota year catch was 5334 t. Australia increased its effective total allowable catch in 2015–16 by 38 t to account for undercatch in the 2014–15 season and, by 32 t in 2016–17 to account for undercatch in the 2015–16 season.

In 2015–16, 25 vessels landed SBT in Australian waters: 86.9 per cent of the catch was taken by five purse seiners off South Australia, with the remainder taken by 18 longliners and one vessel conducting trolling operations in the Eastern Tuna and Billfish Fishery (ETBF); and, one longliner, two vessels conducting pole-and-line operations and three vessels conducting rod-and-reel operations (some vessels using multiple methods) in the Western Tuna and Billfish Fishery (WTBF).

In 2016–17, 23 vessels landed SBT in Australian waters: 87.8 per cent of the catch was taken by six purse seiners off South Australia, with the remainder taken by 18 longliners and one vessel conducting rod-and-reel operations in the ETBF; and, one vessel conducting pole-and-line operations, one vessel conducting handline operation and one vessel conducting trolling operation (some vessels using multiple methods) in the WTBF.

Observer coverage

In the 2015–16 fishing season, purse-seine observer coverage was 18.9 per cent of sets, representing 25 sets observed where SBT were retained. In 2016, observers monitored 12.4 per cent of shots where SBT was caught in the ETBF. No SBT were observed caught in the WTBF in 2016, therefore observer coverage, defined as shots where SBT were caught, was zero per cent.

In the 2016–17 fishing season, the purse-seine observer coverage was 18.3 per cent of sets, representing 20 sets observed where SBT were retained. In 2017, observers monitored 11.3 per cent of shots where SBT was caught in the ETBF. No SBT were observed caught in the WTBF in 2017, therefore observer coverage, defined as shots where SBT were caught, as zero per cent.

Interactions with ERS

Details of ERS interactions in the SBT fishery and ETBF and WTBF are provided in the report. Interactions in the ETBF are for only those shots where SBT was taken as SBT is targeted only at certain locations and time periods. Interactions with seabirds, sharks, non-target fish and marine mammals are reported for the ETBF and WTBF where data are available. No ERS interactions were reported for the purse seine SBT fishery.

Mitigation measures

Australia has implemented mitigation measures to address seabird and turtle bycatch in the longline fisheries to ensure the best practice mitigation measures are in place. These measures are provided in detail.

1 Introduction

Three domestic fisheries managed by the Australian Government interact with southern bluefin tuna (SBT; *Thunnus maccoyii*) in varying quantities: the Southern Bluefin Tuna Fishery (SBTF), the Eastern Tuna and Billfish Fishery (ETBF) and the Western Tuna and Billfish Fishery (WTBF). The SBTF targets SBT in the Great Australian Bight using purse seine, with the fishing season running from 1 December to 30 November[1]. After capture, the SBT are transferred to grow-out cages and fattened for up to approximately 6 months before being harvested. The ETBF and WTBF are longline fisheries primarily targeting yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), albacore (*Thunnus alalunga*), swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*). Longlining for SBT occurs primarily in the Australian winter months between May and October in the ETBF. The fishing season in the WTBF begins on 1 February each year, while in the ETBF the fishing season has changed in 2019 and is now the calendar year. Because the three fisheries have distinct characteristics and management plans, they are separated within this report.

Australia separates its ecologically related species (ERS), or non-target catch, into byproduct and bycatch (including protected species under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999)). The purse seine fishery has very little interaction with ERS as the purse seine fishing method is highly selective. The longline fisheries are multi-species fisheries that, while being relatively selective, catch a range of fish and shark species and have reported interactions with seabirds and, to a lesser extent, marine turtles. A reduction in discarding of species with little commercial value has been a focus of management initiatives. For example, in 2000 the Australian Fisheries Management Authority (AFMA) implemented Bycatch Action Plans for the SBTF, WTBF and ETBF. Since 2008, a bycatch and discarding program has been in place to deal with bycatch issues and develop workplans for each fishery http://www.afma.gov.au/sustainability-environment/bycatch-discarding/.

Australia has made considerable investments to mitigate the rate of seabird, turtle and shark interactions and capture during longline fishing operations. Australia has also completed research on mitigation measures to reduce the capture of seabirds and other ERS in longline fisheries (e.g. Robertson et al. 2013). In addition, electronic monitoring (e-monitoring) has been introduced in longline fisheries to verify logbooks.

This report includes information and data on ERS from Australia's SBT fishery for the 2015–16 and the 2016–17 fishing seasons.

[1] Various time periods, such as 'calendar years', 'fishing seasons' and Australian 'quota years', can be used when describing Australia's SBTF. Unless otherwise indicated, we have used fishing seasons in this report, but note that fishing seasons of the various fishery components often span quota years.

2 Review of SBT Fisheries

Fleet size and distribution

Historical fleet size and distribution

Fishing for SBT began in the early 1950s off New South Wales and South Australia and then later, in 1970, off Western Australia. The catch, then used primarily for canning, peaked at 21 500 t in 1982.

Progressively over the mid to late 1980s, the Australian catch focused on supplying the Japanese sashimi market. The introduction of an individual transferable quota-based management plan in the Australian SBTF in 1984, based on an Australian total allowable catch (TAC) of 14 500 t, resulted in the redistribution of quota ownership. In the late 1980s, the Australian quota was reduced to 5265 t, which led to further restructuring of quota distribution. Since 1992 there has been a progressive increase in the proportion of SBT taken under farming operations. Currently, about 93 per cent of the Australian SBT quota is captured using the purse-seine method.

From 1990 to 1994, approximately half the Australian quota was taken by Australia-Japan joint venture longliners. With the termination of the joint venture arrangement in 1995, Australian catches again focused on the surface fishery with poling operations supplying the fresh chilled sashimi market and purse seiners providing SBT to farms for mariculture.

Historically, there has been longlining for SBT off Tasmania and Western Australia, with occasional catches in South Australian waters. There were also some purse seine, trolling and poling operations in the offshore waters of the Australian Fishing Zone (AFZ). Currently, longlining in which SBT is taken occurs primarily off south eastern New South Wales during the winter months (May to October), in core and buffer zones (described below) which move as the SBT migrate.

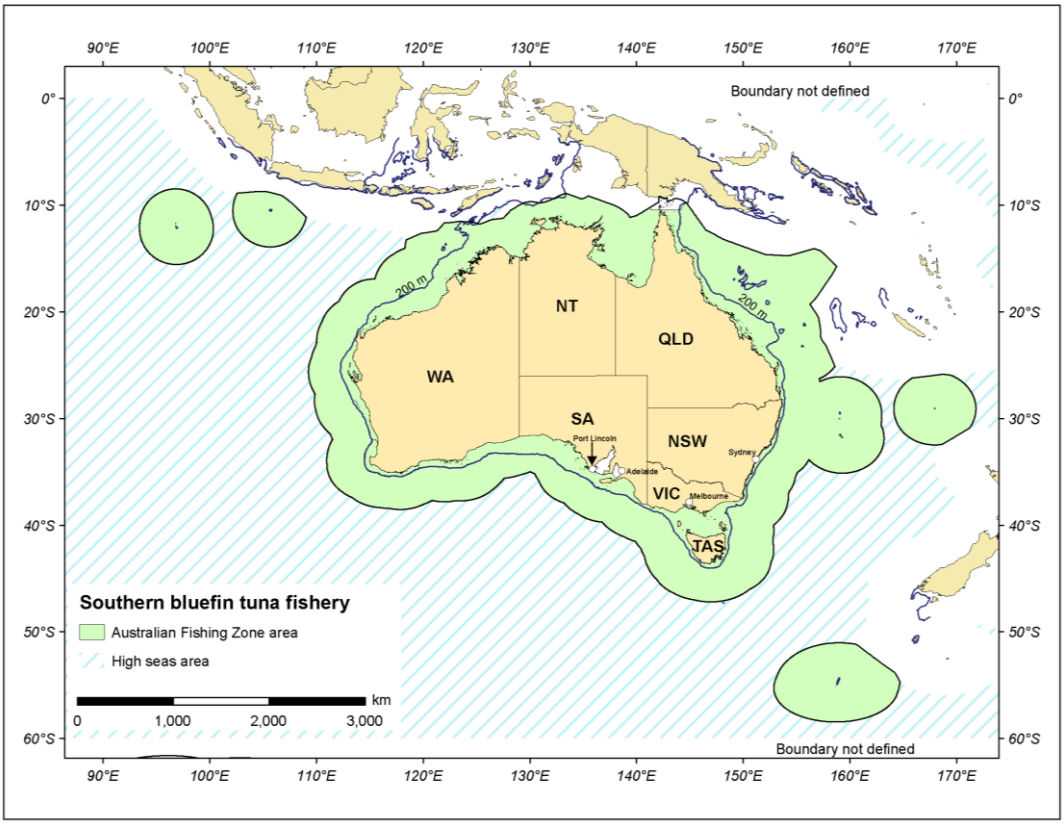
Current fleet size and distribution

Southern Bluefin Tuna Fishery

All SBT caught commercially in Australia is taken under the Southern Bluefin Tuna Fishery Management Plan 1995 and is required to be covered by quota. The area of the SBTF encompasses the entire AFZ and extends onto the high seas (Figure 1). The definition of the AFZ is consistent with Australia's Exclusive Economic Zone (EEZ) and extends out to 200 nautical miles from the coast. There are two main components for the fishery: the purse seine fleet operating out of Port Lincoln, South Australia, and longline fleets operating off eastern and western Australia, which take SBT as a byproduct of fishing for other tuna and billfish species. To longline in these areas, operators are required to have a Boat Statutory Fishing Right in either the ETBF or WTBF, hold uncaught quota for SBT and meet observer or e-monitoring requirements. Management measures in terms of gear restrictions and bycatch are managed separately in these fisheries.

The purse seine fleet operating out of Port Lincoln currently (2017–18) takes about 85 per cent of the total SBT commercial catch, fishing in the Great Australian Bight. The SBT are towed back to Port Lincoln, transferred into grow-out pontoons and farmed for a period of time before harvest. In 2015–16 and 2016–17, SBT were also landed by longline and minor line methods in the ETBF, mainly off New South Wales; and, a small amount of SBT was taken by longline off Western Australia and minor line methods off South Australia in the WTBF.

