Progress on Developing Australia's National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries.

Australia has made an international commitment through the Food and Agriculture Organisation of the United Nations (FAO) to undertake an assessment on all its longline fisheries to determine whether seabird interactions occur, and to develop a *National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries* (NPOA-Seabirds) if it is deemed there is a need.

The Australian Government has recently completed an assessment on *Seabird Interactions in Longline Fisheries in the Australian Fishing Zone.* It reviews and assesses each Australian longline fishery and its interactions with seabirds. It also provides a summary of mitigation measures implemented and trialed in Australia to date. This assessment will be used as a basis for developing Australia's NPOA-Seabirds. A draft assessment report was made available for public comment in September 2002. The assessment report is attached.

Australia has already considered the issue of seabird bycatch in its Australian Government-managed longline fisheries. A *Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fisheries operations* (the TAP) was released in 1998 under the then *Endangered Species Protection Act 1992* (now legislated through the *Environment Protection and Biodiversity Conservation Act 1999* – EPBC Act) outlining measures to reduce these interactions, and is binding on all Australian Government agencies. Fisheries regulations developed by the Australian Fisheries Management Authority were gazetted to meet the TAP requirements.

State-managed longline fisheries are not required to abide by the TAP but it will be necessary for them to participate in the NPOA-Seabirds, as it will be a national plan. The State governments are currently required to consider the issue of all bycatch in the environment assessments of export fisheries under the EPBC Act, as well as under their own State environment legislation.

We have established a Seabirds Stakeholder Reference Group (SRG) to develop the NPOA-Seabirds based on the information presented in the assessment report. The SRG is made up of all relevant State and Australian Government agencies, fishing associations, conservation groups and scientists.

It is envisaged that the actions under the TAP will become the actions under the NPOA-Seabirds for Australian Government-managed longline fisheries. The State-managed longline fisheries will be requested to consider the issue of seabird bycatch and suitable actions in the development of the NPOA-Seabirds.

Australian Government

Department of Agriculture, Fisheries and Forestry

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

Part 1– Review and Assessment of Bycatch
Part 2 – Evaluation of Mitigation Measures

June 2003

Australian Government

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Prepared by the Australian Government Department of Agriculture, Fisheries and Forestry; the Department of Primary Industries, Water and the Environment, Tasmania; the Australian Government Department of the Environment and Heritage; and, the Australian Fisheries Management Authority.

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Shy Albatross image courtesy of Department of Primary Industries, Water and the Environment, Tasmania.

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Editors: Ms Louise Galli and Ms Lyn Brown (DAFF).

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I SCOPE

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 IPOAs that have been developed to date include: *IPOA for the Conservation and Management of Shark; IPOA for the Management of Fishing Capacit;* and the *IPOA to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. The IPOAs 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 States to cooperate to ensure conservation and provides a framework for cooperation. Similarly, the IPOA-Seabirds is consistent with the objectives of the Convention on Migratory Species, under which seabirds are listed.

By endorsing the IPOA-Seabirds, member countries, such as Australia, undertook to prepare National Plans of Action (NPOAs) to address seabird bycatch nationally, thereby achieving a degree of global action.

The IPOA-Seabirds complements environmental laws in this country, 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 provides the framework for coordinating action to reduce impacts of longline fishing activities on seabirds in Australian waters. In February 2001, Australian Government fisheries regulations were gazetted which prescribe measures to minimise the likelihood of interactions. The regulations recognize that the main area of concern for seabird bycatch is in waters south of latitude 30˚S. The regulations state that longline operators in this area must: set their longlines at night, when seabirds are less active; thaw their baits so they sink faster thereby reducing the time baits are visible to seabirds; carry a 'tori pole' device to scare seabirds; and adhere to the conditions set for discharging offal from fishing vessels to avoid attracting seabirds.

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 TAP is due to be reviewed in 2003 and its actions brought up to date.

Preparation of an NPOA-Seabirds will entail development of:

- a series of objectives which lie under the broad objective of the IPOA which is to reduce the incidental catch of seabirds in longline fisheries where this occurs
- a set of actions to meet those objectives. These actions will identify a priority or timeframe and the responsible management agency
- an evaluation process so that progress may be monitored and performance assessed each three to four years.

The NPOA-Seabirds will incorporate any new technical information relating to Australian Government-managed fisheries since the TAP was developed, address any issues in State-managed fisheries, evaluate more recent developments in mitigation measures and identify emerging issues relevant to seabird bycatch. As such, the NPOA-Seabirds will extend the framework for action provided through the TAP. This document represents the first step in the development of Australia's NPOA-Seabirds by reviewing levels of bycatch to serve as the basis for future or additional actions, as envisaged by the IPOA-Seabirds.

II INTRODUCTION

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 albatross and petrel species. 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.* 1999a). 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.

National Measures

On 24 July 1995, the incidental catch of seabirds during oceanic longline fishing was declared a key threatening process by the Australian Government under the then *Endangered Species Protection Act 1992*. As a requirement of this listing, a *Threat Abatement Plan for the incidental catch (or by-catch) of seabirds during oceanic longline fishing operations* (the TAP) was released in 1998, which provides the framework for coordinating action to reduce the impact of longline fishing activities on seabirds in Australian waters. The TAP is now legislated through the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The target objective of the TAP is to reduce seabird bycatch in longline fisheries to less than 0.05 seabirds per thousand hooks within the five year life of the Plan by implementing a number of actions:

- prescribing appropriate mitigation measures
- providing for the development of new mitigation measures
- educating
- collecting data on longline fishery interactions with seabirds.

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

A package of fishery regulations identified through the TAP was introduced into Australian Government longline fisheries in February 2001, which prescribe measures to minimise the likelihood of interactions. These will be outlined in the NPOA-Seabirds.

More recently, a *Recovery Plan for Albatrosses and Giant-Petrels* was released in October 2001 (See Appendix 5). 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 maximize 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".

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 identify bycatch issues, data requirements, options and possible solutions for each fishery. Similarly, Western Australia released the *Western Australian Policy on Fisheries Bycatch in 1999*, which also requires the development of fishery-specific BAPs.

Further to this initiative, under the EPBC Act, strategic environmental assessments must be carried out and approved by the Minister for the Environment and Heritage by 1 December 2004 on all fisheries with an export component and 16 July 2005 for all other Australian Government fisheries. These assessments will include an explanation of the form of data collection, assessment and management responses in place in each fishery for target, byproduct and bycatch species and the broader environment. The assessments include interactions with species listed under Part 13 of the EPBC Act that are threatened or migratory, such as albatrosses and petrels. The relevant impacts of actions taken under a management plan for a fishery on the marine environment are to be assessed. The outcomes of the assessment must be addressed in the management plan or management arrangements for each fishery. Similarly, State or Territory managed fisheries that have or are likely to have a significant impact on a matter of National Environmental Significance may require approval under the EPBC Act. This includes interactions with listed threatened or migratory species, such as albatrosses and petrels.

International Measures

Over the past several years, Australia has led the development of a southern hemisphere regional agreement for the conservation of seabirds. The *Agreement on the Conservation of Albatrosses and Petrels* under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) was opened for signature on 19 June 2001. As at June 2003, the Agreement has been signed by Australia (ratified), Brazil, Chile, France, New Zealand (ratified), Peru, Spain, Ecuador (ratified) and the United Kingdom. The Agreement includes an assessment of the effects of mortality on individual populations, coordinating and exchanging information across jurisdictions, monitoring risk and threats over an entire range of a species and standardising data collection and risk assessment methodologies. The Agreement requires ratification by at least five countries before it comes into effect.

