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**2008 National assessment report for
reducing the incidental catch of
seabirds in longline fisheries**

G Barry Baker and Luke A Finley

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Postal address:

Bureau of Rural Sciences
GPO Box 858
Canberra, ACT 2601

Website: www.brs.gov.au

Email: info@brs.gov.au

Telephone: +61 2 6272 4282

Facsimile: +61 2 6272 4747

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Executive summary

Incidental mortality of seabirds arising from the effects of fishing has been recognised as a serious issue in fisheries management and conservation of seabirds for at least two decades. The 23rd session of the Food and Agriculture Organization of the United Nations (FAO) Committee on Fisheries, held in Rome from 15–19 February 1999, adopted the *International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries* (IPOA-Seabirds). The IPOA-Seabirds is a voluntary instrument elaborated within the framework of the *FAO Code of Conduct for Responsible Fisheries*. This Code sets out principles and international standards of behaviour for responsible fishing practices to enable effective conservation and management of living aquatic organisms, while considering impacts on the ecosystem and biodiversity. By endorsing the IPOA-Seabirds, member countries such as Australia undertook to prepare a National Plan of Action (NPOA-Seabirds) to address seabird bycatch nationally, thereby achieving a degree of global action.

The IPOA-Seabirds complements environmental laws in Australia, where seabirds are protected under various state and Commonwealth legislation. In particular, the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations was listed as a key threatening process under Commonwealth legislation in 1995 (now the *Environment Protection and Biodiversity Conservation Act 1999* – EPBC Act), and a Threat Abatement Plan (TAP) was first introduced in 1998 to manage this threat. The TAP sets out to coordinate national action to alleviate the impact of longline fishing activities on all seabirds in Australian waters. It applies to all fisheries under Commonwealth jurisdiction, and sets maximum bycatch rates ranging from 0.01 to 0.05 birds per thousand hooks for longline fisheries known to impact seabirds. The bycatch rates act as a threshold management trigger and also a benchmark against which the success of the TAP can be measured. These rates are to be achieved by implementing a number of mandatory actions.

The TAP was introduced prior to the IPOA-Seabirds and it has been the principle management tool that Australia has used over the last 10 years to manage the major longline threat to seabirds in Australian fisheries. The focus on the TAP has resulted in limited attention being paid to the development of a NPOA-Seabirds. However, the scope and legislative basis of the TAP are considered more effective at reducing the incidental catch of seabirds in longline fisheries – the principle objective of the IPOA – Seabirds. The TAP does not cover all of the preferred elements of an NPOA-Seabirds, which are discussed further in the report. Work to address these gaps nationally is ongoing.

The IPOA-Seabirds stipulates that countries with longline fisheries should carry out an assessment of these fisheries to determine if a bycatch problem exists and, if so, to determine its extent and nature. If a problem is identified, countries should adopt a National Plan of Action–Seabirds (hereafter NPOA-Seabirds) for reducing the incidental catch of seabirds in their fisheries. This report is Australia’s assessment of all longline fisheries that were operating within Australian jurisdiction in 2007. The purpose of the assessment was to:

- determine the extent and nature of the incidental catch of seabirds in Australian longline fisheries for 2003–2006
- describe changes that have occurred in fisheries since an initial assessment report was carried out in 2003
- update the core information provided in the 2003 Assessment Report and provide information on new research where appropriate
- provide an assessment of the risks to seabirds from the expansion or contraction of fishing effort in any existing fisheries and/or the development of new longline fisheries
- provide a statement of conclusions and next steps to implement a NPOA-Seabirds

- recommend future work to identify and address seabird bycatch issues in other fisheries, such as trawl and gillnet fisheries.

In conducting this assessment eight Commonwealth and 22 state fisheries employing longline gear were assessed for their impact on seabird species. As a primary source of data the authors identified all Australian fisheries that used longline methods between 2003 and 2006, and the agencies that manage them. Where available, more recent information is presented for some fisheries. Each agency was sent a request for background information and data for all of their fisheries. Where possible, the fisheries descriptions and assessments of seabird interactions reported were derived from these data. In the absence of primary data from Commonwealth, state, and territory fisheries management agencies, publicly available information was obtained from published literature, online or other sources.

Thirty two separate taxa of seabirds were identified as having been killed in longline fishing operations in the Australian Fishing Zone (AFZ). These species are typically large seabirds which naturally feed on fish and squid found on or close to the sea surface. They all exhibit behaviours which make them susceptible to being caught on longlines, they dive for baits and have learned to follow vessels and forage on discards. They are aggressive feeders and in most cases travel large distances seeking food. The groups most affected are the albatrosses and petrels because of their limited population sizes and low reproduction rates. While albatrosses represented 75 per cent of the birds killed by Japanese longline vessels operating in the AFZ during the early 1990s, recent observer data indicates that albatrosses form less than 10 per cent of the species killed annually by the Australian domestic fleet. Flesh-footed shearwaters and other petrels now dominate the catch, reflecting a change in the distribution of fishing effort and the extent of overlap with these species.

The seabird species caught on longlines are highly varied in conservation status. They include endangered species such as the northern royal albatross and prolific species such as the short-tailed shearwater. It should be noted, however, that the IPOA-Seabirds is focused on minimising bycatch of all seabirds, and not just those listed to a category of threat. Seabirds affected by longline fisheries in Australia are principally found in waters south of 25° S (Fraser Island on the east coast and Shark Bay on the west coast) and more commonly south of 30° S. These species are also pelagic in distribution and typically only occasionally forage in inshore waters.

Although high levels of seabird bycatch have been documented in the past for some of Australia's Commonwealth fisheries, there is now evidence to show that bycatch levels have declined substantially, at least in the Eastern Tuna and Billfish Fishery (ETBF), since the development of the longline fishing TAP. It is estimated that mean annual seabird bycatch for all Commonwealth fisheries in 2007 was less than 200 seabirds, with more than 50 per cent of captures being attributed to the ETBF. For this fishery, this estimate was derived from bycatch data collected by observer programs and appropriate estimation techniques.

For most other Commonwealth fisheries, with the exception of Antarctic fisheries, the estimates represent the authors expert opinion, and were derived from knowledge of the gear used, the level and spatial distribution of hooking effort, and the bycatch rates reported for each fishery, where available.

The ETBF is the fishery of most concern due to the level of effort in the fishery and annual seabird bycatch rates. When compared to the levels of bycatch observed in the fishery in 2001–2003, when it was estimated that between 1800–4500 birds may be killed each year, it is clear that bycatch has been considerably reduced. This has mainly been brought about by the rigorous implementation of mitigation measures such as night-setting and line-weighting since the implementation of the TAP, but also due to a gradual northwards shift in fishing effort since 2003. The seabird bycatch has continued to be dominated by flesh-footed shearwaters but some albatrosses have been caught over the last couple of years, mainly when fishers failed to deploy mitigation measures. In recent years, mean observed bycatch rates have generally approached but not exceeded the TAP performance criterion of 0.05 birds per 1000 hooks in most fishing areas and seasons. Observer coverage rates

have been steadily increasing in the ETBF and currently, on average, around five per cent of all hooks set are observed annually, however, some concerns remain about low observer coverage rates in some areas. Despite mandatory reporting requirements, logbooks, generally, are not considered a reliable source of data on seabird bycatch.

Information on the levels of bycatch in all state and territory fisheries is generally poor and mainly reliant on logbook data. With some exceptions (e.g. Qld Rocky Reef Fin Fish Fishery, Qld Deepwater Fin Fish Fishery, Qld Gulf of Carpentaria Line Fishery, NT Timor Reef Fishery, NT Spanish Mackerel Fishery, NT Offshore Line and Net Fishery), there are few fishery-independent observer programs in state fisheries. However, most of these fisheries are multi-gear fisheries and hook and line methods do not play a major role in effort. Most of these fisheries also operate in coastal waters where seabird species known to be at risk from longline interactions do not occur regularly. When these factors are taken into consideration, it is reasonable to conclude that state and territory longline fisheries are unlikely to experience significant seabird interactions.

While the bycatch of seabirds associated with longline fishing was the focus of this assessment report, there is growing awareness of seabird mortality in trawl fisheries in some parts of the world. Recent evidence in other parts of the world suggests that seabird mortality in trawl fisheries may exceed that recorded in some longline fisheries. Within Australia, few bycatch studies have specifically focused on trawl fisheries, with the exception of Australia's Antarctic trawl fisheries. There is considerable trawl fishing within Australian waters, with much of this fishing effort occurring within the foraging areas of albatrosses and petrels. Reliable data on the levels of seabird bycatch in Australian trawl fisheries will likely only be obtained when observer programs are established to focus on this issue.

There has been a substantial reduction in seabird mortality in Australia's Commonwealth fisheries that has occurred since the initial national assessment in 2003. This has been achieved through development of a suite of mitigation approaches prescribed by the TAP, which have been implemented and strengthened following the review and subsequent updating of the TAP in 2006. Other significant developments include:

- the introduction of observer programs in all Commonwealth longline fisheries
- the willingness of some members of industry to cooperate with scientific observers and researchers to refine and improve the suite of mitigation measures adopted
- a substantial reduction in longline effort in pelagic tuna fisheries
- changes in the spatial distribution of fishing effort in the ETBF.

This experience demonstrates that seabird mortality can be reduced substantially in large-scale regulated longline fisheries. The fishery policies and practices developed and implemented through the TAP offer a model of best practice in the development and implementation of mitigation and enforcement of measures, using an adaptive management approach, and one that already has had a wide application to other fisheries and administrations.

In considering the need for Australia to develop a national plan, it is relevant that the form of the existing TAP is such that it is largely performing the function of an NPOA-Seabirds. Notably, its prescriptions are supported by the EPBC Act, and do not rely on voluntary uptake. However, the TAP does not apply in state and territory fisheries.

Nevertheless, a review of state and territory-managed fisheries indicates that current levels of longline fishing effort are low. This, together with a reliance on inshore fishing areas where spatial overlap of effort with vulnerable seabird species is low, leads to the conclusion that seabird bycatch in these fisheries is unlikely to be causing an impact at the population level to seabird breeding populations.

Note, however, the assessment of seabird bycatch in state and territory fisheries is based on 'expert opinion', not on empirical data and should be verified. Most state fisheries do not have independent

observer programs and managers have concluded that seabird bycatch is not a problem based on logbook information. Decisions based on logbooks that are not verified have often been shown to be unreliable in fisheries management.

Information gathering through independent observer programs is costly, and many of the state and territory fisheries are small scale, low value fisheries. Therefore, generating the priority and resources necessary to support the level of data gathering required to determine bycatch levels will be challenging. The development of a nationally consistent risk-based approach to assessing seabird bycatch within state and territory fisheries may be more appropriate.

This assessment also considered the likelihood that other Australian fisheries may be significantly impacting on seabird populations. Australian trawl fisheries were identified as warranting further investigation. For reducing seabird strikes on trawl warps, the use of bird-scaring lines has been proven to be the most effective mitigation measure. However, strategic management through retention of fish waste (offal and discards) is the most likely long-term solution to reducing seabird incidental catch in trawl fisheries.

- The TAP is largely fulfilling the role of an NPOA-Seabirds and effective implementation of the TAP should address the major risks posed to seabirds by Australian longline fisheries
- Shortfalls in achieving the levels of observer coverage required by the TAP for all Commonwealth fisheries need to be addressed
- State and territory fisheries are unlikely to be causing an impact at the population level to seabird breeding populations. In the absence of robust risk assessments, data validation needs to be encouraged in state and territory longline fisheries to confirm that seabird interactions are low
- Further development and trialling of seabird bycatch mitigation measures for pelagic longline gear remains a high priority
- An assessment of seabird bycatch in Australian trawl fisheries is warranted to ensure Australian trawl fisheries are not impacting seabird populations.

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National Plan of Action – Seabirds Assessment Report

Part A – Overview of seabird bycatch and management approaches

Introduction

The 23rd session of the Food and Agriculture Organization of the United Nations (FAO) Committee on Fisheries, held in Rome from 15–19 February 1999, adopted the *International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries* (IPOA-Seabirds). The IPOA-Seabirds is a voluntary instrument elaborated within the framework of the FAO *Code of Conduct for Responsible Fisheries*. This Code sets out principles and international standards of behaviour for responsible fishing practices to enable effective conservation and management of living aquatic organisms, whilst considering impacts on the ecosystem and biodiversity.

Other IPOA's that have been developed to date include *IPOA for the Conservation and Management of Sharks*; *IPOA for the Management of Fishing Capacity* and the *IPOA to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. The IPOA's give effect to the provisions of the United Nations Agreement for the Implementation of the Provisions of the *United Nations Convention on the Law of the Sea* of 10 December 1982 relating to the *Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks* (otherwise known as the UN Fish Stocks Agreement). This agreement encourages countries to cooperate to ensure conservation and provides a framework for cooperation. By endorsing the IPOA-Seabirds, member countries such as Australia undertook to prepare National Plans of Action (NPOA's) to address seabird bycatch nationally, thereby achieving a degree of global action.

The IPOA-Seabirds complements environmental laws in Australia, where seabirds are protected under various state and Commonwealth legislation. In addition, the *National Policy on Fisheries Bycatch*, released in 1999, provides a framework for coordinating efforts to reduce the bycatch of all species. In relation to impacts of longline fishing activities on seabirds, the *Threat Abatement Plan for the incidental catch (or by-catch) of seabirds during oceanic longline fishing operations* (the TAP) was released in 1998 at the same time as the development of the IPOA. The TAP has subsequently been reviewed and updated (Department of Environment and Heritage 2006), and provides the framework for coordinating action to reduce impacts of longline fishing activities on seabirds in Australian waters. The IPOA-Seabirds framework is reflected in the aims of the TAP for the Australian Government-managed fisheries in which seabird bycatch had been identified as a concern.

The IPOA-Seabirds stipulates that countries with longline fisheries (conducted by their own or foreign vessels) or a fleet that fishes elsewhere should carry out an assessment of these fisheries to determine if a bycatch problem exists and, if so, to determine its extent and nature. If a problem is identified, countries should adopt a National Plan of Action – Seabirds (NPOA-Seabirds) for reducing the incidental catch of seabirds in their fisheries.

This report is Australia's assessment of all longline fisheries that were operating within Australian jurisdiction from 2003–2006. The purpose of the assessment was to:

- determine the extent and nature of the incidental catch of seabirds in Australian longline fisheries for 2003–2006¹
- describe changes that have occurred in fisheries since the initial assessment report, carried out in 2003 (Commonwealth of Australia 2003)
- update the core information provided in the 2003 Assessment Report and provide information on new research where appropriate
- provide an assessment of the risks to seabirds from the expansion or contraction of effort in any existing fisheries and/or the development of new longline fisheries
- provide a statement of conclusions and next steps to implement a NPOA-Seabirds
- recommend future work to identify and address seabird bycatch issues in other fisheries, such as trawl and gillnet fisheries.

The assessment begins by providing a brief global overview of longline seabird bycatch, the international policy and legal framework which has been developed to address it, and a summary of current mitigation measures to reduce or eliminate the problem (Part A). This is followed by a review of the seabird bycatch issues in each of Australia's longline fisheries on a fishery-by-fishery basis (Part B), a general review and assessment of bycatch in other Australian fisheries (Part C), and an evaluation of the need for an NPOA-Seabirds covering these fisheries (Part D).

Seabird bycatch

Seabirds, including albatrosses and petrels, are killed in a range of longline fisheries throughout the world (Robertson and Gales 1998; Kock 2001). The birds drown after being accidentally caught while scavenging on the baited hooks set for target pelagic and demersal fish. There is compelling evidence that longline mortality is responsible for population decreases in many species of seabird. Removal of baits by seabirds may also have an adverse effect on the profitability of longline fishing by reducing the availability of baited hooks for fish such as tuna and swordfish (Brothers 1991). Initially concerns related to pelagic longline fishing for species such as tuna (Weimerskirch and Jouventin 1987; Brothers 1991; Murray et al. 1993), but demersal fisheries targeting other species have also been shown to catch large numbers of seabirds (e.g. Ashford et al. 1995; Barnes et al. 1997; Brothers et al. 1999). Trawl fisheries in some areas also kill large numbers of seabirds (Bartle 1991; New Zealand Department of Conservation and Ministry of Fisheries 2000).

Recognition of the extent of seabird mortality in longline fisheries has resulted in a number of organisations and governments introducing measures to mitigate the threat both nationally and internationally.

Mitigation and risk assessment

A range of mitigation measures for reducing the incidental catch of seabirds in longline fisheries has been developed (Brothers et al. 1999; Dietrich et al. 2004; Bull 2007) that can be employed according to circumstance. They include night setting; line weighting; seasonal and/or area closures; bird scaring lines; controlling offal discharge and bait thawing. These measures focus on reducing bycatch during the critical period following release of the bait from the stern of the longline vessel until it has sunk out of reach of diving seabirds by increasing the sink rate of bait; deterring birds from foraging where baits are being set; blocking access to baits and minimising the congregation of seabirds around vessels. Each has different attributes, costs and potential to successfully reduce seabird catch. Some measures such as night-setting have been consistently

¹ More recent information is presented in some instances where it was readily available.

successful in a number of longline fisheries (Baker and Wise 2005; Gales et al. 1998; Gilman et al. 2005; Klaer and Polacheck 1997; McNamara et al. 1999; SC-CAMLR 2005), while the effectiveness of others has varied between vessels and seabird species (ACAP Seabird Bycatch Working Group 2007).

While considerable progress has been made in mitigating bycatch in demersal longline fisheries (e.g. Moreno et al. 2007), principally through the development of effective bird scaring lines (Melvin 2003; Melvin et al. 2004), integrated weight line in autoline systems (Robertson et al. 2006), night setting and seasonal closures (SC-CAMLR 2005), proven and accepted seabird avoidance measures in pelagic fisheries require substantial improvement. In 2007, the *Agreement on the Conservation of Albatrosses and Petrels* (ACAP) Seabird Bycatch Working Group reviewed available research on seabird bycatch mitigation measures for pelagic longline fishing (ACAP Seabird Bycatch Working Group 2007; also see Melvin and Baker 2006). Development is currently underway on a number of mitigation measures for this gear type, with bird scaring lines, an underwater bait setting capsule and side setting assessed as being the highest priority for research. Other measures considered priorities for research include weighted branchlines, the bait pod and smart hooks (methods of preventing seabirds from accessing hooks during setting), circle hooks and blue dyed squid. Night setting is currently the only mitigation measure proven to be widely effective with pelagic longline gear, but its widespread adoption is constrained because it is considered to impact operational efficiency when targeting some pelagic fish species. Appendix 3 summarises a review conducted by ACAP's Seabird Bycatch Working Group of seabird bycatch mitigation measures for pelagic longline fishing and the knowledge gaps that were identified, together with the minimum standards that should apply to each mitigation measure. The review was based on published literature and expert opinion (ACAP Seabird Bycatch Working Group 2007), and completed during the June 2007 workshop. This review has been endorsed by ACAP as representing the best current scientific advice.

To understand the conservation implications of fisheries bycatch mortality on seabirds, improved knowledge of levels of bycatch in all major fisheries known to kill these birds is urgently needed. For many of the world's fisheries, independent observer coverage is either non-existent or falls below the level required to accurately estimate bycatch levels (Small 2005; Baker et al. 2007a). It is also important that fisheries observers retain all seabirds killed in fishing operations and return carcasses for analysis to determine species, age, sex, breeding status and, where possible, provenance. This is a mandatory requirement of the longline TAP, and is essential in assessing risk to species and improving knowledge of fishery impacts (Gales 1998; Department of Environment and Heritage 2006; Abbott et al. 2006a).

Bycatch risk assessments for all fisheries need to be developed and regularly reviewed. Spatio-temporal effort in fisheries is dynamic and fluctuates in response to market forces and the status of target stocks. Changes in effort can rapidly change the impact upon bycatch species. Waugh et al. (2008) recognised several factors as pivotal to the highly effective management of seabird bycatch in CCAMLR longline fisheries that have wider application to fisheries management throughout the world. Among these is the detailed annual review of information on fishery performance, the seabird species that interact with the fishery, and improvements in bycatch mitigation practice. This has resulted in regular revision to conservation measures, ensuring that the mitigation measures are close to international best-practice for the fishery at any time. Risk assessments should also consider establishing bycatch limits in fisheries and areas adjacent to breeding colonies of albatrosses and giant-petrels with small populations (Hewitt and Hay 2007), as discussed above. This has been a standard practice in new and developing fisheries in Antarctic fisheries (CCAMLR 2006).

An essential tool in reducing bycatch in fisheries is the establishment of a working group that meets regularly to consider all aspects of interactions with seabirds in a fishery (Waugh et al. 2008; refer also Section 2.16.iii). Perhaps the best example of how to successfully manage bycatch in a fishery is that of CCAMLR, which has seen seabird bycatch virtually eliminated in its Antarctic

longline fisheries over the last 10 years (SC-CAMLR 2007). Pivotal to the success of CCAMLR in reducing seabird bycatch has been the formation of the specialist ad hoc Working Group on Incidental Mortality Associated with Fishing (IMAF). This group was established in 1994 to provide advice to CCAMLR's Scientific Committee on seabird interactions. The group meets annually and reviews all fishing data from the previous year, together with fishing proposals for the forthcoming year. Matters considered include the performance of each fishing vessel in avoiding bycatch; the effectiveness of mitigation measures in use; recent developments with mitigation and their applicability to CCAMLR fisheries; an annual risk assessment for all fisheries to identify the risk of capture of seabirds in fishing operations; and a review of existing conservation measures. Updated advice from the IMAF Working Group is taken to the CCAMLR Commission via the Scientific Committee on an annual basis, ensuring best-practice seabird bycatch mitigation measures and advice can be rapidly adopted. Generally, Regional Fisheries Management Organisations (RFMOs) and some domestic fisheries have various working groups that are tasked with providing advice on bycatch issues but they do not work as effectively. Adoption of the IMAF model by all fishery managers may be a significant step toward reducing incidental mortality of albatrosses and giant-petrels in both coastal and high seas fisheries.

National measures

The incidental catch (or bycatch) of seabirds during oceanic longline fishing operations was listed as a key threatening process on 24 July 1995. Under Commonwealth legislation (now the *Environment Protection and Biodiversity Conservation Act 1999* – EPBC Act), a Threat Abatement Plan (TAP) was prepared to manage this threat in 1998 (Environment Australia 1998), and subsequently reviewed in 2006 (Department of Environment and Heritage 2006). The TAP sets out to coordinate national action to alleviate the impact of longline fishing activities on all seabirds in Australian waters. It applies to all fisheries under Commonwealth jurisdiction, and sets maximum bycatch rates ranging from 0.01 to 0.05 birds per thousand hooks for longline fisheries known to impact seabirds as criteria upon which the success of the TAP can be measured. These rates are to be achieved by implementing a number of actions:

- prescribing appropriate mitigation measures
- providing for the development of new mitigation measures
- educating fishers and the public
- collecting information necessary to improve knowledge of seabird-longline fishery interactions and measure progress with implementation of the TAP.

The TAP is binding on the Australian Government and its agencies and encourages complementary actions in state/territory waters.

A Recovery Plan for Albatrosses and Giant-Petrels was released in October 2001. The EPBC Act requires the preparation of recovery plans within three years of a species being included on the threatened species list. These plans set out the actions necessary to support the recovery of threatened species to maximise their chances of long-term survival. These actions relate to identifying direct and indirect threats to survival through data collection and monitoring programs, education strategies, seasonal or permanent closures of significant habitat sites, and progressing international agreements. The overall objective of the recovery plan is to 'minimise (or eliminate) threats due to human activity to albatrosses and giant petrels to ensure their recovery in the wild'. The recovery plan is currently being reviewed and revised.

Other initiatives broadly dealing with the issue of bycatch have also been adopted in Australia. In 1999, a *National Policy on Fisheries Bycatch* was released where all Australian governments agreed to develop a bycatch policy that provides options by which each jurisdiction can manage bycatch according to its situation. The Australian Government subsequently released the *Commonwealth Policy on Fisheries Bycatch* in 2000, which requires the development of Bycatch

Action Plans (BAPs) for all Australian Government-managed fisheries. The BAPs are intended to identify bycatch issues, data requirements, options and possible solutions for each fishery.

Further to this initiative, the EPBC Act requires that all Commonwealth fisheries undergo strategic assessment (Part 10). Each fishery is also assessed to determine whether the fishery should be accredited for the purposes of the protected species provisions (Part 13), and in accordance with the wildlife trade provisions (Part 13A). An assessment must demonstrate that the fishery is ecologically sustainable in terms of its impact on target species; non-target species and bycatch; and, the ecosystem generally (including habitat). Accreditation of Fisheries Management Plans under Section 208A of the EPBC Act requires that the Minister for the Environment, Heritage and the Arts must be satisfied that any plan requires persons engaged in fishing under the plan to take all reasonable steps to ensure that members of listed threatened species are not killed or injured as a result of the fishing. Most exporting fisheries have received accreditation under the EPBC Act and some are currently being re-assessed following the expiration of the initial assessment period.

International measures

Agreement on the Conservation of Albatrosses and Petrels

Australia led the development of an international agreement for the conservation of seabirds. The *Agreement on the Conservation of Albatrosses and Petrels* (ACAP) has been developed under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). It seeks to coordinate international activity to mitigate known threats to albatross and petrel populations throughout the southern hemisphere. In particular, Annex 1 of the agreement provides a framework for implementation of effective conservation measures for albatrosses and petrels.

ACAP entered into force in February 2004 and now has 12 Parties. An advisory committee has been established to guide the implementation of the agreement, which is served by four working groups: the Taxonomy Working Group, Status and Trends Working Group, Breeding Sites Working Group and the Seabird Bycatch Working Group (www.acap.aq).

The Seabird Bycatch Working Group comprises representatives from all ACAP parties, as well as invited specialists and NGOs with expertise in mitigation research, RFMO and high seas governance, and management of seabird-fisheries interactions. It aims to address issues related to fisheries interactions with seabirds. Key activities identified include:

- collation of information on the foraging distribution of ACAP species and the degree of spatial and temporal overlap with fisheries
- development of risk assessments for fishing operations on seabirds in fishing regions
- reviewing information on mitigation measures for various fishing methods, initially focusing on pelagic longline methods
- developing products to assist RFMOs to reduce bycatch, such as the design of observer programs and guidelines for best-practice mitigation measures.

Through ACAP, there is now strong international commitment to protect albatrosses and petrels but much needs to be done to ensure the agreement becomes an effective mechanism to assist in eliminating threats to albatrosses and petrels and ensuring that population declines are reversed. The Action Plan, established by Article VI of the Agreement, remains to be fully implemented, and priority needs to be given to capacity building in range states that require training, information and institutional support.

Regional fisheries management organisations

Other regional agreements such as the Regional Fisheries Management Organisations (RFMOs) are of central importance to sustainable management of the world's oceans. Their obligation to conserve fish stocks and threatened species such as albatrosses has been established by legal instruments, including agreements such as the United Nations (UN) Food and Agricultural Organisation (FAO) *Code of Conduct for Responsible Fisheries* and the UN Agreement for the Implementation of the Provisions of the *United Nations Convention on the Law of the Sea* of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (Fish Stocks Agreement). Some of these organisations include specific actions for seabird protection, which have already been implemented.