Figure 1 Area of Australia's Southern Bluefin Tuna Fishery

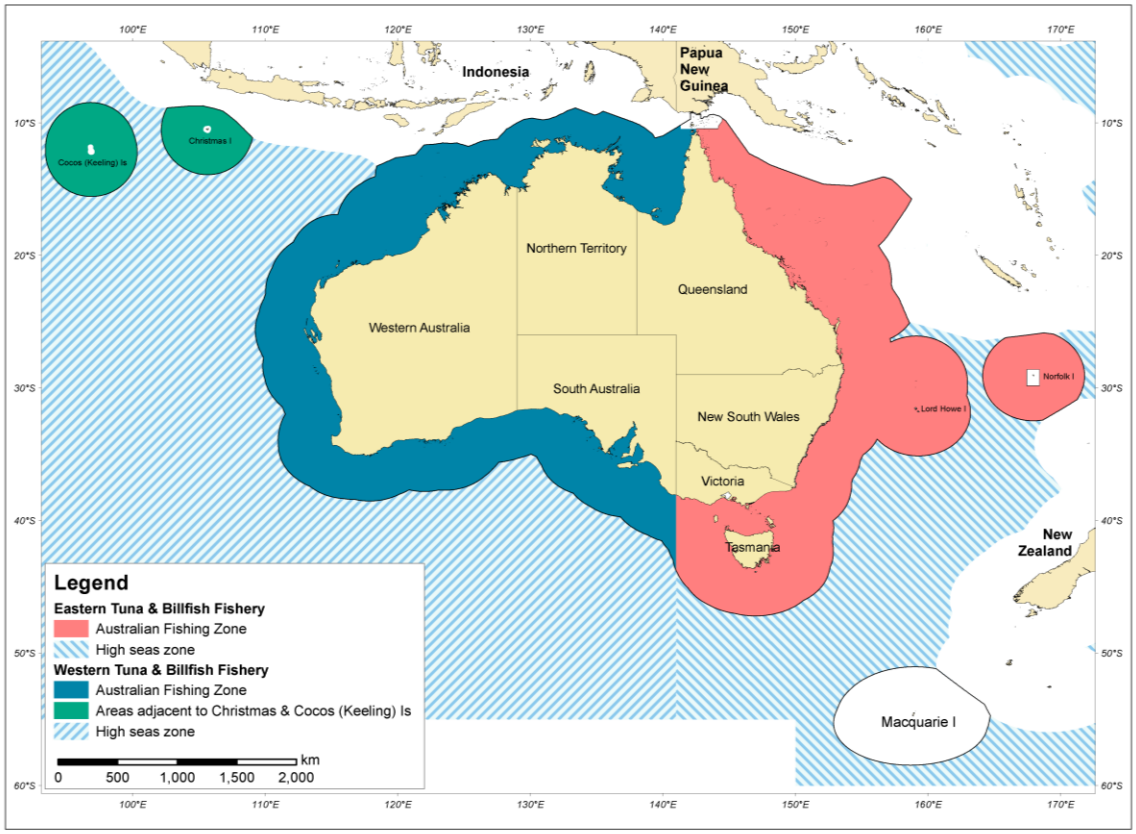


Eastern Tuna and Billfish Fishery

The ETBF extends from Cape York to the Victoria–South Australia border, including waters around Tasmania (Figure 2). Domestic longline vessels are mostly 15–25 m long and use monofilament gear. Fishing practices vary with target species, location and season. Vessels usually conduct one longline operation per day or night, depending on the target species. A typical longline set will comprise about 1200 hooks. Fishers commonly operate around 107 days per year. Most trips are between 2 and 15 days, but occasionally trips extend up to 30 days. Typical fishing trips range from 40–300 nautical miles from port, though in the past some vessels journeyed out to 1000 nautical miles or further to fish.

The *Eastern Tuna and Billfish Fishery Management Plan* 2010 came into effect on 1 March 2011. The ETBF Plan outlines specific ecosystem requirements, the process for setting total allowable commercial catch (TACC) limits and the provisions for granting of statutory fishing rights (SFRs) in the ETBF. This was the first time that TACCs had been permanently implemented in the ETBF and marked a significant change in management as the fishery moved from input controls based on total allowable effort to output controls with individually transferable quotas operating under a TACC. The species managed under the ETBF Plan include albacore, bigeye tuna, billfish, longtail tuna, northern bluefin tuna, Ray's bream, skipjack tuna and yellowfin tuna.

Figure 2 Area of Australia's Eastern and Western Tuna and Billfish Fisheries



Western Tuna and Billfish Fishery

The WTBF encompasses the area of the AFZ off the northern, western and southern coastline westward from Cape York Peninsula (142°30'E) off Queensland to 141°E at the Victoria–South Australia boarder (Figure 2). The fishery includes waters seaward of territorial waters (outside 12 nautical miles from the coast) adjacent to Christmas and Cocos (Keeling) Islands and high seas areas throughout the Indian Ocean, consistent with the area of competency of the Indian Ocean Tuna Commission. Most longline vessels in the fishery are 15–25 m long and set 1000–1500 hooks on monofilament lines, with an average of one set per day. Vessels fish throughout the year with an average trip of 4 to 10 days.

The *Western Tuna and Billfish Management Plan* 2005 came into effect on 12 November 2006. The WTBF Plan removed the internal barrier at 34°S, which had previously separated the Southern and the Western Tuna and Billfish Fisheries, and renamed the entire area the 'Western Tuna and Billfish Fishery'. The WTBF Plan provides for a system of individual transferable quota SFRs, with the quota species including bigeye tuna, yellowfin tuna, striped marlin and swordfish. For one fishing season, each SFR entitles an equal share to the TACC for the relevant species.

Distribution of catch and effort

The Australian domestic SBT catches for the 2016 and 2017 calendar years were 5962 t and 5221 t, respectively. The 2015–16 quota year catch was 5633 t, and the 2016–17 quota year catch was 5334 t. Australia increased its effective total allowable catch in 2015–16 by 38 t to account for undercatch in the 2014–15 season; and, by 32 t in 2016–17 to account for undercatch in the 2015–16 season.

In 2015–16, 25 vessels landed SBT in Australian waters: 86.9 per cent of the catch was taken by five purse seiners off South Australia. The remainder of the catch was taken by 18 longliners and one vessel conducting trolling operations in the ETBF; and, two vessels conducting pole-and-line operations and three vessels conducting rod-and-reel operations (some vessels using multiple methods) in the WTBF. Longliners deployed a total of 432 716 hooks (in 2016) for shots that caught SBT (Figures 3a and 3b).

In 2016–17, 23 vessels landed SBT in Australian waters: 87.8 per cent of the catch was taken by six purse seiners off South Australia. The remainder of the catch was taken by 18 longliners and one vessel conducting rod-and-reel operations in the ETBF; and two vessels conducting pole-and-line operations and three vessels conducting rod-and-reel operations (some vessels using multiple methods) in the WTBF. Longliners deployed a total of 455 818 hooks (in 2017) for shots that caught SBT (Figures 3a and 3b[2]).

[2] SBT catch has been filtered so that only operations from a total of five or more vessels over the time period from 2015–16 and 2016–17 are shown. The catch was first aggregated using a kernel density algorithm at a spatial resolution of 25 km square. A neighbourhood analysis was then carried out on the same data and at the same spatial resolution; only the cells where five boats or more operated were then used to make the final map of catch per units of area. The footprint shows grid cells at a spatial resolution of one degree (111 km square) where vessels have reported catch during the time period.

Figure 3a Location of SBT catch by purse seine in 2015–16 and 2016–17.

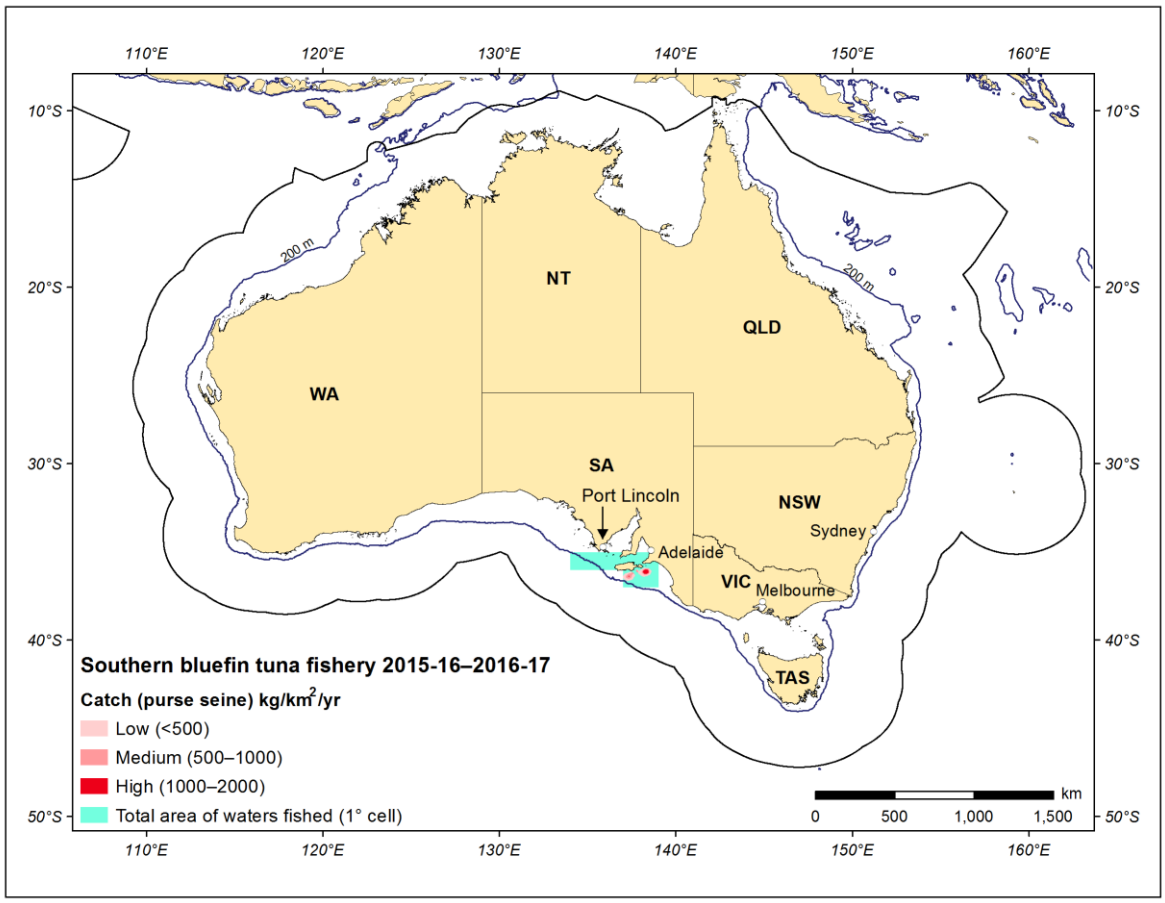
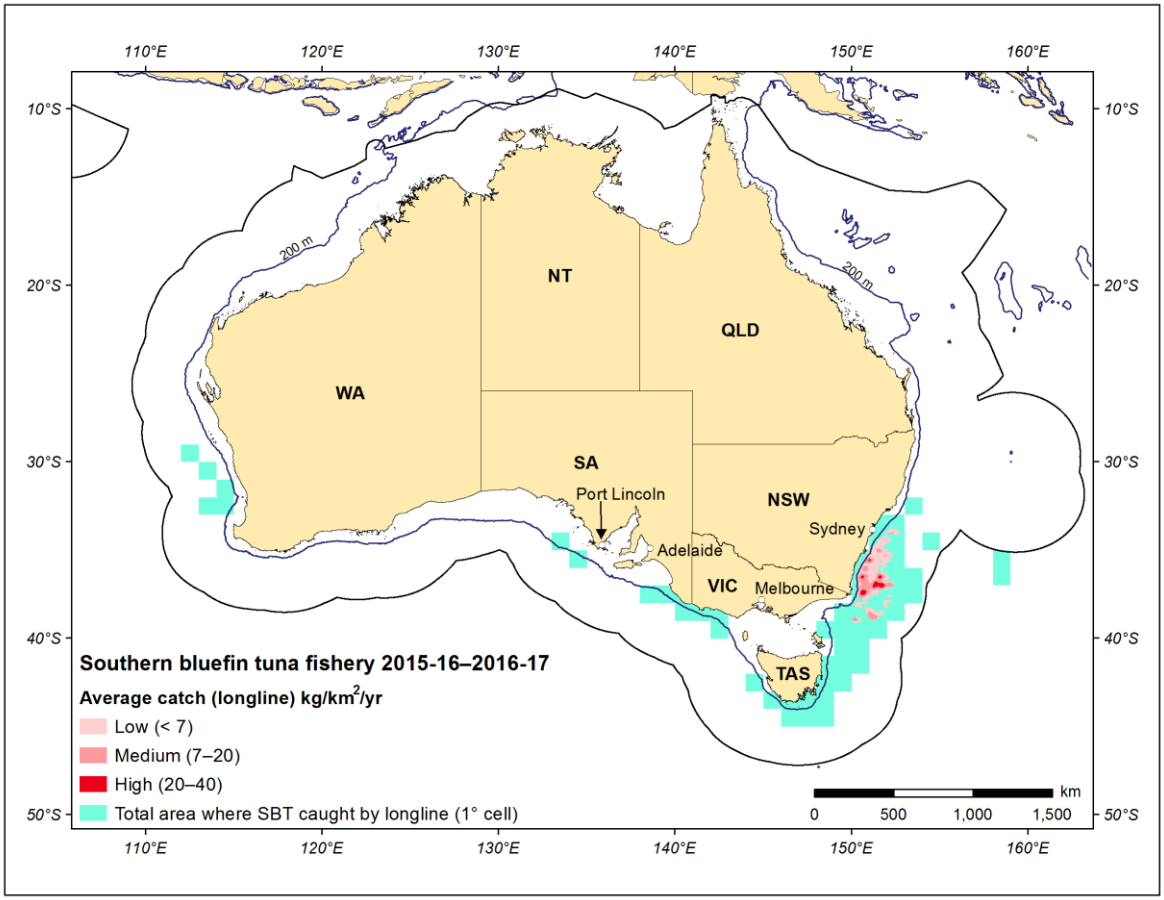