There are, however, other regional agreements that include specific actions for seabird protection, which have already been implemented. In 1992, the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) introduced measures recommending the use of bird-scaring lines (tori poles) and night setting for the 23 member States. Similarly, in 1995 the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) made the use of bird lines mandatory on fishing vessels of the member States (Japan, New Zealand, Australia, Korea and Fishing Entity of Taiwan).

Out of recognition of the scale of seabird bycatch and the need for global action, in 1997 the FAO commissioned expert consultation to develop guidelines for the reduction of incidental seabird catches (Brothers *et al*. 1999a). From this consultation, an *International Plan of Action for reducing incidental catch of seabirds in longline fisheries* (IPOA-Seabirds) was developed (FAO 1999). As part of this plan, each member State of the FAO has agreed to develop and adopt a National Plan of Action for reducing the incidental catch of seabirds in longline fisheries (NPOA-Seabirds).

A staged approach has been taken in the development of Australia's NPOA-Seabirds:

- This Assessment Report, which will review and assess each Australian longline fishery and its interaction with seabirds, plus provide a summary of mitigation measures implemented and trialed to date.
- Drafting of the NPOA-Seabirds, which will include actions to promote seabird bycatch mitigation.

The information in this Assessment Report is presented in four sections: a review of longline fisheries in Australia; a review of seabird biology and what makes them vulnerable to bycatch; an assessment of seabird fishery interactions; a review of mitigation measures that have been trialed; and recommendations for solving the problem of seabird bycatch.

Fishery descriptions and assessments of seabird interactions reported in this paper were obtained from each respective fishery management body and research data, where available.

Part 1 – Review and Assessment of Bycatch

III AUSTRALIAN LONGLINE FISHING METHODS

There are a number of different longline fishing techniques, however all involve 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.

Longlining methods can be grouped into surface set and bottom set longlines. These methods are described by Alexander *et al.* (1997) as follows:

Pelagic (Surface Set) Longlining

Surface set longlining involves a single longline up to 60 nautical miles in length holding between 600 and 3000 branch lines each about six metres in length terminating in a baited hook. The average set is 800–1000 hooks per shot. Hooks are usually suspended 35–150 metres below the surface of the water from lines suspended by floats depending on the phase of the moon (AFMA observer data) (see figure 1 below). This method is mainly used to target various species of tuna and broadbill.

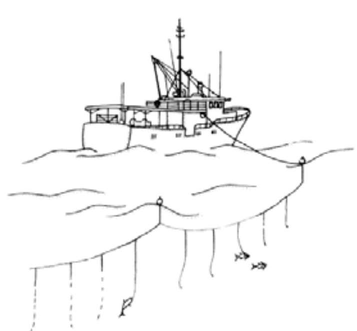


Figure 1: Diagram of pelagic longline fishing method (Diagram from Genetic Prints).

Demersal (Bottom Set) Longlining

Bottom-set longlines are principally used to target ling (*Genypterus* spp) and gummy shark (*Mustelos antarcticus*) in the Australian Fishing Zone (AFZ). Bottom-set longlines may be set in water depths ranging from 100–2500 metres. This method of fishing is also used extensively in Antarctic waters to target toothfish (*Dissostichus* spp), where only demersal and midwater trawl is permitted. There are three methods: Dropline, Demersal Longline and Trotline.

1 Dropline Fishing

A dropline comprises a series of baited hooks attached by (generally) short snoods to a main line. A buoy is attached at one end of the mainline and a weight is attached to the other end. The mainline extends from the water surface (buoy end of the line) to the seabed (weighted end of the line). Because most target species of Australian dropline operations commonly aggregate within 100 metres of the seabed, the hooks are usually attached to the bottom 100 metres of the line (the weighted end), approximately one metre apart (see figure 2 below). This can be varied for other target species with different behavioural characteristics.

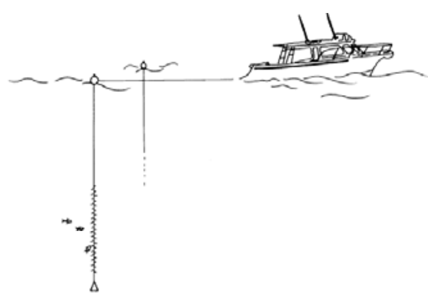


Figure 2: Diagram of dropline fishing method (Diagram from Genetic Prints).

2 Demersal Longline Fishing

Demersal longlines comprise a series of baited hooks that are attached by (generally) short snoods to a rope mainline, which is anchored to the ocean floor at each end (see figure 3 below). This method is most often used by fishers to target shark or ling. Other scale fish species are also caught, but usually as commercial bycatch of shark fishing operations. A buoy and dahn pole carrying a flag are attached by way of a buoy-line to the main-line at each of its ends, for retrieval of the gear. The main-line is hauled by a line hauler from one end of the main-line, usually over a roller mounted on the vessel gunnels in the mid-section of the boat.

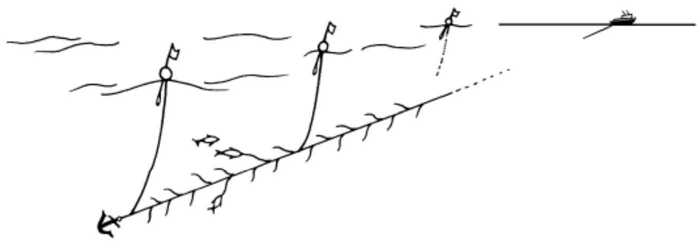


Figure 3: Diagram of demersal longline fishing method (Diagram from Genetic Prints).

3 Trotline Fishing

A trotline usually comprises two main-lines, suspended from the water surface (buoy end) to the sea bed (weighted end). These are joined by a rope fastened at each end, at a pre-determined depth, to one of the main-lines. Sets of 'droppers' suspend from the cross-rope, each of which may have up to 20–30 baited hooks attached to it by short snoods. To counter the weight of these droppers, the cross-rope usually has a certain number of floats attached to it at regular intervals (see figure 4 below).

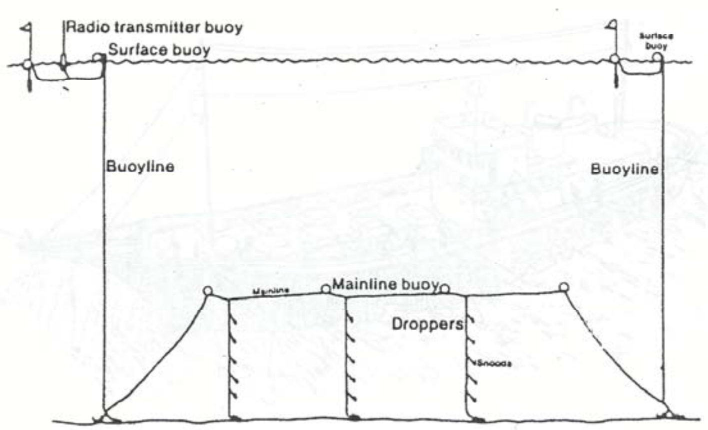


Figure 4: Diagram of trotline fishing method (Diagram from Australian Maritime College).

IV AUSTRALIAN LONGLINE FISHERIES

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) (see figure 5 below).