The five RFMOs with the greatest overlap with albatross distribution are the Commission for Conservation of Southern Bluefin Tuna (CCSBT), the Western and Central Pacific Fisheries Commission (WCPFC), the Indian Ocean Tuna Commission (IOTC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) (Small 2005). Only one of these, CCAMLR, has implemented a comprehensive conservation measure that has seen seabird bycatch reduced by over 99 per cent (SC-CAMLR 2007). The tuna RFMOs lag behind considerably in comparison. The WCPFC only came into force in 2004, and has not yet fully established measures for reducing bycatch – the current seabird conservation measure includes mitigation methods such as short streamer lines that are not proven to be effective in reducing bycatch. CCSBT has required its vessels to use a bird-scaring line south of 30° S for over 10 years, and was the first tuna RFMO to agree on a mandatory mitigation measure for seabird interactions in longline fisheries. However, the CCSBT's early momentum in respect of seabird bycatch has not been sustained and few tangible benefits have been delivered. Since 1997, the seabird mitigation measure has not been amended to reflect international developments in mitigation measures. The CCSBT is not monitoring compliance with, or the effectiveness of, this measure, and was recently assessed as lagging behind other RFMOs in management of non-target species (Lack 2007).

Of the remaining two RFMOs that are likely to have a high impact on albatross and petrels species (Small 2005), ICCAT have only recently considered adopting mitigation measures to reduce bycatch of non-target species. Yet, the IOTC has recently adopted some of the more progressive mitigation measures. Unlike in Australia, none of the five tuna RFMOs require onboard observer programs, which are essential to understanding the extent of seabird bycatch within a fishery and guiding, refining and monitoring the implementation of effective mitigation measures.

The need for improved performance by RFMOs in their data collection, management and enforcement of management measures for albatrosses and giant-petrels and other non-target species is now widely accepted. Recently, the United Nations General Assembly, the 2006 Review Conference on the Implementation of the United Nations Fish Stocks Agreement, the 27th meeting of the Food and Agriculture Organisation of the United Nations Committee on Fisheries (COFI) and the joint meeting in Kobe, Japan, of tuna RFMOs have each identified this need (Anon. 2007; Lack 2007).

There is considerable information and advice available to the tuna RFMOs in relation to best practice in seabird mitigation measures. While no single measure or even combination of measures is likely to completely resolve the problem, there is sufficient evidence to indicate that combinations of measures are effective in significantly reducing seabird interactions. In 2006 and 2007, international workshops on mitigation of seabird catch in pelagic longline fisheries endorsed the approach proposed by the WCPFC of identifying combinations of measures that could be used and selected on the basis of the operational characteristics of the vessel (Melvin and Baker 2006; ACAP Seabird Bycatch Working Group 2007).

There is a need for RFMOs to agree on and adopt effective mitigation measures. These measures need to be applied both within their members' domestic jurisdictions and on the high seas. Until

each of the members of the tuna RFMOs acknowledge their responsibility to adopt a precautionary and ecosystem-based approach to management there is little likelihood of better assessment and management of impacts on seabirds. Some RFMOs such as CCSBT have been slow to recognise the merits of a risk-based approach to management of non-target species (Lack 2007; Waugh et al. 2008). Under such an arrangement, an RFMO would establish the context and problem formulation for capture of non-target species; assesses the risk through identification, analysis and evaluation of the risks; manage the risk through applying mitigation measures to address the risk and monitor and review the effectiveness of management measures through examination of appropriate data.

This approach is embedded in CCAMLR management practices (Waugh et al. 2008) and is becoming increasingly common in other RFMOs. ICCAT has agreed that an ecological risk assessment framework may be a good way to prioritise research activities and is undertaking such an assessment using the available data on species taken by ICCAT fisheries (ICCAT Subcommittee on Ecosystems, in Lack 2007). Similarly, the WCPFC Scientific Committee has endorsed ecological risk assessment as an appropriate way to assist in prioritising species for management action or further research (WCPFC Scientific Committee, in Lack 2007).

International plan of action – seabirds

The IPOA-Seabirds, introduced in 1999, was developed principally in accordance with Articles 7.6.9 and 8.5 of the *FAO Code of Conduct for Responsible Fisheries*, which state that fisheries should adopt appropriate remedial measures, employ fishing gear and methods that minimise catch of non-target species (both fish and non-fish species), and minimise negative impacts on associated or dependent species. In addition, Article 6.2.9 states that ‘Fisheries management should promote the maintenance of the quality, diversity and availability of fishery resources in sufficient quantities for present and future generations in the context of food security, poverty alleviation and sustainable development. Management measures should not only ensure the conservation of target species but also of species belonging to the same ecosystem or associated with or dependent upon the target species’. The IPOA-Seabirds requires each country involved in longline fishing to conduct an assessment of seabird bycatch in their longline fisheries, which is the specific objective of this report. Countries with a bycatch problem should elaborate and adopt a National Plan of Action-Seabirds to address the issue.

The IPOA-Seabirds is voluntary and concerns States with longline fisheries, including States operating fisheries on the high seas and in the EEZs of other States. As of March 2008, IPOA-Seabirds have been developed and officially adopted by Brazil, Chile, the Falkland Islands, Uruguay, Japan, New Zealand, USA and Canada, while several others are either in an advanced draft stage or awaiting government endorsement (Australia, Namibia and South Africa), or others currently being drafted (Argentina, South Georgia and Sandwich Islands).

Part B – Review and assessment of bycatch

Australian longline fishing methods

This report has adopted Australia's definition of longline fishing from the Threat Abatement Plan 2006 (Department of Environment and Heritage 2006). Longline fishing – 'the setting of one or more single lines (mainline) containing many individual hooks on branch lines or snoods. The mainline can either be anchored or drifting. It can be oriented vertically or horizontally and vary considerably in length and number of hooks'.

Currently, only domestic vessels use longline gear in Australian waters, but between 1979 and 1997 Japanese vessels operated within the AFZ under a Bilateral Access Agreement between the governments of Australia and Japan. Longlining methods can be divided into two groups: pelagic (midwater set) and bottom set longlines. A detailed description of the various longline methods used in Australian waters can be located in the background paper to the Threat Abatement Plan (Australian Antarctic Division 2005).

Sources of information

As a primary source of data the authors identified all Australian fisheries that used longline methods between 2003 and 2006, and the agencies that manage them. Each agency was sent a request for background information and data for all of their fisheries. Where possible, the fisheries descriptions and assessments of seabird interactions reported in this paper were derived from these data. In the absence of primary data from Commonwealth, state, and territory fisheries management agencies, publicly available information was obtained from published literature, online or other sources. Where different data sources have been used these have been cited in the text as appropriate.

Fisheries jurisdiction

Jurisdiction over Australian fisheries is a mix of state/territory and Australian Government responsibility. Australia has eight states and territories: New South Wales, Victoria, Tasmania, South Australia, Western Australia, Northern Territory, Queensland and the Australian Capital Territory (the latter is located inland and hence no at-sea fishing occurs).

The division of responsibility between the Australian Government and state/territory for fisheries management is determined under an Offshore Constitutional Settlement (OCS). The OCS outlines the jurisdictional arrangements over areas, fisheries, species or methods and identifies the responsible management authority. Four management categories currently exist through the OCS arrangements:

- State/territory management – a fishery is located in waters adjacent to only one state/territory and is managed under that state/territory's law
- Australian Government management – a fishery is located in waters adjacent to one or more state/territory and is managed under Commonwealth law
- Joint authority management – a fishery is located in waters adjacent to one or more state/territory and is managed by a single entity under a single law (either Australian Government or the state/territory)
- Status quo management (no OCS arrangement) – state/territory laws control fishing in coastal waters within three nautical miles of the coastline and Commonwealth laws control fishing between 3 and the 200 nautical mile limit of the AFZ (National Oceans Office 2002).

Commonwealth fisheries

The Australian Fisheries Management Authority (AFMA) is the statutory authority responsible for the efficient management and sustainable use of Commonwealth fish resources. AFMA changed from a statutory authority to an independent Commission of the same name, effective from 1 July 2008. The effect of this change on industry will be minimal with AFMA's functions and powers remaining essentially unchanged. The main difference was a change to AFMA's governance arrangements, ensuring the organisation is administered in accordance with the *Financial Management and Accountability Act 1997* rather than the *Commonwealth Authorities and Companies Act 1997*.

AFMA manages fisheries within the 200 nautical mile Australian Fishing Zone (AFZ), on the high seas, and in some cases, by agreement with the state/territory to the low water mark. As a general guide, AFMA looks after commercial fisheries from three nautical miles off the coastline to the extent of the AFZ. The states and Northern Territory generally look after recreational fishing, commercial coastal and inland fishing and aquaculture.

Eastern Tuna and Billfish Fishery

(Australian Government)

Fishery characteristics

The Eastern Tuna and Billfish Fishery (ETBF) targets yellowfin tuna, bigeye tuna, albacore tuna, broadbill swordfish and striped marlin.

Number of vessels

Domestic longliners are mostly 15–25 m long. The number of vessels operating in the fishery declined from 136 in 2003 to about 60 in 2007.

Fishing techniques

ETBF longliners use monofilament gear and, on average, set between 1000–1200 hooks per day on around 93 days per year. Main lines are set between 35 and 150 m below the surface. Branch lines are approximately six metres long. Since 2006 many longliners have set deeper than this to target albacore tuna. Trip length ranges up to 30 days, but most are between 2 and 15 days. A large proportion of the fleet consists of small vessels, which are influenced by weather, only leaving port if there is a suitable period for a set and haul. The catch is stored on ice, in ice slurry or in refrigerated brine. Some vessels range up to 1000 nm or further from port to fishing areas, but 40–300 nm is more typical. Actual fishing practices vary with target species, location and season. Vessels fishing for swordfish attach light sticks on their branchlines to act as lures.

Fishing areas

The ETBF extends from Cape York to the South Australia and Victorian border and includes waters around Tasmania, although since 2003 an increasing amount of effort has been directed toward the area north of latitude 25° S (Figure 1).

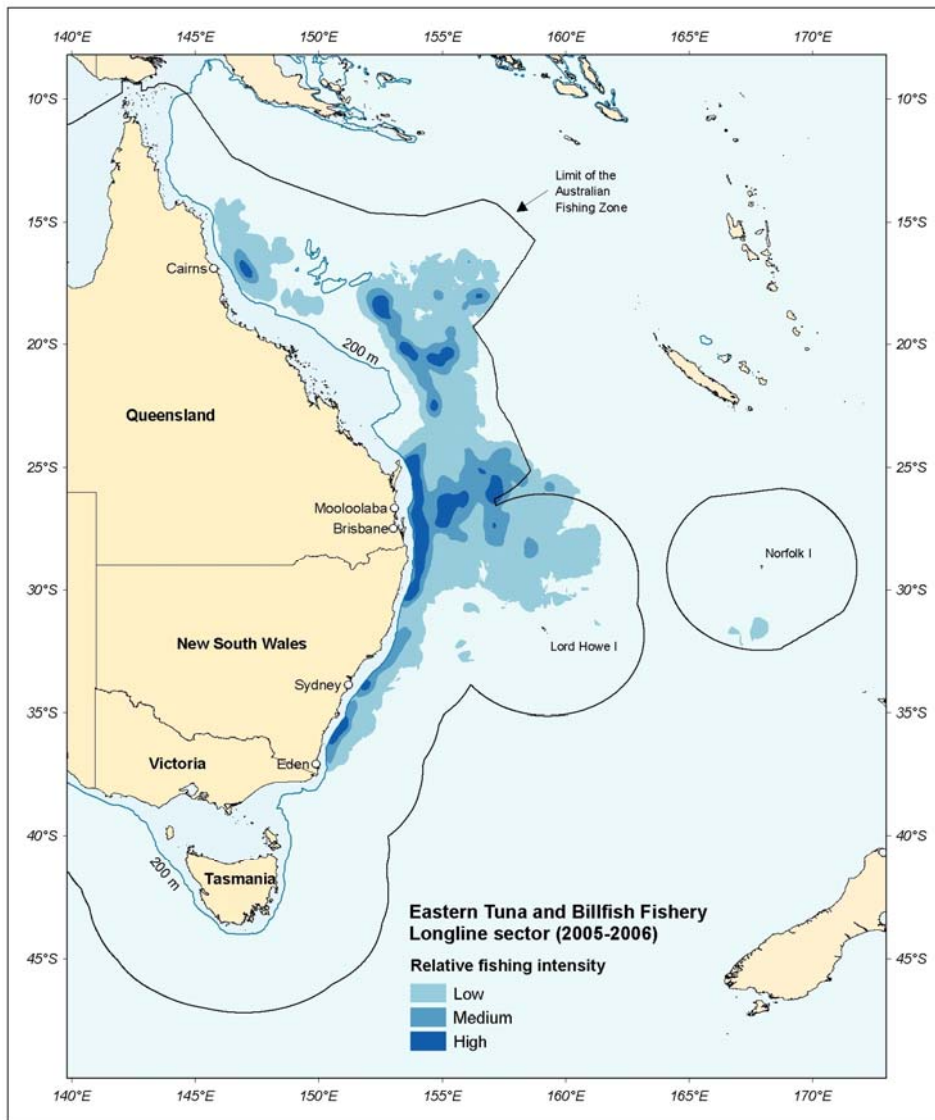


Figure 1: Map of the Eastern Tuna and Billfish Fishery longline sector 2005-2006 (Larcombe and McLoughlin 2007)

Effort and observer coverage

Pelagic longline fishing occurred sporadically since the late 1950s, but commenced in earnest in the ETBF in 1985, but effort was limited for many years. Following the exclusion of Japanese longline vessels from the AFZ in 1997, fishing effort increased substantially, rising from 6.0 million hooks set in 1997 (Baker and Wise 2005) to 12.4 million hooks in 2003. Effort subsequently declined to 8.4 million hooks in 2007, and is evenly distributed throughout the year (Table 1).

Table 1: ETBF effort (number of hooks set) from logbook data from 2003 to 2007

Year	Q1	Q2	Q3	Q4	Total	Vessels
2003	3 166 845	3 227 288	3 246 172	2 761 398	12 401 703	135
2004	2 179 845	2 946 048	2 819 397	2 000 440	9 936 730	121
2005	2 211 907	2 384 756	2 316 491	2 035 453	9 948 607	97
2006	1 786 638	2 421 900	2 630 621	1 973 292	8 822 451	80
2007	2 016 141	2 284 291	2 322 770	1 820 580	8 443 782	61

There were few data on the composition and rate of seabird bycatch in the ETBF until 2001 when a fisheries-independent observer program was established, and bycatch mitigation measures were evaluated in a series of at-sea trials. The trials occurred off eastern Australia, between latitudes 28 to 37° S and were monitored by independent fishery observers (Lawrence et al. 2006).

In 2003, AFMA agreed to a 5-year observer program for the ETBF with an aim of 5.1 per cent coverage across the ETBF per year. The 5-year program was designed to get a reliable estimate of the level of incidental catches of threatened, endangered and protected (TEP) species such as turtles and seabirds, as well as, collecting information about the catch of target and byproduct species. The data collected are also used to validate the accuracy of logbook data and as a source of information in setting the total allowable effort and sub-area factors under the ETBF Management Plan. Observers collect data on catch composition, fate of target and non-target species, fishing effort and fishing practices. One of their main tasks in the ETBF is to report on the use and effectiveness of mitigation measures under the TAP and monitor interactions with TEP species (AFMA 2008).

In recent years AFMA has made a decision to increase observer coverage and has achieved a coverage of seven per cent of the total fishing effort (number of hooks) reported in logbooks. However, because of the patchy nature of fishing effort the program has had trouble obtaining a representative sample of the full spatial and temporal extent of the fishery in areas of low fishing intensity. The Threat Abatement Plan (TAP) for seabirds specifies that AFMA will collect data on the bycatch of seabirds on longline vessels using observer programs. The level of observer effort shall be commensurate with the nature and level of bycatch in each area, season and fishery and aims to cover five per cent of all hooks set and hauled in all areas of the ETBF (Department of Environment and Heritage 2006). This level of coverage has generally been achieved, although at times it has fallen below that required for some fishing areas and seasons (Larcombe and McLoughlin 2007). In December 2006, in response to the 2005 Ministerial Direction, AFMA increased observer coverage to 8.5 per cent of all fishing effort. In addition, an increased level of observer coverage (up to 100 per cent) has been implemented for vessels operating in identified Southern Bluefin Tuna zones of the fishery (AFMA 2008).

Since 2006, AFMA has checked logbook records for retained catch against the verified weights recorded in Catch Disposal Records after each trip. However, verification of logbook records of seabird bycatch against observer data has not been carried out.

Seabird interactions²

The TAP 2006 was developed to significantly reduce the bycatch of seabirds during longline operations at current fishing levels. One of the criteria to measure the performance of the TAP is the application of performance criteria across all fishing areas and fishing seasons. In the ETBF all seabird bycatch rates should be below 0.05 birds per 1000 hooks. Fishing areas are divided into 5 ° latitudinal bands within the AFZ, with the area between Latitude 30° and 35° S further divided into two zones by the meridian of longitude 156° E. For the purposes of the TAP criteria fishing seasons are ‘Summer’ (1 September to 30 April) and ‘Winter’ (1 May to 31 August) (Department of Environment and Heritage 2006; Lawrence et al. 2009).

In the past, bycatch rates have been high in this fishery. Between 2001 and 2003, bycatch rates assessed from 316 000 hooks observed during the trials of mitigation measures were 0.378 birds per 1000 hooks for night sets, and 0.945 birds per 1000 hooks for day sets. Based on these data the mean number of birds killed from 1998 to 2002 was estimated to be 1794–4486 birds per year (Baker and Wise 2005).

Most of the birds taken as bycatch have been flesh-footed shearwaters (*Puffinus carneipes*). Of 369 birds killed as bycatch and returned for analysis during 2001 to 2006, the great majority (78 per cent) were this species. Smaller numbers of medium to large sized albatross (family Diomedidae), other shearwaters (*Puffinus* spp.) and petrels (*Pterodroma* spp.) dominated the remainder of the bycatch.

Data collected by AFMA observers on seabirds caught on longline operations in the ETBF since 2001 were recently analysed by Lawrence et al. (2009). They reported that while the AFMA logbook sheets have a field for recording seabird bycatch, comparisons between logbook and observer data indicated that the logbook reporting rate is poor. Consequently, seabird bycatch rates based on logbook information were largely underestimated, making observer data critical in calculating estimates of seabird bycatch. Observed coverage over the ETBF between 2002 and 2007 was 3.5 per cent on average of shots recorded in logbooks. Annual observer coverage has generally been increasing over this period (Table 2).

Table 2: Per cent observer coverage in the ETBF from 2002 to 2007

Year	% Observer Coverage
2002	3.2
2003	3.0
2004	4.2
2005	5.4
2006	5.8
2007	5.4

² An interaction with a seabird, as defined in the TAP, is where a seabird is observed caught under one of the following situations:

1. Dead not landed on board – birds observed to be killed by direct interaction with fishing gear but not landed on the fishing vessel
2. Dead landed on board – birds landed on the vessel that are dead
3. Alive landed on board following direct interaction with fishing gear
 - injured, or
 - released uninjured.

Of the observer data collected, approximately 60 per cent was part of an ongoing observer program (2003–2007) while the remainder was collected as part of three mitigation device trials (2001–2004).

Lawrence et al. (2009) were unable to produce estimates of seabird bycatch across the ETBF at some scales defined by the TAP (fishing season and fishing area) because spatial and temporal coverage of observer data were not representative of total effort in particular TAP stratum, as determined from logbooks. As a result they did not estimate seabird bycatch for latitudes above 20° S and below 40° S. However, based on knowledge of the distributions and foraging behaviours of the suite of seabirds species that occur above 20° S (most of which rarely interact with fishing vessels), and the minimal effort that occurred below latitude 40° S, their estimates can be considered to approximate the total bycatch in the fishery.

Bycatch rates were estimated using a statistical model derived using observer data combined with fishing effort and explanatory variables reported in logbooks; the model was used to predict fishery-wide catch rates and catch levels. Confidence intervals were calculated by bootstrap procedures. The mean seabird bycatch rates produced for the 2001–2007 ETBF logbook data are presented in Tables 3 to 6.

Table 3: Summary of annual seabird bycatch rate estimates (birds per 1000 hooks) and 95 per cent confidence intervals for the ETBF between 2002 and 2007 (from Lawrence et al. 2009)

Year	Mean Rate (birds per 1000 hooks)	95% Confidence Interval	
		Lower	Upper
2002	0.0416	0.0281	0.0683
2003	0.0368	0.0255	0.0550
2004	0.0389	0.0256	0.0590
2005	0.0334	0.0217	0.0508
2006	0.0330	0.0203	0.0574
2007	0.0248	0.0146	0.0383

Table 4: Summary of seabird bycatch rate estimates (birds per 1000 hooks) and 95 per cent confidence intervals for Areas as defined by the Threat Abatement Plan, 2006 between latitudes 20 and 40° S for 2002–2007 (from Lawrence et al. 2009)

TAP Band	Mean Rate (birds per 1000 hooks)	95% Confidence Interval	
		Lower	Upper
20 to 25° S	0.0240	0.0000	0.0582
25 to 30° S	0.0169	0.0078	0.0305
30 to 35° S (<=156° E)	0.0997	0.0620	0.1499
30 to 35° S (>156° E)	0.0553	0.0267	0.1168
35 to 40° S	0.0482	0.0238	0.0732

Table 5: Summary of seabird bycatch rate estimates (birds per 1000 hooks) and 95 per cent confidence intervals for seasons as defined by the Threat Abatement Plan, 2006 for 2002–2007 (from Lawrence et al. 2009)

TAP Season	Mean Rate (birds per 1000 hooks)	95% Confidence Interval	
		Lower	Upper
Summer	0.0501	0.0334	0.0773
Winter	0.0133	0.0081	0.0218

The estimated mean annual seabird bycatch rate from 2002 to 2007 falls below the target rate of 0.05 birds per 1000 hooks specified by the TAP, however, the upper confidence bound exceeds the target rate from 2002–2006 (Table 3). With respect to fishing areas, as defined by the TAP (Department of Environment and Heritage 2006), the mean rate exceeds the TAP level in both areas between latitude 30 and 35° S (Table 4). The lower confidence interval exceeds 0.05 birds per 1000 hooks in the 30 to 35° S (<=156° E) area while the upper confidence intervals exceed the TAP level in all but the 25 to 30° S areas. With respect to fishing seasons, as defined by the TAP, the 0.05 birds per 1000 hooks level is exceeded by the upper confidence bound in summer, while in winter the upper confidence bound is below 0.05 birds per 1000 hooks (Table 5). In assessing the bycatch rate in fishing areas and seasons, it should be noted that the initial TAP (Environment Australia 1998) did not define ‘fishing areas’ and ‘fishing seasons’. Additionally, for operational purposes assessments of management performance against the TAP criteria are based on mean observed bycatch rates which differ from the model-based estimates presented in Lawrence et al. 2009. For this reason, it is debatable whether the bycatch rates observed prior to 2006 can be considered to represent a failure to achieve the target rate.

Looking at just the 2007 data the mean rate of seabird bycatch is below 0.05 seabirds per 1000 hooks in three of the five areas, with the upper confidence interval exceeded in three areas (Table 6). The upper confidence interval for summer was also exceeded in this year (Table 7). This suggests that although the majority of fishing in 2007 did not occur in the areas of higher seabird bycatch, the fishing that did occur in these areas may have been associated with high seabird bycatch rates (Lawrence et al. 2009).

Table 6: Seabird bycatch rate estimates (birds per 1000 hooks) and 95 per cent confidence intervals between 20 and 40° S for 2007

TAP Band	Mean Rate (birds per 1000 hooks)	95% Confidence Interval	
		Lower	Upper
20 to 25° S	0.0155	0.0000	0.0419
25 to 30° S	0.0106	0.0043	0.0192
30 to 35° S (<=156° E)	0.0788	0.0428	0.1245
30 to 35° S (>156° E)	0.0393	0.0180	0.0736
35 to 40° S	0.0606	0.0278	0.0957

Table 7: Seabird bycatch rate estimates (birds per 1000 hooks) and 95 per cent confidence intervals for TAP seasons 2007

TAP Season	Mean Rate (birds per 1000 hooks)	95% Confidence Interval	
		Lower	Upper
Summer	0.0398	0.0246	0.0590
Winter	0.0123	0.0061	0.0241

The results show that while seabird bycatch rates have generally decreased over time, there remains the concern that the level of seabird bycatch is still likely to exceed 0.05 birds per 1000 hooks in some fishing areas and seasons. The fishing area of greatest concern is between 30 and 35° S and the fishing season of most concern is summer. Extrapolation of the bycatch rates observed in 2007 (Lawrence et al. 2009) and total hooking effort derived from logbooks indicates that the mean number of seabirds killed in that year was 114 (95% CI 48–205; Table 8). While this is a considerable reduction on the numbers estimated to have been killed at the turn of the century, the fishery should be encouraged to strive for further reductions in seabird bycatch, consistent with TAP targets.

Table 8: Estimated number of birds killed in the ETBF in 2007 for TAP areas

TAP Band	Bycatch Rate			Birds killed		
	Mean (birds per 1000 hooks)	95% CI		Mean	95% CI	
		Lower	Upper		Lower	Upper
20 to 25° S	0.0155	0	0.0419	15	0	39
25 to 30° S	0.0106	0.0043	0.0192	32	13	58
30 to 35° S (<=156° E)	0.0788	0.0428	0.1245	44	24	70
30 to 35° S (>156° E)	0.0393	0.0180	0.0736	6	3	10
35 to 40° S	0.0606	0.0278	0.0957	17	8	27
Total				114	48	205

Current management requirements

AFMA controls the ETBF by limiting entry and introducing specific responses to emerging issues. In 2004, AFMA established separate management arrangements for skipjack tuna, which are taken by purse seine and pole-and-line. In 2004 and 2005, there were 222 longline permits and 67 minor-line permits in the ETBF, many held in combined-method packages. Total effort in the ETBF trebled during 1996–2003, when the swordfish fishery developed. However, domestic longline activity off eastern Australia subsequently declined, with fewer than 50 vessels active after the buy-back of tenders under the Securing Our Fishing Future package in 2006, however, only a

small portion of this reduction is attributable to the buyback as some of the tenders returned were not being actively fished. Other economic factors have also lead to a decrease in effort. Longline fishing effort declined from a peak of 12.4 million hooks in 2003 to 8.4 million hooks in 2007.

Mitigation

Development and adoption of seabird bycatch mitigation measures in the ETBF and other Australian Government-managed fisheries is carried out in accordance with the TAP (Department of Environment and Heritage 2006). Under this process industry and government have investigated ways of reducing interactions between seabirds and longlines and hence associated mortality. Longline vessels are now required to carry an approved bird-scaring line, which must be used when setting south of latitude 25° S. In this southern area they are also required to either set hooks at night or use weighted swivels on longlines set during the day. Other compulsory measures in the ETBF include bans on offal discharge and compulsory use of thawed bait.

From 2001 to 2004, industry trialled the use of underwater line-setting ‘chutes’ that released baited hooks 4–5 m below the sea surface. Line-weighting, twin bird scaring lines and ‘side setting’ trials have also been undertaken at various times. Some industry members continue to work cooperatively with government researchers on the development and trialling of mitigation measures to further reduce bycatch in pelagic longline fisheries.

In 2006, AFMA observers reported a high rate of non-compliance or partial compliance with the mitigation measures, resulting in high catch rates of seabirds by some vessels. In response, AFMA introduced a ban on daytime longline operations in July-August 2006 only, off southern New South Wales (AFMA unpublished).

Western Tuna and Billfish Fishery

Fishery characteristics

The Western Tuna and Billfish Fishery (WTBF) catches a range of pelagic species including broadbill swordfish, yellowfin tuna, big-eye tuna and albacore tuna. Targeted purse seine fishing for skipjack tuna is not permitted under the Western Tuna and Billfish Fishery Management Plan 2005 and is managed separately.

Number of vessels

There are approximately 100 permits to operate in this fishery. The number of active longliners increased from 5 in 1997 to 46 in 2001, but decreased to 27 in 2003, and fewer than 5 vessels have fished since 2005. Data on catches and effort since 2004 are confidential owing to fewer than five vessels fishing in 2005 and 2006.

Fishing techniques

Pelagic longline and minor line (hand line, rod and reel, troll and poling).