Figure 3b Location of SBT catch by longline in 2015–16 and 2016–17.



3 Fisheries monitoring for each fleet

Catch documentation

There are a series of compulsory fishery-specific logbooks and associated catch disposal records that are required by law to be completed by Australian fishers. Current fishery-specific logbooks and catch disposal records can be downloaded from http://www.afma.gov.au/fisheries-services/logbooks-and-catch-disposal/

All of the data provided in logbooks and catch disposal records must be supplied to AFMA within specified time periods. Verification of these data is undertaken through either observer programs or e-monitoring and, as a minimum, through an annual audit process undertaken by AFMA. In addition, specific reporting forms for protected species under the EPBC Act 1999 (e.g. seabirds, marine mammals etc) are included with the fishery-specific logbooks in all Australian Commonwealth fisheries.

Observer programs

Observer programs for the purse seine and longline fisheries have been in place for a number of years. The observer program began in 2001 in the ETBF and 2003 in the WTBF and SBTF. Approximately 15 observers are currently employed in the AFMA observer program. They are sourced from universities and the maritime industries and require the ability to live and work at sea, have demonstrated experience in collecting biological data at sea, and have experience in fisheries research methodologies and collection of associated scientific data. Observers must complete an AFMA observer training course.

Observer reports include details of daily fishing operations, the mitigation measures employed and any non-target species interactions. In terms of ERS species interactions, the number (and weight where appropriate) of each species caught is recorded for each shot observed as well as the life status (alive, dead, injured) and whether it was retained or discarded. Australia's observer program aims to monitor 10 per cent of SBT fishing activities and employs international and domestic observers in compliance with CCSBT observer standards.

In the 2015–16 fishing season, the purse-seine coverage was 18.9 per cent of sets, representing 25 sets observed where SBT were retained and 20.2 per cent of the estimated SBT catch. In 2016, observers monitored 12.4 per cent of shots where SBT was caught in the ETBF. No SBT were observed caught in the WTBF in 2016, therefore observer coverage, defined as shots where SBT were caught, was zero per cent.

In the 2016–17 fishing season, observers monitored 18.3 per cent of purse seine sets, representing 20 sets observed where SBT were retained, representing 16.8 per cent of the estimated SBT catch. Two sets were aborted because of fish being of insufficient size and fish were released from a third shot as they were deemed to be too small. In 2017, observers monitored 11.3 per cent of shots where SBT was caught in the ETBF. No SBT were observed caught in the WTBF in 2017, therefore observer coverage, defined as shots where SBT were caught, as zero per cent.

Electronic monitoring

In Australian Commonwealth fisheries, fishers are required to complete catch and effort information for each operation in their logbook, which includes information on retained and discarded catch and interactions with protected species. These data are used in scientific analyses, such as catch standardisations that provide AFMA with information to meet its legislative objectives under the Fisheries Management Act 1991. Historically, AFMA has used at-sea observer programs as a way of verifying fisher-reported logbook data through the at-sea observer's ability to collect a range of data on catch (both retained and discarded) and effort (gear characteristics and their utilisation), as well as recording interactions with protected species. However, the increasing financial and logistical costs associated with AFMA's at-sea observer program, as well as ongoing data quality issues present in fishing logbooks prompted AFMA to investigate more cost effective ways of monitoring fishing operations.

E-monitoring technologies were identified as a potential cost effective tool that could aid in improving the accuracy of logbook data without the limitations associated with at-sea observer programs (e.g. non-random placement of at-sea observers on fishing vessels), while also allowing for greater monitoring coverage of fishing activities.

On 1 July 2015, AFMA implemented integrated E-monitoring systems in several of its managed fisheries, including the ETBF and the Gillnet Hook and Trap (GHaT) sector of the Southern and Eastern Scalefish and Shark Fishery (SESSF). As a result, at-sea observers have been phased out of the ETBF. Important biological data continues to be collected through an established in-port sampling program in the ETBF.

Under the current program, AFMA uses the integrated e-monitoring system to validate fisher-reported logbook information with an audit target of 10 per cent of hauls from each vessel. This audit includes an analysis of catch composition, discards and interactions with protected species. Through the auditing process and accompanying feedback to fishers, AFMA aims to independently evaluate the veracity of fisheries logbook information as a source of data for assessing and managing fisheries.

Emery et al. (2019b) recently compared changes in logbook reporting by commercial fishers following the implementation of e-monitoring in the ETBF. The study concluded that there was a significant increase in logbook-reported discard per unit effort and interactions with protected species per-unit-effort following the implementation of an integrated e-monitoring system. Overall, the weight of evidence suggests the use of an integrated e-monitoring system has led to significant changes in logbook reporting of discarded catch and protected species in the ETBF.

Vessel Monitoring System

All vessels operating in the SBTF, ETBF and WTBF are required to operate Integrated Computer Vessel Monitoring Systems (ICVMS) while fishing and transiting to and from fishing grounds. This allows real-time vessel position and activity reporting to a central Vessel Monitoring Systems (VMS) operations area at AFMA.

Australian SBT purse seine and tow vessels off Port Lincoln are required to report their locations and catch details on a daily basis. This may be done by ICVMS, or at sea by satellite phone, mobile phone or fax.

Port monitoring

Australian fisheries officers conduct random inspections of landings at key SBT ports, as well as at-sea boardings and inspection of vessels taking SBT in the longline and purse seine fisheries.

Compliance risk assessments for all sectors taking SBT are completed annually. Likewise, a specific compliance operational plan is developed and implemented on an annual basis for each fishery.

4 Seabirds

Seabirds can be attracted to longline vessels by discharged offal and baits, and on occasion ingest baited hooks during the setting or, less commonly, hauling of longlines. Bait is not used when purse seining, therefore the rate of seabird interactions in this sector is very low.

Oceanic longline fishing is listed as a key threatening process for seabirds under the EPBC Act 1999, requiring the development of the Threat Abatement Plan (TAP) for the Incidental Catch (or bycatch) of Seabirds during Oceanic Longline Fishing Operations (Commonwealth of Australia 2018). The current TAP (2018) requires the ETBF and WTBF to reduce the bycatch of seabirds in oceanic longline operations and maintain a bycatch rate of less than 0.05 seabirds per 1000 hooks in all fishing areas southwards of the parallel of 25°S (by 5° latitudinal bands) and season (1 September–30 April; 1 May–31 August). More recently, Australia has recognised the need to extend our commitment to addressing the incidental catch of seabirds from other fishing methods. Australia has recently developed an National Plan of Action (NPOA) seabirds that applies to all fisheries under Commonwealth jurisdiction and coordinates national action to alleviate the impact of longline fishing activities on seabirds in Australian waters (DAWR 2018). This document is available at:
http://www.agriculture.gov.au/fisheries/environment/bycatch/seabirds

Australia has implemented permit conditions on fishing operators that are designed to prevent the capture of seabirds. For example, Australian vessel fishing south of 25°S must deploy bird-scaring lines (streamers), known as 'tori' lines, to deter seabirds from diving on the line and line weighting to quickly sink the line out of reach of seabirds.

Vessel/crew responses to interactions with seabirds are mandated in the TAP (2018). Consistent with the objectives and prescriptions of the TAP, Australia has implemented conditions aimed at reducing seabird mortality through requirements on fishing permits. These are detailed in Section 7 of this report.

Observed seabird interactions

Southern Bluefin Tuna Fishery

There are very few recorded incidences of seabirds interacting with fishing vessels or purse-seine gear in the SBTF. There have been no observed seabird interactions in the purse-seine sector since the 2007–08 fishing season.

Eastern Tuna and Billfish Fishery

The ETBF does interact with seabirds, although the current interaction rate is low. With the implementation of the TAP, a large proportion of the longline fleet on the east coast began to set their lines during the night to avoid interactions with albatross species. In doing so, they reduced the probability of catching albatross but increased the probability of catching of shearwaters. Through a number of at-sea trials with a variety of mitigation measures, the catch of all seabirds has been reduced to a level under the 0.05 seabirds per 1000 hooks set as the performance indicator under the TAP (Lawrence et al. 2009).

There were no observed seabird interactions in the Australian ETBF in 2016 and two observed seabird interactions in 2017 (Table 1a). Seabird interactions occurring in the ETBF are reported annually to the Western and Central Pacific Fisheries Commission (WCPFC; e.g. Patterson et al. 2018).