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

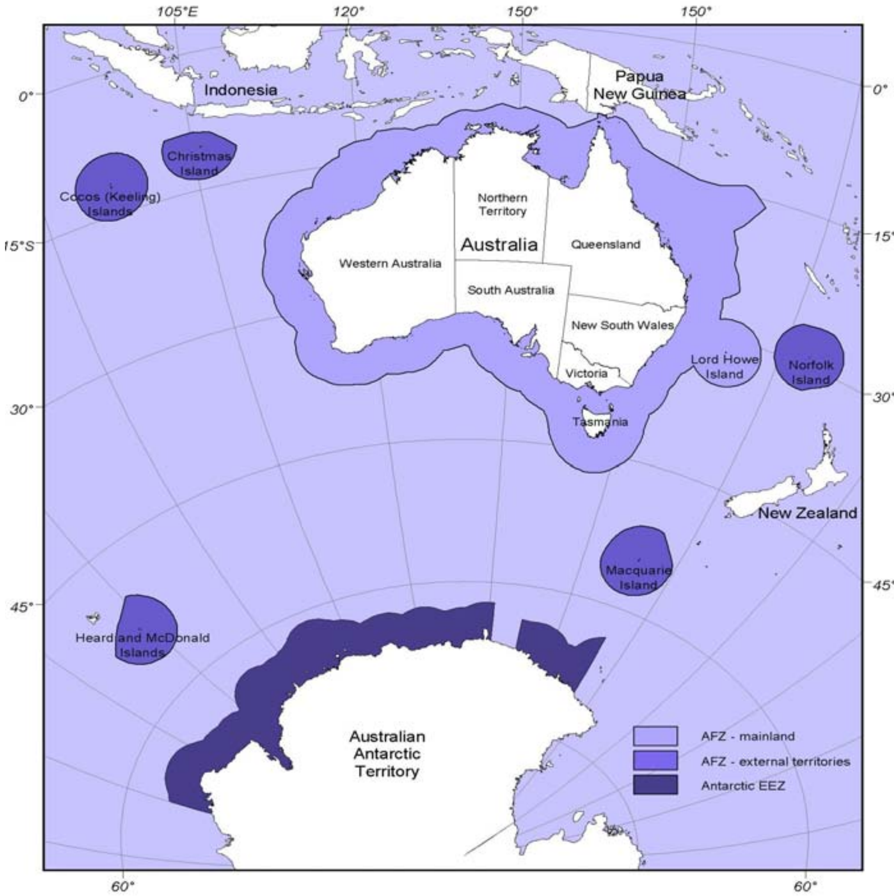


Figure 5: Australia's states and territories (figure taken from the Bureau of Rural Sciences Fishery Status Reports 2000–2001, p223).

A number of longline fisheries operate in Australian waters. The main longline fisheries are pelagic longline fishing for tuna (*Thunnus* spp.) or broadbill swordfish (*Xiphias gladius*) and demersal longline fishing for shark (*Mustelus antarcticus* and *Gaeorhinus galeus*) and species such as ling (*Genypterus blacodes*). In addition, there are a number of other hook and line fisheries that use the dropline and trotline techniques. Dropline and trotline fishing techniques differ in a number of ways from longline fishing and so, in terms of the suitability of mitigation measures, are most appropriately treated individually.

There have been two quite distinct fisheries targeting these species within the AFZ. A Japanese tuna longline fishery operated until 1997 under a Bilateral Access Agreement between the Governments of Australia and Japan. This fishery operated from the declaration of the AFZ in 1979, until 1997 when fishing ceased due to failure by the CCSBT to deliver agreed quota levels. A fleet of about 60 Japanese vessels operated within the AFZ in the later years of this arrangement. AFMA observers onboard the Japanese vessels monitored fishing operators and collected data, providing a valuable data set on seabird interactions. These data are not entirely comparable with the Australian domestic fishery, as the Australian vessels are more diverse in configuration, operating techniques and equipment than the Japanese freezer vessels. Fishing effort in this fishery has been increasing since 1990.

The fishery and bycatch characteristics of these and other longline fisheries are described below. The managing jurisdiction is in parentheses after the title of the fishery.

A Domestic Tuna Longline Fishery (Australian Government)

1 Fishery Characteristics

The domestic tuna longline fishery extends throughout the AFZ on the east (Eastern tuna and billfish fishery) and west coasts (Southern and western tuna and billfish fishery) of Australia and has been operating since the late 1980's. The Australian fleet is comprised of around 160 active vessels, each typically 18–25 metres in length, although there is considerable variability within the fleet. Vessels used in this fishery set between 800 and 1 000 hooks on each set. Branch lines are approximately six metres long. Most vessels use nylon monofilament main lines and set between 35 and 150 metres below the surface. Vessels fishing for swordfish attach light sticks on their lines to act as lures. 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. Also, as they land fresh fish rather than frozen fish, trip duration is limited to between one day and two weeks. The fleet operates largely within 100 nautical miles of shore, though there is a growing portion which is fishing further offshore and beyond the AFZ onto the high seas. Included among these vessels are those which move seasonally north/south to follow currents.

2 *Effort and Observer Coverage*

Pelagic longline fishing within the AFZ began in the early 1980s in the east and late 1980s in the west, and increased from 1.7 million hooks in 1991 to almost 17.5 million in 2001 (Brothers *et al*. 1999b; see tables 3 and 4 in Appendix 1). During the 1990s, effort was concentrated off New South Wales and Queensland (83% of total hooks set in 1998, 68% in 1999), where it continues to expand (Brothers *et al*. 1999c). During 1999 there was a considerable expansion in effort off Western Australia (from one million hooks in 1998 to over six million hooks in 2001) where approximately one-third of longline activity now occurs (AFMA data).

Limited observations have been conducted in these domestic fisheries by a range of agencies and for various specified purposes. These include seabird bycatch observations by the Tasmanian Department of Primary Industries, Water and Environment (DPIWE), and fisheries observations by AFMA, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Rural Sciences. Observer coverage has been limited, both in terms of percent coverage and representativeness. While observations have taken place off Tasmania, an area of relatively little fishing effort, and Northern Queensland, an area of low bird interactions, a low level of coverage has been placed on vessels involved in seabird mitigation trials south of 30ºS in the eastern tuna and billfish fishery (ETBF), which operate east of 141ºE longitude. Much of this effort has focused between 30ºS and 35ºS. Since 2001 there has been an increased level of observer coverage south of 30°S (see below) with a coverage level for the year to date (end June 2003) of around 12.75%.

Year	Total number of hooks	Number of hooks observed	Percentage coverage
2000-01	2 588 197	0	0
2001-02	3 279 044	175 518	5.35
2002-03	3 454 254	440 535	12.75

AFMA observer coverage on vessels in the ETBF south of 30°, given as a percentage of the number of longline hooks set and observed in 2000-2003 (source AFMA logbook and observer data).

3 Seabird Interactions

An industry-initiated underwater-setting device trial took place in the ETBF in summer months between September 2001 and March 2002. The chute used in isolation failed to meet the TAP objective of less than 0.05 birds/1000 hooks. However, the effectiveness of the chute improved as operators became more accustomed to using it. A total of 173 seabirds were incidentally caught on 92 589 observed hooks set during the day using the chute; a seabird bycatch rate of 1.87 birds/1 000 hooks. 97% of the seabird mortalities were flesh-footed shearwaters (*Puffinus carneipes*) thought to be from around Lord Howe Island. The remaining 3% of mortalities were made up of wedge-tailed shearwaters (*Puffinus pacificus*) and great-winged petrels (*Pterodroma macroptera*) (see table 2 in Appendix 1). The highest interactions with these species occurred between 30ºS and 32ºS. Based on the limited number of hooks observed and the experimental nature of the trial, the seabird bycatch rate should not be extrapolated to the rest of the fleet. However, the data indicate that during summer months there is clearly a seabird bycatch issue in the fishery, particularly in relation to flesh-footed shearwaters off Lord Howe Island. Industry will soon commence a trial, which will modify the chute and test it in conjunction with other mitigation measures.