Fishing areas

The WTBF extends westward from Cape York Peninsula (142° 30' E) off Queensland around the west coast of Western Australia and from there extends eastward across the Great Australian Bight to 141° E at the South Australian and Victorian border (Figure 2). The WTBF also includes Australian waters outside of 12 nm off Christmas Island and Cocos Keeling Islands in what was previously known as the Christmas Island and Cocos (Keeling) Islands Offshore Tuna Fishery. The WTBF Management Plan also applies to Australian vessels fishing in the high seas within the IOTC's Area of Competence.

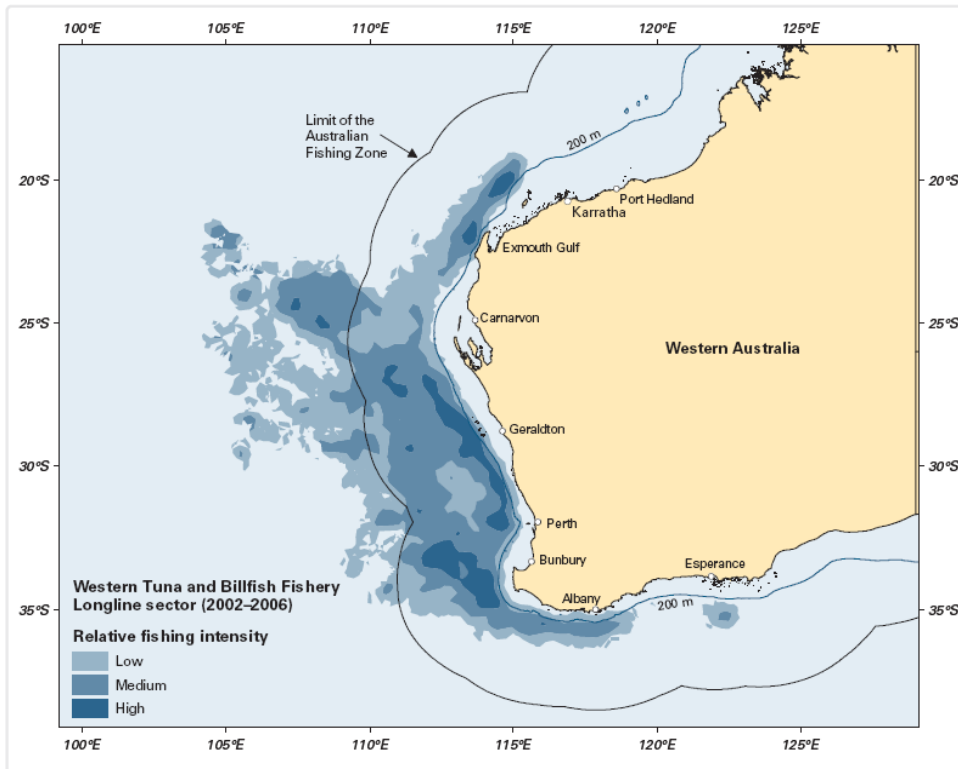


Figure 2: Map of the Western Tuna and Billfish Fishery Longline Sector 2002 to 2006 (Larcombe and McLoughlin 2007)

Effort and observer coverage

Fishing effort peaked at around six million hooks per year in 2000–02, before declining markedly to four million hooks in 2003 and 1.5 million in 2004, owing to lower prices and higher operating costs. The number of hook sets from 2005 to 2007 has averaged around 720 000 per year. The peak reported domestic catch for the fishery was 3355 t in 2001. A total of 3015 t was reported in 2002, 1764 t in 2003, and 700 t in 2004. Three vessels operated in the fishery in 2007. The WTBF accounts for a small percentage (<0.5 per cent) of the total tuna and billfish catch in the Indian Ocean.

The BRS, with funding from AFMA, coordinated the placement of observers on WTBF longliners during 2003–06. The aim was to recommend protocols and coverage levels as the basis for a routine, cost-effective observer program that would meet conservation and management requirements for the fishery. The program has collected catch and size data on target and non-target species, including protected species and other marine wildlife.

The TAP for seabirds specifies that AFMA will collect data on the bycatch of seabirds on longline vessels using observer programs. The level of observer effort shall be commensurate with the nature and level of bycatch in each area, season and fishery and aims to cover five per cent of all hooks set and hauled in all areas of the WTBF.

Seabird interactions

Longline vessels are required to carry an approved bird-scaring line, which must be used when setting south of latitude 30° S. In this southern area they are also required to set hooks at night. Other compulsory measures in the WTBF include bans on offal discharge and compulsory use of thawed bait (Department of Environment and Heritage 2006).

Within the WTBF the mean bycatch of seabirds during 2002–2004 was 0.02 birds per 1000 hooks, four per cent of total fishing effort (200 000 hooks) was observed. No albatrosses were observed

caught during this period (AFMA, unpublished data). This low bycatch has been attributed to the four active vessels at that time all fishing at night to target broadbill swordfish (Baker et al. 2007a). These data suggest that perhaps a maximum of 50 birds may be caught in these fisheries annually, of which very few are likely to be albatrosses (AFMA 2007a; Baker et al. 2007)

A subsequent analysis of observer data collected between April 2003 and June 2006 indicated that seabird interactions were occurring at a rate of 0.055 birds per 1000 hooks (0.032 non-fatal, 0.023 fatal). All birds caught were flesh-footed shearwaters and the non-fatal interactions were entanglements that occurred during hauling (AFMA 2007b).

In 2007, no birds were captured (AFMA 2007a). The maximum observer coverage achieved was 7.4 per cent in the area 30° to 35° S in winter. In a number of other TAP fishing areas (5° latitude bands) the minimum observer coverage of five per cent was not achieved. Often no observer coverage was achieved because of the low level of effort and its opportunistic nature. In 2007, 10 500 hooks were observed, resulting in an overall observer coverage of 2.4 per cent.

Current management requirements

AFMA controls the WTBF by limiting input controls, including limited entry, gear and area restrictions, as well as bycatch restrictions. Output controls via individual transferable quotas (ITQs) under the WTBF Management Plan 2005 are planned for 2007 (Larcombe and McLoughlin 2007).

Mitigation

Development and adoption of seabird bycatch mitigation measures in the WTBF and other Australian Government-managed fisheries are carried out in accordance with the TAP (Department of Environment and Heritage 2006). Under this process industry and government have investigated ways of reducing interactions between seabirds and longlines and hence associated mortality. Longline vessels are now required to carry an approved bird-scaring line, to use it and set their longlines only at night when operating south of 30° S, and to not discharge offal during line setting and hauling. The limited observer program data indicate that seabird bycatch rates in the WTBF are generally below the TAP target of less than 0.05 birds per thousand hooks, although when bycatch has been observed the bycatch rates have not included confidence intervals.

Southern Bluefin Tuna Fishery

Fishery characteristics

Southern bluefin tuna (SBT) is a highly migratory species and is widely distributed throughout waters of the southern oceans, including the Australian fishing zone (AFZ).

Number of vessels

There were 98 Statutory Fishing Right (SFR) owners as at 11 May 2007. Eight longline vessels contributed to the catch of approximately 5 t of longline caught SBT in 2006–07.

Fishing techniques

SBT is a valuable and largely incidental catch for longline vessels operating in southern Australian waters (approximately 100 tonnes per year). Most of the SBT caught in the SBT fishery are taken by purse-seining for 'tuna farming'. This involves purse-seining the schools of SBT, transferring them to floating pens, towing the pens to Port Lincoln in South Australia and transferring the fish to moored 'farm' pens. While it accounted for three per cent of the Australian Total Allowable Catch (TAC) in 1991–92, farming now uses more than 98 per cent of the TAC, with the remainder taken by domestic longline vessels. Nearly all longlining occurs off the east coast of NSW by vessels that also operate in the ETBF. They are also taken in small amounts by pole and line, and trolling (Larcombe and McLoughlin 2007).

Fishing areas

The key areas where SBT are caught are the Great Australian Bight (principally purse-seine) and waters off south eastern Australia (longlining) (Figure 3).

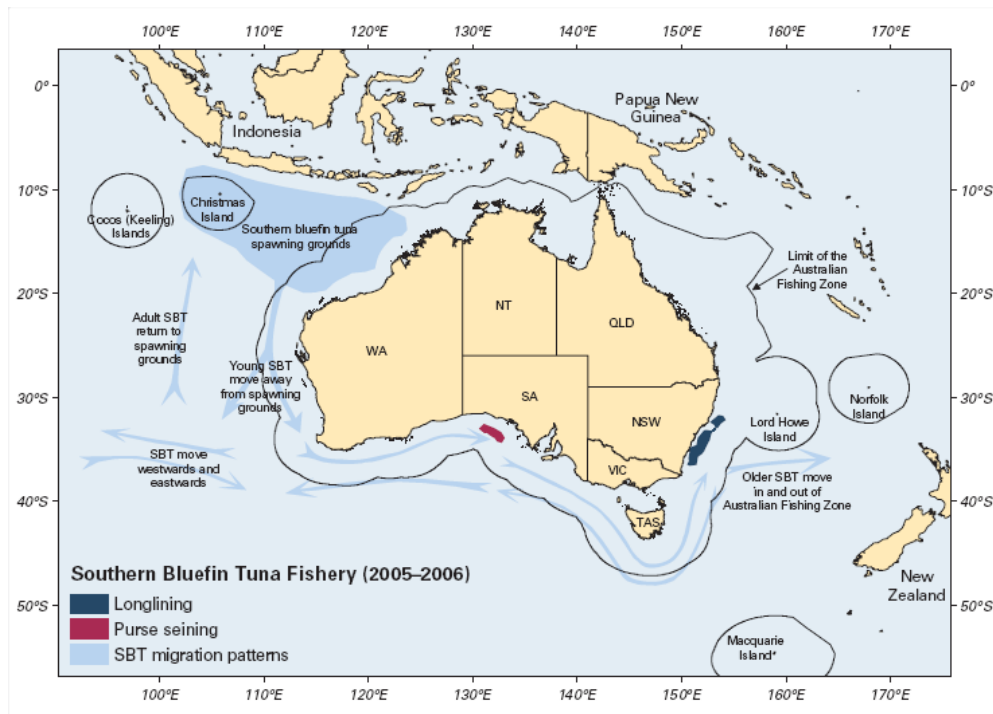


Figure 3: Map of the Southern Bluefin Tuna Fishery 2005-2006 (Larcombe and McLoughlin 2007)

Effort and observer coverage

Longline effort and observer coverage are discussed under the ETBF.

Seabird interactions

Seabird interactions with longline effort are discussed under the ETBF.

Current management requirements

Current management requirements relating to longline effort are discussed under the ETBF.

Mitigation

Seabird bycatch mitigation relating to longline effort is discussed under the ETBF.

South and Eastern Scalefish and Shark Fishery

Fishery characteristics

The Southern and Eastern Scalefish and Shark Fishery (SESSF) was created in 2003 through the amalgamation of four fisheries previously under separate management arrangements. A management plan for the fishery came into operation on 1 January 2005, but management arrangements (including TACs) are revised annually. The SESSF is a complex, multi-sector, multi-gear and multi-species fishery targeting scalefish and shark stocks of various size, distribution and composition. It extends from waters off southern Queensland, south around Tasmania and then west to Cape Leeuwin in Western Australia (Figure 4). The fishery's management area encompasses almost half the waters of the AFZ. The fishery operates in both Commonwealth and state waters under complex jurisdictional arrangements resulting from different OCS arrangements with state governments. The principle sectors of the SESSF that are managed under the Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 are the:

1. Commonwealth trawl sector (CTS) – derived from the South East Fishery trawl sector (which includes the Danish-seine fleet)
2. Scalefish hook sector (ScHS) – derived from the South East Fishery non-trawl sector
3. Great Australian Bight trawl sector (GABTS) – derived from the former Great Australian Bight Trawl Fishery
4. Shark hook sector (ShHS) – derived from the Southern Shark Fishery
5. Gillnet sector (GS) – derived from the Southern Shark Fishery
6. East coast deepwater trawl sector (ECDWTS) – near Lord Howe Island, was managed as a separate fishery until 2000.

The sectors of the SESSF that use longlines are the Scalefish hook Sector and the Shark hook Sector. Fishery characteristics and seabird bycatch matters relating to these sectors are discussed below.

SESSF - Scalefish Hook Sector (ScHS)

This fishery was derived from the South East Fishery non-trawl sector. The principal hook target species are blue-eye trevalla and pink ling. A shift to automatic-longline (or autoline) technology has led to increased pink ling catches by this sector and continued rises in effort during recent years

Fishery characteristics

Number of vessels

There were 59 Statutory Fishing Right (SFR) owners.

Fishing techniques

The most commonly used hook methods are droplines and demersal longlines, with many fishers using both methods. In the last few years there has been a marked increase in autoline effort. The main quota species targeted are blue-eye trevalla and pink ling.

Prior to 2002 there was only one autoline permit in the non-trawl sector. In early 2002, a further 14 'trial' permits were issued. Concerns over possible overfishing and perceived inequities in the allocation of permits led to a moratorium in October 2002 on the issue of further permits (AFMA unpublished). Owing to the efficiency of these additional auto-longliners, SESSF hook effort rose sharply from 665 000 hooks set in 2001 to 8 504 902 hooks set in 2004 and 8 967 241 in 2006, before dropping by 25 per cent to 6 732 100 hook sets in 2007.

Fishing areas

The scalefish-hook sector (ScHS) was originally part of the former South East Fishery non-trawl sector. This sector incorporates all waters outside a line 80 nm off the New South Wales coast, and all waters outside state internal water boundaries of Victoria, Tasmania and South Australia (Figure 4).

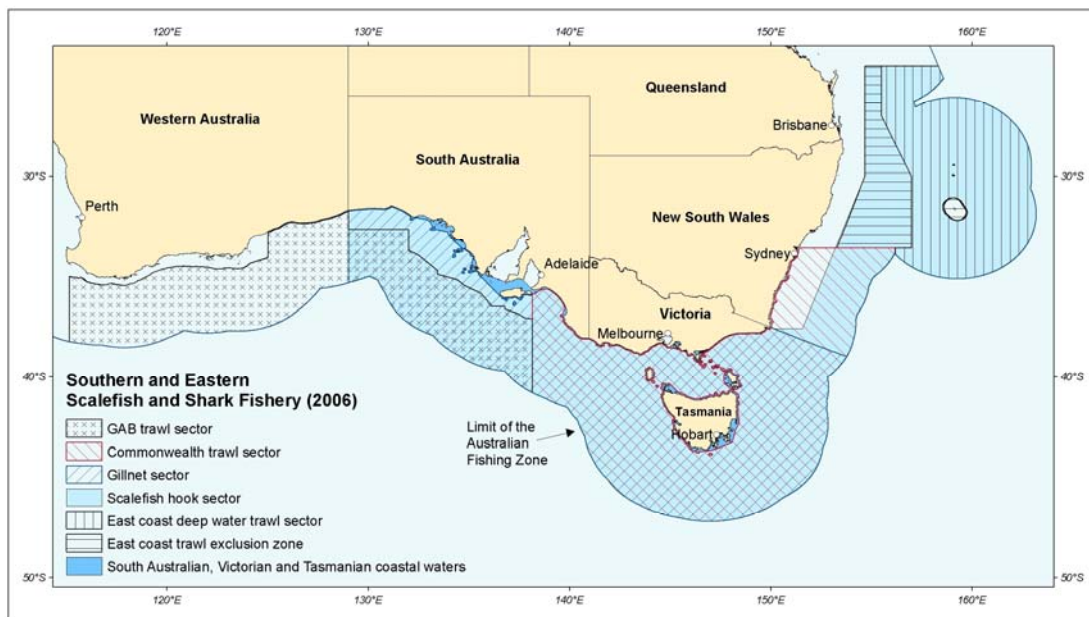


Figure 4: Map of the Southern and Eastern Scalefish and Shark Fishery in 2006 (Larcombe and McLoughlin 2007)

Effort and observer coverage

Effort increased from close to 4 million hooks set in 2003 to 9.8 million hooks set in 2005, and then fell to 8.9 million hooks in 2006, and 6.7 million in 2007. AFMA does not anticipate that effort will increase substantially higher than the 2005 level as catches are now constrained by TACs for target species. Increased effort by automatic-longliners has resulted in lower effort by dropliners, traps, gillnets, trawlers and traps targeting ling and blue eye trevalla in slope waters (AFMA 2006).

Since 1994, detailed information on the composition of both the retained and discarded catch of trawl and non-trawl vessels has been collected by the Integrated Scientific Monitoring Program (ISMP), which places scientific observers on a sample of fishing trips to gather data on species, size and age composition, and information on fishing practices. This program was not initially designed to collect information on TEP species and only commenced considering this in 2003. In contrast, automatic-longline vessels have had considerable observer coverage and are still required to have observer coverage for every 8th trip with a view to ensuring 10 per cent coverage as required by the TAP (Department of Environment and Heritage 2006).

Seabird interactions

For the SESSF ScHS the TAP 2006 performance criteria specify all seabird bycatch rates should be below 0.01 birds per 1000 hooks. Fishing areas are divided into 5° latitudinal bands within the AFZ. For the purposes of the TAP criteria fishing seasons are 'Summer' (1 September to 30 April) and 'Winter' (1 May to 31 August). The TAP requires that observer coverage of 10 per cent be achieved in this fishery (Department of Environment and Heritage 2006).

Demersal autoline fishing has been associated with high levels of bycatch in other fisheries e.g. CCAMLR fisheries (SC-CAMLR 2007). Because of concerns for the use of this gear, vessels using automatic baiting equipment have been required to carry observers to monitor bycatch of seabirds, deepwater shark species and school shark since its introduction into the fishery. Since 2002, vessels have been required to have a fisheries observer on board for every 4th trip. Between 2002 and 2005, over 3.3 million hooks (13.3 per cent of hooks set) were observed and the bycatch rate was 0.01 birds per 1000 hooks. All of the 26 birds observed killed were caught by one vessel which, as a result, had 100 per cent observer coverage and adopted strict mitigation measures (AFMA 2006), including the use of integrated weight line, until the issue was resolved. No other interactions have been reported in this sector since. In 2007, observer coverage over the summer season was 5.7 per cent of 4 739 750 hooks). However, none of the 2 038 300 hooks deployed in winter were observed. Based on annual hooking effort and the low level of bycatch observed in this fishery, it is likely that less than 10 birds per year are killed by autoliners operating in this sector of the SESSF.

Knowledge of seabird interactions in the other longline gear types used in the ScHS (demersal longline, trotline and dropline) is less reliable as the observer program was not initially designed to monitor TEP species interactions. AFMA is now promoting the legal requirement of fishers to report interactions with TEP species in the Australian General Confidential Daily Fishing Log (GNO1A). There is a lack of verifiable information on seabird bycatch in these other longline gear types although effort is very low and appears to be declining. In 2007 there were 131 470 hooks deployed on droplines, and 345 407 hooks deployed by non-autoline demersal longlines (AFMA unpublished data).

Current management requirements

The SESSF is formally managed under the Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 (the Management Plan). The Management Plan limits access to the fishery through the grant of boat SFRs that provide access to an area of the fishery using a particular type of gear, and allow fishing for non-quota species (SESSF BAP 2007).

AFMA controls the SESSF by input controls, including limited entry, gear and area restrictions and other forms of spatial management such as depth restrictions, as well as bycatch restrictions, trip limits and minimum size limits for some species (Larcombe and McLoughlin 2007).

Mitigation

Autoliners are required to deploy a bird scaring line and most of the hooks (c. 70 per cent) are set at night (AFMA unpublished data). The limited observer data indicate that seabird bycatch rates in the SESSF autoline sector are generally below the TAP target of 0.01 birds per 1000 hooks, although when bycatch has been observed the resulting estimates have not included confidence intervals.

SESSF - Shark Hook Sector (ShHS)

The former Southern Shark Fishery (SSF) now makes up the gillnet sector (GS) and the shark hook sector (ShHS) within the larger SESSF.

The GS and the ShHS are managed by the AFMA on behalf of the Australian Government.

Fishery characteristics

Number of vessels

The buyout of fishing effort resulting from the government's Securing Our Fishing Future package removed 26 gillnet boat SFRs from the fishery (leaving 62) and 17 shark hook boat SFRs (leaving 13).

Fishing techniques

The fishery has operated for more than 70 years. Initially, fishers targeted school shark with longlines. Monofilament gillnets were introduced in the 1960s, and by the early 1970s gillnetting was the main fishing method. Today less than 10 per cent of the total reported shark catch (2099 t in 2003 and 13 t in 2004) is taken by longline. The most commonly used hook methods are droplines and demersal longlines, with many fishers using both methods.

Today the principal species targeted is gummy shark. However school shark, southern sawshark, common sawshark, elephantfish and other shark species constitute about 12 per cent of the total catch.

Fishing areas

The fishery operates in coastal waters of Victoria, Tasmania and South Australia (Figure 5).

Effort and observer coverage

Hook effort was 400 000 hook lifts in 2003 (246 000 hooks set offshore and 154 000 inshore), 247 000 hook lifts in 2004 (151 000 and 96 000 offshore/inshore) and 229 000 hook lifts in 2005 (154 000 and 75 000 offshore/inshore). There is no fishery observer program in place for the ShHS of the SESSF fishery but effort is relatively low.

Seabird interactions

Seabird bycatch has always been considered to be very low in the ShHS but there are no data available to support this view. However annual seabird mortality is likely to be low because of the nature of the gear used, which is designed to sink rapidly, and the low level of hook effort. The TAP requires that observer coverage of 10 per cent be achieved in this fishery (Department of Environment and Heritage 2006).

Current management requirements

AFMA controls the SESSF by limiting input controls, including individual transferable quotas (ITQs) for the four main target species, gear and area restrictions, and minimum size limits (Larcombe and McLoughlin 2007).

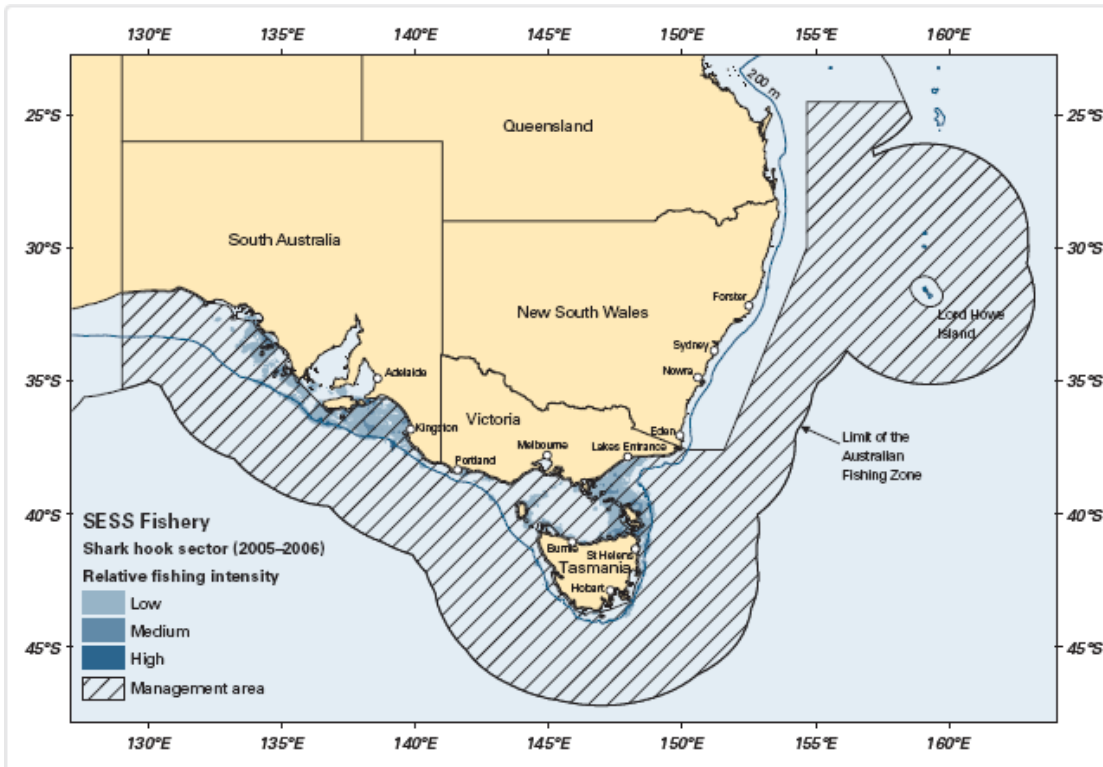


Figure 5: Map of the SESS Fishery – Shark Hook Sector during 2005-2006 (Larcombe and McLoughlin 2007)

Mitigation

Development and adoption of seabird bycatch mitigation measures in the SESSF ShHS and other Australian Government-managed fisheries is carried out in accordance with the TAP (Department of Environment and Heritage 2006). Under this process industry and government have investigated ways of reducing interactions between seabirds and longlines and hence associated mortality. Demersal longline vessels are now required to adopt proven mitigation measures that ensure the performance criteria for each fishery are achieved in all fishing areas and seasons. There are no observer program data to assess if seabird bycatch rates in the SESSF ShHS are below the TAP target of 0.01 birds per thousand hooks, although few hooks are now set using this method.

Coral Sea Fishery

Fishery characteristics

The Coral Sea Fishery (CSF) is a small fishery that targets a broad range of finfish including tropical snappers and emperors, alfonsino, gemfish, several species of cod, amberfish, blackfish, black teat fish, greenfish, lollyfish, prickly red fish, sand fish, surf red fish, white teat fish, damselfish, butterflyfish, angelfish, wrasse, anemone fish, surgeonfish, blennies and gobies. Trochus shell and tropical rock lobster are also taken.

Number of vessels

There are 18 fishing permits spread across the demersal line, otter trawl, sea cucumber, aquarium collection, and lobster and trochus-collection sectors. There are 9 line and 2 trawl concession holders that have access to the demersal line and trawl sector, with the line-fishing sector predominantly targeting coral cods, snapper and emperor species and threadfin bream. The sector is not permitted to take tuna or tuna-like species.

Fishing techniques

A range of gear, including trawl and bottom longline, are used to target reef and seamount associated species. Demersal otter trawling targets fish and crustaceans. If approved by AFMA, automatic longline equipment can be used, and finfish traps have been adopted as a new method in the fishery associated with the line and trawl concessions. Operators were required to complete a minimum of 20 fishing days in the sector for the season to maintain their permits, but this requirement was removed in 2006–07.

The fishery has relatively low participation levels and comprises diverse fishing methods and an equally diverse catch, ranging from deep sea fishes to coral reef molluscs.

Fishing areas

The CSF is a multi-species, multi-gear fishery that extends from Cape York to Sandy Cape off Queensland. It is bounded on the east by the AFZ boundary and on the west by a line 10 to 100 nm seaward of the Great Barrier Reef, excluding the areas that comprise the Coringa-Herald and Lihou Reef National Nature Reserves (Figure 6).