Table 1a Observed interactions between seabird species and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given as per thousand hooks. Note: data are from shots in the ETBF where SBT were caught. The fate of some individuals is 'undetermined' and is therefore not listed as a live release or a mortality. Observed interactions in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort[3]				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort[4]	Total Observed Effort[4]	Observer Coverage[5]	Species[6]	Captures (*number*)	Capture Rate[7]	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities[8] (*number*)	TP + NS[9]	TP + WB[9]	NS + WB[9]	TP + WB + NS[9]	Others[10]
							Retained (dead)	Discarded (dead)	Released (live)							
4	339300	44795	13.2	nil	0	0	0	0	0	0	0	0	56.9	0	43.1	0
7	81244	7277	9.0	nil	0	0	0	0	0	0	0	0	29.7	0	70.3	0
TOTAL	420544	52072	12.4		0	0	0	0	0	0	0					

[3] Values in these shaded cells will be repeated for all species within a strata.
[4] For longline provide number of hooks, for purse seine provide number of sets.
[5] For longline provide as a percentage of the number of hooks, for purse seine provide as a percentage of the number of shots.
[6] Use FAO's 3 alpha species codes.
[7] For longline provide as captures per thousand hooks, for purse seine provide as captures per set.
[8] Total mortalities should be estimated using either a simple ratio or another approach such as modeling. If using an approach other than a simple ratio, the method used to estimate total mortalities should be described in detail within the report and 95% confidence intervals should be provided if possible.
[9] TP = tori poles, NS = night setting, WB = weighted branchline.
[10] Add extra columns for other categories of mitigation measures, including use of no mitigation measures, if required.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS[9]	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	354009	37420	10.6	nil	0	0	0	0	0	0	0	0	57.7	0	42.3	0
7	100709	13981	13.9	Unid albatross	2	0.143	0	0	0	0.143	14.388	0	35.4	0	64.6	0
TOTAL	454718	51401	11.3		2	0	0	2	0	0	14.388					

Table 1b Observed interactions between seabird species and WTBF vessels (CCSBT statistical area 2 and 3) in 2016 and 2017. Capture and mortality rates ar given as per thousand hooks. Note: data are from shots in the ETBF where SBT were caught. The fate of some individuals is 'undetermined' and is therefore not listed as a live release or a mortality. Observed interactions in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
2	12172	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	12172	0	0.0		na	na	na	na	na	na	na					

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB	NS + WB	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
3	1100	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	1100	0	0.0		na	na	na	na	na	na	na					

Western Tuna and Billfish Fishery

There were no observed SBT captured in the WTBF in 2016 or 2017, so there was no observer coverage, as defined by operations where SBT were caught, in those years (Table 1b). Seabird interactions occurring in the WTBF are reported annually to the Indian Ocean Tuna Commission (IOTC) (e.g. Hobsbawn et al. 2018).

The prevalence of seabirds on the west coast of Australia is considerably less than that of the east coast. In addition to the lower abundance of seabirds, the majority of the fleet in the WTBF targets swordfish and therefore sets at night. While observer data are only available for recent years, when fishing activity has been very low, the data indicate that seabird interactions are below the limit of 0.05 seabirds per 1000 hooks prescribed by the TAP (2018).

Non-observed seabird interactions

Southern Bluefin Tuna Fishery

No seabird interactions have been recorded in logbooks for the purse-seine fishery.

Eastern Tuna and Billfish Fishery

Fishers in the ETBF encounter SBT during a limited time of the year when SBT migrate into the ETBF area, typically May to October. In addition, fishing for SBT is permitted only in designated areas. To minimise the risk of non-quota take of SBT by longliners off New South Wales, access to the waters through which SBT migrate has been restricted to only vessels holding SBT quota. This arrangement has resulted in a significant reduction in longline effort in southern areas, and corresponding reductions in seabird and bycatch species interactions. There were a number of seabird interactions in 2016 and 2017 in shots where SBT was caught recorded in the logbooks (Table 2). Seabird interactions are reported annually to the WCPFC (e.g. Patterson et al. 2018).

Western Tuna and Billfish Fishery

There were no seabird interactions in 2016 or 2017 in shots where SBT was caught recorded in the logbooks. Seabird interactions occurring in the WTBF are reported annually to the IOTC (e.g. Hobsbawn et al. 2018).

Table 2 Unobserved interactions (logbooks) between seabirds and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Releases indicate the number of individuals released alive.

Species 2016	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Black-browed albatross	420544	5	0.0119	4	0.00951	1
Albatross (unidentified)	420544	11	0.0262	6	0.1427	5
Shearwaters	420544	1	0.00237	1	0.00237	0
Australian gannet	420544	1	0.00237	0	0	1

Species 2017	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Black-browed albatross	454718	1	0.00219	1	0.00519	0
Albatross (unidentified)	454718	25	0.0549	20	0.0439	5
Flesh-footed shearwaters	454718	2	0.00440	2	0.00440	0

5 Non-target fish

Observed and non-observed fish interactions

Southern Bluefin Tuna Fishery

The purse seine fishery is highly selective and takes few non-target fish. Because purse seine trips often exceed 20 days and there are limited freezer facilities on board the vessels, any non-target fish catch is generally discarded alive. There was no observed non-target catch for the 2015–16 and 2016–17 fishing seasons and no non-target fish catch was reported in logbooks.

Eastern Tuna and Billfish Fishery

Table 3a provides observed non-target catch in the ETBF for 2016 and 2017. Table 4a provide the non-target scalefish catch recorded in logbooks. Again, only non-target fish captured during shots that captured SBT are provided.

Western Tuna and Billfish Fishery

Table 3b provides observed non-target catch in the WTBF for 2016 and 2017. Table 4b provide the non-target scalefish catch recorded in logbooks.

Table 3a Observed interactions between non-target scalefish species and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Note: data are from shots where SBT were caught and only species where 10 or more individuals were caugh are reported. The fate of some individuals is 'undetermined' and is therefore not listed as a live release or a mortality. Observed interaction in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort	Total Observed Effort	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	339300	44795	13.2	Lancetfishes	110	2.45	0	0	49	0	0	0	56.9	0	43.1	0
4	339300	44795	13.2	Ray's bream	42	0.938	42	0	0	0	0	0	56.9	0	43.1	0
4	339300	44795	13.2	Escolar	22	0.491	22	0	0	0	0	0	56.9	0	43.1	0
4	339300	44795	13.2	Snake mackerel	16	0.357	0	0	0	0	0	0	56.9	0	43.1	0
4	339300	44795	13.2	Tuna (mixed)	89	1.99	0	15	35	0.335	113.63	0	56.9	0	43.1	0
4	339300	44795	13.2	Ocean sunfish	58	1.29	0	0	14	0	0	0	56.9	0	43.1	0

7	81244	7277	9.0	Tuna (mixed)	26	3.57	0	0	14	0	0	0	29.7	0	70.3	0
TOTAL	420544	52072	12.4		363		64	15	112		113.63					

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS[9]	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	354009	37420	10.6	Tuna (Thunnus)	184	4.92	0	0	84	0	0	0	57.7	0	42.3	0
7	100709	13981	13.9	Ray's bream	148	10.59	148	0	0	0	0	0	35.4	0	64.6	0
7	100709	13981	13.9	Tuna (Thunnus)	97	6.94	0	0	46	0	0	0	35.4	0	64.6	0
TOTAL	454718	51401	11.3		429		148	0	130		0					

Table 3b Observed interactions between non-target scalefish species and WTBF vessels (CCSBT statistical area 2 and 3) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Note: data are from shots where SBT were caught and only species where 10 or more individuals were caugh are reported. Observed interaction in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
2	12172	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	12172	0	0.0		na	na	na	na	na	na	na					

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB	NS + WB	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
3	1100	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	1100	0	0.0		na	na	na	na	na	na	na					

Table 4a Unobserved interactions (logbooks) between non-target scalefish species and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are based on the number of retained individuals. Releases indicate the number of individuals released, but life status at the time of release is unknown. Note: data are from shots in the ETBF where SBT were caught and only species where 10 or more individuals were caught are reported.

Species 2016	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Lancetfishes	420544	523	1.244	0	0	523
Mahi mahi	420544	45	0.1070	40	0.9511	5
Ray's bream	420544	220	0.5231	214	0.5088	6
Barracouta	420544	27	0.0642	0	0	27
Escolar	420544	160	0.3804	73	0.1735	87
Butterfly mackerel	420544	12	0.0285	12	0.0285	0
Rudderfish	420544	136	0.3233	32	0.0760	104
Short sunfish	420544	100	0.2378	0	0	100
Ocean sunfish	420544	231	0.5493	4	0.0095	227

Species 2017	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Lancetfishes	454718	509	1.1193	0	0	509
Ray's bream	454718	354	0.7785	345	0.7587	9
Escolar	454718	64	0.1407	17	0.0374	47
Butterfly mackerel	454718	22	0.0483	22	0.0483	0
Rudderfish	454718	152	0.3342	32	0.0704	120
Shortbill spearfish	454718	10	0.0218	9	0.1979	1
Short sunfish	454718	99	0.2177	0	0	99
Ocean sunfish	454718	367	0.8071	0	0	367
Fish (mixed)	454718	20	0.0439	20	0.0439	0

Table 4b Unobserved interactions (logbooks) between non-target scalefish species and WTBF vessels (CCSBT statistical area 2 and 3) in 2016 and 2017, respectively. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are based on the number of retained individuals. Releases indicate the number of individuals released, but life status at the time of release is unknown. Note: data are from shots in the WTBF where SBT were caught and only species where 10 or more individuals were caught are reported.

Species 2016	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Lancetfishes	12172	27	2.218	0	0	25
Mahi mahi	12172	26	2.136	14	1.150	12
Escolar	12172	26	2.136	0	0	26
Rudderfish	12172	82	6.736	14	1.150	68

Species 2017	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Nil	1100	0	0	0	0	0

Observed and non-observed shark interactions

Southern Bluefin Tuna Fishery

Bycatch of sharks during pole-and-line and purse seine fishing (including farm operations) for SBT is minimal. Sharks taken incidentally during purse seining are able to be released before the net is retrieved and fish are transferred to tow cages. Sharks are known to interact with tow cages containing SBT being towed back to farms, and divers work to release these sharks alive.

No interactions, observed or non-observed, between purse-seine vessels and sharks were recorded in 2016 or 2017.

Eastern Tuna and Billfish Fishery

Shark catch details from observers in the ETBF are provided in Table 5a for 2016 and 2017. Catches from logbooks are provided in Table 6a for 2016 and 2017. Mitigation measures to reduce shark bycatch are in place in the ETBF and WTBF (see section 7). The catch of sharks in the ETBF is reported annually to the WCPFC (e.g. Patterson et al. 2018).

Western Tuna and Billfish Fishery

Shark catch details from observers in the WTBF are provided in Table 5b for 2016 and 2017. Catches from logbooks are provided in Table 6b for 2016 and 2017. Mitigation measures to reduce shark bycatch are in place in the ETBF and WTBF (see section 7). The catch of sharks in the WTBF is reported annually to the IOTC (e.g. Hobsbawn et al. 2018).