Between April and November 2002, operators of the ETBF initiated and funded a 38 gram line-weighting and twin bird-scaring line trial. The key objective was to assess whether these two measures when combined could reduce seabirds bycatch to below 0.05 seabirds/1 000 hooks (TAP objective) and provide an alternative to night setting. 193 055 hooks were observed during the trial, and a trigger limit was set at which the trial ceased (26 seabirds over 350 000 hooks). The trial ceased in November 2002 when the trigger limit was reached (28 birds were caught in total), however only nine of the 29 vessels participating in the trial caught seabirds. The issue appears to be more problematic in waters between 30–33°S latitude, where the catch rates were 0.39 seabirds/1 000 hooks (see table 2 in Appendix 1). The main species caught was the flesh-footed shearwater. Industry has recently commenced a similar trial, involving the use of 60 gram swivels and twin bird-scaring lines. Until 4 June 2003, 41 255 hooks have been observed during the day. From these observations, 10 birds have been caught, being nine flesh-footed shearwaters *(P. carneipes)* and one great-winged petrel *(P. macroptera).* For further information on these two bycatch mitigation methods, see Technical Measures under section VIII MITIGATION MEASURES.

Based on data collected through limited observation in the rest of the fishery, seabird bycatch rates in waters adjacent to Tasmania were recorded as 0.07 birds/1 000 hooks, and the summer observed bycatch rate is 0.80 birds/1000 hooks. Significant fishing effort occurs off southern Western Australia, an area characterised by high seabird bycatch rates in the Japanese fishery. No formal observer coverage has taken place in this region, however less than 0.1% of the four million hooks were observed in 1999 (see figure 6).

Despite the limited observations, it is apparent that the catch rate on domestic vessels in the ETBF is much higher in summer than winter. Bycatch rates in the southern and western tuna and billfish fishery (operates west of 141ºE longitude) have yet to be appropriately determined. A pilot observer program has now commenced.

Flesh-footed shearwaters *(P. carneipes)* were the most frequently caught species during the chute and line weighting/twin bird-scaring line trials off the northern New South Wales coastline. Great-winged petrels (*Pterodroma macroptera*) were the second most caught species during observed trips in the same region. In waters adjacent to Tasmania, shy albatrosses (*Thalassarche cauta*) were the most common species caught.

4 Current Management Requirements

Requirements to reduce seabird mortality in this fishery are prescribed in the TAP and implemented through AFMA fishery management controls. This requires that all vessels operating south of 30^{o}S must: (i) set lines at night; (ii) use a bird scaring line; (iii) thaw baits; and (iv) not discharge offal during the set. If offal is discharged during the haul, then it must be discharged on the opposite side of the vessel to which hauling occurs.

Fishers can apply for exemptions from night setting if they can demonstrate alternate methods which satisfactorily set hooks without catching birds, or if they wish to test or develop new mitigation measures (scientific permits must be issued in the latter case). Some operators are currently trialing underwater-setting chutes and line weighting/twin bird-scaring lines and have authority to fish during the day (see section VIII MITIGATION MEASURES). When fishing north of 30^{o}S, fishing vessels are required to carry a bird-scaring line, which should be used if seabirds are present and there is a potential for interactions to occur. Vessels should also minimise offal discharge.

The ETBF has also produced an *Industry Code of Practice for Responsible Fishing* (1st Edition May 2003), which includes all relevant information necessary to fulfill the objectives of the BAP and TAP regarding seabird bycatch mitigation and bycatch of protected species.

The Australian Pelagic Longline Fishing Logbook–ALO5 is required under permit conditions to be filled out on a shot-by-shot basis by all operators, and provides for the recording of seabird interactions.

B Foreign Tuna Longline Fishery (ceased operation in 1997) (Australian Government)

1 Fishery Characteristics

Each Japanese longline vessel targeting southern bluefin tuna (*Thunnus maccoyii*) within the AFZ each day typically set 2 500-3 500 baited, barbed steel hooks attached to 40 metre branch lines from a 100 kilometre synthetic rope mainline. Baited hooks were cast every six seconds for the five hours taken to set the line. Baited hooks were set at target depths of between 60 and 150 metres. Following setting, the line was left to soak before hauling occurred, which took approximately 12 hours. Fishing was more or less continuous, with one set and haul per day except during bad weather. When targeting species other than southern bluefin tuna, slight variations occurred in this overall setting plan, such as the target depth and bait species (see Baron 1996 for greater detail).

2 *Effort and Observer Coverage*

Between 1988 and 1995, the Japanese effort ranged between 15 and 30 million hooks set annually within the AFZ (see figures 2 and 3 in section III AUSTRALIAN LONGLINE FISHING METHODS). Effort decreased in the AFZ during the 1990's. During the late 1980's most fishing effort occurred around Tasmania, but during the 1990's effort around Tasmania declined such that by 1997 only 7% of hooks were set in the Tasmanian region with most hooks being set off the Australian east coast (Brothers *et al*. 1998b). In 2001, CCSBT had overcome the quota disagreements, but it was considered unlikely that Japanese fishing would resume in the AFZ (P. Neave, AFMA, pers. comm.). The Japanese tuna longline fleet continues to fish seasonally in southern waters adjacent to the AFZ.

While operating within the AFZ, a condition of the access permits for Japanese longline vessels required them to carry fisheries observers for a prescribed proportion of fishing effort. Whilst the primary aim of these observers was to collect fisheries data, they were also requested to retain dead seabirds that were hauled aboard. Fisheries observers were deployed on these vessels since 1979, however quantitative records were kept only since 1988. AFMA aimed for observers to record data on the hauling of 10% of hooks set each year since 1991. In fact, observed effort varied between 6.4% in 1995 and 14.1% in 1996 (figure 4). For practical considerations, the aim was for 10% coverage of the total effort in the fleet, with many vessels receiving zero observer coverage in any one year. This consideration is important in analysing seabird bycatch, as bycatch rates can be highly vessel dependent (See section VII SEABIRD-FISHERY INTERACTIONS).

3 *Seabird Interactions*

Seabird catch rates in the Japanese longline fishery in the AFZ were estimated each year from 1988-1997 (see table 1 in Appendix 1; Gales *et al*. 1998; Brothers *et al*. 1998b). Seabird catch rate (number of birds killed/1 000 hooks) was reasonably consistent from 1992-1996 (between 0.10-0.18 birds/1 000 hooks), though the estimated number of birds killed each year reduced due to declining fishing effort. The estimated catch rate in 1997 was lower than in previous years, likely due to the reduced concentration of effort around Tasmania (7%) that year, an area previously noted to have a high seabird catch rate, or in summer (a period with characteristic high catch rate; Brothers *et al*. 1998b). Despite the limited observations, it is apparent that the catch rate on domestic vessels is much higher in summer than in winter, and south of 30^{o}S (see table 5 in Appendix 1). It appears that bycatch rates fell as a result of declining fishing effort rather than any other causality. Twenty-one species of seabird were observed killed (see table 2 in Appendix 1), with Black-browed (*Thalassarche chrysostoma*), Campbell (*Thalassarche impavida*), Grey-headed (*Thalassarche chlororhynchos*) and Indian yellow-nosed (*Thalassarche bassi*) albatrosses the most common species.

4 *Current Management Requirements*

There is currently no foreign pelagic longline fishing in the AFZ. If foreign vessels resume fishing in the AFZ, which is unlikely, operators would be required to comply with the requirements of the TAP for domestic tuna longline fishing (described previously). The CCSBT collects and analyses information about southern bluefin tuna and the fishery, as well as bycatch species including seabirds. As previously mentioned, in 1995 the CCSBT made the use of bird lines mandatory on fishing vessels of the member states (Japan, New Zealand, Australia, Korea and Fishing Entity of Taiwan).