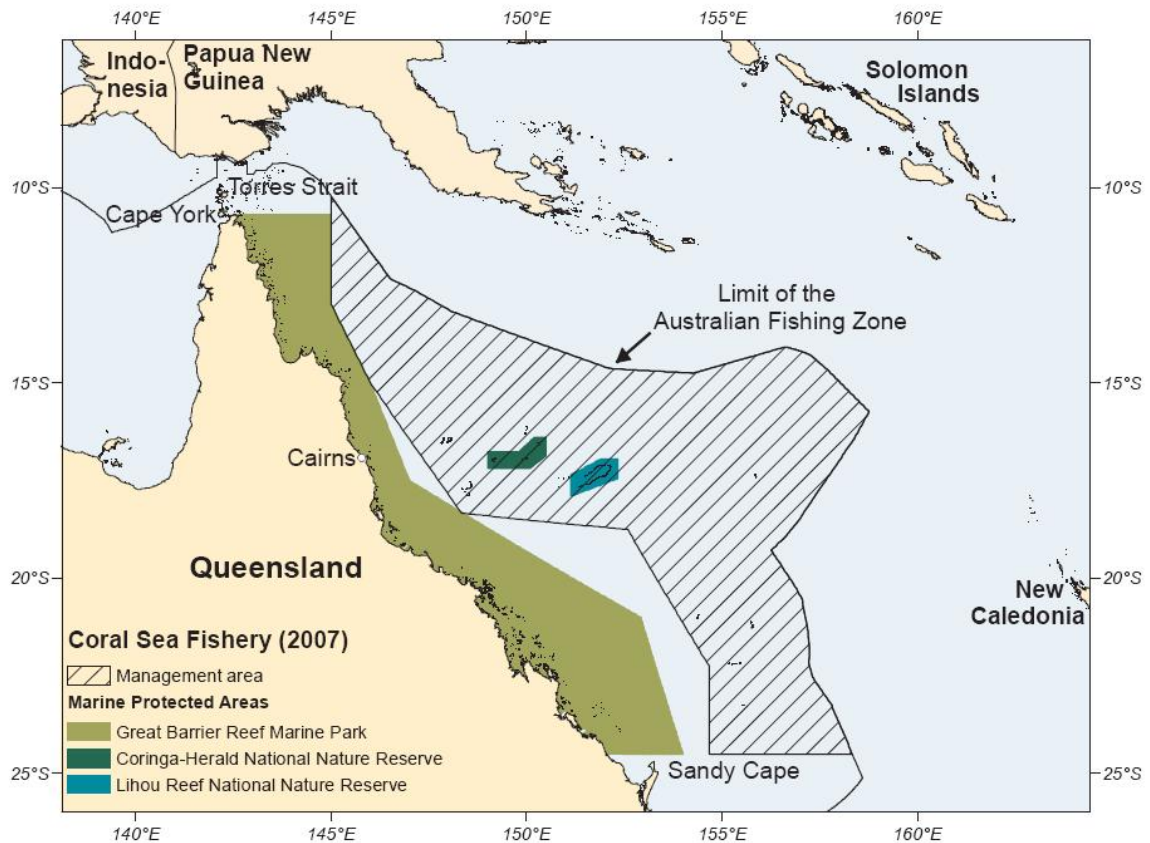


Figure 6: Map of the Coral Sea Fishery (Larcombe and Begg 2008)

Effort and observer coverage

A total catch of 153 t was reported for line-fishing and trawl in 2005, but catch data for 2006 remains confidential owing to low participation levels in the sector (<5 vessels). To date there have been no assessments of the impact of fishing on the stocks. Observer coverage requirements applying to trawl, autolongline and trap sectors have provided adequate data on bycatch and byproduct, which is used by AFMA to monitor catches to assess species composition and species dominance. Automatic longline vessels are required to have observer coverage for every 8th trip with a view to ensuring 10 per cent coverage as required by the TAP for longline fishing (Department of Environment and Heritage 2006).

Seabird interactions

In the CSF, the TAP 2006 performance criterion requires that all seabird bycatch rates should be below 0.01 birds per 1000 hooks.

Demersal autoline fishing has been associated with high levels of bycatch in other fisheries (SC-CAMLR 2007). Because of concerns on the use of this gear, vessels using automatic baiting equipment have been required to carry observers to monitor bycatch of seabirds. Vessels were required to have a fisheries observer on board for every 4th trip but this was relaxed to every 8th trip in 2005 once a specified number of hook sets had been observed. To date no birds have been observed caught. In 2007 the overall observer coverage was 15.7 per cent (21 000 hooks observed from a total of 134 000 hooks deployed). The number of seabirds killed by autoliners in this fishery is unknown, but is likely to be low.

Current management requirements

The CSF Management Arrangements describe the arrangements in place for the fishery including relevant permit conditions and arrangements that have been agreed to at a policy level. Each of the five sectors in the fishery is primarily managed under permit conditions using different controls that include limited entry, gear restrictions, size limits, TAC and spatial controls.

Mitigation

The limited observer program data indicate that seabird bycatch rates in the CSF autoline sector are below the TAP target of 0.01 birds per thousand hooks. Autoliners are required to deploy a bird scaring line at all times.

The use of automatic or random baiting equipment is prohibited unless specifically approved by AFMA and reflected in the permit conditions. If the use of automatic or random baiting equipment is approved additional criteria such as the submission of a detailed fishing plan and supplementary catch and reporting requirements are imposed on the operator. There are a number of mitigation measures included in the permit conditions to address incidental interactions with TEP species, including the use of tori lines, hook and depth limits and observer coverage.

Antarctic Fisheries (Australian Government)

Fishery characteristics

Australia's Antarctic Fisheries principally operate around Macquarie Island and Australia's external territories of Heard Island and McDonald Islands (HIMI). These include high seas and waters within the Australian Antarctic Exclusive Economic Zone (EEZ). The area of the Antarctic continent is almost 14 million km², of which the Australian Antarctic Territory comprises about 42 per cent. The 200 nm EEZ extending from the Territory is not at present defined as part of the AFZ for the purposes of the *Commonwealth Fisheries Management Act 1991*. However, under the Fisheries Management Regulations, the Act extends to Australian citizens and bodies corporate, Australian vessels and Australian persons on Australian vessels in this area. The Act also allows for the formation of regulations to apply to areas defined by the regulations as outside the EEZ. At present, Australian vessels do not fish outside the EEZ, but this has occurred within the last 10 years. Fishing around HIMI and Australia's EEZ adjacent to its Antarctic Territory falls within the jurisdiction of CCAMLR, which is responsible for assessing the status of marine populations and formulating conservation measures such as the provision of logbook data, restriction of gear and the determination of TACs for the various management areas. Conservation measures adopted by CCAMLR apply to its 25 member nations, as well as to the 9 non-member contracting parties.

Number of vessels

Demersal longlining and trawlers using both demersal and pelagic trawl gear operate within the fishery. A single demersal longliner has fished each year at HIMI since 2002 and at Macquarie Island since 2007. The longline vessels in both areas target Patagonian toothfish, while the trawlers also catch mackerel icefish. Australia has also sought and obtained approval to conduct new and exploratory fisheries in a number of statistical areas within the CCAMLR convention area, where the target species have included Antarctic toothfish.

Fishing techniques

While longlining is almost universally employed in CCAMLR's toothfish fisheries, it was initially not permitted within the HIMI Fishery because of the potential of seabird bycatch. Between 2002 and 2005 a range of suitable mitigation measures was developed and trialled in the HIMI Fishery. These proved successful and longlining was formally introduced into the fishery on 25 November 2005. Longlining is currently being trialled at Macquarie Island. Demersal autolongline gear has been used at both HIMI and Macquarie Island. One of the vessels regularly used has a moon pool, permitting hooks to be hauled through the hull of the vessel. The use of pots was also trialled in 2005–06 at HIMI.

Fishing areas

The Australian external territories of Heard Island and McDonald Islands are located in the southern Indian Ocean about 4000 km southwest of Perth. The islands and their surrounding territorial waters (out to 12 nm) form the Heard Island Wilderness Reserve, which is managed under a formal management plan by the Australian Antarctic Division (Figure 7). The plan prohibits commercial fishing within this 12 nm zone. Waters between 12 nm and 200 nm are part of the AFZ and are under the jurisdiction of AFMA.

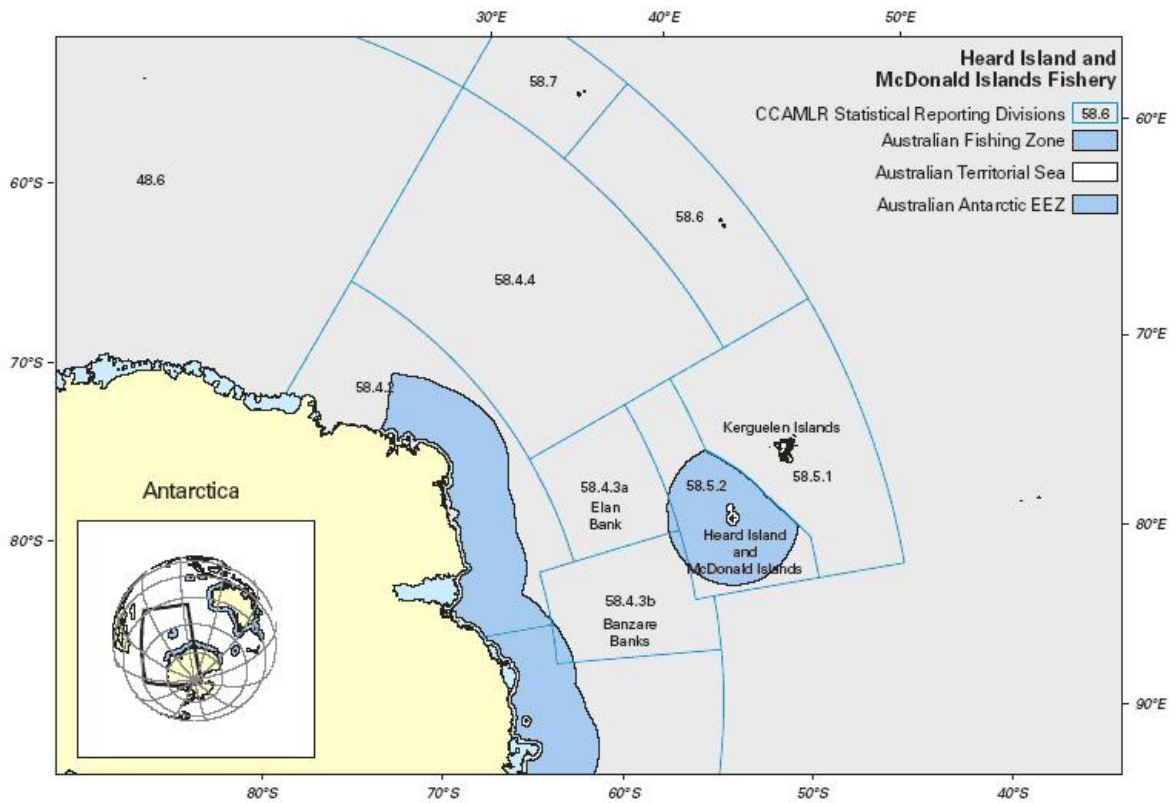


Figure 7: Map of the Heard Island and McDonald Islands Fishery Zones (Larcombe and Begg 2008)

Macquarie Island is a small and isolated island located 1500 km due south of Australia. It is a Nature Reserve, an International Biosphere Reserve, and a World Heritage Area (including waters to 12 nm from the coast). Fishing is not permitted within 3 nm of the coast of Macquarie Island. Embedded within the Australian EEZ around Macquarie Island is the Macquarie Island Marine Park, an area of approximately 16 million hectares. The Marine Park is divided into a central Highly Protected Zone (HPZ) and two Habitat/Species Management Zones (HSMZ) either side of the HPZ. Waters from the 3 nm boundary out to the 200 nm outer boundary of the AFZ are under Commonwealth jurisdiction and fishing in these waters is managed by AFMA under the *Fisheries Management Act 1991*, although fishing is prohibited in the HPZ (Figure 8).

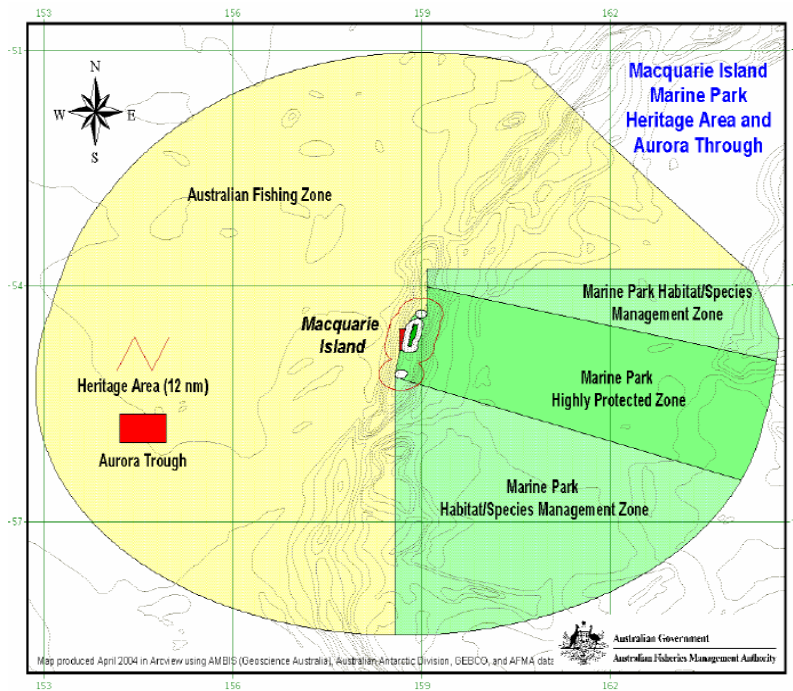


Figure 8: Map of the Macquarie Island Fishery Zone (AFMA 2004)

Effort and observer coverage

Longline fishing at HIMI is carried out during a fishing season commencing in May and finishing in October each year. Around 1.8 million hooks have been set each year in the HIMI Fishery. In 2007, 171 000 hooks were set in the Macquarie Island longline fishery (AFMA 2007a). More than 90 per cent of all hooks set in both fisheries have been observed.

The TAP for seabirds specifies that AFMA will collect data on the bycatch of seabirds on longline vessels using observer programs. The level of observer effort shall be commensurate with the nature and level of bycatch in each area, season and fishery and aims to cover 20 per cent of all hooks set and 40 per cent of all hooks hauled in all Antarctic fisheries (Department of Environment and Heritage 2006). These levels of observer coverage have been consistently achieved. Two observers are present on all Antarctic fishing trips undertaken by Australian vessels. One of the observers is specifically tasked with observing seabird interactions and they often have specialist knowledge in this area.

Seabird Interactions

The TAP 2006 for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (Department of Environment and Heritage 2006) was developed to significantly reduce the bycatch of seabirds during longline operations at current fishing levels. One of the criteria to measure the performance of the TAP is the application of seabird bycatch rates across all fishing areas and fishing seasons. In the Antarctic fisheries, all rates should be below 0.01 birds per 1000 hooks (Department of Environment and Heritage 2006). Vessels operating at HIMI and in other areas falling under the jurisdiction of CCAMLR are also bound to adopt all conservation measures required by CCAMLR.

Longline vessels are required to use integrated weight line, paired streamer lines, blue snoods, brickle curtains and seasonal closures to avoid seabirds attending baits (AFMA 2007d). At Macquarie Island other compulsory measures include a requirement to set all hooks at night. A ban on offal discharge is applied to all Australian vessels fishing in Antarctic waters.

Since 2003 three birds have been recorded interacting with fishing gear in the HIMI Fishery, although no seabird deaths have been recorded (AFMA 2007d). No birds were killed during the 2007 longline fishing season at Macquarie Island (AFMA 2007a). The bycatch rate in both fisheries is currently zero.

Current management requirements

Management arrangements are consistent with (and extend) CCAMLR's principles and conservation measures. Management is by TACs, bycatch TACs, limited entry, and rigorous fishing and environmental controls (AFMA 2007d).

Mitigation

Development and adoption of seabird bycatch mitigation measures in the Antarctic and other Australian Government-managed fisheries is carried out in accordance with the TAP (Department of Environment and Heritage 2006) and the requirements of CCAMLR. Under this process industry and government have investigated ways of reducing interactions between seabirds and longlines and hence associated mortality. The adoption of mitigation measures described above represents current best practice and has ensured this fishery is amongst the safest in the world with respect to seabird conservation.

State and territory fisheries

Australia's commercial fisheries are managed by the Commonwealth, the States/Northern Territory, or through a joint authority comprising the Commonwealth and one or more state/territory. A number of fisheries cross state, territory, and Commonwealth jurisdictions which created the need for the development of an arrangement that provided practical management across these jurisdictions. Offshore Constitutional Settlement (OCS) arrangements were first established in the mid 1980s to address this need, and to better reflect fish abundance, distributions and fishing practices.

Fisheries managed under OCS arrangements are defined in terms of species, fishing method and area. They underpin the major fishery management plans implemented under Commonwealth, state or Northern Territory laws. The OCS also forms the basis for ongoing cooperation between governments who share the management responsibilities. Arrangements were developed to establish joint authorities, under which a state or the Northern Territory undertake the day-to-day management of the fishery with the Commonwealth focusing on the broader management arrangements.

In the absence of an OCS arrangement, State/Territory laws apply to coastal waters (up to 3 nm) and Commonwealth laws apply from those waters out to the limit of the AFZ (200 nm).

Currently there are fisheries OCS arrangements in place with all states and the Northern Territory. They have been negotiated on the broad concept that localised fisheries adjacent to a state should be managed by the state, and the Commonwealth should manage fisheries occurring off more than one state or where there is involvement of foreign fishing vessels.

Western Australia

Western Australian Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery

(Western Australian Fisheries Joint Authority; managed under WA legislation)

Fishery characteristics

Number of vessels

There were 57 licenses in the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF) in 2005–06; 24 in Zone 1 and 33 in Zone 2. However, only 7 Zone 1 vessels (1 more than in 2004–05) and 14 Zone 2 vessels (4 less than in 2004–05) reported active fishing during 2005–06.

Fishing techniques

Demersal gillnetting is the main fishing method, though a few fishers use demersal longlines. Shark meat is the main product, with fins accounting for approximately 25 per cent of the value of the fishery.

Fishing areas

The JASDGDLF covers the waters from latitude 33° S to the WA/SA border. The fishery is managed primarily using two zones. Zone 1 extends from latitude 33° S around the coast as far as longitude 116° 30' E, and Zone 2 from 116° 30' E to the WA/SA border (129° E).

Effort and observer coverage

Gillnetting is the dominant fishing method and effort is expressed in standardised units of kilometre gillnet hours. The historically small amount of longline effort is converted into equivalent gillnet effort by comparing longline and gillnet catch per unit effort data.

The total effort expended in 2005–06 was 143 131 kilometre gillnet hours (on this standardised basis), a decrease of 18 per cent from 2004–05.

There is currently no observer program operating in this fishery, but observer data were collected between 1993 and 2005 through research programs.

Seabird interactions

Interactions with seabirds were ranked as a negligible risk in a 2002 risk assessment workshop conducted as part of an EPBC Act assessment of the temperate WA shark fisheries (Department of Fisheries Western Australia 2005). It was decided that the seabird interaction risk rating was negligible as there is only a very small amount of demersal longlining in this fishery. Demersal longlines sink quickly due to the amount of line weighting and baits are therefore less accessible to seabirds when compared with some other longlining methods.

Current management requirements

A joint authority between the Australian Government and Western Australian Government manages the fishery under Western Australian legislation. Management is through input controls implemented as time-gear units. The main management objective is to achieve target biomass levels of 40 per cent of the initial biomass by 2010 for whiskery and gummy shark, and by 2040 for dusky shark.

Under a complementary management plan, Western Australia also manages a demersal gillnet-longline fishery that extends north from Cape Bouvard and catches many of the same species. The status of the major species of the two fisheries is assessed jointly.

The value of the production of the two fisheries was \$6 million in 2003–04 and 2004–05. JASDGDLF management is by input controls, with limited entry and with limits on the amount of gear that can be used and the months in which it can be operated.

The management plan was reviewed to reduce effort in line with sustainability objectives. The final suite of arrangements developed to achieve this are intended to come into force June 2009. These new management arrangements have been complemented by regulations for improved management of shark catches in non-target fisheries. The Western Australian Department of Fisheries has carried out research on the fishery, using on-board monitoring to collect size and species-composition data, as well as biological data on feeding, reproduction, age and growth. Ongoing stock assessments use catch-and-effort data from fishers' monthly returns (Fletcher and Santoro 2007).

Mitigation

Seabird mitigation methods are not used in this fishery.

West Coast Demersal Gillnet and Demersal Longline Fishery

(Western Australian Government jurisdiction fishery)

Fishery characteristics

A Western Australian Government fishery managed under Western Australian legislation.

Number of vessels

There were 26 licenses in the West Coast Demersal Gillnet and Demersal Longline Fishery (WCDGDLF) in 2005–06, although only 10 (5 less than in 2004–05) reported active fishing during 2005–06.

Fishing techniques

Demersal gillnet and demersal longline fishing methods are used, although it is predominantly demersal gillnet.

Fishing areas

The WCDGDLF extends north from latitude 33° S to latitude 26° S. However, shark fishing has been prohibited between Steep Point (26° 30' S) and North West Cape since 1993, effectively making Steep Point the fishery's northern boundary.

While the WCDGDLF is not divided into management zones, on 15 November 2007 the southern part of the fishery (between 31° S and 33° S – known as the Metropolitan Area), was closed as part of a suite of arrangements introduced to address concerns regarding demersal scalefish stocks on the west coast.

Effort and observer coverage

Gillnetting is the dominant method employed in the fishery and effort is expressed in standardised units of kilometre gillnet hours by converting the historically small amount of longline effort into the equivalent gillnet effort, on the basis of comparative longline and gillnet catch per unit effort data.

On this standardised basis, total effort in the WCDGDLF increased by 17 per cent in 2005–06. The effort expended in 2005–06 was 80 384 kilometre gillnet hours.

There is currently no observer program for this fishery, but observer data were collected between 1993 and 2005 through research programs.

Seabird interactions

Interactions with seabirds were ranked as a negligible risk in a 2002 risk assessment workshop conducted as part of an EPBC Act assessment of the temperate shark fisheries (Department of Fisheries Western Australia 2005). It was decided that the seabird interaction risk rating was negligible as there is only a very small amount of demersal longlining in this fishery. Demersal longlines sink quickly due to the amount of line weighting and baits are therefore less accessible to seabirds when compared with some other longlining methods.

Current management requirements

The WCDGDLF is currently managed as a limited entry fishery, under an interim management plan introduced in 1997. Under the interim plan, the fishery is managed using effort controls in the form of time-gear units.

The management plan was reviewed to reduce effort in line with sustainability objectives for key shark stocks. The final suite of arrangements developed to achieve this are intended to come into force June 2009. These new management arrangements have been complemented by regulations for improved management of shark catches in non-target fisheries. Following the closure of the Metropolitan Area of the fishery on 15 November 2007, a voluntary buy-back commenced to reduce entitlement in the fishery by 33 per cent (in line with the catch historically taken from that part of the Fishery). Based on the success of the buy-back at the time of reporting, it is forecast to achieve its objective.

The Western Australian Department of Fisheries carries out research on the fishery, using on-board monitoring to collect size and species-composition data, as well as biological data on feeding, reproduction, age and growth. Ongoing stock assessments use catch-and-effort data from fishers' monthly returns (Fletcher and Santoro 2007).

Mitigation

Seabird mitigation methods are not used in this fishery.

Northern Shark Fisheries

(Australian Government and Western Australian Government - Joint Authority)

Fishery characteristics

The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery (WANCSF) in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery (JANSF) in the eastern Kimberley. The principle fishing methods and some target species are common to both the WANCSF and the JANSF. Thus, the data have been combined as a single fishery for reporting purposes. The Northern Shark Fisheries target a variety of species including sandbar, blacktip, tiger and lemon sharks.

Number of vessels

There are four authorisation holders in the WANCSF (potentially able to use eight vessels) and four vessels entitled to fish in the JANSF. However, in both fisheries there is the capacity for assigning these fishing rights to others through contractual arrangements. Since 2006–07, less than five vessels have been active across both fisheries and frequently no more than one vessel has been active.

Fishing techniques

The primary fishing method employed in these fisheries is demersal longline, with a small amount of pelagic gillnetting in the JANSF in recent years.

Fishing areas

The WANCSF extends from longitude 114° 06' E (North West Cape) to 123° 45' E (Koolan Island), and the JANSF from longitude 123° 45' E to the WA/NT border.

The WANCSF is zoned into three areas. The area between North West Cape and a line of longitude at 120° E and all waters south of latitude 18° S has been closed indefinitely, primarily to protect the breeding stock of sandbar sharks. Operators are only allowed to fish in the area between 16° 23' S and 18° S latitude between 1 October and 31 January. Operators are allowed to fish in the remaining area (north of 16° 23' S latitude and between 120° and 123° 45' E longitude) throughout the year.

Effort and observer coverage

Catches and fishing effort have been less than the levels prescribed by the new management arrangements. There was less than 1 t of sandbar sharks reported as catch in 2005–06.

There were 133 days of longlining and 19 days of gillnetting reported in 2005–06, less than the total of 900 days permitted under the new management arrangements.

There is currently no observer program for this fishery, but observer data were collected between 2000 and 2003 through research programs.

Seabird interactions

The use of demersal longlines in the Northern Shark Fisheries was assessed as having a generally low risk of interacting with TEP species, including seabirds, through an ecologically sustainable development risk assessment workshop conducted in 2002 as part of an EPBC Act assessment of the tropical shark fisheries (refer to the report – Application to the Australian Government Department of Environment and Heritage on the Western Australian Tropical Shark Fisheries, November 2005). Demersal longlines sink quickly due to the amount of line weighting and baits

are therefore less accessible to seabirds when compared with some other longlining methods. It is also noted that these are tropical fisheries and risks of seabird interactions are minimal.

Current management requirements

The Northern Shark Fisheries are input-controlled, with limited numbers of operators authorised to fish in each fishery.

New management arrangements for the Northern Shark Fisheries were agreed in May 2005. Regulations supporting these arrangements were introduced in their entirety for the WANCSF in June 2005. Implementation of complementary management measures for the JANSF are subject to consideration by the joint authority of the risks related to stock sustainability of sharks and TEP species interactions potentially associated with any shift to pelagic gillnet usage.

The solely Western Australian managed sector of the Northern Shark Fisheries was closed in 2005; subsequently WANCSF fishers are restricted to a small portion of the fishery's previous area under a Ministerial Exemption. All vessels operating in the WANCSF are now also required to report fishing activities via the WA Department of Fisheries' Vessel Monitoring System (VMS) and daily logbooks.

Mitigation

Seabird mitigation methods are not used in this fishery.

Queensland

Rocky Reef Fin Fish Fishery

(Queensland Government)

Fishery characteristics

The Rocky Reef Fin Fish Fishery targets a suite of species associated with inshore rocky reefs, including snapper, pearl perch and teraglin jew. The fishery is mostly restricted to the southern part of Queensland. Other minor species in the fishery include black kingfish, dolphin fish, yellowtail kingfish, amberjack and samsonfish.

Number of vessels

1536 primary licences current.

Fishing techniques

Rocky reef finfish are generally taken using hook and line. Both recreational and commercial fishers are permitted to use up to six hooks.

Fishing areas

Most rocky reef finfish is taken in the area south of the Great Barrier Reef (GBR), which can be fished by commercial operators in possession of an L1, L6 or L7 fishery symbol. However, fishers are permitted to harvest rocky reef fish species throughout Queensland waters provided they have the appropriate line endorsement for the area. The line symbol they are operating under dictates the area in which they can fish.

Effort and observer coverage

There was an increase in the commercial catch of snapper in 2003, 2004 and 2005 that was related to improved catchrates, rather than an expansion in the number of days fished. Over this period, the number of days fished remained stable at around 2700 days while the catch rate increased from around 30 kg per day, to just under 80 kg per day over the same period. Prior to this period, a dramatic increase was observed in fishing effort for snapper between 2002 and 2003, when the number of days fished increased from an historic average of approximately 1800 days to 2700 days.

There has been a change in the fleet dynamics, with some operators more focused on targeting rocky reef fin fish, particularly following the introduction of the Fisheries (Coral Reef Fin Fish) Management Plan 2003 and the rezoning of the Great Barrier Reef Marine Park (GBRMP) which increased the extent of areas closed to commercial fishing. Spatial commercial catch information indicates that commercial operators have targeted new areas in recent times. In many fisheries, elevated catchrates are often seen when fishers start fishing new grounds.