Table 5a Observed interactions between shark species and ETBF vessels (CCSBT statistical area 4) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Note: data are from shots in the ETBF where SBT were caught. The fate of some individuals is 'undetermined' and is therefore not listed as a live release or a mortality. Observed interaction in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort	Total Observed Effort	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB	NS + WB	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	339300	44795	13.2	Shortfin mako	9	0.201	1	2	6	0.067	22.73	0	56.9	0	43.1	0
4	339300	44795	13.2	Porbeagle	1	0.022	0	0	0	0.00	0.00	0	56.9	0	43.1	0
4	339300	44795	13.2	Mackerel sharks	1	0.022	0	1	0	0.022	7.58	0	56.9	0	43.1	0
4	339300	44795	13.2	Thresher	3	0.067	0	0	3	0.00	0.00	0	56.9	0	43.1	0
4	339300	44795	13.2	Whaler & weasel sharks	7	0.156	0	1	4	0.022	7.58	0	56.9	0	43.1	0
4	339300	44795	13.2	Blue sharks	82	1.831	0	8	44	0.179	60.61	0	56.9	0	43.1	0

4	339300	44795	13.2	Tiger shark	6	0.134	0	0	6	0.00	0.00	0	56.9	0	43.1	0
4	339300	44795	13.2	Sharks (mixed)	21	0.469	0	0	6	0.00	0.00	0	56.9	0	43.1	0
7	81244	7277	9.0	Porbeagle	1	0.137	0	1	0	0.137	11.11	0	29.7	0	70.3	0
7	81244	7277	9.0	Thresher	1	0.137	0	1	0	0.137	11.11	0	29.7	0	70.3	0
7	81244	7277	9.0	Blue shark	24	3.298	0	2	11	0.275	22.22	0	29.7	0	70.3	0
7	81244	7277	9.0	Sharks (mixed)	7	0.962	0	1	1	0.137	11.11	0	29.7	0	70.3	0
TOTAL	420544	52072	12.4		163		1	18	75							

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS[9]	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	354009	37420	10.6	Shortfin mako	17	0.454	7	7	3	0.187	66.03	0	57.7	0	42.3	0

4	354009	37420	10.6	Mackerel sharks	1	0.027	0	0	1	0.00	0.00	0	57.7	0	42.3	0
4	354009	37420	10.6	Porbeagle	1	0.027	1	0	0	0.00	0.00	0	57.7	0	42.3	0
4	354009	37420	10.6	Whaler & weasel sharks	4	0.107	0	0	0	0.00	0.00	0	57.7	0	42.3	0
4	354009	37420	10.6	Dusky whaler	8	0.214	1	1	1	0.027	9.43	0	57.7	0	42.3	0
4	354009	37420	10.6	Blue shark	350	9.353	0	3	84	0.080	28.29	0	57.7	0	42.3	0
4	354009	37420	10.6	Tiger shark	1	0.027	0	0	1	0.00	0.00	0	57.7	0	42.3	0
4	354009	37420	10.6	Sharks (mixed)	84	2.244	0	1	13	0.027	9.43	0	57.7	0	42.3	0
7	100709	13981	13.9	Mackerel sharks	10	0.715	0	3	3	0.215	21.58	0	35.4	0	64.6	0
7	100709	13981	13.9	Shortfin mako	5	0.358	3	0	1	0.00	0.00	0	35.4	0	64.6	0
7	100709	13981	13.9	Porbeagle	10	0.715	7	0	0	0.00	0.00	0	35.4	0	64.6	0
7	100709	13981	13.9	Blue shark	259	18.525	0	3	128	0.215	21.58	0	35.4	0	64.6	0

7	100709	13981	13.9	Sharks (mixed)	113	8.082	0	3	92	0.215	21.58	0	35.4	0	64.6	0
TOTAL	454718	51401	11.3		863		0	2	0		177.92					

Table 5b Observed interactions between shark species and WTBF vessels (CCSBT statistical area 2 and 3) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Note: data are from shots in the ETBF where SBT were caught. Observed interaction in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2016	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
2	12172	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	12172	0	0.0		na	na	na	na	na	na	na					

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate	Estimated total mortalities (*number*)	TP + NS	TP + WB	NS + WB	TP + WB + NS	Others
							Retained (dead)	Discarded (dead)	Released (live)							
3	1100	0	0.0	nil	na	na	na	na	na	na	na	na	na	na	na	na
TOTAL	1100	0	0.0		na	na	na	na	na	na	na					

Table 6a Unobserved interactions (logbooks) between shark species and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are based on the number of retained individuals. Releases indicate the number of individuals released, but life status at the time of release is unknown. Note: data are from shots in the ETBF where SBT were caught. Scientific names are given in Appendix IV.

Species 2016	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Shortfin mako	420544	271	0.6444	134	0.318	137
Hammerheads	420544	2	0.0048	0	0	2
Porbeagle	420544	1	0.0023	0	0	1
Thresher sharks (mixed)	420544	10	0.0237	0	0	10
Bronze whaler	420544	13	0.0309	0	0	13
Dusky whaler	420544	91	0.2163	0	0	91
Blue shark	420544	2877	6.8411	0	0	2877
Tiger shark	420544	22	0.0523	0	0	22
Oceanic whitetip	420544	6	0.0142	0	0	6
Sharks (mixed)	420544	1	0.0023	0	0	1

Table 6a Continued

Species 2017	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Shortfin mako	454718	144	0.317	29	0.0637	115
Porbeagle	454718	149	0.328	28	0.0616	121
Thresher sharks (mixed)	454718	3	0.0066	0	0	3
School shark	454718	1	0.0022	0	0	1
Bronze whaler	454718	10	0.0219	0	0	10
Dusky whaler	454718	96	0.211	0	0	96
Blue shark	454718	6600	14.514	2	0.0044	6598
Tiger shark	454718	7	0.0154	0	0	7
Oceanic whitetip	454718	1	0.0022	0	0	1
Hammerhead sharks	454718	2	0.0044	0	0	2

Table 6b Unobserved interactions (logbooks) between shark species and WTBF vessels (CCSBT statistical area 2 and 3) in 2016 and 2017, respectively. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are based on the number of retained individuals. Releases indicate the number of individuals released, but life status at the time of release is unknown. Note: data are from shots in the WTBF where SBT were caught. Scientific names are given in Appendix IV.

Species 2016	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Crocodile shark	12172	65	5.340	0	0	65
Shortfin mako	12172	7	0.575	0	0	7
Thresher sharks (mixed)	12172	1	0.082	0	0	1
Hammerheads	12172	9	0.739	0	0	9
Blue shark	12172	45	3.697	0	0	45

Table 6b Continued

Species 2017	Total effort (no. hooks)	Captures	Capture rate (per 1000 hooks)	Mortalities	Mortality rate (per 1000 hooks)	Releases
Shortfin mako	1100	27	24.545	0	0	27
Thresher sharks (mixed)	1100	9	8.182	0	0	9
Blue shark	1100	58	52.727	0	0	58

6 Marine mammals and marine reptiles

The SBTF and the ETBF and WTBF longline fisheries all have a very low incidence of marine mammal and reptile interactions.

Southern Bluefin Tuna Fishery

No interactions with marine mammals or reptiles, observed or non-observed, were recorded in the SBTF in 2015–16 or 2016–17.

Eastern Tuna and Billfish Fishery

There were unobserved interactions with reptile and mammal species in 2016 and 2017 (Table 7). There were no observed interactions with marine mammals or reptiles in a shot where SBT was taken in the ETBF in 2016. In 2017, there was one observed interaction with a reptile and one with a mammal (Table 8). Interactions with marine mammals and reptiles are reported annually to the WCPFC (e.g. Patterson et al. 2018).

Western Tuna and Billfish Fishery

There were no observed interactions with marine mammals or reptiles in a shot where SBT was taken in the WTBF in 2016 or 2017 and only 1 unobserved interaction in 2016 (Table 9). Interactions with marine mammals and reptiles are reported annually to the IOTC (e.g. Hobsbawn et al. 2018).

Table 7 Unobserved interactions (logbooks) between shark species and ETBF vessels (CCSBT statistical area 4 and 2016 and 2017. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are ba the number of retained individuals. Releases indicate the number of individuals released, but life status at the ti release is unknown. Note: data are from shots in the ETBF where SBT were caught. Scientific names are given in Appendix IV.

Species **2016**	**Total effort**	**Captures**	**Capture rate**	**Mortalities**	**Mortality ra**
Leatherback turtle	420544	4	0.00951	0	0
Turtles	420544	1	0.00237	0	0
Australian sea lion	420544	1	0.00237	0	0

Species **2017**	**Total effort**	**Captures**	**Capture rate**	**Mortalities**	**Mortality rat**
Leatherback turtle	454718	3	0.00615	0	0
Loggerhead turtle	454718	1	0.00219	0	0
Turtles	454718	1	0.00219	0	0
Whales (mixed)	454718	1	0.00219	0	0
Humpback whale	454718	1	0.00219	0	0
Seals	454718	2	0.00439	0	0

Table 8 Observed interactions between reptile and mammal species and ETBF vessels (CCSBT statistical area 4 and 7) in 2016 and 2017. Capture and mortality rates are given per thousand hooks. Note: data are from shots in the ETBF where SBT were caught. The fate of some individuals is 'undetermined and is therefore not listed as a live release or a mortality. Observed interaction in 2016 and 2017 are from electronic monitoring. Scientific names are given in Appendix IV.

	Total & Observed Effort				Observed Captures						Estimate	Proportion of observed effort with specific mitigation measures				
Stratum 2017	Total Effort	Total Observed Effort[4]	Observer Coverage	Species	Captures (*number*)	Capture Rate	Fate (*numbers*)			Mortality Rate[7]	Estimated total mortalities (*number*)	TP + NS	TP + WB[9]	NS + WB[9]	TP + WB + NS[9]	Others
							Retained (dead)	Discarded (dead)	Released (live)							
4	354009	37420	10.6	Leatherback turtle	1	0.027	0	0	1	0	0	0	57.7	0	42.3	0
4	354009	37420	10.6	Whales (mixed)	1	0.027	0	0	0	0	0	0	57.7	0	42.3	0
TOTAL	354009	37420	10.6		2		0	0	1	0	0.00					

Table 9 Unobserved interactions (logbooks) between shark species and WTBF vessels (CCSBT statistical area 2) in 2016. Capture and mortality rates are given per thousand hooks. Mortalities and mortality rates are based on the number of retained individuals. Releases indicate the number of individuals released, but life status at the time of release is unknown. Note: data are from shots in the WTBF where SBT were caught. Scientific names are given in Appendix IV.

Species 2016	**Total effort**	**Captures**	**Capture rate**	**Mortalities**	**Mortality rate**	**Releases**
Australian sea lion	12172	1	0.0821	0	0	1

7 Mitigation measures to minimise seabird and other species bycatch

In Australia, the EPBC Act (1999) is the primary legislation that covers environmental issues, including the ecologically sustainable use of marine resources. The EPBC Act requires that:

- all Commonwealth-managed and State/Northern Territory wild capture marine fisheries with an export component be assessed to determine the extent to which management arrangements will ensure each fishery is being managed in an ecologically sustainable way;
- all Commonwealth-managed fisheries are also assessed to determine the impact of actions taken under a fishery management plan on matters of national environmental significance; and
- all Commonwealth-managed fisheries and any State-managed fisheries that operate in Commonwealth waters should also be assessed to determine the impacts of fishing operations on cetaceans, listed threatened species and ecological communities, migratory species, and listed marine species under the EPBC Act.

The assessments consider the impacts of the fishery on target and non-target species caught and the impacts of fishing on the broader marine environment. Initial and subsequent assessments have been completed for the SBT Fishery, ETBF and WTBF (see http://environment.gov.au/coasts/fisheries/commonwealth/index.html), and continue to guide the development of improved management arrangements to reduce the ecological impacts of Australian fisheries catching SBT.

Measures to reduce the ecological impacts of fisheries catching SBT rely initially on the analysis of fishery-dependent and -independent data collected through e-monitoring, observer programs, logbooks and targeted research activities. As more data are collected and the impacts of SBT fishing operations on ERS become clearer, strategies to reduce these impacts continue to be developed and refined.