C Gillnet, Hooks and Trap Fishery – Longline (Australian Government)

1 Fishery Characteristics

The gillnet, hooks and trap fishery operates in Australian Government waters between Sandy Cape (Queensland) and the Western Australia/South Australia border, including waters around Tasmania. This fishery targets demersal species, unlike the tuna fisheries. Some vessels use similar gear to that described for the shark hook fishery (see section IV, E) to fish for pink ling (*Genypterus blacodes*), blue eye trevalla (*Hyperoglyphe antarctica*) or blue warehou (*Seriolella brama*). Many of these vessels also operate in the southern shark fishery. One vessel has been authorized to use autoline gear since 1993—a method commonly used in CCAMLR waters to fish for Patagonian toothfish (*Dissostichus eleginoides*)—and sets approximately 6 000 hooks per set. In this method, hooks are set through a machine that automatically baits the hooks before they are set. Following a relaxation of the auto-longlining restriction, two other vessels have been approved to use the equipment and another vessel has been approved to use random baiting equipment.

2 Effort and Observer Coverage

Between 1996 and 1998, 160 500 hooks were observed by Brothers *et al*. (1999b); in 1999 a further 73 000 hooks were observed by fisheries observers in the Integrated Scientific Monitoring Program (AFMA data). All observations have been made from the single autoline vessel.

Since 1 January 2002, the carriage of an observer is compulsory for the duration of 25% of all fishing trips on vessels equipped with automatic baiting equipment. Vessels permitted to use this method are restricted to an upper limit of 15 000 hooks until the completion of the trial in December 2003. A review of seabird interactions with the automatic baiting equipment will occur once the trial is complete, however data will be considered after 12 months.

3 *Seabird Interactions*

During observation of this fishery, no seabird interactions were witnessed. The captain of the vessel indicated that only a small number of birds have been killed in the setting of over three million hooks (Brothers *et al*. 1998b). Anecdotal information from the masters indicate that this may be due to the low angle from the stern of the boat to where the hooks enter the water (less than 50 metres). The propeller wash also appeared to impede seabirds taking baits.

In some similar demersal fishing operations in other areas of the world, there is a significant seabird bycatch problem. For example, a study in the north Atlantic groundfish fishery in 1996 showed that a vessel using a Mustad autoline system incidentally caught 99 seabirds in 12 days (1.75 birds per 1000 hooks) (Lokkeborg 1998).

4 *Current Management Requirements*

Individually Transferable Quotas (ITQs) are used in the management of this fishery. The TAP prescribes the same conditions for the retention of offal during fishing operations for both demersal and pelagic longline fishing.

The Australian General Confidential Daily Fishing Logbook-GN01A is required under permit conditions to be filled out on a shot-by-shot basis when line fishing, and provides for the recording of seabird interactions.

D Gillnet, Hooks and Trap Fishery – Scalefish hook (Australian Government)

1 Fishery Characteristics

Other forms of commercial hook fisheries take place under the South-east non trawl fishery; these are dropline and trotline fishing. Generally, 70-100 hooks are attached to a line. A set consists of seven to 15 of these lines deployed over a distance of a couple of kilometres. Each line takes approximately 10-20 minutes to set. After setting the lines are left to soak for two to four hours. During setting, the line leaves the vessel vertically and fast so that there is minimal likelihood of birds becoming hooked. On average, 1700 hooks are set during any single operation.

Trotlines are similar to droplines except that several droppers (or trots) are attached to a mainline, which is set horizontally, approximately 30 metres above the seabed. Each dropper has 20-30 hooks, and a float at the top to keep it taught. This fishing method is rarely used (AFMA data).

2 Effort and Observer Coverage

Limited observing has been conducted on dropline vessels. In 1996, 179 sets and 23 640 hooks were observed (DPIWE, unpublished data). Observer coverage has been increasing on auto-longline vessels in the Integrated Scientific Monitoring Program (see below, AFMA data).

2000/2001	Shots	Hooks	Birds
Dropline (DL),	289	32 742	0
Auto-longline (ALL)	26	70 250	0
2001/2002			
DL	255	27 575	0
ALL	438	190 775	0
2002/2003			
DL	219	21 950	0
ALL	92	331 285	0

Observer coverage of dropline and auto line vessels in the Integrated Scientific Management Program

Trotline operations have not been observed.

3 Seabird Interactions

No seabirds have been observed hooked in the dropline fishery.

4 Current Management Requirements

ITQs are used in the management of this fishery for the target species of pink ling (*G. blacodes*) and blue eye trevalla (*H. antarctica*).

The Australian General Confidential Daily Fishing Logbook-GN01A is required under permit conditions to be filled out on a daily basis when line fishing, and provides for the recording of seabird interactions.

E Gillnet, Hooks and Trap Fishery – Shark Hook (Australian Government)

1 Fishery Characteristics

The shark hook fishery operates in an area off south-east Australia, from the New South Wales/Victoria border to the South Australian/Western Australian border, including waters off Tasmania. State fisheries exist within this area in waters within the limits of the States involved, including historic bays and gulfs. This fishery uses demersal longlines or gill nets. In 1992, 25% of target fish were landed by longlining, but this proportion has since decreased (McLoughlin *et al*. 1997). In the southern shark fishery, 1000-metre synthetic or lead-core mainlines are used, with baited hooks attached on one-metre branch lines every five to 10 metres. The line is anchored at each end, with smaller anchors at intervals in between. Vessels set one to 2 000 hooks and leave the line to soak for several hours. Most effort occurs off Victoria, Tasmania and south-east South Australia.

2 Effort and Observer Coverage

In 2002, there were 195 permit holders in this fishery. There have been a number of observer trips in this fishery. No seabird interactions have been recorded.

3 Seabird Interactions

No seabird bycatch was observed in the Integrated Scientific Monitoring Program 2000-2003 in this fishery (AFMA data).

4 Current Management Requirements

The southern shark fishery is managed with the use of ITQs for four key species, which make up 90% of the catch.

The Australian General Confidential Daily Fishing Logbook-GN01A is required under permit conditions to be filled out on a shot-by-shot basis when line fishing, and provides for the recording of seabird interactions.

F Christmas Island and Cocos (Keeling) Islands Offshore Tuna Fishery (Australian Government)

1 Fishery Characteristics

Australian vessels only began operating in the offshore waters around Christmas Island and the Cocos (Keeling) Islands in 1998/1999. Japanese longline vessels had occasionally operated in the AFZ south of Christmas Island and north of the Cocos (Keeling) Islands.

Four commercial pelagic longline fishing permits have been issued for waters outside 12 nautical miles of Christmas Island, and two commercial longline permits at the Cocos (Keeling) Islands have been issued for pelagic fishing outside 12 nautical miles. Strict management conditions apply, including limitations on the number of hooks per longline (1 000 maximum during night sets and 500 during day sets).

The permits are issued under a controlled three-year fishing program and are subject to strict conditions. The program aims to monitor impacts of fishing, including impacts on two species of endemic threatened seabirds. Little fishing activity has been undertaken to date.

2 Effort and Observer Coverage

Only two pelagic longline trips have occurred since 1998/1999 in the Christmas and Cocos Keeling Islands sector, setting approximately 11 670 hooks. 100% of the 6 450 hooks set on the observed trip were observed, giving a total of 55% observed hook coverage for the sector.

3 Seabird Interactions

Two endangered seabirds occur on the island – the Abbot's booby (*Sula abbotti*) and the Christmas Island frigatebird (*Fregata andrewsi*). To date, there have been no observed interactions with seabirds.

4 Current Management Requirements

Operators are required to use bird deterrent devices on their vessels and retain all offal for disposal ashore. In addition, there is a minimum of 30% observer coverage of operations.

The Australian Pelagic Longline Fishing Logbook – AL05 is required under permit conditions to be filled out on a shot-by-shot basis by all operators, and provides for the recording of seabird interactions.