A voluntary fishery observer program was introduced in the commercial sector of the Rocky Reef Fin Fish Fishery in 2005. The aims of the program are to collect information on catch composition, length frequencies, bycatch and any interactions with TEP species. A number of observer trips have been undertaken for the rocky reef fishery with approximately 30 different species of fish recorded. Snapper is the most common, comprising 31 per cent of the catch by number, followed by pearl perch, which comprises 28 per cent of the catch by number. A number of other species were also caught, including a number of species of coral reef fin fish.

Seabird interactions

The current risk to TEP species from the Rocky Reef Fin Fish Fishery is considered negligible as a result of the hook and line gear used. A number of rocky reef operators also use the LFO4 logbook, which requires reporting of TEP species interactions. No interactions were recorded in 2005 through the LFO4 logbook. Fishery observers have not recorded any interactions with TEP species to date.

Current management requirements

A range of input and output controls are used by Queensland Department of Primary Industries and Fisheries (QDPI&F) to manage the harvest of rocky reef fish species, including:

- Minimum size limits for snapper (35 cm), pearl perch (35 cm) and teraglin (38 cm) for both commercial and recreational fishers
- Recreational in-possession limits for snapper, pearl perch and teraglin (a limit of five for each species)
- Gear restrictions with a limit on the number of hooks and lines that can be used by both commercial and recreational fishers
- Limited entry in the commercial sector.

Mitigation

The current risk to TEP species from the Rocky Reef Fin Fish Fishery is considered negligible as a result of the hook and line gear used.

Coral Reef Fin Fish Fishery

(Queensland Government)

Fishery characteristics

The Coral Reef Finfish Fishery (CRFF) is a line-only fishery that targets a range of bottom-dwelling reef fish. It consists of a lucrative live-fish commercial fishery and an iconic recreational and charter fishery. The fishery operates predominantly in the GBRMP, with operators generally using smaller tender vessels (dories) working independently from a mother-ship. A comprehensive management system, including an individual transferable quota system, is in place for the commercial fishery to ensure its sustainability into the future.

Number of vessels

In 2005–06, the recreational sector harvested more of the total coral reef finfish product (approximately 61 per cent) than the commercial, Indigenous and charter sectors combined (approximately 39 per cent) (QDPI&F 2007).

Fishing techniques

The CRFF is a line fishery, in which commercial and recreational fishers are permitted to use up to three lines, with no more than six hooks in total, using either a rod and reel or a handline.

Fishing areas

Commercial operators with an RQ fishery symbol and who possess a line fishing endorsement in the form of an 'L' fishery symbol (i.e. L1, L2, L3, L6, L7 and L8) are permitted to take coral reef species in east coast Queensland waters. The line symbol they are operating under dictates the area in which they can fish.

Effort and observer coverage

The annual commercial catch and effort information for the CRFF has historically exhibited a varied trend in catch per unit effort, based on market demand. There was a significant take-up of latent commercial fishing effort in the fishery during the 1990s, and an increase in effort in 2000–01. There was a decrease in both catch and effort in 2003–04 that may be a reflection of management changes implemented in December 2003. These measures prohibited operators from fishing in the CRFF if they did not hold an RQ symbol. The catch and effort continued to decrease in 2004–05 and was most likely the result of the introduction of a quota to the fishery, and the increase in areas closed to the fishery in July 2004 through the Great Barrier Reef Marine Park Authority (GBRMPA) Representative Areas Program (RAP) rezoning.

Seabird interactions

None reported. The type of fishing gear used in this fishery is unlikely to be associated with incidental seabird mortalities.

Current management requirements

Management of the CRFF is the responsibility of the QDPI&F. A comprehensive set of management arrangements is in place under the Fisheries (Coral Reef Fin Fish) Management Plan 2003 to manage the total harvest of coral reef finfish. These include:

- limited entry into the commercial fishery

- a TAC for the commercial sector, separated into commercial TACs for coral trout, red throat emperor and 'other coral reef finfish species', the commercial TACs are shared through individual transferable quotas
- a range of minimum and maximum fish size limits that apply to both the recreational sector and commercial sector
- a range of recreational in-possession limits for key species, including a number of 'no-take' species (barramundi cod, potato cod, Queensland groper, Chinaman fish, hump-headed Maori wrasse, paddletail and red bass)
- a combined recreational in-possession limit of 20 coral reef finfish
- three annual nine-day spawning closures that apply to all fishers operating on the east coast between latitude 10°41' S and 24°50' S.

The fishery is also subject to restrictions on areas in which it can operate through no-fishing areas declared under the GBRMP and Queensland Marine Parks and Zoning Plans.

Mitigation

No mitigation measures are employed in the fishery, or are likely to be necessary.

Deepwater Fin Fish Fishery

(Queensland Government)

Fishery characteristics

The Deepwater Fin Fish Fishery (DFFF) is a relatively small commercial multi-hook, line fishery that operates in Queensland waters deeper than 200 m. Target species include various coral reef finfish (e.g. emperors, cods and lutjanids) and rocky reef finfish (e.g. pearl perch), as well as a range of other species (including various pelagics).

Number of vessels

There were seven licenses in the DFFF (L8) fishery as at 30 June 2005 (5 with L8 and RQ). Commercial vessels accessing the fishery: six in 2005.

Fishing techniques

Commercial operators working in the DFFF are permitted to use multi-hook apparatus on trotline or dropline. A maximum of six vertically set droplines, with not more than 50 hooks on each, can be used at one time. Alternatively, operators can use up to three bottom set trotlines, with no more than a total of 300 hooks.

Fishing areas

Commercial fishers within the DFFF are permitted to operate in east coast waters deeper than 200 m (Figure 9). However, there is some overlap between the DFFF area and the GBRMP with no more than six hooks per line allowed in the GBRMP.

Effort and observer coverage

The number of days fished has declined as the number of commercial fishers endorsed to operate in the fishery has reached an historic low of only seven DFFF fishers in 2005. Six operators recorded a total catch of approximately 25 tonnes in 2005.

A fishery observer program was introduced in the DFFF in 2005. The aims of the program are to collect information on catch composition, length frequencies, bycatch and any interactions with TEP species.

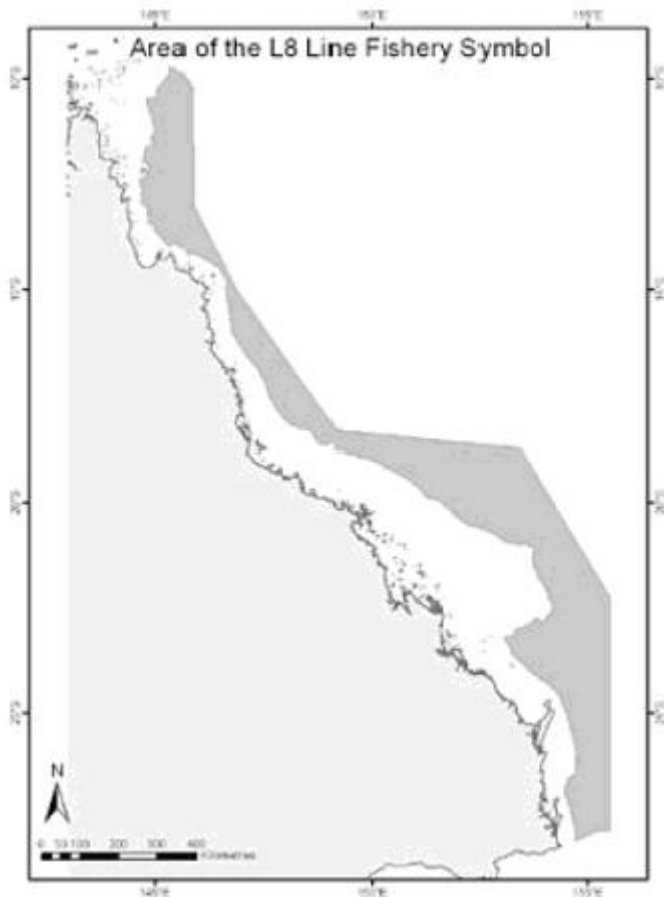


Figure 9: Map of the Queensland DFFF (L8) line fishery area (QDPI&F 2006a)

Seabird interactions

Commercial operators using an LFO4 logbook are required to fill in a Species of Conservation Interest (SOCI) logbook. This requirement will continue with the introduction of the new MH01 logbook. However, some operators may still be using the LFO3 logbook, which does not have a requirement to report interactions with TEP species. A review of logbooks is being undertaken for a range of line fisheries. It is expected that, as part of this review, the requirement to report TEP species interactions will be expanded across all line fisheries. No interactions with TEP species were recorded by line fishers that filled in SOCI logbooks in 2005. In addition, fishery observers on DFFF vessels have not recorded any interactions to date.

Current management requirements

A range of input and output controls are used to manage the DFFF. Because of overlap between the DFFF and other line fisheries operating in Queensland waters there is a complex array of management arrangements in place, including:

- Limited entry
- Prohibition on taking barramundi, snapper, Spanish mackerel, red emperor and coral trout when using multi-hook gear

- Minimum size limits that apply to a range of species, including coral reef finfish and rocky reef finfish
- Restrictions on the type of gear that can be used (i.e. number of lines and hooks)
- Restriction on the size of vessel that can be used in the fishery
- Requirement to have an RQ fishery symbol and quota to retain any coral reef finfish that are taken.

Mitigation

No mitigation measures are employed in the fishery, or are likely to be necessary.

East Coast Spanish Mackerel Fishery

(Queensland Government)

Fishery characteristics

The East Coast Spanish Mackerel Fishery (ECSMF) is a line fishery targeting the largest of the mackerel species in Queensland; Spanish mackerel are highly sought after by both commercial and recreational fishers.

Number of vessels

As of November 2006 there were 297 licenses in the ECSMF. There were 154 commercial fishing vessels accessing the fishery in 2005–06.

Fishing techniques

The ECSMF is a line-only fishery in which both commercial and recreational fishers are permitted to use a maximum of three lines and up to six hooks. Spanish mackerel are generally caught while trolling.

Fishing areas

Commercial operators with a Spanish Mackerel (SM) fishery symbol and who possess a line fishing endorsement (L) (i.e. L1, L2, L3, L6, L7 and L8), are permitted to take Spanish mackerel in east coast Queensland waters. The L symbol dictates the area in which they can fish. The harvest of Spanish mackerel in the Gulf of Carpentaria (GOC) is managed separately to the east coast and reported in the GOC Line Fishery Annual Status Report.

Effort and observer coverage

There was a large decline in catch during the first quota year, from 561 t in 2003–04 to 309 t in 2004–05. In 2005–06 the catch decreased further to 271 t. Effort also declined by more than half, from 10 531 days in 2003–04 to 4733 days in 2004–05, and continued to decline in 2005–06 to 4047 days. The number of vessels accessing the fishery also continued to decline to an historic low of 154 in 2005–06. As well as decreases in effort, the catch per unit effort continues to rise (67 kg/day compared with 65.3 and 53.3 kg/day in 2004–05 and 2003–04, respectively). It is likely that this increase in catch per unit effort is a result of the more active and efficient operators remaining in the fishery following the introduction of new management arrangements in early 2004 and the removal of less efficient Spanish mackerel fishers.

A voluntary fishery observer program was introduced in the commercial sector of the Spanish mackerel fishery in 2006. In this fishery, observers collect information on catch composition, length frequencies, bycatch and any interactions with SOCI. In addition, methods are being investigated to validate the distribution of effort within the fishery to develop further understanding of the dynamics of this fishery.

A number of observer trips have been undertaken in the Spanish mackerel fishery with approximately five different species of fish recorded. Spanish mackerel is the most common, comprising 76 per cent of the catch by number. To date, fishery observers have not recorded any interactions with SOCI.

Seabird interactions

Spanish mackerel commercial fishers are required to record interactions with TEP species in their SOCI logbook. No interactions were reported in the 2007–08 quota year. Results of the risk

assessment indicated that the risk to TEP species associated with the fishery is low as a result of the targeted nature of the fishery and the constant attendance of troll lines while fishing.

Current management requirements

Management of the ECSMF is the responsibility of QDPI&F. A range of input and output controls are set out in the *Fisheries Regulation 1995* and are used to manage the harvest of Spanish mackerel. These controls include:

- A commercial TAC, shared through ITQs
- A minimum size limit of 75 cm
- A recreational in-possession limit of three fish
- Total closures to the take of Spanish mackerel in certain areas
- Permits to commercially fish for Spanish mackerel in grey nurse shark designated areas in southern Queensland
- A mandatory requirement for recreational fishers to remove a pectoral fin from a retained fish
- Restrictions on the maximum size of vessel permitted in the commercial fishery.

Mitigation

No information regarding seabird mitigation measures have been provided for this fishery. It is unlikely however that any mitigation measures are used.

Gulf of Carpentaria Line Fishery

(Queensland Government)

Fishery characteristics

The Gulf of Carpentaria Line Fishery (GOCLF) targets Spanish mackerel using surface troll lines. Small quantities of demersal (bottom-dwelling) fish species including cods, tropical snappers, wrasses and sweetlip are also taken using set hand lines. Product from the GOCLF is predominately sold on the Australian domestic market. It is likely that there is only limited export from this fishery (for example, grey mackerel).

Number of vessels

Forty-seven primary licences have been issued. Of these, only 27 accessed the fishery in 2006. The commercial fishery operates as a small vessel fishery with a number of tender vessels operating from a mother-ship (<20 m).

Fishing techniques

Commercial operators use hand-hauled, hand winch-hauled, electric/hydraulic winch-hauled lines and heavy rod-and-reel lines. Combinations of these gears vary according to areas fished, weather conditions, frequency of catch and time of day. Recreational fishers primarily use hook and line gear while Indigenous fishers use recreational fishing methods (e.g. hook and line), as well as traditional subsistence fishing methods.

Fishing areas

The GOCLF extends from Slade Point near the tip of Cape York Peninsula westward to the Northern Territory (NT) border and operates in all tidal waterways out to the 25 nm line (Figure 10). On 1 July 2006 the inshore fishery (L5 – out to 3 nm from the coast) and the offshore fishery (L4 – out to 25 nm from the coast) were amalgamated under the fishery symbol L4 to streamline management arrangements.

Effort and observer coverage

Bycatch in the GOCLF has been assessed as negligible by QDPI&F. The fishing gear and species targeting practices limit the take of species other than Spanish mackerel and the main demersal fish species.

The QDPI&F voluntary Fisheries Observer Program was active in the commercial sector of the GOCLF in 2006. The program objectives are to collect information on the composition and length frequencies of the retained catch and bycatch, as well as interactions with TEP species. A single observer trip was conducted in the GOCLF fishery in 2006, with a total of 12 different species of fish recorded from the observed catch. No interactions with TEP species were observed during 2006.

Seabird interactions

No interactions with TEP species were recorded between 2004 and 2006. A SOCI logbook was implemented in the commercial fishery in 2006 and is likely to provide improved reporting of protected species interactions.

Given the low level of TEP species interactions under current fishing operations, DEWHA considers that the operation of the fishery does not, or is not likely to, adversely affect the survival in nature of a listed threatened species or population of that species, or the conservation status of a listed migratory species, cetacean or listed marine species or a population of any of those species.

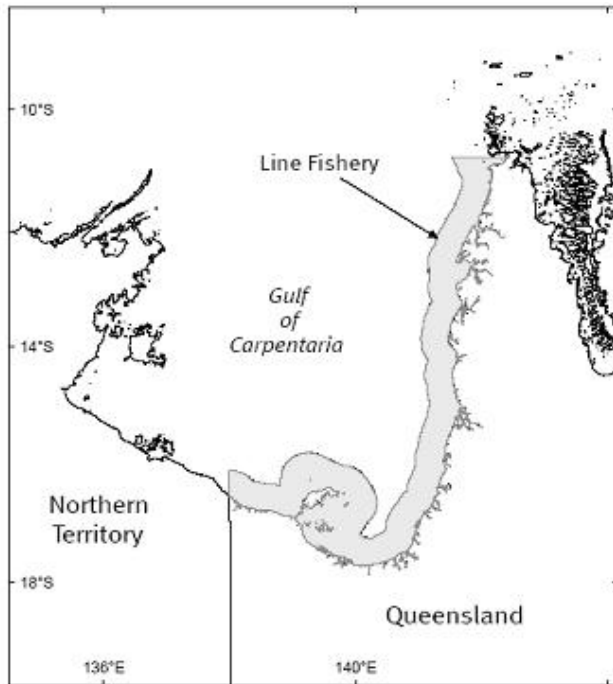


Figure 10: Map of the Gulf of Carpentaria Line Fishery (QDPI&F 2006b)

Current management requirements

Management arrangements in the GOCLF include a combination of input and output controls as outlined below. Input controls include:

- Limited entry – limited to the number of vessels operating within the fishery
- Closed area – South Mitchell River
- Gear restrictions, including:
 - Fish may only be taken by using hand held fishing lines and fishing rods with hand or mechanically operated reels and lines
 - Each fishing line must have no more than six hooks attached to it
 - A fishing line may have lures attached to it
 - The person in control of a vessel must ensure that a person does not use more than three fishing apparatus from the vessel at a time
 - Vessel replacement and licence surrender/transfer provisions.

Mitigation

GOCLF fishing methods include the use of troll lines and hand lines, which are always attended during fishing operations. This allows fishers to release any unwanted species alive.

Northern Territory

Timor Reef Fishery

(Northern Territory Fisheries Joint Authority).

Fishery characteristics

The Timor Reef Fishery primarily targets the higher valued goldband snapper and other *Pristipomoides* species. Significant quantities of red snappers, red emperor and cods are also harvested. Most products from this fishery are marketed as 'fresh on ice' product with the majority sold as whole fish on the Australian domestic market. In 2006, the total catch from the Timor Reef Fishery was 726 tonnes. This is an increase in total catch compared to 2005 when 669 tonnes were landed.

Number of vessels

In 2006, there were 12 licences in the fishery, a reduction from 22 licences in 1993. The reduction resulted from a 'two-for-one' licence reduction scheme that has been in place since 1995. Since that time 20 licences have been through the two-for-one process, meaning the original 22 licences in the fishery have been reduced by ten to a total of 12 licences. Vessels in the Timor Fishery are mostly between 15 and 30 m in length.

Fishing techniques

Commercial operators are authorised to use baited traps and vertical lines, including hand lines and drop lines. Prior to 1999, the majority of operators in the Timor Reef Fishery used drop lines. However, during 1999–2000 there was an industry-wide change to trap fishing, with only one operator using drop lines during 2002. However, owing to the better quality of line-caught fish, there was a reversal of this trend back to drop lines by many operators in 2004. In 2006 two vessels used traps and the rest used drop lines.

Fishing areas

The Timor Reef Fishery operates well offshore out in the Timor Sea, in a remote region extending north-west of Darwin to the WA/NT border and to the outer limit of the AFZ. The fishery has an area of approximately 8400 nm².

Effort and observer coverage

During 2006, seven licence holders actively fished and 1178 vessel days were recorded, which was a decrease from 2005 of 1503 vessel days.

The fishery is monitored primarily through logbooks, which operators are required to fill out on a daily basis during fishing operations. The logbooks provide detailed catch and effort information, as well as information on the spatial distribution of the fishery. Logbooks are submitted with monthly marketing information by the 28th day of the following month. In addition to logbooks, NT Fisheries officers conduct on-board monitoring of commercial fishing trips. While on-board, observers document vessel and gear information, location, depth, fishing practices, catch composition (including by-catch), and where possible, measure all landed species. Eight on-board monitoring trips were conducted during 2006. These trips represented approximately seven per cent of fishing effort.

Seabird interactions

In 2006, there were no recorded interactions with TEP species in the Timor Reef Fishery. The method of fishing and the location of the fishery generally prevent interactions with TEP species.

Current management requirements

The management arrangements relating to the Timor Reef Fishery are recognised by the Australian Government Department of Environment and Heritage (now known as the Department of Environment, Water, Heritage and the Arts) to be operating in an ecologically sustainable manner. The fishery is exempt from export regulations until May 2013.

Mitigation

None required. Mitigation measures are not considered necessary in this fishery because seabird interactions do not occur. Furthermore, this region of the AFZ is considered low risk with regard to seabird interactions (DPIWE 2004).

Demersal Fishery

(Northern Territory Fisheries Joint Authority)

Fishery characteristics

The Demersal Fishery targets goldband snapper, but also catches large numbers of red snappers, with the remainder of the catch comprising red emperor and cods. Most products from this fishery are marketed as 'fresh on ice' with the majority sold as whole fish on the Australian domestic market.

In 2006, many Timor Reef fishers (who also hold demersal licences) began exploring grounds immediately adjacent to the Timor Reef Fishery area for goldband and red snapper species. In 2006, the total catch from the Demersal Fishery was 223 tonnes, a significant increase from the 2005 total catch of 79 tonnes. The lingering effects of oil and gas exploration companies carrying out seismic surveys within the more productive regions of the Timor Reef Fishery in combination with business decisions to more actively target the Demersal Fishery has led to an expansion of fishing effort in the Demersal Fishery from mid 2006 onwards (Department of Primary Industry, Fisheries and Mines 2006).

Number of vessels

During 2006, there were six active licences in the Demersal Fishery. These vessels were all less than 30 m in length.

Fishing techniques

Methods in this fishery are identical to those of the Timor Reef Fishery where operators use either traps or drop lines to target goldband snapper.

Fishing areas

The Demersal fishery operates in waters 15 nm from shore to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery. Within the Demersal Fishery, the majority of fishing effort occurs in areas adjacent to the Timor Reef Fishery.

Effort and observer coverage

The reported effort in 2007 for this fishery was 297 vessel days, which was substantially higher than the 173 vessel days recorded in 2005. There was no observer coverage in the Demersal Fishery during 2006.

The Demersal Fishery is monitored primarily through logbooks, which operators are required to fill out on a daily basis during fishing operations. These logbooks provide detailed catch and effort information, as well as information on the spatial distribution of the fishery. Logbooks are submitted with monthly marketing information by the 28th day of the following month. No monitoring trips were conducted in the Demersal Fishery during 2006, due to the high level of observer activity required in the Timor Sea to monitor fish catches prior to, during and following seismic survey activity in the area. However, due to the similarity of methods, fishing grounds and catch composition of this fishery with the Timor Reef Fishery, it is felt that observer information from the Timor Reef Fishery adequately covers the Demersal Fishery, especially given the low level of fishing activity in the Demersal fishery (Department of Primary Industry, Fisheries and Mines 2006).

Seabird interactions

In 2006, there were no recorded interactions with TEP species in the Demersal Fishery. The method of fishing and the location of the fishery generally prevent the interaction with these species.

Current management requirements

The management arrangements relating to the Demersal Fishery are recognised by the Australian Government Department of Environment, Water, Heritage and the Arts to be operating in an ecologically sustainable manner. The fishery is exempt from export regulations until May 2013.

Mitigation

None required. Mitigation measures are not considered necessary in this fishery because seabird interactions do not occur. Furthermore, this region of the AFZ is considered low risk with regard to seabird interactions (DPIWE 2004).

Spanish Mackerel Fishery

(Northern Territory Government)

Fishery characteristics

This fishery is based on the capture of narrow-barred Spanish mackerel, using lures or baited lines. Although these methods do not involve 'longlines' they use surface lures, which have been known to attract seabirds in other fisheries (Commonwealth of Australia 2003). However, no seabirds have been observed or recorded as being taken in this fishery.

Number of vessels

There are 17 active licenses in the Spanish Mackerel Fishery in 2006. Fishers may operate from a mother-ship with up to two dories. All of the mother-ships are less than 30 m in length with a maximum 6.5 metres for dories. Fishing effort is provided as 'vessel days' and a typical fishing operation would tow up to 12 lines, each with a single hook. There were 1098 'vessel days' of fishing during 2006 in the Spanish Mackerel Fishery, compared with 1115 vessel days reported in 2005. Effort since the early 1990s has shown a generally increasing trend, with a peak of 1155 vessel days in 2001.

Fishing techniques

The Spanish Mackerel Fishery uses trolling techniques, and fishers may use any number or combination of troll lines, floating handlines and rod and lines. It is common for fishers to troll two to four lines behind a dory and up to eight lines from a mother-ship. Most commercial fishers purchase bait (usually southern Australian garfish) for their fishing operations. However, a small number of operators (less than five) fish for bait under a restricted bait net entitlement. Bait fish, usually garfish, harvested under this entitlement may only be used for the commercial fishing of Spanish mackerel. The fishery is highly specific and has less than 1 per cent bycatch.

Fishing areas

Licensees in the Spanish Mackerel Fishery may fish in Northern Territory waters seaward of the coast and river mouths, to the outer limit of the AFZ. The principal fishing areas include waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts. Fishing generally takes place around reefs, headlands and shoals.

Effort and observer coverage

The fishery has an observer program which consists of four to six trips per year of approximately 10 days each trip. This represents approximately 5–6 per cent observer coverage per year. Observers measure and gather biological data of the target species and for bycatch species.

Seabird interactions

There have been no reported seabird interactions from the logbook data and this is supported by NT Fisheries Observer data. All bycatch is recorded by observers and is currently very low (less than one per cent). Seabird captures are unlikely, primarily because the fishery operates in an area where there is an absence of the species vulnerable to bycatch (shearwater, large petrel and albatross species). Observer records show that the major species observed behind Spanish mackerel vessels are various tern species, which are not capable of swallowing the large baits and lures used to catch Spanish mackerel. Additionally the troll lines are continually monitored while fishing,

meaning that if ever a seabird was to become entangled in the gear it could be quickly released (Northern Territory Department of Primary Industry, Fisheries and Mines unpublished data).

Current management requirements

The management arrangements relating to the Spanish Mackerel Fishery are recognised by the Australian Government Department of Environment, Water, Heritage and the Arts to be operating in an ecologically sustainable manner.

Mitigation

None required. Mitigation measures are not considered necessary in this fishery because seabird interactions do not occur. Furthermore, this region of the AFZ is considered low risk with regard to seabird interactions (DPIWE 2004).

Offshore Net and Line Fishery

(Northern Territory Fisheries Joint Authority)

Fishery characteristics

The key target species in the Offshore Net and Line Fishery (ONLF) (previously the Shark Fishery) are the blacktip sharks, and grey mackerel with a number of other sharks and finfish being landed or taken as bycatch.

Number of vessels

There is only one operator who uses longline methods (uses a 23.6m vessel). There are 17 fishing licenses in the fishery in total, with all vessels under 30 m in length.

Fishing techniques

Operators may use either longlines or pelagic nets, but the use of bottom set gillnets is prohibited. Total longline length limit of no more than 15 nm with maximum 1000 snoods (hooks). Most shark fishing is undertaken by pelagic gillnet. Operators are not allowed to use auto-baiting gear in the ONLF.

Fishing areas

Operators are authorised to fish in Northern Territory waters from high water to the AFZ boundary, an area of approximately 522 632 km², with spatial restrictions placed on the use of certain gear. However, the majority of fishing is undertaken within the coastal zone (within 12 nm of the coast or baseline) and immediately offshore in the Gulf of Carpentaria. Little fishing was undertaken in the offshore area of the fishery during 2006.

Effort and observer coverage

Information on fishing effort is not readily available for the ONLF – effort is measured in ‘vessel days’ and there is an annual cap of 234 days for longline fishing gear to be shared between all licensees. Measures were introduced to contain effort and have resulted in a decline from 1538 vessel days in 2004, 1176 vessel days in 2005, to 899 vessel days in 2006. The total catch for all species in the fishery for 2004 was 1559 tonnes, a slight decrease from 2003 (1687 tonnes).

The collaborative Fisheries Observer Program, introduced in 2002, regularly collects biological samples and spatial data from ONLF vessels and bycatch operations to improve stock assessments. There is 7 per cent observer coverage, which was recommended by the Northern Stock Assessment Group. Observers provide valuable information on all species landed, including byproduct, bycatch and interactions with threatened species. Observers also document vessel and gear information, location and depth fished.