In this context, Australia has:

- Continued to use catch and effort logbooks to collect data on the catch of target and non-target species
- Introduced observer programs in the SBT surface fishery (2003), and its longline fisheries targeting SBT (2001 and 2003 for the ETBF and WTBF, respectively), which include specific reporting requirements for protected species
- Introduced e-monitoring in the longline fisheries (2015) and undertaken research that has shown this is an effective technology for providing required fields in the WCPFC observer program and that the introduction of this technology has greatly improved logbook reporting (Emery et al. 2018, 2019a, 2019b)
- Initiated a range of at-sea programs to trial strategies to reduce the incidental mortality of seabirds caught during longlining operations (e.g. by increasing hook sink rates, see Table 10)
- Introduced detailed strategies to reduce bycatch and impacts on ecologically related species, performance measures to monitor progress, and reporting and review targets to assess the

effectiveness of these strategies, and refine them where necessary. An important part of these strategies is the development of fishing industry codes of practice to reduce impacts on ERS (see below)

AFMA has completed ecological risk assessments for each fishery managed by the Commonwealth to quantify impacts on ecologically related species and the broader marine environment (http://www.afma.gov.au/managing-our-fisheries/environment-and-sustainability/Ecological-Risk-Management/). Ecological risk management reports for the SBTF, ETBF and WTBF are also available and detail management priorities in those fisheries, based on the results of the assessments. The ecological risk assessments rely on existing biological and catch information and consider five ecosystem components: target species, by-product and bycatch species, protected species, habitats, and communities. The assessments categorise various species as being at high, medium or low risk on the basis of inter alia susceptibility to capture by the various fishing methods, their distribution, and the ability for species populations to recover.

Current measures

Mandatory measures for each fleet

Mitigation measures to minimise seabird bycatch

Seabirds are opportunistic feeders and are attracted to longline vessels, particularly during line setting, but also during line hauling, when the seabirds are at risk of being caught or entangled in the fishing gear. Seabirds are also attracted to discarded offal and are at risk of ingesting still baited hooks being retrieved. The design of purse-seine nets and the way this fishing gear is deployed, means that the risk of seabird bycatch during purse seine fishing operations is very low.

The adverse impact of longline fishing activities on seabirds was not fully realised until the 1980s. The incidental catch of seabirds during pelagic longline fishing operations was listed as a key threatening process on 24 July 1995. Threat abatement plans for this key threatening process have been in place since 1998 with the current plan, *TAP 2018*,. The ultimate aim of this plan is to achieve zero bycatch of seabirds from longline fishing in Commonwealth fisheries, especially threatened albatross and petrel species. The plan is subject to review within five years. Copies of this plan may be obtained from the Department of the Environment: http://www.antarctica.gov.au/environment/plants-and-animals/threat-abatement-plan-seabirds

Considerable progress has been made under successive TAPs to reduce the impact of pelagic longlining on seabirds. The incidental bycatch rates for several fisheries are well below 0.01 or 0.05 birds per 1000 hooks, which are the maximum permissible levels set as performance criteria for different fisheries under the current plan, and which apply to individual fishing seasons and fishing areas, as relevant. This reduction in bycatch rates has been achieved through the combined efforts of the fishing industry, researchers and non-governmental stakeholders working with government to reduce seabird bycatch in longline fisheries in a feasible, effective and efficient way. The prescriptions in the current plan recognise this success and seek to further reduce the incidental capture of seabirds.

Information on the level and nature of interactions between seabirds and fishing gear has increased significantly since 1995, and there is now extensive information available upon which to base decision-making. Considerable research and development activities have been undertaken into seabird bycatch mitigation measures including at-sea trials. This work could not

have been achieved without the continued engagement and support of industry. The prescriptions in the TAP also draw on best and improving practices in seabird bycatch mitigation for pelagic longline fishing developed under the *Agreement on the Conservation of Albatrosses and Petrels* (ACAP). This international agreement, to which Australia is a Party, aims to achieve and maintain a favourable conservation status for albatrosses and petrels. ACAP has been developed under the auspices of another international agreement, the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS). There is now increased confidence concerning the effectiveness of several mitigation measures, particularly line weighting strategies, use of bird-scaring lines, retention of offal during line setting, and night setting (in certain instances). These mitigation measures form the basis of the prescriptions set out in this threat abatement plan.

Threat abatement plans must specify actions needed to achieve their objective. Under the current plan:

- AFMA will require all pelagic longline tuna fishers operating within either the ETBF or WTBF, or both fisheries, southwards of the parallel of 25 degrees South to:

    a. employ a line-weighting strategy approved by AFMA that enables the bait to be rapidly taken below the reach of most seabirds;

    b. employ at least one bird-scaring line constructed to a specified standard approved by AFMA, or use another proven mitigation measure approved by AFMA for use without such a line;

    c. not discharge offal during line setting; and

    d. employ, as part of an adaptive management approach to seabird bycatch mitigation, such other mitigation measures as AFMA may stipulate following consultation with the Department of the Environment (including, but not limited to, use of bird exclusion devices and/or managing offal discharge during line hauling, night setting, and area closures).

- AFMA will continue to require domestic and foreign vessels in all longline fisheries operating within Australian jurisdiction to adopt proven mitigation measures that ensure the performance criteria for each fishery are achieved in all areas and seasons.

- AFMA will implement an appropriate management response if identified circumstances occur, or data analysis indicates that the performance criteria, defined in this threat abatement plan, have not been met in any fishing area, season or fishery, or that independent monitoring has dropped below acceptable levels. Consistent with an adaptive management approach, the management response will be implemented as soon as practical, but no later than within three months of identification of a problem.

- Require that seabird bycatch in all fishing areas and seasons in the ETBF and WTBF is less than 0.05 birds per 1000 hooks.

- Areas within the ETBF or WTBF south of the parallel of 25 degrees South are divided for the purposes of the above bycatch rate criteria into five degree latitudinal bands. Seasons are defined, for the purposes of the criteria, into two: summer 1 September – 30 April, and winter 1 May – 31 August.

See Appendix I and II for specific measures required for the ETBF and WTBF in 2018.

A pre-season briefing booklet for the SBTF is also available: https://afma.govcms.gov.au/sites/g/files/net5531/f/uploads/2014/02/SBT-pre-season-brief-2017-18-Final.pdf

Mitigation measures to minimise shark bycatch

Australia has developed a National Plan of Action for the Conservation and Management of Sharks (Shark-plan 2004) in line with the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks). This plan was reviewed and revised in 2012 (Shark plan 2; see section 11). Accordingly, regulations have been put in place in the pelagic longline fisheries to minimise shark bycatch and prevent indiscriminate finning.

The regulations applying to the ETBF and WTBF are:

- A ban on the use of wire leaders
- A limit of 20 sharks per trip, excluding school shark, gummy shark, elephantfish (Callorhinchidae), chimaerids (Chimaeridae and Rhinochimaeridae) and sawshark. This limit does not apply to great white sharks and grey nurse sharks, which are no-take protected species
- Fishing permit holders are prohibited from carrying, retaining, or landing all shark dorsal, pectoral, caudal, pelvic and anal fins that are not attached to their carcass
- Fishing permit holders are prohibited from carrying, retaining and landing livers obtained from sharks unless the individual carcasses from which the livers were obtained are also landed

Note that shortfin makos, longfin makos and porbeagles were listed under the Convention of Migratory Species (CMS) in 2008, which triggered a mandatory legal obligation to list them for protection under Australia's EPBC Act 1999. Listing under the EPBC Act 1999 came into effect on 29 January 2010. As a consequence, in February 2010 all Australian fisheries that interact with these species in Commonwealth waters were assessed under the EPBC Act. The management arrangements for each fishery was reaccredited on the basis that the arrangements in place required all reasonable steps to be taken to ensure that shortfin and longfin makos and porbeagles are not killed or injured as a result of fishing activities. These species may be retained in accredited fisheries if the sharks have come onboard dead. Live caught specimens must be released unharmed and fishers are required to report interactions.

CITES Appendix II listings for sharks and manta rays

The 16th meeting the Conference of Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Bangkok, March 2013) listed a number of shark and manta ray species (oceanic whitetip shark, great, smooth and scalloped hammerhead sharks, porbeagle shark, giant oceanic manta ray and reef manta ray) on Appendix II of CITES (CITES Appendix II lists species that, while not threatened with extinction now, may become so in the future if trade is not regulated). These listings took effect on 14 September 2014. All these species may be encountered by different fishing gears that target tuna and tuna-like species.

The CITES Appendix II listing of shark species does not entail a ban on capture, however the listing does require that any international trade, including any *Introduction from the Sea* (i.e. catch sourced from the High Seas), is informed by a non-detriment finding which determines the harvest is sustainable and that specimens are accompanied by CITES permits for either their import or export.

Non-detriment findings consider, but are not limited to, standard information on species biology and life history characteristics, historical and current range, population structure, status and trends, information on all sources of mortality and management measures in place.

Since 14 September 2014, Australia has had a non-detriment finding in place for the commercial harvest and export, with national harvest levels set for each of the newly-listed shark species. The manta ray species are not included in the non-detriment finding as they are not retained in Australian fisheries for trade. The non-detriment finding is available at:

http://www.environment.gov.au/biodiversity/wildlife-trade/publications/non-detriment-finding-five-shark-species

Mitigation measures to minimise sea turtle bycatch

Interactions between sea turtles and pelagic longline fisheries in the AFZ are rare, particularly in areas where SBT are targeted. Guidelines for mitigating the impact of longline fisheries on marine turtles are described under 'Voluntary measures for each fleet', although there is compulsory carriage of line cutters and dehookers. Interactions with the purse seine fishery are negligible and there has been no need to develop mitigation measures for this sector.

In 2009, Australia formally submitted a mitigation plan, *Eastern Tuna and Billfish Fishery Sea Turtle Mitigation Plan*, for review by the Western and Central Pacific Fisheries Commission Scientific Committee and Technical Compliance Committee, and approval by the Commission. The mitigation plan was submitted under CMM 2008-03 (Conservation and Management of Sea Turtles) and was designed to reduce the interaction rate of turtles in pelagic longline fisheries which target swordfish. It took effect 1 January 2010.

Prior to the start of the 2013 fishing season, AFMA revoked the mitigation plan as the trigger limits established were being breached and the plan was not proving effective. Instead, there is now a requirement for vessels targeting swordfish using shallow sets to use large circle hooks when setting less than 8 hooks per bubble. There is also a requirement that at least one de-hooker and one line cutter be carried at all times.

Mitigation measures to minimise fish bycatch

Effective from 27 July 1998, the commercial take of blue and black marlin was banned under the Fisheries Management Act 1991. Regulations specified that blue and black marlin must be returned to the water irrespective of life status. In addition, specific limits for some species apply (see the management arrangement booklets noted above for further details).

Compliance monitoring system

AFMA's observer program currently places observers on domestic and, if required, foreign vessels fishing within the AFZ and some adjacent areas under international arrangements. Observers are trained in specialised sampling techniques including environmental observations, and are briefed to educate fishers on their responsibilities to complete logbooks and other data sources, and to use mitigation strategies to reduce impacts on ERS.

AFMA has a responsibility to enforce the provisions of the Fisheries Management Act 1991 and the Torres Strait Fisheries Act 1984 through the detection and investigation of illegal activities by both domestic and foreign fishing boats in the AFZ and Commonwealth-managed fisheries. The Australian Customs and Border Protection Services also patrol waters in the AFZ as part of the Australian Government's anti-illegal fishing strategy.

Level of Compliance

Mitigation measures to minimise seabird bycatch

Australia's level of compliance with measures to minimise seabird bycatch is high, based on e-monitoring, observer and compliance reports. Australia is continuing to conduct research to develop and domestically implement new and more effective seabird mitigation measures and has promoted their adoption by various RFMOs. Australia is compliant with all relevant resolutions and conservation and management measures in the IOTC and WCPFC.