G Norfolk Island Offshore Demersal Finfish Fishery (Australian Government)

1 Fishery Characteristics

This fishery is currently operating under a three-year exploratory fishing program, which commenced in 2000. Five permits have been issued for demersal line fishing allowing for demersal longlining, droplining or trotlining and two permits for demersal trawling.

2 Effort and Observer Coverage

To date, four vessels, including one auto-longliner, have operated in the line sector of the fishery, mainly using demersal longlining methods and setting over 100 000 hooks in 2001. Observer coverage (25%) is required in the fishery. For 2001, 36 days were observed out of 53 days of fishing (68% observer coverage) using dropline, trotline and demersal longline methods. For 2002, five days were observed out of 17 days of fishing (29% observer coverage) using dropline, trotline and demersal longline methods.

3 Seabird Interactions

Thirteen seabird species breed on Norfolk Island or adjacent islands. None of these species have been listed as endangered or vulnerable under Australian Government legislation. However, various albatross, petrel and shearwater species have been sighted by observers and recorded as incidental bycatch by Japanese longlining operations in these waters in the past.

No seabird interactions have been observed in the first two years of operation (2001-2002) in the fishery, however during observations, birds were reported to be attracted to floating baits from the auto-longliner.

4 Current Management Requirements

Precautionary trigger limits for target species are used in the fishery under the three-year exploratory fishing program. The demersal line sector is subject to conditions set out in the TAP, including the retention of offal (including unused bait) during fishing operations, reporting of interactions within 24 hours, retention of any fatally injured seabirds, and reduced lighting is required when setting at night.

The Australian General Confidential Daily Fishing Logbook-GN01A is required under permit conditions to be filled out on a shot-by-shot basis when line fishing, and provides for the recording of seabird interactions.

H Coral Sea Fishery (Australian Government)

1 Fishery Characteristics

The Coral Sea fishery was previously known as the north-east deep water fishery but now encompasses shallow and deepwater line for finfish, trawl fisheries for finfish and crustaceans, and diving operations. There are nine fishing permits, which allow the use of demersal line methods (dropline, demersal longline and trotline) targeting a range of demersal species. Many of the line-endorsed operators also operate in the Queensland-managed line fishery. The re-issuing of fishing permits is subject to satisfying performance criteria (a minimum of 20 days operation in the previous year). Interim management arrangements are in place. A Strategic Assessment report for the fishery is currently being assessed under the EPBC Act.

2 Effort and Observer Coverage

There is limited fishing activity, mostly using dropline and demersal longline methods. Two auto-longliners operated in the fishery during 2002 and had a 25% observer coverage requirement. No incidents of interactions with seabirds were recorded.
No observer coverage is currently required for operators other than those who have approval to use automatic baiting equipment.

3 Seabird Interactions

No seabird interactions have been recorded for this fishery, despite the 25% observer coverage requirement for auto-longlines and reporting arrangements for all operations.

4 Current Management Requirements

The Coral Sea Line, Trawl and Collector Confidential Daily Fishing Logbook - CS01 implemented in December 1999, is required under permit conditions to be completed and provides for the recording of seabird interactions.

Conditions set out in the TAP are being applied in this fishery.

I Timor Reef and Demersal Fisheries (Northern Territory Government)

1 Fishery Characteristics

Operators in the Timor Reef fishery target demersal tropical snappers, emperors and cods using baited traps and droplines. This fishery operates in the remote north-west corner of the Northern Territory portion of the AFZ, generally in waters 80 to 160 metres deep. Fifteen licences have been issued, with approximately six boats operational on an annual basis. A license reduction program will further reduce the number of operators in this fishery. The majority of operators now use baited traps in preference to droplines.

The demersal fishery operates in waters seaward of 15 nautical miles from the shore to the outer limit of the AFZ. Trap and dropline are the main means of operating in the fishery. A total of 60 licences have been issued for this fishery, of which approximately two full-time equivalent boats are operational on an annual basis. Up to eight boats have been active, albeit at very low levels.

Only one part-time operator uses weighted droplines in both the Timor Reef and the Demersal Fisheries, setting an average of 30-40 tuna circle hooks per line, with up to six lines deployed (attached) from a single vessel (size 11/0 to 13/0). Vessel length ranges from 15 to 24 metres.

2 Effort and Observer Coverage

Observer coverage in these fisheries is low and in keeping with the number of active participants. Fisheries scientists undertake trips and record operational, catch and bycatch composition detail. Fishing trips are generally seven to 10 days in duration depending on fish availability and market demand.

3 Seabird Interactions

No seabird interactions with these fisheries has been observed or reported.

4 Current Management Requirements

These fisheries are managed by a limitation on the number of operators, a restriction on the type of gear which can be used and licence transfer conditions.

J Shark Fishery (Northern Territory Government)

1 Fishery Characteristics

The northern shark fishery was fished by Taiwanese gillnetters from 1974 until 1986. Since 1985, approximately 600 tonnes of shark have been caught each year in the domestic fishery using gillnets. The Northern Territory pelagic net and longline fishery targets blacktip sharks (*Carcharinus tilstoni* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*). The majority of fishing effort occurs in inshore areas in the Joseph Bonaparte Gulf, Fog Bay, Van Dieman Gulf and from Goulburn Islands to the southern Gulf of Carpentaria.

The holder of a shark fishery licence may use a demersal longline or pelagic longline of not more than 20 nautical miles in length. Little longline activity has been observed in the fishery.

2 Effort and Observer Coverage

Observer coverage of longline fishing trials undertaken by Government and commercial participants is high. Independent observation of commercial shark fishing vessels is currently underway.

3 Seabird Interactions

No interactions with seabirds have been observed or reported.

4 Current Management Requirements

A licence reduction scheme has reduced the overall number of commercial participants from 39 to 19 operators.

K Port Phillip/Westernport Bay Access Fishery (Victorian Government)

1 Fishery Characteristics

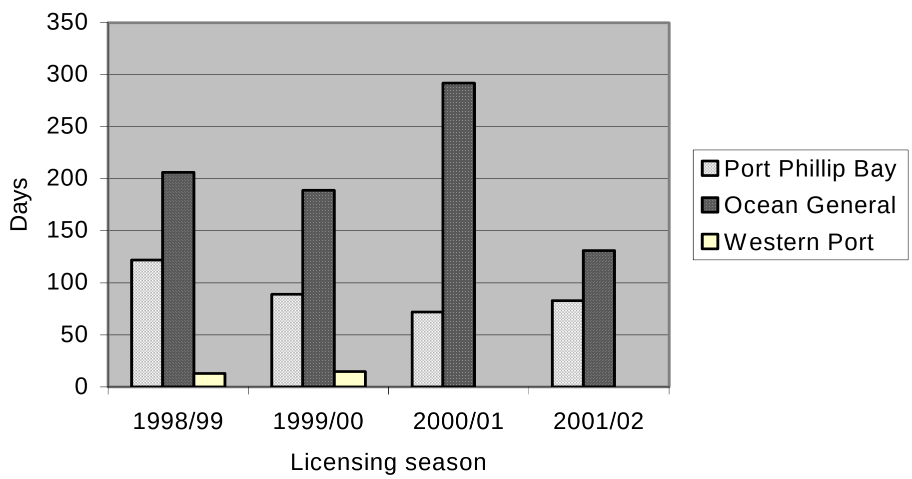
There are currently 52 access licences in this fishery. Under the current policy, the number of licences will not increase. All licence holders are authorised to longline in Westernport, however only a small number of fishers employ the method. Forty-four access licence holders have an authorisation to use longlines in Port Phillip Bay and the longline method is more commonly employed in this area.

Longlines are used primarily to target snapper with a maximum of 200 hooks. Branch lines or snoods are maximum two metres long and depth lines are set at between 10-20 metres.