Seabird interactions

There have been no recorded interactions with seabirds in the ONLF. The fishery operates mainly at night and this is thought to reduce interactions with seabirds.

Current management requirements

Environmental accreditation under the EPBC Act has been provided for the ONLF. The ONLF is a limited entry fishery with only 17 licence entitlements (licences) operating. A licence reduction program has reduced the overall capacity from 39 to the current 17 entitlements. The significantly low number of vessels operating in the fleet, combined with methods and effort limits ensure

sustainable harvests are maintained within this fishery. Additionally, all new entrants to the fishery undertake a detailed fishery interview with managers prior to fishing.

Mitigation

Mitigation measures are not specifically employed in this fishery because seabird interactions do not occur. However, some of the operational procedures employed, such as predominately using pelagic net gear set at night, combined with regulations prohibiting auto-baiting, restricting sets to a maximum of 1000 hooks per set, requiring gear to be set at night, permitting demersal longline gear only, and a longline length limit of no more than 15 nm, will all serve to reduce seabird bycatch in longline gear. This region of the AFZ is considered low risk with regard to seabird interactions (DPIW 2004).

Coastal Line Fishery

(Northern Territory Government)

Fishery characteristics

The commercial Coastal Line Fishery is a multi-species line and trap fishery that operates in coastal waters along the NT coastline. The fishery primarily targets black jewfish, but a range of other reef species such as snappers, emperors and cods are also harvested. The commercial Coastal Line Fishery began as a lifestyle fishery, but has now developed into a professional industry.

Number of vessels

In 2006, there were 22 licences active in the Coastal Line Fishery. The number of active licences varies each year, with 26 licences active in 2005 and 25 licences active in 2004. Most vessels are less than 15 m in length.

Fishing techniques

Coastal Line Fishery licensees are permitted to use a variety of fishing gear. Vertical lines, a cast net (for bait only), scoop net or gaff can be used from the high water mark to 2 nm from the low water mark. Drop lines and a maximum of 5 fish traps per licence may also be used from the 2 to the 15 nm limit.

Commercial fishers are permitted to use up to five hooks per vertical line, but most choose to use only two. They may also use between 6 and 40 hooks per drop line, but typically they use up to 20. The use of different fishing gears was reported for the first time in 2002, with drop lines and traps adopted by a small number of commercial fishers. In 2006, line fishing was the only method reported in the fishery.

Fishing areas

The Coastal Line Fishery extends from the high water mark to 15 nm from the low water mark across the entire NT coast. Some finer scale access restrictions apply due to the presence of Aboriginal sacred sites and protected area reserves.

Effort and observer coverage

There is no observer program operating in the Coastal Line Fishery. Catch and effort trends in the commercial and fishing tour sectors are monitored through fishery interviews and analysis of logbook data submitted by fishers on a monthly basis as a condition of their licence.

Seabird interactions

In 2006, there were no reported interactions with TEP species. The targeted nature of the Coastal Line Fishery minimises the risk of interactions with TEP species.

Current management requirements

In consultation with stakeholders, the NT Department of Regional Development, Primary Industry, Fisheries and Resources aims to manage the Coastal Line Fishery in a manner that is equitable and in line with nationally agreed ecologically sustainable development principles to optimise benefits to the community now and into the future.

The Coastal Line Fishery is also an important recreational fishery. Several species targeted by the commercial sector are also favoured by recreational fishers and Fishing Tour Operators (FTOs). Conservative estimates suggest that the recreational harvest of jewfish, snappers and emperors

alone surpasses the total commercial take. Hence, the primary management objective for the fishery is to ensure the sustainable harvest of coastal fish species by all sectors.

Mitigation

Mitigation measures are not considered necessary in this fishery because seabird interactions are unlikely to occur. This region of the AFZ is considered low risk with regard to seabird interactions (DPIW 2004).

Victoria

The commercial bay and inlet fisheries of Victoria are a collection of complex multi-species, multi-gear fisheries which operate in environments that are ecologically distinct to those existing in waters of both their catchment tributaries and the nearby ocean. Although between 60–80 fish species have been recorded from commercial bay and inlet catches, only about a dozen or so key species are usually targeted by commercial fishers.

Commercial fishing for finfish occurs in Port Phillip Bay, Western Port Bay, Corner Inlet/Nooramunga, the Gippsland Lakes and Bass Strait. All other Victorian bays, inlets and estuaries are closed to commercial fishing (other than for eels and bait). The main bay and inlet commercial fishing methods are haul seine nets and mesh (gill) nets. Longlines and purse seine nets are also used in Port Phillip Bay, and to a lesser extent the Offshore Fishery, Corner Inlet Fishery and Western Port Bay Fishery.

Western Port Bay/Port Phillip Bay Commercial Fishery

(Victorian Government)

Fishery characteristics

Multiple species are targeted in Port Phillip Bay and Western Port Bay using a variety of fishing methods including haul seines, mesh nets, purse seines and longlines. The main species targeted using longlines are snapper, flathead and gummy shark, with incidental catches of flathead. In June 2006, there were 48 Fishery Access Licences in the Western Port/Port Phillip Bay fishery and one Fishery Access Licence in the Purse Seine (Port Phillip Bay) fishery. In the ten years to 2005–06, commercial fisheries in Port Phillip Bay produced annual catches of 391 to 1461 tonnes of finfish with a wholesale market value of \$2.5 to \$3.1 million. Longlining has contributed between 5 per cent and 18 per cent of total annual Port Phillip Bay catches during this period, including approximately 70 tonnes of the 391 tonne total in 2005–06.

Number of vessels

Several voluntary commercial bay and inlet fishery licence buy-back schemes implemented since 1999 have removed nearly 60 per cent of licences from the Western Port/Port Phillip Bay Fishery. In December 2007 Western Port Bay was closed to all commercial net fishing, although the use of commercial hook and line methods is still allowed. A Western Port/Port Phillip Bay Fishery Access Licence allows access to commercial fishing in both bays, although management of fishing activities in each bay is considered separately.

Fishing techniques

In the Port Phillip Bay Fishery, snapper is the main target species using longline methods and fishers are allowed to set a maximum of 200 hooks at any one time. In Western Port Bay, fishers are limited to 1000 hooks per set. There are no restrictions on the timing of fishing, either time of day, or season. Branch lines or snoods are up to 2 m long and main lines are usually bottom set at between 10–20 m.

Effort and observer coverage

No dedicated observer program for seabirds is in place for this fishery at present.

There has been a substantial long-term decline in hook and line fishing effort from 4600 days in 1979–80 to 608 days in 2006. Snapper is the main species targeted in this fishery. While catches from the hook and line fishery have declined with declining fishing effort, catch rates have reached their highest recorded level in 2005–06. An increase in the catch rate since the mid 1990s is

thought to reflect higher snapper recruitment in Port Phillip Bay in the past decade, as well as lower levels of fishing effort. The lower levels of commercial fishing effort, due in part to the buy-out of commercial access licences, have had a positive effect on catch rates of mesh nets, longlines and haul seines. Given the relatively small scale of the Port Phillip Bay commercial fishery, particularly compared to the recreational fishery, it is much more likely that fluctuations in commercial catch rates are a reflection of fluctuations in the abundance/availability of fish stocks in the Bay, rather than fluctuations in commercial effort levels.

Seabird interactions

DPI Victoria has implemented a Protected Species Action Plan. The plan describes the actions to be taken by DPI once data on TEP species interactions are recorded in logbooks. The Action Plan outlines a process for monitoring the data, summarising the data, sharing the summarised data with the Department of Sustainability and Environment (DSE) and DEWHA, and management action to be taken should there be any unacceptable fisheries impacts on TEP species. In particular, the plan will:

- ensure that species protected under Victorian and Commonwealth legislation are not unacceptably impacted as a result of fishing
- meet EPBC Act requirements and national bycatch-related policies
- identify fisheries with significant interactions with TEP species, to assist those fisheries in developing effective and practical mitigation strategies

No information exists on seabird interactions in this fishery.

Current management requirements

Incidental catch of seabirds during longline fishing is listed as a Potentially Threatening Process under the *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act). An Action Statement has been developed by the Department of Sustainability and Environment to address this listed threat in accordance with the requirements of the FFG Act. The Action Statement has assessed the risk to seabirds from Victorian longline fisheries to be low because of the near-shore location of these fisheries and because the longlines are mostly set on the bottom rather than in midwater or near the surface. The Action Statement therefore focuses on supporting national and international approaches to minimising seabird interactions with longline fishing.

In November 2007 the Victorian Department of Primary Industries (DPI) and the then Commonwealth Department of the Environment and Water Resources signed a Memorandum of Understanding (MOU) which resulted in a requirement for selected Victorian commercial fisheries to report interactions with seabirds and other species listed as TEP under the EPBC Act. Reporting of TEP species interactions to DPI is required as part of the routine mandatory logbook reporting of commercial fishing activities. Currently the TEP species reporting requirement only applies to the Victorian rock lobster, giant crab and scallop fisheries (fisheries that require export accreditation under the EPBC Act) and does not apply to any Victorian longline fishery.

A limited entry licensing regime and a 2-for-1 licence transfer policy applies to the Western Port/Port Phillip Bay Fishery and to other Victorian commercial bay and inlet fisheries. These fisheries are also subject to other input (effort) controls including area/season closures, gear restrictions and legal minimum lengths for many species.

When operating in Port Phillip Bay, commercial licence holders may use only one longline with a maximum of 200 hooks attached. When operating in Western Port Bay, fishers must not use more than one longline or use a longline with more than 1000 hooks attached.

The Victorian Rock Lobster, Giant Crab, and Scallop Fishery have been assessed against, and found to comply with, the criteria for export accreditation under the EPBC Act. It is thought that

this accreditation process will be expanded in coming years to include other Victorian fisheries, including longline fisheries.

It is legal to longline during daylight hours but it is not common and the standard operational practice is to set lines before daybreak and to haul on sunrise.

Mitigation

There are currently no bycatch mitigation methods in use for any Victorian longline fishery. Fishers mostly set and haul their line before daybreak and this would act to reduce interactions with seabirds. Observations by fisheries officers and fisheries managers suggest that seabird interactions in the Port Phillip Bay Fishery are uncommon.

Corner Inlet Commercial Fishery

(Victorian Government)

Fishery characteristics

There are currently 18 access licences in this fishery. Under the current policy, the number of licences will not increase. The Corner Inlet-Nooramunga fishery occurs in shallow tidal waters over mud flats and seagrass beds in Corner Inlet (western region) and around the islands of the Nooramunga (eastern region) near Wilsons Promontory. The commercial fishery has a long history and has been providing fresh fish to Victorian consumers for more than 165 years. In the ten years to 2005–06, the Corner Inlet commercial fishery produced annual catches of 262 to 340 tonnes of finfish with a wholesale market value of \$1.3 to \$2.0 million. This is the third most valuable Victorian commercial finfish fishery after Port Phillip Bay and the Gippsland Lakes. Longlining has contributed less than one per cent of total Corner Inlet catches during this period.

Fishing techniques

The main commercial fishing gears are haul seines and mesh nets. A number of other fishing methods are permitted in Corner Inlet, including demersal longlining and droplining, however the hook and line component of total commercial fishing effort is considered negligible. Branch lines or snoods are 2 m maximum and the main lines are bottom set at a depth of between 8–20 m. Species recorded as being caught using longlines include snapper, gummy sharks, flathead, skates and southern calamari.

Effort and observer coverage

In the Corner Inlet Fishery during 2005–06, the total catch of 284 tonnes was taken during 2224 days of fishing and this level of fishing has been stable over the last 20 years. This stability has occurred despite changes in catch and effort by different gear types. There has been a fluctuation in mesh net fishing effort over the past two years. Hook and line effort is minimal with only a few days effort reported each year since 2002. No dedicated observer program for seabirds exists in this fishery.

Seabird interactions

No information has been collected on seabird interactions in any Victorian longline fishery. However, given the type of longlining and the low effort level in the Corner Inlet longline fishery, seabird interactions are likely to be negligible.

Current management requirements

Operators must not use a longline or a combination of longlines with more than 400 hooks attached. It is legal to longline during daylight hours, however it is not common and the operational practice is to set lines before daybreak and haul on sunrise.

Mitigation

There are currently no bycatch mitigation methods in use for any Victorian longline fishery. Corner Inlet fishers mostly set and haul their longlines before daybreak and this would act to reduce interactions with seabirds.

Ocean (open coastal waters) Fishery

(Victorian Government)

Fishery Characteristics

The Victorian Ocean Fishery is a multi-method fishery operating in Victorian coastal waters that targets or takes byproduct catches of a variety of finfish species including snapper, sharks (other than gummy and school shark), Australian salmon, silver trevally, barracouta, King George whiting and garfish.

In the eight years to 2005–06, the Ocean Fishery in Victorian coastal waters has produced annual catches of 146 to 562 tonnes of finfish with a wholesale market value of \$0.7 to \$1.8 million. Longlining has contributed 2 – 10 per cent of total Ocean Fishery catches during this period. Annual longline catches in the Ocean Fishery have steadily declined from 35 tonnes in 1998–99 to less than 5 tonnes in 2005–06. This is partly due to the introduction of gummy and school shark trip limits in 2000 in accordance with OCS fisheries arrangements agreed between Victoria and the Commonwealth.

There are currently 287 non-transferable licences in the Victorian Ocean Fishery and under the current policy the number of licences will continue to reduce as licence holders leave the fishery.

Fishing techniques

The main commercial fishing gears are haul seines and mesh nets. A number of other fishing methods are permitted, including demersal longlining and droplining. Branch lines are 2 m in length.

Effort and Observer Coverage

In the Victorian Ocean Fishery longline effort has declined from 273 days of fishing in 2002 to 156 days of fishing in 2006. No dedicated observer program for seabirds exists in this fishery.

Seabird Interactions

No specific information exists on seabird interactions with this fishery. It is the opinion of fisheries officers and fisheries managers that seabird interactions with this fishery are likely to be uncommon.

Current Management Requirements

When operating in this fishery, the licence holder must not use more than one longline or combination of longlines, and must ensure that any longline or combination of longlines has no more than 200 hooks attached.

It is legal to longline during daylight hours however, the common operational practice is to set lines before daybreak and haul on sunrise.

Mitigation

There are currently no mitigation methods in use in this fishery.

South Australia

Marine Scalefish Fishery

(South Australian Government)

Fishery characteristics

There are 360 marine scalefish licenses in this fishery, with a further 218 rock lobster licences, with each licence having different access entitlements. The key target species for the longline fishery is snapper. There is also some targeting of whaler shark, and some incidental take of school and gummy shark that is managed under OCS arrangements with the Commonwealth.

Number of vessels

The majority of vessels in the Marine Scalefish Fishery (MSF) are less than 10 m, however, exact numbers are difficult to determine, as many licences have more than two vessels registered.

Fishing techniques

There are 302 longline licences in the MSF and 204 in the Rock Lobster Fishery. There are a further 130 dropline licenses in the MSF and 145 in the Rock Lobster Fishery.

When fishing with longlines fishers can only use a maximum of 400 hooks. These hooks may be used over a number of separate lines up to the number endorsed on each licence.

The annual harvest of snapper by longline has until recent years remained below 100 t, however in recent years this has approached 200 t. The annual harvest of whaler shark by longline has been variable over recent years but on average is approximately 50–60 t.

Fishing areas

The main fishing area for longline fishing in the MSF is within Spencer Gulf – fishing blocks 29, 30, 32, 33 as well as other inshore areas of the state.

Effort and observer coverage

There is no observer program operating in the South Australian MSF. There have been ad-hoc observations of hook fishing operations in the fishery as part of other scientific research programs, none of which have recorded any seabird interactions.

Seabird interactions

The MSF is currently undertaking a comprehensive snapshot survey of bycatch composition across the major sectors and fishing areas, which includes longline fishing. During this survey, scientific observers will be recording information on bycatch of all species in the fishery, including any seabird interactions.

Current management requirements

South Australia has recently introduced a mandatory wildlife interaction logbook for all licensed commercial fishing operators to record all interactions with TEP species, including all seabirds. This will provide the mechanism for a consistent reporting framework across SA managed fisheries.

Mitigation

Current regulations state that the licence holder must be in attendance of the longlines at all times. That is, licence holders must be within 50 m of the gear. The proximity of the vessel to the gear may mitigate potential interaction with seabirds and other non-target species.

The MSF longline fishery is not considered to have a seabird interaction problem. Therefore no specific mitigation measures have been developed at this stage. Table 4.1 on page 32 of the MSF Management Plan outlines a set of strategies to work towards the goal of 'minimise adverse impacts of all fishing operations on the ecosystem upon which the MSF depends'. The Plan is available on the PIRSA Fisheries website www.pir.sa.gov.au/fisheries.

New South Wales

Ocean Trap and Line Fishery

(New South Wales Government)

Fishery characteristics

The Ocean Trap and Line Fishery (OTLF) is a multi-gear, multi-species fishery targeting demersal and pelagic fish along the entire NSW coast, in continental shelf and slope waters. Snapper, spanner crabs, yellowtail kingfish, leatherjackets, bonito and silver trevally form the bulk of the commercial catch. Other key species include rubberlip (grey) morwong, blue-eye trevalla, gummy shark, bar cod and yellowfin bream. Spanner crabs are harvested from Tweed Heads to Korogoro Point, near Hat Head on the mid-north coast of NSW. Tuna and tuna-like species are primarily managed by the Commonwealth Government outside 3 nm.

In 2004–05 an estimated 1511 tonnes of fish were caught in the fishery with an estimated value of \$8.4 million at first point of sale.

Number of vessels

Due to the diverse nature of the OTLF, the composition of the fleet varies significantly depending on the methods used and species targeted. Fishers who operate in near shore waters are able to use relatively small vessels, whereas, fishers involved in fish trapping or deepwater lining operations generally use large ocean going vessels up to 20 m in length. However, the average vessel length is approximately 6–8 m. Under the share management plan (as described below), it is proposed to implement a maximum vessel length limit of 16 m in the OTLF. This will not apply to vessels above this length that have historically operated in the fishery. In 2006 there were approximately 478 fishing businesses involved in the OTLF.

Fishing techniques

The fishery uses a variety of methods, most commonly involving a line with hooks or traps. The methods used in the trap and line fishery (and the key species taken by each method) includes: demersal fish trap (snapper, rubberlip morwong and leatherjackets); setlines/trotlines (snapper and shark); driftline (spotted mackerel); hand-held line (mulloway, yellowtail kingfish and bonito); dropline (blue-eye and hapuku); trolling/leadlining (yellowtail kingfish, mackerel and tuna); and spanner crab net, known as a 'dilly'.

Fishing areas

The OTLF extends from the NSW coast line seaward to the 4000 m isobath (approx. 60 to 80 nm offshore). The ocean waters from the NSW coastal baseline to 3 nm offshore are state waters and fall under the jurisdiction of NSW. The waters from 3 nm to the 4000 m isobath are Commonwealth waters, however an OCS established in 1990 allows NSW to manage some of the fishing activities in those waters.

Effort and observer coverage

Information on effort was not provided. There is no known observer program for this fishery.

Seabird interactions

Interactions with seabirds and other TEP species have not been assessed in this fishery.

Current management requirements

There are two broad types of fishery management controls, known as input and output controls. Input controls limit the amount of effort commercial fishers put into their fishing activities, indirectly controlling the amount of fish caught. Output controls directly limit the amount of fish that can be taken from the water.

The OTLF has historically been managed by a series of licensing arrangements, such as restrictions on the number of fishers, length of vessels, and input controls such as trap size and limits on the numbers of hooks that can be used inside 3 nm. Trip limits currently apply for some species in the fishery. Size limits also apply to a number of species taken in the fishery.

An Environmental Impact Statement was prepared for the OTLF and submitted to the Commonwealth Government for export approval. The Commonwealth has since issued a number of Wildlife Trade Operation (WTO) export approvals for the fishery.

A comprehensive Fishery Management Strategy has been prepared for the OTLF and was approved by the Minister in November 2006. The strategy includes a description of the fishery and the management arrangements that apply and are proposed into the future.

The Ocean Trap and Line Management Advisory Committee (MAC), an advisory body to the Minister and NSW DPI, provided significant input into the management strategy for the fishery. The Committee consists of a number of industry representatives, as well as recreational, conservation and Indigenous representatives.

The OTLF is in the process of moving from being a restricted fishery to a category 2 share management fishery. The category 2 share management provisions allow for the allocation of shares that have a 15-year term and a statutory right to compensation if the Government cancels the shares during their term. A share management plan for the fishery will be prepared in accordance with the agreed goals, objectives and management responses outlined in the management strategy.

Mitigation

Although interactions with TEP species have not been commonly recorded in this fishery, the Fishery Management Strategy (FMS) includes two direct measures to obtain data on any such interactions. The first of these measures is the implementation of a cross-fishery observer-based survey which will collect data on occurrences of TEP species in catches. Secondly, a modification to the catch reporting system incorporates mandatory reporting of fishers' interactions with TEP species during fishing operations. A number of management responses also appear in section 9 of this FMS aimed at minimising impacts on TEP species. These measures include educating fishers in the identification/avoidance of TEP species, using fishing closures, modifying gear use and implementing the provisions of any TEP species recovery plans and threat abatement plans.

Tasmania

Scalefish Fishery

(Tasmanian Government)

Fishery characteristics

The Tasmanian Scalefish Fishery is a multi-gear and multi-species fishery. The main gear types include gillnet, hooks and seine nets, harvesting a diverse range of scalefish, shark and cephalopod species. Other fishing gears include traps, Danish seine, dip nets and spears.

Number of vessels

There are approximately 560 operators within the Scalefish Fishery (including lobster fishers); however some operators hold more than one licence to catch various species. Less than half are active fishers. Demersal longlining represents less than 5 per cent of the fishing operations.

In many respects the scalefish fishery is dynamic, with fishers readily adapting and changing their operations in response to changes in fish availability and market requirements and opportunities. As a consequence, only a small proportion of the fleet has specialised in a single activity or targeting a primary species. For many operators, scalefish represent an adjunct to other activities, for instance rock lobster fishing.

Fishing techniques

Whilst school and gummy sharks are also an important component of the scalefish catch taken in Tasmanian waters, jurisdiction for managing both of these species in state waters was transferred to the Australian Government in 2001. The management of a number of important scalefish species is complicated by jurisdictional boundaries separating a range of overlapping species.

All those who hold a licence in this fishery or a rock lobster fishing licence are permitted to use hooks by any method. The number of hooks permitted ranges from 1 to 200 hooks.

Depth at which lines are set varies depending on species targeted, weather and other environmental conditions. The minimum depth is one metre with no depth restrictions.

Fishing areas

In the main, scalefish fishing occurs within 3 nm of the Tasmanian coastline, however, rock lobster fishers are allowed to take scalefish out to 200 nm off the Tasmanian coast. There are particular regional differences in scalefish fishing operations state-wide, and the types of fishing activities undertaken by fishers appears to be influenced by the level of exposure to poor weather and sea conditions.

Effort and observer coverage

Dropline effort is expressed in terms of number of hooks set, and there is currently no limit on the number of hooks that can be set.

No observer program for seabirds exists for this fishery. Fisheries logbooks were recently expanded to include sections for reporting interactions with TEP species, including seabirds such as penguins.

In 2002–03, the scalefish catch using dropline methods was 18.8 tonnes. Catches increased slightly in 2003–04 to 19.4 tonnes, but declined in the following two years to 8.1 tonnes in 2005–06.

Seabird interactions

No information exists on seabird interactions with these fisheries, although it is believed to be low. Most fishers use droplines on hand reels and as such are not of high risk to seabirds.

Current management requirements

The Tasmanian Scalefish Fishery really began as an adjunct to rock lobster and scallop fishing. Prior to 1987, there were little, if any, controls regulating commercial fishing in state waters. However, regulations have been progressively introduced to limit the level of participation in specific fisheries (shark hook, shark gillnet, inshore trawl), some areas have been closed to fishing (such as shark refuge areas), while access to some sheltered and coastal waters have been restricted (such as Frederick Henry and Norfolk Bays).

A suite of management arrangements were introduced in 1998 to extend a more formal management regime to all of the sectors within the Scalefish Fishery. Generic gear entitlements, as well as a limited number of species-specific and gear-specific licences were issued to fishers based on the level of catch history accrued by fishers. The Tasmanian Scalefish Fishery Management Plan has been reviewed annually since 1998, and is the basis for managing the Scalefish Fishery according to the principles of ecologically sustainable development.

Mitigation

Seabird bycatch mitigation measures are not routinely employed within this fishery.

Part C: Assessment of seabird bycatch in Australian fisheries

Species vulnerable to incidental mortality in Australian waters

Fourteen species of seabirds were identified as being affected by the key threatening process of longlining when it was listed in July 1995. Since the listing, further species have been recorded as bycatch in Australian longline fisheries. The 32 separate taxa of seabirds known to have been killed in longline fishing operations in the AFZ and their current conservation status are listed in Appendix 2.

These species are typically large seabirds which naturally feed on fish and squid found on or close to the surface. They all exhibit behaviours which make them susceptible to being caught on longlines, they dive for baits and have learned to follow vessels and forage on discards. They are aggressive feeders, and in most cases travel large distances seeking food. The groups most affected are the albatrosses and petrels because of their limited population sizes and low reproduction rates. While albatrosses represented 75 per cent of the birds killed by Japanese longliners operating in the AFZ during the 1990s (Gales and Brothers 1995), recent observer data from domestic pelagic vessels indicates that albatrosses form less than 10 per cent of the species killed annually, with flesh-footed shearwaters and other petrels dominating the catch (Baker and Wise 2005). This most likely reflects a change in the distribution of fishing effort. Less is known on the seabird species vulnerable to bycatch in demersal longline operations within the AFZ. This is because there is limited or no data available on the incidence of seabird bycatch in most Australian demersal fisheries, with the exception of Antarctic fisheries and the SESSF, which most likely experience low bycatch levels.

The seabird species caught on longlines are highly varied in conservation status. They include endangered species such as the northern royal albatross and prolific species such as the short-tailed shearwater. The EPBC Act requires that the TAP considers not only endangered and vulnerable seabird species but other seabird species that could become endangered or vulnerable as a result of the key threatening process. Similarly, the IPOA-Seabirds is focused on minimising bycatch of all seabirds, and not just those listed to a category of threat.

The seabird species affected by longline fisheries are principally found in waters south of 25° S (Fraser Island on the east coast and Shark Bay on the west coast) and more commonly south of 30° S. These species are also pelagic in distribution and typically only occasionally forage in inshore waters. Seabird species found in northern areas where longline fishing operations occur are not typically caught as bycatch because they are not attracted to the fishing vessels or longline baits.

Bycatch of seabirds varies across fisheries, seasons and areas. Mitigation of bycatch first requires that the risk to seabirds posed by longline fisheries at the regional level be understood. In 2004, a spatial and temporal assessment of the risks to threatened seabirds from fisheries operations was carried out to document the seabird species vulnerable to longline fishing that inhabit and/or visit Australian waters (DPIWE 2004). The study assigned a level of risk associated with fishing activities to each sector of the AFZ based upon available seabird distribution data and expert opinion. Advice was then developed on the application of mitigation measures that should be applied during fishing operations within each sector to ensure bycatch was minimised (DPIWE 2004). The report found that most of the seabirds at risk from interactions with longline fisheries occurred in waters south of latitude 25° S, and fisheries that operated in this area posed a greater risk to seabirds than did tropical fisheries. Using a five-point risk rating based on the number of at-risk species documented in each area their conservation status and propensity to interact with longline fishing operations, all fishing areas located south of latitude 25° S were ranked in the three highest risk categories. South-eastern Australia, Tasmania and Macquarie Island were in the highest

risk category (DPIWE 2004). A similar process of risk assessment undertaken in the DPIWE study is carried out each year by CCAMLR as standard practice. Detailed annual review of information on fishery performance, the seabird species that interact with the fishery and advice to managers on improvements to management actions are essential if bycatch levels are to be continually improved. Within CCAMLR this has resulted in regular revision to conservation measures, ensuring that the mitigation measures are close to international best-practice for the fishery at any time (Waugh et al. 2008).