Mitigation measures to minimise shark bycatch

Australia's level of compliance with measures to minimise shark bycatch is high based on e-monitoring, observer and compliance reports. Australia has continued to promote the adoption of shark mitigation measures, such as a ban on wire trace and requiring that sharks be landed with fins attached, in various international meetings. Australia is compliant with all relevant resolutions and conservation and management measures in the IOTC and WCPFC.

Mitigation measures to minimise sea turtle bycatch

Australia's level of compliance with sea turtles mitigation measures is high based on e-monitoring, observer and compliance reports. Australia considers that current sea turtle bycatch management and mitigation measure in place in its pelagic longline fisheries, principally the ETBF and WTBF, fulfil Australia's obligations to *FAO Guidelines to Reduce Sea turtle Mortality in Fishing Operations.* In addition, AFMA has provided line cutters and de-hookers to all longline vessels in the ETBF and WTBF, thus ensuring the requirement to carry them is very likely to be met. Australia is compliant with all relevant resolutions and conservation and management measures in the IOTC and WCPFC.

Mitigation measures to minimise fish bycatch

There is a very high level of compliance with the requirement that blue and black marlin be returned to the water (see management arrangement booklets for a complete list of species that cannot be taken), with no logbooks or observer reports noting the retention of these species in 2016 or 2017. In addition, there is a high level of compliance with the State finfish catch restrictions on some species.

Voluntary measures for each fleet

'Industry codes of practice' are in place for a number of fisheries, including the ETBF. These generally include voluntary bycatch mitigation measures together with handling and release guidelines for seabirds, including:

- Puncturing of swim bladders of thawed baits to increase sinking rates
- Gear selection that minimises the probability of seabird bycatch
- Promoting safe handling and release of seabirds caught alive on longlines.

AFMA has run a 'seabird bycatch education program' in the ETBF to teach fishers about fishing practices designed to minimise seabird bycatch, effective line weighting, and correctly assembling/deploying tori lines.

A recovery plan for sea turtles in Australia has been developed by the Australian Government Department of the Environment. The overall objective of the plan is to reduce the detrimental impacts on Australian populations of marine turtles and hence promote their recovery in the

wild. A copy of the recovery plan can be obtained from http://www.environment.gov.au/coasts/publications/turtle-recovery/index.html.

A video 'Crossing the line: sea turtle handling guidelines for the longline fishing industry' has been produced by the Fisheries Research and Development Corporation to help the Australian longline fishing industry minimise its impact on sea turtle populations. It shows how to use de-hooking devices on deck and on turtles still in the water, how to safely bring turtles aboard and handle them on deck, how to help comatose turtles recover and how to release them back into the water. Similarly, AFMA conducted port visits in 2013 and 2014 in the ETBF to provide de-hookers to all boats with instructions on how to use them and on safe handling of marine turtles.

Proportion of fleet using voluntary measures

The proportion of the fleets using the voluntary measures is generally thought to be high. This is based on information such as the generally low seabird bycatch in longline fisheries, as well as observer data reported to AFMA.

Measures under development/testing

Australia has conducted a number of scientific trials to further reduce seabird bycatch in longline fisheries, including a variety of line-weighting trials, methods to increase line sink rates and an underwater bait setting machine (e.g. Robertson & van den Hoff 2010; Robertson et al. 2010a, b; Robertson & Candy 2013; Robertson et al. 2013; Robertson et al. 2015). Scientific studies have been conducted to investigate the most appropriate minimum sink rate of line, differences in the sink rates of live and dead baits, the sink rates of different stages of thawed bait and a variety of weighted branchline arrangements. AFMA is currently investigating the use of new tori line designs for use on longline vessels that are more durable and improve aerial extent. This project is in the early stages of development and results are not expected to be available until early 2020.

Previous research on wire versus nylon leaders indicates that catch rates of sharks are significantly reduced when nylon leaders are used (Ward et al. 2008); conversely, catch rates of sharks increase when circle hooks are used instead of tuna hooks (Ward et al. 2009).

Despite the relatively rare occurrence of interactions between pelagic longliners and sea turtles within the AFZ, the Australian Government has recognised the potential for these interactions to threaten the survivability of the species. Australian research quantified the relative effects of circle and tuna hooks on catches of target and common non-target species (Ward et al. 2009). Although not designed to compare capture rates of marine turtles on circle and tuna hooks (owing to the rarity of sea turtle interactions in Australian longline fisheries), results demonstrated that higher catch rates of target species were attained when circle hooks were used (Ward et al. 2009).

8 Public relations and education activities

Public relations activities

All mitigation strategies in place or being trialled by Australia to reduce impacts of SBT fishing on ERS include a level of education and extension to increase their effectiveness. Specific activities to educate fishers on ERS issues are included in the TAP, National Plan of Action for Sharks, and Bycatch Action Plans for both the tuna purse seine and longline fisheries. AFMA's Resource Assessment Groups and Management Advisory Committees are valuable forums in which government, non-government, industry and other stakeholders can discuss current and emerging mitigation strategies.

AFMA staff regularly visit key SBT fishing ports and engage in education and extension activities during these visits. AFMA also provides education materials in the form of brochures, fact sheets, communication post cards, media releases and other written material for extension to fishers and the general public. A large amount of material is made available through the websites of AFMA and the Fisheries Research and Development Corporation (FRDC). Industry representatives are continuing to refine existing codes of practice to reduce the environmental impacts of Australian tuna fisheries.

Communication (media releases, published material, video, public presentations)

AFMA provides education materials in the form of booklets, posters, media releases, educational videos and other written material for further education of vessel skippers and crews. Industry and the general public are able to subscribe to AFMA for electronic media releases and be informed of upcoming extension activities in their local area. A large amount of material is made available through the websites of AFMA and the FRDC: see http://www.afma.gov.au/sustainability-environment/and http://www.frdc.com.au/resources/resources for further information. Media releases and other publications can be found at http://www.afma.gov.au/news-media/

Education

Training of fishers

Specific activities to educate fishers on ERS issues are included in the TAP, National Plans of Action for Sharks and Seabirds and Bycatch Action Plans for both the tuna purse seine and longline fisheries, and in the Ecological Risk Assessment project.

In addition, Australian observers are briefed to educate fishers on their responsibilities to complete logbooks and other data submission obligations, and in the requirements for, and use of, mitigation strategies to manage impacts on ERS. This information is passed onto vessel skippers and crews during observer trips and while in port.

A series of voluntary training workshops for ETBF operators about bycatch handling, reporting and mitigation was completed. The program was a key initiative under the Australian Tuna and Billfish Longline Fisheries Bycatch and Discarding Workplan, which came into effect on 1 November 2008. Through the program, on-shore workshop sessions and on-board demonstrations provided training to vessel owners, skippers, crew and shore managers on their

obligations in relation to bycatch, including reporting requirements and mitigations measures. Objectives under the discarding plan, which came into effect 1 July 2014, include the development of a best practice handling guide for chondrichthyans and the development of more education courses for crew. The new discarding plan can be found here: https://www.afma.gov.au/sites/default/files/uploads/2014/11/Bycatch-and-Discarding-Workplan-ATBF-2014-2016-8.pdf

Managers

The Australian Government is committed to the ecologically sustainable development of Australian fisheries and all associated international obligations. On-the-job and specific training is provided to meet this commitment.

Observers

AFMA has recruited and trained scientific observers since its establishment in 1992. Observers are sourced from universities and maritime industries and require the ability to live and work at sea, have demonstrated experience in collecting biological data at sea, and have experience in fisheries research methodologies and collection of associated scientific data.

E-monitoring

In July 2015, e-monitoring became mandatory in the Australian longline fisheries (ETBF and WTBF). This system has proven to be effective in improving logbooks and verifying bycatch (Emery 2019a, b).

Information exchange

Australia is committed to its data exchange obligations, and information exchange in general, and actively encourages open and transparent regional approaches in line with the revised requirements for CCSBT member's annual report to ERSWG, and the Recommendation to Mitigate the Impact on Ecologically Related Species of Fishing for Southern Bluefin Tuna, adopted at the 15th meeting of the Commission in October 2008.

Australia's commitment is also evident in the priority given to meeting data exchange obligations to the WCPFC, IOTC and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).

9 Information on other ERS (non-bycatch) such as prey and predator species

In 2001, AFMA initiated the project Ecological Risk Assessment for Commonwealth Fisheries (ERACF). This project undertook ecological risk assessments (ERAs) that looked at the impact, both direct and indirect, of fisheries activities on all aspects of the marine ecosystem, which includes prey and predator species. This work forms part of a transition to ecosystem-based fisheries management by AFMA.

The ERA framework details a process for assessing and progressively addressing the impacts that fisheries activities have on five aspects of the marine ecosystem, including:

- Target species
- Bycatch and byproduct species
- Threatened, endangered and protected species
- Habitats
- Communities

All ERAs for Australian Government-managed fisheries are now publicly available, as are the management reports detailing the response planned to the results of the ERAs http://www.afma.gov.au/sustainability-environment/ecological-risk-management-strategies/

10 Other

Not applicable.

11 Implementation of the IPOA-Seabirds and IPOA-Sharks

Australia endorsed the IPOA-Seabirds, and has undertaken a national assessment of longline fisheries to determine seabird bycatch rates. The Australian longline fisheries that principally interact with seabirds operate in Commonwealth waters, which generally refers to waters from three nautical miles offshore to the extent of Australia's EEZ. To manage these interactions, Australia has put in place the TAP. The TAP is a legislative instrument that directs mandatory seabird bycatch management measures. It was first introduced in 1998 and was revised in 2006, 2014 and 2018 and applies to all longline fisheries managed by the Australian Government. The TAP (2018) is Australia's key national measure for mitigating the impact of longline fisheries on seabird populations, and is consistent with the IPOA-Seabirds. In 2018, an NPOA for Seabirds was also implemented for all fisheries under Commonwealth Jurisdiction.

Australia's National Plan of Action for Conservation and Management of Sharks (NPOA-Sharks) was released in 2004 according to guidelines as set out in the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks). The NPOA-Sharks was designed to provide advice and guidance to fisheries managers, conservation managers and the general public on action needed to ensure that Australia's shark populations are managed sustainably into the future.

As part of the review of Australia's NPOA-Sharks, the Australian Government produced the 2009 Shark Assessment Report (SAR) which is the scientific basis for the adoption of the NPOA. The 2009 SAR (Bensley et al. 2010) builds upon the information provided in the 2001 SAR and identifies any significant changes that have occurred in fisheries since the release of the 2001 SAR. This report was updated in 2018 (Woodhams & Harte 2018) and can be found here http://agriculture.gov.au/abares/research-topics/fisheries/fisheries-research/shark-assessment-report-2018.