2 Effort and Observer Program

No dedicated observer program for seabirds is in place for this fishery at present. See figure 8 below for a summary of longline effort expressed in days fished with longlines per licensing year between 1998/1999 to 2001/2002.

Figure 8. Longlining effort (days) in Victorian fisheries between 1998/99 to 2001/2002*



3 Seabird Interactions

No validated information exists on seabird interactions with this fishery. Two mail surveys were circulated to fishers with Victorian licences in 1996 and 1997 requesting information on bycatches of birds, mammals and turtles (Norman 2000). The results indicated that bycatch numbers were usually small, mostly with net fisheries and mainly in Port Phillip Bay. Regarding bird species, the number of incidences where species were caught were reported (see table 6 in Appendix 1). The information was not separated into specific fisheries, so it is unknown whether seabirds were reported caught in any of Victoria's longline fisheries.

Between July 1985 and June 1996, 11 little penguins (*Eudyptula minor*) were received at the Phillip Island National Park shelter with injuries associated with fishing lines or hooks (or unspecified origin) (Norman 2000). The incidence of such injuries varied from zero to two per year. In addition, silver gulls (no further information) were found entangled or hooked each year, and a juvenile Pacific gull (*Larus pacificus*) and a barn owl (*Tyto alba*) were reported as entangled. It is unknown if this was the result of discarded fishing gear or direct bycatch. Large albatrosses and procellariids were not involved. Similarly, while short-tailed shearwaters (*Puffinus tenuirostris*) breed extensively along the Victorian coast, few instances of bycatch were recovered in fishing gear in southern waters in the 1986-1995 period (Norman 2000).

There are currently no mitigation methods in use in Victoria, other than fishers setting and hauling the line before day-break. It is the opinion of fisheries officers and fisheries managers that seabird interactions with this fishery are unlikely.

4 Current Management Requirements

When operating in Port Phillip Bay, operators may use only one longline with a maximum of 200 hooks attached.

When operating in or within 200 metres of Westernport Bay during the period 1 March to 31 October, the licence holder must not use more than one longline or use a longline with more than 1000 hooks attached.

When longlining, all licence holders must attach a dahn buoy or buoy with a flag to each end of the longline to identify its location.

A number of permanent and temporal area closures are in place for this fishery. These are more a result of multiple-uses of the water bodies for shipping and recreational fishing, rather than for fisheries management purposes.

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

L Corner Inlet Access Fishery (Victorian Government)

1 Fishery Characteristics

There are currently 20 access licences in this fishery. Under the current policy, the number of licences will not increase. A number of fishing methods are permitted in Corner Inlet, including demersal longlining and droplining, however the longline component is considered negligible. Branch lines or snoods are two metres maximum and depth lines are set at a range between 10-20 metres from the surface. Species caught include snapper, gummy sharks, skates and southern calamari (*Sepioteuthis australis*).

2 Effort and Observer Coverage

In Victoria, it is a policy requirement to withhold any catch data if less than five fishers have participated in a fishery to protect commercial confidentiality. In Corner Inlet between 1998/1999 to 2001/2002, there were insufficient data to report because less than five licence holders used the method in any given year. As a general indication the use of longlines as a method in this area is extremely limited.

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

3 Seabird Interactions

No validated information exists on seabird interactions with this fishery at present. However, see section IV, K above, (Port Phillip/Westernport Bay access fishery) for information on a study conducted by Norman (2000) on seabird, marine mammal and turtle bycatch in all Victorian fisheries.

There are currently no mitigation methods in use in Victoria. 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. It is the opinion of fisheries officers and fisheries managers that seabird interactions are unlikely with this fishery.

4 Current Management Requirements

Operators must not use a longline or a combination of longlines with more than 400 hooks attached.

Temporal area closures are in place for this fishery. These closures are more a result of multi-uses of the water bodies for shipping and recreational fishing, rather than for fisheries management purposes.

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.

M Oceans Access Fishery (Victorian Government)

1 Fishery Characteristics

The oceans access fishery is a multi-method fishery, predominantly targeting snapper. Other species caught include, sharks, skates and rays, wrasse, deep sea trevalla (*H. antarctica*) and Australian salmon (*Arripis trutta*). Demersal longlines are the only longlines permitted for use.

There are 485 licences currently issued for this fishery and under the current policy, the number of licences will not increase.

2 *Effort and Observer Coverage*

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

See figure 6 above (section IV, L Corner Inlet Access Fishery) for a summary of longline effort expressed in days fished with longlines per licensing year between 1998/1999 to 2001/2002.

3 *Seabird Interactions*

No specific information exists on seabird interactions with this fishery. However, see section IV, K above (Port Phillip/Westernport Bay Access Fishery), for information on a study conducted by Norman (2000) on seabird, marine mammal and turtle bycatch in all Victorian fisheries.

There are currently no mitigation methods in use in Victoria. It is the opinion of fisheries officers and fisheries managers that seabird interactions with this fishery are unlikely.

4 *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 used has no more than 200 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.

N Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (Western Australian Government)

1 Fishery Characteristics

This fishery is managed by a Joint Authority arrangement between the Western Australia and Australian Governments. The responsibility of day-to-day management, however, lies with Western Australia.

The OCS (1995) arrangements for this fishery cover the take of sharks, rays and bony fish by "demersal gillnets and all other lines" (demersal longlines only) from 33°S latitude to the Western Australia/South Australia border and the limit of the AFZ. After a series of phased effort reductions between 1992 and 2000, each unit in the fishery permits the use of 90 hooks per month.

There are currently 57 managed fishery licences in this fishery. In 2000/2001, 29 vessels were active in the fishery and the number of units equaled 2515 for the fishery.

Average vessel length is 10-12 metres. Approximately 10-20% of the overall retained catch is comprised of finfish species. Species targeted include dusky shark (*Carcharhinus obscurus*), gummy shark (*Mustelus antarcticus*), school sharks (*Galeorhinus galeus*), whiskery shark (*Furgaleus macki*), sandbar shark (*Carcharhinus plumbeus*), other shark and ray species and scalefish species.

2 Effort and Observer Coverage

No observer program for seabirds exists for this fishery.

The catch for this fishery was 811 tonnes (live weight) for sharks and 147 tonnes (live weight) for scalefish in 2000/2001.

3 Seabird Interactions

The demersal nature of the longline gear used in this fishery means that the incidence of catching seabirds is likely to be minimal, although no quantitative data are available and the sink times of demersal longlines are not known. Most of the fishery uses demersal gillnets. In 2000/2001, longlines accounted for only 1.5% of the catch in the Joint Authority southern demersal gillnet and demersal longline managed fishery.

4 Current Management Requirements

This fishery is managed using effort controls in the form of time/gear units, with each unit allowing the use of one length of net or a set number of hooks for one month.

Western Australia's shark fisheries are open all year but many of the operators in this fishery usually do not fish in the winter months (June–August).

Shark fishing between Steep Point (26°30'S latitude) and North West Cape (114°06'E longitude) to the AFZ is currently prohibited by way of a gear prohibition notice.

Under the *Western Australian Policy on Fisheries Bycatch* (1999), the Western Australian Department of Fisheries is embarking on a program to target bycatch issues in fisheries throughout the State. Specific BAPs will be developed for all Western Australian fisheries. The Department has also taken a lead role in the reporting of all fisheries against a national framework for Ecological Sustainable Development. There are no bycatch reduction devices or other modified gears in place, however this issue will be addressed during the Ecologically Sustainable Development Assessment for Western Australian shark fisheries.

Preliminary research data suggest that the gear is selective for target species of a particular size, i.e. larger hooks and larger bait will increase the percentage of larger fish caught, and reduce the percentage of smaller unwanted bycatch, including potential seabird catch.