Assessed levels of bycatch in Australian fisheries

Although high levels of seabird bycatch have been documented in the past for some of Australia's Commonwealth fisheries, there is now evidence to show that bycatch levels have substantially declined, at least in the ETBF (the main fishery of concern), since the development of the longline fishing TAP (Lawrence et al. 2009, Table 1). Estimated annual seabird bycatch levels for all Commonwealth fisheries in 2007 are shown in Table 9. For the ETBF, this estimate has been derived by applying mean bycatch rates estimated by Lawrence et al. (2009) to effort in the fishery (AFMA unpublished), with the uncertainty estimated by bootstrapping (Lawrence et al. 2009). For the other fisheries, the estimates represent the authors expert opinion, and have been derived from knowledge of the gear used, the level and spatial distribution of hooking effort, and bycatch rates reported for each fishery, where available.

Table 9: Estimated annual seabird bycatch for all Commonwealth fisheries in 2007 including upper and lower confidence intervals where known

Fishery	Mean no. of seabirds killed	95% Confidence Interval	
		Lower	Upper
ETBF	114	48	205
WTBF	< 50		
SBTF	Included with ETBF		
SESSF: Scalefish Hook Sector	< 10		
SESSF: Shark Hook Sector	< 10		
CSF	< 10		
Antarctic fisheries	<5		

The ETBF is the only longline fishery where the estimated number of seabirds killed each year is of note, and where fishing effort is significant. When compared to the levels of bycatch seen in the fishery in 2001–2003, when Baker and Wise (2005) estimated from 1794 to 4486 birds may be killed each year, it is clear that bycatch has been considerably reduced. This has mainly been brought about by the rigorous implementation of mitigation measures such as night-setting and line-weighting, but also due to the gradual northwards shift in fishing effort that has coincidentally occurred since the implementation of the TAP. The bycatch has continued to be dominated by flesh-footed shearwaters but some albatrosses have been caught over the last couple of years, mainly when fishers failed to deploy mitigation measures (AFMA unpublished data).

In recent years, mean observed bycatch rates have generally approached but not exceeded the TAP performance criterion of 0.05 birds per 1000 hooks in most fishing areas and seasons. However, estimates constrained by the coverage of observer effort may be biased, and potentially over- or under-estimate bycatch rates. Therefore, model-based estimates (as in Lawrence et al. 2009) are preferred. With respect to the ETBF, the modelled estimates produced by Lawrence et al. 2009 show that while seabird bycatch rates have generally decreased over time, there remains concern

that the level of seabird bycatch is likely to exceed 0.05 birds per 1000 hooks in some areas at times. To account for the well-documented operational challenges of maintaining representative observer coverage, these types of analyses should be taken into consideration when looking to optimise management responses at times and in areas of most concern.

AFMA has acknowledged that maintaining observer coverage at the prescribed TAP levels for each fishing area and season has proven to be challenging (AFMA 2007). There are difficulties in predicting how much fishing effort is likely to be directed to any particular area during a season, and hence the level of observer coverage required, because where effort is directed can rapidly change due to market forces and availability of target species. Overcoming this problem will either require higher levels of observer coverage in some areas than would otherwise be required to achieve prescribed coverage levels specified by the TAP, or closer coordination between operators and AFMA to ensure observer coverage is otherwise representative of fishing effort. Electronic monitoring of catches via on-board cameras is being considered which, if successful, may supplement but not replace observer coverage.

In the WTBF, seabird interactions (0.055 birds per 1000 hooks), on average, slightly exceeded the TAP rate between 2003 and 2006. All birds caught were flesh-footed shearwaters. In 2007 no birds were captured (AFMA unpublished). The maximum observer coverage achieved was 7.4 per cent in the area 30° S to 35° S in winter. In a number of other TAP fishing areas the minimum observer coverage of 5 per cent was not achieved, often because of the low level of effort and its opportunistic nature. Overall, 446 729 hooks were deployed in 2007 with only 2.4 per cent of these observed. In the SESSF, Scalefish Hook Sector, autoline bycatch has remained below the TAP performance criteria level of 0.01, with no birds recorded caught in 2006 and 2007 (AFMA unpublished). Observer levels failed to reach the required 10 per cent level in 2007, however, the large number of hooks observed on autoline vessels in the past provides a level of confidence that fewer than 10 birds are killed each year by autoliners. The level of bycatch in non-autoline hook sets is unknown, but effort is limited and the type of gear deployed (drop lines) is unlikely to be impacting seabirds.

Antarctic fisheries remain the best observed of all Commonwealth fisheries and bycatch is minimal. All vessels operating in the fisheries have observers on board and in excess of 40 per cent of hooks set are usually observed. Since 2003 only three birds have been recorded interacting with fishing gear, with no seabird deaths recorded.

The Coral Sea Fishery remains a low hook effort fishery, with no seabird bycatch problems. There are few species known to be at risk that occur in the fishing area, and to date no seabirds have been observed caught. In 2007, the overall observer coverage was 15.7 per cent, well in excess of that prescribed in the TAP.

Information on the levels of bycatch in all state and territory fisheries is generally poor and mainly reliant on logbook data. With some exceptions (e.g. Qld Rocky Reef Fin Fish Fishery, Qld Deepwater Fin Fish Fishery, Qld Gulf of Carpentaria Line Fishery, NT Timor Reef Fishery, NT Spanish Mackerel Fishery, NT Offshore Line and Net Fishery), there are few fishery-independent observer programs in place in state fisheries. However, most of these fisheries are multi-gear fisheries and hook and line methods do not play a major role in effort. Most of these fisheries also operate in coastal waters where seabird species known to be at risk from longline interactions do not occur regularly. When these factors are taken into consideration, it is reasonable to conclude that they are unlikely to experience significant seabird interactions.

Seabird bycatch issues in other fisheries

While the bycatch of seabirds associated with longline fishing is the focus of this assessment report, it is now recognised that large numbers of seabirds are killed in trawl fisheries worldwide (Sullivan and Reid 2002; Sullivan 2004; Gonzalez-Zevallos and Yorio 2006; Sullivan et al. 2006; Baker et al. 2007a). Traditionally, high levels of seabird mortality caused by trawlers had been

associated with netsonde cable collisions (e.g. Bartle 1991; Weimerskirch et al. 2000), which are now prohibited in many Southern Hemisphere fisheries (e.g. CCAMLR 2006). The banning of these cables was considered to have largely eliminated the trawling related mortality, however, more recently significant levels of trawler mortality are reported to have been caused by net entanglements (SC-CAMLR 2001, 2002) and warp cable strikes (Sullivan and Reid 2002, 2003). Most net related mortality recorded in recent years has been caused by pelagic trawlers. Pelagic nets remain at or near the sea surface for extended periods, in contrast to demersal nets which are weighted to sink quickly. Mortality is predominantly caused by birds diving into the net and becoming entangled, particularly in the intermediate size meshes (Weimerskirch et al. 2000; SC-CAMLR 2001, 2002).

Within Australia, few bycatch studies have specifically focused on trawl fisheries, with the exception of Australia's Antarctic trawl fisheries (Wienecke and Robertson 2002). These studies show that bycatch is generally low. However, in 2004–05 seven black-browed albatrosses and five white-chinned petrels were killed in mid-water trawl operations (Lawton et al. 2007) over a few days, demonstrating the potential risks imposed by trawling.

There is considerable trawl fishing elsewhere within Australian waters, with much of this fishing effort occurring within the foraging areas of albatrosses and petrels. Hundreds of seabirds routinely attend fishing vessels during trawling operations (e.g. in the SESSF) (Gales and Brothers 1996; AFMA unpublished observer reports). Incidental mortality may be occurring in these fisheries but incidents are unlikely to be detected unless observers are specifically tasked with quantifying seabird interactions (Baker et al. 2002; Sullivan et al. 2006b). Collection of data on seabird incidental capture in trawl fisheries is difficult because birds initially caught in the net may be lost underwater, and birds that hit warps during various stages of trawling operations are often undetected because they fall into the water and may not be captured in the net, thus avoiding detection (Sullivan et al. 2006a). Reliable data on the levels of seabird bycatch in Australian trawl fisheries will likely only be obtained when observer programs are established to focus on this issue.

The use of bird-scaring lines has been proven to be the most effective seabird warp strike mitigation measure. However the retention of strategic management of fish waste (offal and discards) is the most likely long-term solution to reducing seabird incidental catch in trawl fisheries (FAO, 2008). Effective fish waste management combined with operational measures such as cleaning the net prior to shooting and reducing the time the net is on the surface at shooting and hauling are the best practice measures available for reducing seabird net entanglements (FAO, 2008).

While the IPOA-Seabirds contains a framework to identify and reduce the incidental catch of seabirds in longline fisheries, where this occurs, no such framework currently exists to deal with other forms of fishery-related mortality (e.g. trawl and gillnet fisheries). Other FAO member states e.g. New Zealand and British sub-Antarctic territories have broadened their NPOA-Seabirds approach to include all fisheries. This approach is also supported by the recently developed FAO IPOA-Seabirds Best Practice Technical Guidelines (FAO, 2008).

Part D: Assessment of the need for an NPOA-Seabirds for Australia

Criteria used to evaluate need for an NPOA-Seabirds

The IPOA-Seabirds is based upon the framework of the FAO Code of Conduct for Responsible Fisheries and aims to reduce the incidental catch of seabirds in longline fisheries, where this occurs. The IPOA-Seabirds stipulates that countries with longline fisheries should, as a first step, conduct an assessment of these fisheries to determine if a bycatch problem exists and if so, to determine its extent and nature.

Although the IPOA-Seabirds provides guidelines for the preparation of an assessment, it does not specify the criteria for assessing what constitutes a bycatch problem and therefore whether a state should develop an NPOA-Seabirds. To date, different approaches have been taken to conducting assessments and developing plans. For instance, in the United States, the bycatch assessment is considered the initial first step in the implementation of the US NPOA-Seabirds (Rivera 2000), whereas in most other countries, such as South Africa and Australia, a separate preliminary assessment of all relevant fisheries has been undertaken prior to developing a NPOA-Seabirds (Cooper and Ryan 2004, Commonwealth of Australia 2003).

The approach taken in Australia follows the view that a NPOA-Seabirds is required if there is evidence that fisheries operating within a jurisdiction are potentially causing an impact at the population level to seabird breeding populations, either in that jurisdiction or further afield. Twenty four globally threatened species have been recorded as bycatch in Australian longline fisheries (see Appendix 2).

Need for an NPOA-Seabirds for Australia

Prior to the introduction of the IPOA-Seabirds, the incidental catch of seabirds during oceanic longline fishing operations was listed as a key threatening process under Commonwealth legislation in 1995. To manage this threat, the TAP was put in place in 1998 and amended in 2006.

As a result, there has been a considerable reduction in seabird mortality in Australia's Commonwealth fisheries that has occurred since the initial national assessment in 2003. This has been achieved through development of a suite of mitigation approaches prescribed by the TAP, which have been implemented and strengthened (where appropriate) following the review and subsequent updating of the Plan in 2006 (Department of Environment and Heritage 2006). There have been other significant developments that have contributed toward a lowering of seabird bycatch in Commonwealth fisheries. These include:

- the introduction of observer programs to all Commonwealth fisheries, which have helped define bycatch issues and led to refinements in approaches to mitigation
- the willingness of some members of industry to cooperate with scientific observers and researchers to refine and improve the suite of mitigation measures adopted
- a substantial reduction in longline effort, particularly in the ETBF and WTBF, brought about by market conditions and assisted by structural adjustment in the industry
- changes in the spatial distribution of fishing effort in the ETBF, leading to reduced fishing in areas where seabird species known to be abundant and impacted by longline fishing
- an increase in the adoption by vessels of mandatory mitigation measures over time.

As a result the number of seabirds caught in Australian longline fisheries has continued to decline. In addition, the numbers of TEP species that associate most with longliners, notably albatrosses and the larger petrel and shearwaters, have been caught in sufficiently low numbers in

Commonwealth fisheries since 2004 that these fisheries are unlikely to have had a significant impact on their populations.

This experience demonstrates that seabird mortality can be reduced below critical levels in large-scale regulated longline fisheries. The fishery policies and practices developed and implemented through the TAP offers a model of best practice in the development and implementation of mitigation and enforcement of measures, using an adaptive management approach, and one that already has a wide application to other fisheries and administrations e.g. New Zealand's recent adoption of line-weighting regimes developed for longline tuna and swordfish fisheries.

In considering the need for Australia to develop a National Plan, it is relevant that the form of the existing TAP largely fulfils the role of an NPOA-Seabirds. Notably, its prescriptions are supported by the EPBC Act, and do not rely on voluntary uptake, it has the potential to be much more effective than an NPOA. However, the TAP does not apply in state and territory fisheries.

Nevertheless, a review of state and territory managed fisheries indicates that current levels of longline fishing effort are low. This, together with a reliance on inshore fishing areas where spatial overlap of effort with vulnerable seabird species is low, leads to the conclusion that seabird bycatch in these fisheries is unlikely to be causing an impact at the population level to seabird breeding populations.

The assessment of seabird bycatch in state and territory fisheries is based on expert opinion, not on empirical data and should be verified. Some of the states contacted during the preparation of this assessment did not provide data on fishing effort or catch of both target and non-target species. Most state fisheries do not have independent observer programs and managers have concluded that seabird bycatch is not a problem based on logbook information. Decisions based on logbooks that are not verified by observer data or other data validation methods have often been shown to be unreliable in fisheries management.

Information gathering through independent observer programs is costly, and many of the state and territory fisheries are small scale, low value fisheries. Therefore, generating the priority and resources necessary to support the level of data gathering required to determine bycatch levels will be challenging. The development of a nationally consistent risk-based approach to assessing seabird bycatch within state and territory fisheries may be more appropriate.

Recommendations

- The TAP is largely fulfilling the role of an NPOA-Seabirds and effective implementation of the TAP should address the major risks posed to seabirds by Australian longline fisheries
- Shortfalls in achieving the levels of observer coverage required by the TAP for all Commonwealth fisheries need to be addressed
- State and territory fisheries are unlikely to be causing an impact at the population level to seabird breeding populations. In the absence of robust risk assessments, data validation needs to be encouraged in state and territory longline fisheries to confirm that seabird interactions are low
- Further development and trialling of seabird bycatch mitigation measures for pelagic longline gear remains a high priority
- An assessment of seabird bycatch in Australian trawl fisheries is warranted to ensure Australian trawl fisheries are not impacting seabird populations.

References

- Abbott CL, Double MC, Gales R, Baker GB, Lashko A, Robertson CJR and Ryan PG 2006a, 'Molecular provenance analysis for Shy and White-capped Albatrosses killed by fisheries interactions in Australia, New Zealand, and South Africa', in *Conservation Genetics* vol. 7, p.531–542.
- ACAP Seabird Bycatch Working Group 2007, *Report of the first meeting of the Seabird Bycatch Working Group of the Agreement on the Conservation of Albatrosses and Petrels*, Valdivia, Chile, 17-18 June 2007, ACAP AC3 Doc.14 Rev 5.
- AFMA 2004, *Map of the Macquarie Island Fishery showing fishing areas and the Marine Park*, access 10 July 2009, at http://afma.gov.au/information/maps/mqi_2.htm.
- AFMA 2006, *Southern and Eastern Scalefish and Shark Fishery Wildlife Trade Operation re-assessment 2006*, accessed 19 May 2008, at <http://www.environment.gov.au/coasts/fisheries/commonwealth/scale-fish/pubs/scalefish-submission-sept06.pdf>.
- AFMA 2007a, *First report under the Threat Abatement Plan for Seabirds 1 September 2006 to 31 August 2007*, Australian Fisheries Management Authority (unpublished).
- AFMA 2007b, *Western Tuna and Billfish Fishery - Six-monthly bycatch action plan (BAP) progress report, March 2007*, accessed 16 May 2008, at http://www.afma.gov.au/information/publications/fishery/baps/docs/reports/bap_imp_rep_wtbf_200703.pdf
- AFMA 2007c, *Southern and Eastern Scalefish and Shark Fishery Bycatch Action Plan 2007 – 2009*, Australian Fisheries Management Authority, Canberra http://www.afma.gov.au/fisheries/sess/sess/publications/sessf_bap_march2007.pdf Accessed 16 May 2008.
- AFMA 2007d, *Heard Island and McDonald Islands Fishery annual status report*, accessed 19 May 2008, at <http://www.environment.gov.au/coasts/fisheries/commonwealth/heard-mcdonald/pubs/submission-jan07.pdf>.
- AFMA 2008, *Annual status report 2005–2008 Eastern Tuna and Billfish Fishery*, accessed 15 May 2008, at http://www.afma.gov.au/fisheries/tuna/etbf/publications/strategic_assessment/.
- Anderson S and McArdle B 2002, 'Sink rate of baited hooks during deployment of a pelagic longline from a New Zealand fishing vessel', in *New Zealand Journal of Marine and Freshwater Research* vol. 36, p. 185–195.
- Anon. 2007, *Report of the joint meeting of tuna RFMOs January 22-26, 2007 Kobe Japan*, available at: <http://www.tuna-org.org>
- Ashford JR, Croxall JP, Rubilar PS, Moreno CA 1995, 'Seabird interactions with longlining operations for *Dissostichus eleginoides* at South Sandwich Islands and South Georgia', *CCAMLR, Science* vol. 2, p. 111–121.
- Australian Antarctic Division 2005, *Background to the Threat Abatement Plan for the incidental catch (or by-catch) of seabirds during oceanic longline fishing operations - A key threatening process listed under the EPBC act*, available at http://www.aad.gov.au/MediaLibrary/asset/MediaItems/ml_38623723599537_TAP-2-BackgroundPaper-Sept-2005.pdf
- Baker GB, Gales R, Hamilton S and Wilkinson V 2002, 'Albatrosses and petrels in Australia: a review of their conservation and management', in *Emu* vol. 102, p. 71–97.

- Baker GB and Wise BS 2005, 'The impact of pelagic longline fishing on the flesh-footed shearwater *Puffinus carneipes* in Eastern Australia', in *Biological Conservation*, vol.126, p. 306–316.
- Baker GB, Double MC, Gales R, Tuck GN, Abbott CL, Ryan PG, Petersen SL, Robertson CJR and Alderman R 2007a, 'A global assessment of the impact of fisheries-related mortality on Shy and White-capped Albatrosses: conservation implications', in *Biological Conservation*, vol. 137, p. 319–333.
- Barnes KN, Ryan PG and Boix-Hinzen CH 1997, 'The impact of the hake, *Merluccius* spp. longline fishery off South Africa on Procellariiform seabirds', in *Biological Conservation*, vol. 82, p. 227–234.
- Bartle JA 1991, 'Incidental capture of seabirds in the New Zealand sub-Antarctic squid trawl fishery, 1990', in *Bird Conservation International*, vol. 1, p. 351–359.
- BirdLife International 2004, *Threatened birds of the world 2004*, CD-ROM, BirdLife International. Cambridge, U.K.
- Boggs CH 2001, 'Deterring albatrosses from contacting baits during swordfish longline sets', in Melvin EF and Parrish JK (eds.), *Seabird bycatch trends, roadblocks and solutions*, University of Alaska Sea Grant, AK-SG-01-01, Fairbanks.
- Brothers N 1991, 'Albatross mortality and associated bait loss in the Japanese longline fishery in the southern ocean', in *Biological Conservation* vol. 55, p. 255-268.
- Brothers NP, Cooper J and Løkkeborg S 1999, 'The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation', in FAO (eds.), *FAO Fisheries Circular 937*, FAO, Rome.
- Brothers N, Gales R and Reid T 2001, *The effect of line weighting on the sink rate of pelagic tuna longline hooks, and its potential for minimising seabird mortalities*, Unpublished conference report CCSBT-ERS/0111/53.
- Brothers N and Gilman E 2006, *Technical assistance for Hawaii pelagic longline vessels to change deck design and fishing practices to side set*, WPRFMC Honolulu, Hawaii.
- Bull LS 2007, 'Reducing seabird bycatch in longline, trawl and gillnet fisheries', in *Fish and Fisheries* vol. 8, p. 31–56.
- SC-CAMLR 2001, *Scientific Committee for the Conservation of Antarctic Marine Living Resources, Report of the 20th meeting of the Scientific Committee*, CCAMLR, Hobart.
- SC-CAMLR 2002, *Scientific Committee for the Conservation of Antarctic Marine Living Resources, Report of the 21st meeting of the Scientific Committee*, CCAMLR, Hobart.
- CCAMLR 2006, *Schedule for conservation measures in force, 2005–2006*, Commission for the Conservation of Antarctic Marine Living Resources, Hobart.
- Cherel Y, Weimerskirch H and Duhamel G 1996, 'Interaction between longline vessels and seabirds in Kerguelen waters and a method to reduce seabird mortality', in *Biological Conservation* vol. 75, p. 63–70.
- Commonwealth of Australia 2003, *Seabird interactions with longline fisheries in the Australian Fishing Zone: assessment report for the national plan of action for reducing the incidental catch of seabirds in longline fisheries*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, available at: <http://www.daff.gov.au>.
- Cooper, J and Ryan, PG 2004, *South African National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries*, Department of Environmental Affairs and Tourism, Cape Town, South Africa

Croxall JP and Gales RP 1998, 'An assessment of the conservation status of albatrosses', in Robertson G and Gales R (eds.), *Albatross: Biology and Conservation*, Surrey Beatty and Sons, Chipping Norton, p. 46–65

Department of Environment and Heritage 2006, *Threat Abatement Plan 2006 for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations*, Department of Environment and Heritage, Canberra, Australia.

Department of Fisheries, Western Australia 2005, *Application to the Australian Government Department of Environment and Heritage on the Western Australian Temperate Shark Fisheries*.

Department of Primary Industry, Fisheries and Mines 2006, *Fishery Status Reports 2006*, Fishery Report No. 87.

Dietrich KS, Cornish VR, Rivera KR and Conant TA 2004, *Best practices for the collection of longline data to facilitate research and analysis to reduce bycatch of protected Species*, Report of a workshop held at the International Fisheries Observer Conference Sydney, Australia, November 8, 2004.

Double M and Cocking L. In press.

DPIWE 2004, *Risk assessment of the Australian Fishing Zone: a spatial and temporal assessment of the risks to threatened seabirds from fisheries operations*, Report to Environment Australia. Nature Conservation Branch, Department of Primary Industries Water and Environment, Tasmania.

Duckworth K 1995, 'Analysis of factors which influence seabird bycatch in Japanese southern bluefin tuna longline fishery in New Zealand waters, 1989–1993', in *New Zealand Fisheries Assessment Research Document 95/26*.

Environment Australia 1998, *Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations*, Environment Australia, Canberra.

FAO 2008, *Report of the Expert Consultation on Best Practice Technical Guidelines for IPOA/NPOA–Seabirds*, FAO, Rome.

FAO 1999, *Food and Agriculture Organization of the United Nations. International plan of action for reducing incidental catch of seabirds in longline fisheries*, FAO, Rome.

Fletcher WJ and Santoro K (eds.) 2007, *State of the Fisheries Report 2006/07*, Department of Fisheries, Western Australia.

Gales R 1998, Albatross populations: status and threats, Robertson G and Gales R (eds.), in *Albatross: Biology and Conservation*, Surrey Beatty and Sons, Chipping Norton, p. 20–45

Gales R and Brothers N 1995, 'Characteristics of seabirds caught in the Japanese tuna longline fishery in the Australian region', First International Conference on the Biology and Conservation of Albatrosses, Hobart 28 August – 1 September 1995 (abstract) p 29.

Gales R and Brothers N 1996, 'Status and conservation of albatrosses on Macquarie Island', ANCA Report: SCA10636.

Gales R, Brothers N and Reid T 1998, 'Seabird mortality in the Japanese tuna longline fishery around Australia, 1988–1995', in *Biol Cons* vol. 86, p. 37–56.

Gilman E, Boggs C and Brothers N 2003a, 'Performance assessment of an underwater setting chute to mitigate seabird bycatch in the Hawaii pelagic longline tuna fishery', in *Ocean and Coastal Management*, vol. 46, p. 985–1010.

Gilman E, Brothers N, Kobayashi DR, Martin S, Cook J, Ray J, Ching G and Woods B 2003b, *Performance assessment of underwater setting chutes, side setting, and blue-dyed bait to minimize seabird mortality in Hawaii longline tuna and swordfish fisheries, Final report*, National Audobon Society.

- Gilman E, Brothers N and Kobayashi D 2005, 'Principles and approaches to abate seabird bycatch in longline fisheries', in *Fish and Fisheries* vol. 6, p. 35–49.
- González-Zevallos D and Yorio P 2006, 'Seabird use of discards and incidental captures at the Argentine hake trawl fishery in the Golfo San Jorge, Argentina', in *Marine Ecology Progress Series* vol. 316, p. 175–183.
- Hewitt T and Hay I 2007, *Experience with seabird bycatch limits in a trial of longline fishing in the Macquarie Island toothfish fishery*, CCAMLR WG-FSA-07/19
- Hu F, Shiga M, Yokota K, Shiode D, Tokai T, Sakai H and Arimoto T 2005, 'Effects of specifications of branch line on sinking characteristics of hooks in Japanese tuna longline', in *Nippon Suisan Gakkaishi* vol. 71, issue 1, p. 33–38.
- Imber MJ 1994, 'Report on a tuna longline fishing voyage abroad Southern Venture to observe seabird bycatch problems', in *Science and Research Series* 65, New Zealand Department of Conservation, Wellington.
- Kiyota M and Takeuchi Y 2004, *Estimation of incidental take of seabirds in the Japanese southern bluefin tuna longline fishery in 2001-2002*, Report prepared for the Commission for the Conservation of Southern Bluefin Tuna, CCSBT-ERS/0402/Info02.
- Klaer N and Polacheck T 1997, 'Bycatch of albatrosses and other seabirds by Japanese longline fishing vessels in the Australian Fishing Zone from April 1992 to March 1995', in *Emu* vol. 97, p. 150–167.
- Klaer N and Polacheck T 1998, 'The influence of environmental factors and mitigation measures on bycatch rates of seabirds in Japanese longline fishing vessels in the Australian region,' in *Emu* vol. 98, issue 4, p. 305–316.
- Kock KH 2001, 'The direct influence of fishing and fishery related activities on non-target species in the Southern Ocean with particular emphasis on longline fishing and its impact on albatrosses and petrels – a review', in *Review of Fish Biology and Fisheries*, vol.11, p. 31–56.
- Lack M 2007, *Behind the façade: A decade of inaction on non-target species in southern bluefin tuna fisheries*, WWF International, Gland, Switzerland.
- Larcombe J and McLoughlin K (eds.) 2007, *Fisheries status reports 2006: status of fish stocks managed by the Australian Government*, Bureau of Rural Sciences, Canberra.
- Larcombe J and Begg G (eds.) 2008, *Fishery status reports 2007: status of fish stocks managed by the Australian Government*, Bureau of Rural Sciences, Canberra.
- Lawrence E, Giannini F, Bensley N and Crombie J 2009, *Estimation of seabird bycatch rates in the Eastern Tuna and Billfish Fishery*, Bureau of Rural Sciences, Canberra.
- Lawrence E, Wise B, Bromhead D, Hindmarsh S, Barry S, Bensley N and Findlay J 2006, *Analyses of AFMA seabird mitigation trials-2001 to 2004*, Bureau of Rural Sciences. Canberra.
- Lawrence E, Giannini F, Bensley N and Crombie J 2009, *Estimation of seabird bycatch rates in the Eastern Tuna and Billfish Fishery*, Bureau of Rural Sciences. Canberra.
- Lawton K, Kirkwood R, Robertson G and Raymond B 2007, 'Preferred foraging areas of Heard Island albatrosses during chick raising and implications for the management of incidental mortality in fisheries', in *Aquatic Conservation: Marine and Freshwater Ecosystems* DOI: 10.1002/aqc.857.
- Lokkeborg S and Robertson G 2002, 'Seabird and longline interactions: effects of a bird-scaring streamer line and line shooter on the incidental capture of northern fulmars', in *Fulmarus glacialis. Biological Conservation*, vol. 106, p. 359–364.