The second Australian NPOA-Sharks (Shark-plan 2) was released in July 2012 and identifies how Australia will manage and conserve sharks. In addition, an operational strategy was developed in conjunction with state and territory jurisdictions and stakeholders to identify was actions will be pursued in order to meet the objectives of the plan. Shark-plan 2 and the operational strategy can be found here: http://www.agriculture.gov.au/fisheries/environment/sharks/sharkplan-2

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Appendix I

Mandatory seabird mitigation measures in the ETBF 2018

(*Source*: https://www.afma.gov.au/sites/default/files/uploads/2018/03/2018-ETBF-Management-Arrangements-booklet-FINAL.pdf)

At all times you must:

- Carry one or more assembled tori lines on board
- Not discharge offal while setting

When you are fishing south of 25°S you must:

- Deploy a tori line before commencing a shot when fishing between the hours of nautical dawn and nautical dusk
- A tori line if not required to be deployed when performing fishing operations between the hours of nautical dusk and nautical dawn
- Use only non-frozen bait
- Weight longlines with either a minimum of:
    - 60 g swivels at a distance of no more than 3.5 m from each hook ; or
    - 98 g swivels at a distance of no more than 4 m from each hook; or
    - 40 g weights immediately adjacent to the hook, or at no more than 0.5 m from the hook, with dead, non-frozen baits attached to the hooks or
    - 'Smart Tuna Hooks' with a cap and weighing at least 38 g may be deployed directly at the hook as an alternative.

Your tori line must be:

- At least 100 m long
- Set up from a position on the boat that allows it to stay above the water for at least 90 m from the stern
- Have streamer attached at a maximum interval of 3.5 m
    - Streamers should be maintained, ensuring that their lengths are as close to the water as possible.
- Have a drogue at the end of the line to give sufficient drag to meet the 90 m aerial coverage criteria.

If you are fishing south of 40°S AFMA may require you to implement additional seabird mitigation measures as this is an area in which higher than average numbers of seabird interactions are possible.

Appendix II

Mandatory seabird mitigation measures in the WTBF 2018–19

(Source: https://www.afma.gov.au/sites/g/files/net5531/f/uploads/2014/02/2018-WTBF-Management-Arrangements-booklet-Final-copy.pdf)

At all times you must:

- Carry an assembled tori line on board
- Not discharge offal while setting

When you are fishing south of 25°S you must:

- Deploy a tori line before commencing all shots that take place between nautical dawn and nautical dusk
- A tori line if not required to be deployed when performing fishing operations between the hours of nautical dusk and nautical dawn, providing the vessel uses minimum deck lighting (where minimum deck lighting is a lighting level which does not pose a risk to safety and navigation)
- Use only thawed bait
- Weight longlines with either a minimum of:
    - 60 g swivels at a distance of no more than 3.5 m from each hook ; or
    - 98 g swivels at a distance of no more than 4 m from each hook; or
    - 40 g weights immediately adjacent to the hook, or no more than 0.5 m from the hook, with dead, non-frozen baits attached to the hooks; or
    - 'Smart tuna hooks' with a cap and weighing at least 38 g may be deployed directly at the hook as an alternative.

Tori line specifications:

- At least 100 m long
- Set up from a position on the boat that allows it to stay above the water for at least 90 m;
- Have streamers attached at least every 3.5 m
    - Streamers should be maintained ensuring that their lengths are as close to the water as possible.
- Have a drogue at the end of the line to give sufficient drag to meet the 90 m aerial coverage criteria.

Appendix III

Summary of papers submitted by Australia

Barrington, J. 2019, Developing a multi-year seabird strategy.

The Ecologically Related Species Working Group commenced consideration of a multi-year seabird strategy at its twelfth meeting (ERSWG12). ERSWG12 decided that the strategy should identify, among other things, research, monitoring needs, actions for reducing uncertainty and associated risks, and the recommendations from the *Report of the Effectiveness of Seabird Mitigation* Measures Technical Group. This paper continues the work on a multi-year strategy and provides actions against objectives with proposed timeframes for further discussion with Members.

Emery, TJ, Noriega, R, Williams, AJ & Larcombe, J 2019, Measuring congruence between electronic monitoring and logbook data in Australian Commonwealth longline and gillnet fisheries.

Electronic monitoring (EM) has the capacity to collect fisheries-dependent data to support fisheries management decision-making. Following successful pilot studies, EM was introduced into several Australian Commonwealth fisheries in 2015, including the Eastern Tuna and Billfish Fishery (ETBF) and the Gillnet, Hook and Trap (GHAT) sector of the Southern and Eastern Scalefish and Shark Fishery (SESSF). We compared two years of EM analyst and fisher-reported logbook data from the ETBF and GHAT sector to examine the level of congruence in reporting of both retained and discarded catch and protected species interactions. In general, congruence between EM analyst and fisher-reported logbook data in both the ETBF and GHAT sector was higher for retained than for discarded catch, and the ETBF had a higher level of data equivalency than the GHAT sector. Fishery-wide estimates of congruence, however, concealed a large amount of variation among individual and groups of species. EM analyst and fisher-reported logbook data were highly congruent for some species (e.g. tunas, swordfish and gummy shark), but for others there were clear taxonomic (e.g. escolar and rudderfish), identification (e.g. sharks, marlins) and reporting (e.g. draughtboard shark and elephantfish) issues, which reduced overall congruence. There was evidence of increased congruence through time, particularly for discarded bycatch species in the GHAT sector, due presumably to increased manager feedback and communication with fishers on their logbook reporting. While EM analyst and fisher-reported logbook interactions with protected species in the GHAT sector were equivalent, this was not the case for species other than seabirds in the ETBF. In the ETBF, a greater number of interactions were reported by fishers in their logbooks, suggesting a need to modify existing or install additional EM technology to improve on-board vision for the EM analyst. It is important to review the performance of any integrated EM system through time to ensure it is fulfilling the data requirements for the fishery and meeting the overall objectives of the program.

Emery, TJ, Noriega, R, Williams, AJ & Larcombe, J 2019, Changes in logbook reporting by commercial fisheries following the implementation of electronic monitoring in Australian Commonwealth fisheries.

Technological advancement has allowed for consideration of electronic monitoring (EM) as a tool for improving the accuracy of logbook data and/or increasing the quantity of fishery-dependent data collected. In Australia, an integrated EM system was implemented in several managed fisheries, including the Eastern Tuna and Billfish Fishery (ETBF) and the Gillnet Hook and Trap (GHAT) sector of the Southern and Eastern Scalefish and Shark Fishery (SESSF) from 1 July 2015. We compare

logbook data from the first two years of EM operation to the previous six years, to measure changes in reported nominal catch and discard per unit effort (CPUE and DPUE) and interactions with protected species per-unit-effort (IPUE). We observed no significant increase in CPUE between non-EM (2009–2014) and EM (2015 and 2016) years for any species group in both the ETBF and GHAT. In contrast, DPUE increased significantly during the EM years for target, byproduct and bycatch species in the ETBF and for target species in the GHAT sector. There was a significant increase in the IPUE for seabirds, marine mammals and turtles in the ETBF and for dolphins and pinnipeds in the GHAT sector. While not discounting possible environmentally-driven shifts in availability and abundance, as well as individual vessel effects, the weight of evidence suggests the use of an integrated EM system has led to significant changes in logbook reporting of discarded catch and protected species interactions, particularly in the ETBF. Assuming this supposition is valid, we identify fishery-specific factors that might have influenced reporting behaviour.

Parsa, M, Emery, T, Williams, AK & Nicol, S 2019, An empirical Bayesian hierarchical modelling of fleet and vessel-level bycatch rates in commercial fisheries: a prospective tool for managing risk through targeted intervention.

Assessing the risks of fishing-induced mortality on bycatch and protected species is a priority for fisheries managers, requiring an accurate estimation of the fleet and individual vessel bycatch interaction rates. Standard estimation of individual vessel bycatch rates (number of interactions divided by total effort) can be biased as it doesn't consider effort heterogeneity among the fleet and ignores prior knowledge of the fleet or fishery interaction rate. Consequently, we develop an empirical Bayesian approach for estimating vessel bycatch rates that: (i) considers effort heterogeneity among vessels and; (ii) pools the data from similar vessels for accurate rate estimation. The proposed average interaction rate of a vessel is therefore the weighted average pool rate and the standard interaction rate of the vessel. We apply this inference method to the estimation of seabird bycatch rates in the southern bluefin tuna component of the Australian Eastern Tuna and Billfish Fishery to illustrate its capability to provide fishery managers with insights on fleet-wide bycatch mitigation performance and identification of disparate vessels for targeted compliance intervention. This method can also be used by fishery managers to develop fleet-wide performance criteria or quantitative evaluation standards for bycatch species as similar implemented for seabirds in Australia under the Threat Abatement Plan.

Appendix IV

Common and scientific names

Common names	Scientific names
Albatrosses (other)	*Diomedeidae* spp.
Australian fur seal	*Arctocephalus pusillus doriferus*
Australian sea lion	*Neophoca cinerea*
Black marlin	*Makaira indica*
Black-browed albatross	*Thalassarche melanophris*
Blacktip sharks	*Carcharhinus* spp.
Blue marlin	*Makaira nigricans*
Blue shark	*Prionace glauca*
Bronze whaler	*Carcharhinus brachyurus*
Buller's albatross	*Thalassarche bulleri*
Cape petrel	*Daption capense*
Common dolphin	*Delphinus delphis*
Dusky shark	*Carcharhinus obscurus*
Escolar	*Lepidocybium flavobrunneum*
Flatback turtle	*Natator depressa*
Flesh-footed shearwater	*Ardenna carneipes*
Great hammerhead shark	*Sphyrna mokarran*
Great-winged petrel	*Pterodroma macroptera*
Green turtle	*Chelonia mydas*
Grey-headed albatross	*Thalassarche chrysostoma*
Hammerhead shark	*Sphyrna* spp.
Hawksbill turtle	*Eretmochelys imbricata*
Humpback whale	*Megaptera novaeangliae*

Lancetfish	*Alepisaurus* spp.
Leatherback turtle	*Dermochelys coriacea*
Loggerhead turtle	*Carretta carretta*
Longnose lancetfish	*Alepisaurus ferox*
Manta rays	*Manta* spp.
Mahi mahi	*Coryphaena hippurus*
Moonfish (opah)	*Lampris guttatus*
New Zealand fur seal	*Arctocephalus forsteri*
Ocean sunfish	*Mola mola*
Oceanic whitetip shark	*Carcharhinus longimanus*
Oilfish	*Ruvettus pretiosus*
Pacific (olive) ridley turtle	*Lepidochelys olivacea*
Petrels, prions and shearwaters	*Procellariidae* spp.
Porbeagle	*Lamna nasus*
Ray's bream	*Brama brama*
Rudderfish	*Centrolophus niger*
Sailfish	*Istiophorus platypterus*
Scalloped hammerhead	*Sphyrna lewini*
Shortbill spearfish	*Tetrapturus angustirostris*
Shortfin mako	*Isurus oxyrinchus*
Short-finned pilot whale	*Globicephala macrorhynchus*
Short-tailed shearwater	*Ardenna tenuirostris*
Shy albatross	*Thalassarche cauta*
Silky shark	*Carcharhinus falciformis*
Smooth hammerhead	*Sphyrna zygaena*
Sooty shearwater	*Ardenna griseus*
Southern bluefin tuna	*Thunnus maccoyii*
Southern royal albatross	*Diomedea epomophora*
Thresher shark	*Alopias vulpinus*

Tiger shark	*Galeocerdo cuvier*
Wahoo	*Acanthocybium solandri*
Wandering albatross	*Diomedea exulans*
Wedge-tailed shearwater	*Ardenna pacificus*
Yellow-nosed albatross	*Thalassarche chlororhynchos*