- Lokkeborg S 2003, 'Review and evaluation of three mitigation measures – bird-scaring line, underwater setting and line shooter – to reduce seabird bycatch in the north Atlantic longline fishery', in *Fisheries Research*, vol. 60, p. 11–16.
- Lydon G and Starr P 2005, 'Effect of blue dyed bait on incidental seabird mortalities and fish catch rates in a commercial longliner fishing off East Cape, New Zealand', Unpublished report held by Conservation Services Programme, New Zealand Department of Conservation, Wellington..
- McNamara B, Torre L and Kaaialii G 1999, 'Hawaii longline seabird mortality mitigation project. Final report to Western Pacific Regional Fisheries Management Council (WESPAC)', Honolulu, Hawaii (unpublished).
- Minami H and Kiyota M 2001, *Effect of blue-dyed bait on reduction of incidental take of seabirds*, CCSBT-ERS/0111/61.
- Minami H and Kiyota M 2004, 'Effect of blue-dyed bait and tori-pole streamer on reduction of incidental take of seabirds in the Japanese southern bluefin tuna longline fisheries', unpublished conference report CCSBT-ERS/0402/08.
- Melvin EF, Parrish JK, Dietrich KS and Hamel OS 2001, 'Solutions to seabird bycatch in Alaska's demersal longline fisheries', Washington Sea Grant Programme A/FP7.
- Melvin EF 2003, 'Streamer lines to reduce seabird bycatch in longline fisheries', Washington Sea Grant Program, WSG-AS 00–33.
- Melvin EF, Sullivan B, Robertson G and Wienecke B 2004 'A review of the effectiveness of streamer lines as a seabird bycatch mitigation technique in longline fisheries and CCAMLR streamer line requirements', *CCAMLR Science* vol.11, p. 1–13.
- Melvin EF and Baker GB 2006, 'Summary report: seabird bycatch mitigation in pelagic longline fisheries workshop', Museum of Natural History, Royal Society Room, Hobart, Tasmania, October 14, 2006.
- Moreno CA, Arata JA, Rubilar P, Hucke-Gaete R and Robertson G 2006, 'Artisanal longline fisheries in Southern Chile: Lessons to be learned to avoid incidental seabird mortality', in *Biological Conservation*, vol.127, p. 27–36.
- Murray TE, Bartle JA, Kalish SR and Taylor PR 1993, 'Incidental capture of seabirds in Japanese Southern Bluefin Tuna longline vessels in New Zealand waters 1998–1992', in *Bird Conser. Int.* 3, p. 181–210.
- Moreno, CA, Vega, R, Ruiz, H and Flores, H 2007, 'Albatross Task Force, Chile, Activity Report, April-September 2007', Unpublished report.
- National Oceans Office 2002, *Ocean Management – The Legal Framework, The South East Regional Marine Plan Assessment Reports*, National Oceans Office, Tasmania.
- SARDI 2009, Map of the Marine Scalefish Fishery, accessed 13 July 2009, at http://www.sardi.sa.gov.au/__data/assets/image/0018/46044/stats_msfmap.jpg.
- Rivera, K 2000, *Incidental Catch of Seabirds in Longline Fisheries: Guidelines for Colonial Waterbird Conservation Practicioners (Guide for Colonial Waterbird Conservation Practicioners)*, National Marine Fisheries Service, Juneau, Alaska.
- Robertson G and Gales R (eds.) 1998, *Albatross biology and conservation*, Surrey Beatty and Sons. Australia.
- Robertson G 2003, *Fast-sinking lines reduce seabird mortality in longline fisheries*, Australian Antarctic Division, Tasmania.
- Robertson G, McNeill M, Smith N, Wienecke B, Candy S and Olivier F 2006, 'Fast sinking (integrated weight) longlines reduce mortality of white-chinned petrels (*Procellaria aequinoctialis*)

- and sooty shearwaters (*Puffinus griseus*) in demersal longline fisheries', in *Biological Conservation*.
- QDPI&F 2006a, *Annual status report deepwater fin fish fishery 2006*, Department of Primary Industries and Fisheries, Queensland.
- QDPI&F 2006b, *Annual status report Gulf of Carpentaria line fishery 2006*, Department of Primary Industries and Fisheries, Queensland.
- QDPI&F 2007, *Annual status report coral reef finfish fishery 2006*, Department of Primary Industries and Fisheries, Queensland.
- Sakai H, Fuxiang H and Arimoto T 2004, *Underwater setting device for preventing incidental catches of seabirds in tuna longline fishing*, CCSBT-ERS/0402/Info06.
- SC-CAMLR 2005, *Report of the twenty-fourth meeting of the Scientific Committee of the Commission for the Conservation of Marine Living Resources*, Commission for the Conservation of Marine Living Resources, Hobart.
- SC-CAMLR 2007, *Report of the 26th meeting of the Scientific Committee of the Commission for the Conservation of Marine Living Resources*, CCAMLR, Hobart.
- SC-CAMLR 2007, *Report of the 26th meeting of the Scientific Committee of the Commission for the Conservation of Marine Living Resources*, CCAMLR, Hobart.
- Small C 2005, *Regional fisheries management organisations: their duties and performance in reducing bycatch of albatrosses and other species*, BirdLife Global Seabird Program, BirdLife International, Cambridge.
- Sullivan B 2004, *Falkland Island plan of action for reducing incidental catch of seabirds in trawl fisheries*, Falklands Conservation, Stanley.
- Sullivan B and Reid T 2002, *Seabird interactions/mortality with longliners and trawlers in the Falkland/Malvinas Island Waters 2001/02*, CCAMLR WG-FSA-02/36.
- Sullivan BJ and Reid TA 2003, *Seabird mortality and Falkland Island trawling fleet 2002/03*, WG-FSA-03/91, CCAMLR, Hobart.
- Sullivan BJ, Reid TA and Bugoni L 2006a, 'Seabird mortality on factory trawlers in the Falkland Islands and beyond', in *Biological Conservation*, vol. 131, p. 495-504.
- Sullivan BJ, Brickle P, Reid TA, Bone DG and Middleton DAJ 2006b, 'Mitigation of seabird mortality on factory trawlers: trials of three devices to reduce warp cable strikes', in *Polar Biology*, vol. 29, issue 9, p. 745–753.
- Uozumi Y and Takeuchi Y 1998, *Influence of tori pole on incidental catch rate of seabirds by Japanese southern bluefin tuna longline fishery in high seas*, CCSBT-WRS/9806/9 revised.
- Watkins BP, Petersen SL and Ryan PG 2006, *Interactions between seabirds and deep water hake trawl gear: an assessment of impacts in South African waters 2004/05*, WG-FSA-06/41, SC-CAMLR XXV, CCAMLR, Hobart, Australia.
- Waugh SM, Baker GB, Gales R and Croxall JP 2008, 'CCAMLR process of risk assessment to minimise the effects of longline fishing mortality on seabirds', in *Marine Policy*, vol. 32, p. 442–454. doi:10.1016/j.marpol.2007.08.011
- Weimerskirch H and Jouventin P 1987, 'Population dynamics of the wandering albatross, *Diomedea exulans*, of the Crozet Islands: causes and consequences of the population decline', in *OIKOS*, vol. 49, p. 315–322.
- Weimerskirch H, Capdeville D and Duhamel G 2000, 'Factors affecting the number and mortality of seabirds attending trawlers and longliners in the Kerguelen area', in *Polar Biology*, vol. 23, p. 236–249.

Wienecke B and Robertson G 2002, 'Seabird and seal – fisheries interactions in the Australian Patagonian Toothfish *Dissostichus eliginoides* trawl fishery', in *Fisheries Research*, vol. 54, p. 252–265.

Yokota K and Kiyota M 2006, *Preliminary report of side-setting experiments in a large sized longline vessel*, Report to WCPFC Scientific Committee Manila, Philippines. SC2-2006/EB WP-15.

Appendix 1: List of abbreviations and acronyms

ACAP	Agreement on the Conservation of Albatrosses and Petrels
AAD	Australian Antarctic Division
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
BAP	Bycatch Action Plan
BRS	Bureau of Rural Sciences
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CCSBT	Convention for the Conservation of Southern Bluefin Tuna
CMS	Convention for the Conservation of Migratory Species of Wild Animals
COFI	FAO Committee on Fisheries
DPIW	Tasmanian Department of Primary Industries and Water
EEZ	Exclusive Economic Zone
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FAO	Food and Agriculture Organization of the United Nations
HIMI	Heard Island and McDonald Islands
ICCAT	International Commission for the Conservation of Atlantic Tunas
IMAF	Incidental Mortality Arising from Fishing Working Group of CCAMLR
IOTC	Indian Ocean Tuna Commission
IPOA	International Plan of Action
OCS	Offshore Constitutional Settlement
NHT	Natural Heritage Trust
NPOA	National Plan of Action
RFMO	Regional Fisheries Management Organisations
TAC	Total Allowable Catch
TAP	Threat Abatement Plan
UN	United Nations
VMS	Vessel Monitoring System
WCPCF	Western and Central Pacific Fisheries Commission

Appendix 2: Summary of the seabirds affected by longline fishing bycatch in the AFZ

Species name	International conservation status (BirdLife International 2004)	EPBC Act listing	Likely incidence in longline bycatch ³
Wandering albatross <i>Diomedea exulans</i>	Vulnerable	Vulnerable	Moderate
Antipodean albatross <i>Diomedea antipodensis</i>	Vulnerable (Croxall & Gales 1998)	Vulnerable	Low
Gibson's albatross <i>Diomedea gibsoni</i>	Vulnerable (Croxall & Gales 1998)	Vulnerable	Moderate
Tristan albatross <i>Diomedea dabbenena</i>	Endangered	Endangered	Low
Amsterdam albatross <i>Diomedea amsterdamensis</i>	Critically Endangered	Endangered	Low
Southern royal albatross <i>Diomedea epomophora</i>	Vulnerable	Vulnerable	Low
Northern royal albatross <i>Diomedea sanfordi</i>	Endangered	Endangered	Low
Black-browed albatross <i>Thalassarche melanophrys</i>	Endangered	Vulnerable	High
Campbell albatross <i>Thalassarche impavida</i>	Vulnerable	Vulnerable	High
Buller's albatross <i>Thalassarche bulleri</i>	Vulnerable	Vulnerable	Low
Pacific albatross <i>Thalassarche nov. sp.</i>	Vulnerable (Croxall & Gales 1998)	Vulnerable	Low
Shy albatross <i>Thalassarche cauta</i>	Vulnerable (Croxall & Gales 1998)	Vulnerable	Moderate
White-capped albatross <i>Thalassarche steadi</i>	Vulnerable (Croxall & Gales 1998)	Vulnerable	Moderate
Salvin's albatross <i>Thalassarche salvini</i>	Vulnerable	Vulnerable	Low
Chatham albatross <i>Thalassarche eremita</i>	Critically Endangered	Endangered	Low

³ Department of Environment and Heritage, 2006.

Species name	International conservation status (BirdLife International 2004)	EPBC Act listing	Likely incidence in longline bycatch³
Atlantic yellow-nosed albatross <i>Thalassarche chlororhynchos</i>	Endangered	Not listed	Low
Indian yellow-nosed albatross <i>Thalassarche carteri</i>	Endangered	Vulnerable	Moderate
Laysan albatross <i>Phoebastria immutabilis</i>	Vulnerable	Not listed	Low
Sooty albatross <i>Phoebastria fusca</i>	Endangered	Vulnerable	Low
Light-mantled albatross <i>Phoebastria palpebrata</i>	Near Threatened	Not listed	Low
Southern Giant Petrel <i>Macronectes giganteus</i>	Vulnerable	Endangered	Low
Northern Giant Petrel <i>Macronectes halli</i>	Lower Risk – Near Threatened	Vulnerable	Low
Great-winged Petrel <i>Pterodroma macroptera</i>	Not listed	Not listed	Moderate
White-chinned Petrel <i>Procellaria aequinoctialis</i>	Vulnerable	Not listed	Moderate
Westland Black Petrel <i>Procellaria westlandica</i>	Vulnerable	Not listed	Low
Black Petrel <i>Procellaria parkinsonia</i>	Vulnerable	Not listed	Low
Grey Petrel <i>Procellaria cinerea</i>	Near Threatened	Not listed	Moderate
Wedge-tailed shearwater <i>Puffinus pacificus</i>	Not listed	Not listed	Moderate
Flesh-footed shearwater <i>Puffinus carneipes</i>	Not listed	Not listed	High
Sooty shearwater <i>Puffinus griseus</i>	Near Threatened	Not listed	Low
Short-tailed shearwater <i>Puffinus tenuirostris</i>	Not listed	Not listed	Low
Southern Skua <i>Catharacta antarctica</i>	Not listed	Not listed	Low

Appendix 3: Known seabird bycatch mitigation measures for Pelagic Longline Fishing⁴

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Night setting	Duckworth 1995; Gales et al. 1998; Klaer & Polacheck 1998; Brothers et al. 1999; Brothers et al. 1999; McNamara et al. 1999; Gilman et al. 2005; Baker & Wise 2005.	Less effective during full moon, under intensive deck lighting or in high latitude fisheries in summer. Less effective on nocturnal foragers e.g. White-chinned Petrels (Cherel et al. 1996; Brothers et al. 1999).	Recommend combination with bird scaring lines and/or weighted branch lines.	Data on current time of sets by WCPFC fisheries. Effect of night sets on target catch for different fisheries.	Night defined as nautical dark to nautical dawn. Setting restricted to the hours between nautical dusk and nautical dawn, as set out in the Nautical Almanac tables for the relevant latitude, local time and date.

⁴ Reproduced from Birdlife International 'review of seabird bycatch mitigation measures listed in the seabird recommendation from the WCPFC Scientific Committee'.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Side setting	Brothers & Gilman 2006; Yokota & Kiyota 2006.	Only effective if hooks are sufficiently below the surface by the time they reach the stern of the vessel. In Hawaii, side setting trials were conducted with bird curtain and 45-60 g weighted swivels placed within 0.5 m of hooks. Japanese research concludes it must be used with other measures (Yokota & Kiyota 2006).	Must be combined with other measures. Successful Hawaii trials use bird curtain plus weighted branch lines. In Southern Hemisphere, strongly recommend use with bird scaring lines until side setting is tested in the region.	Currently untested in the southern ocean against seabird assemblages of diving seabirds and albatrosses – urgent need for research. In Japan, NRIFSF will continue testing in 2007.	In Hawaii, side setting is used in conjunction with a bird curtain and 45 weighted swivel within 1m of the baited hook. Clear definition of side setting is required. Hawaiian definition is a minimum of 1 m forward of the stern.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Single bird scaring line	Imber 1994; Klaer & Polacheck 1998; Uozomi & Takeuchi 1998; Brothers et al. 1999; McNamara et al. 1999; Boggs 2001; CCAMLR 2002; Melvin 2003; Minami & Kiyota 2004.	Effective only when streamers are positioned over sinking baits. In pelagic fisheries, baited hooks are unlikely to sink beyond the diving depths of diving seabirds within the 150 m zone of the bird scaring line, unless combined with other measures such as line weighting or underwater setting. Entanglement with fishing gear can lead to poor compliance by fishers and design issues need to be addressed. In crosswinds, bird scaring lines must be deployed from the windward side to be effective.	Effectiveness increased when combined with other measures e.g. weighted branch lines and/or night setting.	Optimal design for pelagic fisheries under development: refine to minimise tangling, optimise aerial extent and positioning, and ease hauling/retrieval. Two studies in progress developing optimal bird scaring lines for pelagic fisheries including Washington Sea Grant and Global Guardian Trust in Japan. Controlled studies demonstrating their effectiveness in pelagic fisheries remain very limited.	A minimum aerial coverage of 100 m is required for this measure to be effective. Deployment should occur prior to longlines entering the water. Current minimum standards for pelagic fisheries are based on CCAMLR Conservation Measure 25-02.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Paired bird scaring lines	Two streamer lines best in crosswinds to maximise protection of baited hooks (Melvin et al. 2004).	Potentially increased likelihood of entanglement – see above. Development of a towed device that keeps gear from crossing surface gear essential to improve adoption and compliance.	Effectiveness will be increased when combined with other measures. Recommend use with weighted branch lines and/or night setting.	Development and trialling of paired bird scaring line systems for pelagic fisheries.	Current minimum standards for pelagic fisheries are based on CCAMLR Conservation Measure 25-02.
Weighted branch lines	Brothers 1991; Boggs 2001; Brothers et al. 2001; Sakai et al. 2001; Anderson & McArdle 2002; Lokkeborg & Robertson 2002; Gilman et al. 2003a; Robertson 2003; Hu et al. 2005.	Supplementary measure. Weights will shorten but not eliminate the zone behind the vessel in which birds can be caught. Even in demersal fisheries where weights are much heavier, weights must be combined with other mitigation measures (e.g. CCAMLR Conservation Measure 25-02).	Must be combined with other measures e.g. bird scaring lines and/or night setting.	Mass and position of weight both affect sink rate. Further research on weighting regimes needed. Testing of safe-leads in progress. Where possible, effect on target catch, as well as seabird bycatch should be evaluated. Research on use of integrated-weight branch lines (wire trace) in pelagic fisheries also needs further exploration.	Global minimum standards not yet established. Requirements now vary by fishery and vessel. Hawaii minimum requirements are 45 g less than 1 m from hook. Australia requires 60 g placed < 3 m from hook; or 100 g placed < 4 m from hook.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Blue dyed bait	Brothers 1991; Boggs 2001; Minami & Kiyota 2001; Gilman et al. 2003a; Minami & Kiyota 2004; Lydon & Starr 2005. Double & Cocking, in press.	New data suggests only effective with squid bait (Double & Cocking). Onboard dyeing requires labour and is difficult under stormy conditions. Results inconsistent across studies.	Must be combined with bird scaring lines or night setting.	Need for tests in Southern Ocean.	Mix to standardised colour placard or specify (e.g. use 'Brilliant Blue' food dye (Colour Index 42090, also known as Food Additive number E133) mixed at 0.5% for a minimum of 20 minutes).
Line shooter	Reduced bycatch of Northern Fulmar in trials of mitigation measures in North Sea, Lokkeborg & Robertson 2002; Lokkeborg 2003. Increased seabird bycatch in Alaska (Melvin et al. 2001).	Supplementary measure. No published data for pelagic fisheries. May enhance hook sink rates in some situations but unlikely to eliminate the zone behind the vessel in which birds can be caught. More data needed. Found ineffective in trials in north Pacific demersal longline fishery (Melvin et al. 2001).	Must be combined with other measures such as night setting and/or bird scaring lines or weighted branch lines.	Data needed on effects on hook sink rates in pelagic fisheries.	Not established.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Bait caster	Duckworth 1995; Klaer & Polacheck 1998.	Not a mitigation measure unless casting machines are available with the capability to control the distance at which baits are cast. This is necessary to allow accurate delivery of baits under a bird scaring line. Needs more development. Few commercially-available machines have this capability.	Not recommended as a mitigation measure.	Not a priority.	Not applicable.
Underwater setting chute	Brothers 1991; Boggs 2001; Gilman et al. 2003a; Gilman et al. 2003b; Sakai et al. 2004; Lawrence et al. 2006.	For pelagic fisheries, existing equipment not yet sturdy enough for large vessels in rough seas. Problems with malfunctions and performance inconsistent (e.g. Gilman et al. 2003a and Australian trials cited in Baker & Wise 2005).	Not recommended for general application.	Design problems to overcome.	Not yet established.

Mitigation measure	Scientific evidence for effectiveness in pelagic fisheries	Caveats /Notes	Need for combination	Research needs	Minimum standards
Management of offal discharge	McNamara et al. 1999; Cherel et al. 1996.	Supplementary measure. Definition essential. Offal attracts birds to vessels and where practical should be eliminated or restricted to discharge when not setting or hauling. Strategic discharge during line setting can increase interactions and should be discouraged. Offal retention and/or incineration may be impractical on small vessels.	Must be combined with other measures.	Further information needed on opportunities and constraints in pelagic fisheries (long- and short-term).	Not yet established for pelagic fisheries. In CCAMLR demersal fisheries, discharge of offal is prohibited during line setting. During line hauling, storage of waste is encouraged, and if discharged must be discharged on the opposite side of the vessel to the hauling bay.
Thawing bait	Brothers 1991; Duckworth 1995; Klaer & Polacheck; Brothers et al 1999.	Supplementary measure. Must be combined with other measures. If lines are set early morning, full thawing of all bait may create practical difficulties.	Must be combined with other measures.	Evaluate sink rate of partially thawed bait.	

Appendix 4: Seabird and fish species names

Seabird names

Species	Scientific name
Abbott's booby	<i>Papasula abbotti</i>
Amsterdam albatross	<i>Diomedea amsterdamensis</i>
Antipodean albatross	<i>Diomedea antipodensis</i>
Atlantic yellow-nosed albatross	<i>Thalassarche chlororhynchos</i>
Australasian gannet	<i>Morus serrator</i>
Black-browed albatross	<i>Thalassarche melanophrys</i>
Buller's albatross	<i>Thalassarche bulleri</i>
Campbell albatross	<i>Thalassarche impavida</i>
Cape petrel	<i>Daption capense</i>
Chatham albatross	<i>Thalassarche eremita</i>
Christmas Island frigatebird	<i>Fregata andrewsi</i>
Cormorant	<i>Phalacrocorax spp.</i>
Flesh-footed shearwater	<i>Puffinus carneipes</i>
Gibson's albatross	<i>Diomedea gibsoni</i>
Great skua	<i>Catharacta skua</i>
Great-winged petrel	<i>Pterodroma macroptera</i>
Grey petrel	<i>Procellaria cinerea</i>
Grey-headed albatross	<i>Thalassarche chrysostoma</i>
Indian yellow-nosed albatross	<i>Thalassarche bassi</i>
Laysan albatross	<i>Phoebastria immutabilis</i>
Light-mantled sooty albatross	<i>Phoebetria palpebrata</i>
Little penguin	<i>Eudyptula minor</i>
Northern fulmar	<i>Fulmarus glacialis</i>
Northern giant-petrel	<i>Macronectes halli</i>
Northern royal albatross	<i>Diomedea sanfordi</i>
Pacific albatross	<i>Thalassarche nov.spp. (platei)</i>
Pacific gull	<i>Larus pacificus</i>
Salvin's albatross	<i>Thalassarche salvini</i>
Short-tailed shearwater	<i>Puffinus tenuirostris</i>
Shy albatross	<i>Thalassarche cauta</i>
Sooty albatross	<i>Phoebetria fusca</i>
Sooty shearwater	<i>Puffinus griseus</i>

Southern giant-petrel	<i>Macronectes giganteus</i>
Southern royal albatross	<i>Diomedea epomophora</i>
Tristan albatross	<i>Diomedea dabbenena</i>
Wandering albatross	<i>Diomedea exulans</i>
Wedge-tailed shearwater	<i>Puffinus pacificus</i>
Westland petrel	<i>Procellaria westlandica</i>
White-capped albatross	<i>Thalassarche steadi</i>
White-chinned petrel	<i>Procellaria aequinoctialis</i>

Fish names

Species	Scientific name
Albacore tuna	<i>Thunnus alalunga</i>
Amberjack	<i>Seriola dumerili</i>
Antarctic toothfish	<i>Dissosticchus mawsoni</i>
Arrow squid	<i>Nototadarus gouldi</i>
Australian salmon	<i>Arripis trutta</i>
Baldchin groper	<i>Choerodon rubescens</i>
Bar cod	<i>Epinephelus ergastularius</i>
Barracouta	<i>Thyrsites atun</i>
Barramundi	<i>Lates calcarifer</i>
Bigeye tuna	<i>Thunnus obesus</i>
Blacktip shark	<i>Carcharinus tilstoni and C. sorrah</i>
Blue eye trevalla	<i>Hyperoglyphe antarctica</i>
Blue grenadier	<i>Macruronus novaezelandiae</i>
Blue wharehou	<i>Seriolella brama</i>
Bonito	<i>Sarda australis</i>
Bony fish	Class <i>Osteichthyes</i>
Broadbill swordfish	<i>Xiphias gladius</i>
Bronze whalershark	Family <i>Carcharhinidae</i>
Calamari	<i>Sepioteuthis australis</i>
Cobia (Black kingfish)	<i>Rachycentron canadum</i>
Cod	Family <i>Serranidae</i>
Commercial scallop	<i>Pecten furnatus</i>
Coral trout	<i>Plectropomus leopardus</i>
Deep sea trevalla	<i>Hyperoglyphe antarctica</i>

Dhufish	<i>Glaucosoma hebraicum</i>
Dolphinfish (Mahi Mahi)	<i>Coryphaena hippurus</i>
Doughboy scallop	<i>Mirnachlarnys asperrimus</i>
Dusky shark	<i>Carcharhinus obscurus</i>
Eight-bar cod	<i>Epinephelus octofasciatus</i>
Emperor	<i>Lethrinus</i> spp.
Flame snapper	<i>Etelis coruscans</i>
Garfish	<i>Hemiramphidae</i> spp.
Gemfish	<i>Rexea solandri</i>
Goldband snapper	<i>Pristipomoides multidentis</i>
Grey mackerel	<i>Scomberomorus semifasciatus</i>
Gummy shark	<i>Mustelus antarcticus</i>
Hammerhead shark	Family <i>Sphyrnidae</i>
Hapuka	<i>Polyprion oxygeneios</i>
King George whiting	<i>Sillaginodes punctata</i>
Leatherjacket	Family <i>Monacanthidae</i>
Marlin spp.	<i>Maikaira</i> spp.
Moorwong	<i>Nemadactylus gouglasii</i>
Mulloway	<i>Argyrosomus hololepidotus</i> / <i>A. japonicus</i>
Orange roughy	<i>Hoplostethus atlanticus</i>
Patagonian toothfish	<i>Dissostichus eleginoides</i>
Pearl perch	<i>Glaucosoma scapulare</i>
Pink ling	<i>Genypterus blacodes</i>
Pink snapper	<i>Pagrus auratus</i>
Queen scallop	<i>Equichlarnys bifrons</i>
Rays	Class <i>Chondrichthyes</i>
Red emperor	<i>Lutianus sebae</i>
Red snapper	<i>Lutjanus erythropterus</i>
Rosy jobfish	<i>Pristipomoides filamentosus</i>
Ruby snapper	<i>Etelis carbunculus</i>
Samsonfish	<i>Seriola hippos</i>
Sandbar shark	<i>Carcharhinus plumbeus</i>
School shark	<i>Gaeorhinus galeus</i>
Silver Trevally	<i>Pseudocaranx dentex</i>
Snapper	<i>Pagrus auratus</i>
Southern bluefin tuna	<i>Thunnus maccoyii</i>

Southern rock lobster	<i>Jasus edwardsii</i>
Spanish Mackerel	<i>Scomberomeros commerson</i>
Spanner crab	<i>Ranina ranina</i>
Striped marlin	<i>Tetrapturus audax</i>
Teraglin	<i>Atractoscion aequidens</i>
Tiger shark	<i>Galeocerdo cuvier</i>
Western rock lobster	<i>Panulirus cygnus</i>
Whiskery shark	<i>Furgaleus macki</i>
Yellowfin tuna	<i>Thunnus albacares</i>
Yellowtail kingfish	<i>Serioli lalandi</i>