O West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery (Western Australian Government)

1 Fishery Characteristics

The area of this fishery extends from 33°S latitude to 26°S latitude in all Western Australian waters. There are currently 26 interim managed fishery permits in this fishery. In 2000/2001, productive returns were received from 13 vessels. One fishery unit permits the use of 180 hooks per month. Operators may use demersal longlines and demersal gillnets.

Vessel length ranges from approximately 10-12 metres. Species targeted include dusky shark (*C. obscurus*), gummy shark (*M. antarcticus*), whiskery shark (*F. macki*), sandbar shark (*C. plumbeus*), other shark and ray species and scalefish species.

2 Effort and Observer Coverage

No observer program for seabirds exists for this fishery.

The catch for this fishery was 322 tonnes (live weight) for sharks and 69 tonnes (live weight) for scalefish in 2000/2001.

3 Seabird Interactions

The demersal nature of the longline gear used in this fishery means that the likelihood of catching seabirds is minimal, although no quantitative data are available and the sink times of demersal longlines are not known. Longlines accounted for only 4% of the total catch in 2000/2001 in the west coast demersal gillnet and demersal longline interim managed fishery with gillnets the preferred fishing method for the fishery.

4 Current Management Requirements

This fishery is managed using effort controls in the form of time/gear units, with each unit allowing the use of a set number of hooks for one month.

Western Australian shark fisheries are open all year, but many of the operators in this fishery usually do not fish in the winter months (June–August).

Shark fishing between Steep Point (26°30'S latitude) and North West Cape (114°06'E longitude) to the AFZ is currently prohibited by way of a gear prohibition notice. Shark fishing is prohibited within the baselines of the Abrolhos Islands.

Preliminary research data suggest that the gear is selective for target species of a particular size, i.e. larger hooks and larger bait will increase the percentage of larger fish caught, and reduce the percentage of smaller unwanted bycatch, including seabirds.

P North Coast Shark Fishery (Western Australian Government)

1 Fishery Characteristics

This fishery covers Western Australian waters in the area from the North West Cape (114°06'E longitude) to Koolan Island (123°45'E longitude) using "shark" longlines and droplines, which contain wire traces. Demersal longline is mostly used. Licencees are permitted to use pelagic longlines but this method is rarely used given its ability to land tuna, which is managed by the Australian Government. As the OCS arrangements for the Joint Authority northern shark fishery (Koolan Island to the Northern Territory border) do not cover droplining, using shark droplines in Western Australian waters is managed under this fishery by way of a licence condition from North West Cape to the Western Australia/Northern Territory border.

Eight operators are permitted to fish in this fishery by way of a licence condition between North West Cape and Koolan Island. In 2000/2001, nine active operators were recorded in the northern shark fisheries (includes this fishery plus the Joint Authority northern shark fishery).

Vessel length ranges from approximately 10-12 metres. There are no limits to the number of hooks that licensees are permitted to use in the northern shark fisheries, however the norm is between 350 and 1100. Longlines are generally between three and seven miles in length and are set either pelagically or, more commonly, demersally as trotlines.

Species targeted include, sandbar shark (*C. plumbeus*), tiger shark (*Galeocerdo cuvier*), blacktip sharks (family Carcharhinidae), bronze whalers (family Carcharhinidae), hammerhead sharks (family Sphyrnidae), other shark and ray species and scalefish species.

2 Effort and Observer Coverage

No observer program for seabirds exists for this fishery.

The northern shark fisheries reported a combined catch of 272 tonnes (live weight) of sharks in 2000/2001. A varied amount of finfish (mostly demersal) were also landed.

3 Seabird Interactions

The mostly demersal nature of the longline gear used in this fishery means that the likelihood of catching seabirds is minimal, although no quantitative data are available and the sink times of demersal longlines are not known.

4 Current Management Requirements

Western Australian shark fisheries are open all year round but operators in this fishery usually fish in the dry season from March to October.

Shark fishing between Steep Point (26°30’S latitude) and North West Cape (114°06’E longitude) to the AFZ is currently prohibited by way of a gear prohibition notice. Shark fishing is prohibited within the baselines of the Abrolhos Islands.

Q Joint Authority Northern Shark Fishery (Western Australian Government)

1 Fishery Characteristics

The OCS arrangement for this fishery covers all Western Australian waters east of Koolan Island (123°45E longitude) to the limit of the AFZ.

The OCS arrangements specify that the use of pelagic gillnets, demersal gillnets and demersal longlines to commercially take sharks and rays (class Chondrichthyes) and bony fish (class Osteichthyes) are to be managed by the Joint Authority under Western Australian law.

Approximately six vessels operate in this fishery, with four vessels operating with demersal longlines. Vessels range from approximately 10-12 metres in length. There are no limits to the number of hooks that licensees are permitted to use in this fishery, however the norm is between 350 and 1 100 hooks. Longlines are generally between 10-12 kilometres in length and are set demersally. It is proposed that the number of hooks per vessels will be restricted, along with other measures in the immediate future.

Species targeted include, sandbar shark (*C. plumbeus*), tiger shark (*G. cuvier*), blacktip sharks (Carcharhinidae), bronze whalers (Carcharhinidae), hammerhead sharks (Sphyrnidae), other shark and ray species and scalefish species.

2 Effort and Observer Coverage

No observer program for seabirds exists for this fishery.

The northern shark fisheries reported a combined catch of 272 tonnes (live weight) of sharks in 2000/2001. A varied amount of finfish (mostly demersal) were also landed.

3 Seabird Interactions

The demersal nature of the longline gear used in this fishery means that the incidence of catching seabirds is minimal, although no quantitative data are available, and the sink times of demersal longlines are not known.

4 Current Management Requirements

Same as north coast shark fishery (see section IV, P North Coast Shark Fishery).

R Marine Scalefish Fishery and Rock Lobster Fishery (South Australian Government)

1 Fishery Characteristics

Commercial licence holders in the marine scalefish and rock lobster fisheries are the only operators, which are permitted to longline or dropline in South Australia. However, those operators that participate in the rock lobster fishery do not generally longline. There are 835 licence holders using these methods and they are able to fish in all waters adjacent to South Australia within the three nautical mile boundary. Historically, longline operations have predominantly been undertaken in Backstairs Passage and the waters adjacent to Ceduna, Port Lincoln and Port Pirie.

The length of droplines and longlines is not restricted, however fishers may only use the number of lines registered on their licence with a maximum of 400 hooks. The majority of the vessels undertaking longlining activities on a regular basis range from five to eight metres long. They operate predominantly in inshore waters, as vessels are not large enough to undertake extended fishing trips on the open ocean.

The length of branchlines used is generally no longer than two metres, with the depth of the predominantly used longlines ranging from 10 to 30 metres. Droplines are generally used in deeper waters, however, catch information illustrates that droplines are not generally utilized.

The predominate species targeted by longline operations are snapper species and demersal shark species, ie. gummy shark (*M. antarcticus*).

2 Effort and Observer Coverage

An observer program for seabirds is not in place.

In 2000/2001, the fishery landed 70 tonnes of snapper, 70 tonnes of gummy shark (*M. antarcticus*), 55 tonnes of whaler shark, 48 tonnes of rays and skates and five tonnes of school shark (*G. galeus*).

3 Seabird Interactions

As a result of the small scale of those fishers undertaking droplining and/or longlining fishing activities, it is considered that limited, if any, interactions with seabirds are occurring. This assumption is predominantly because automated longlining machines are not used and when deployed, the baits are sinking vertically into the water column.

Anecdotal information by a SeaNet[1] officer who has worked with this fishery for two years suggests that no seabird interactions are occurring with these vessels. Similarly, anecdotal information from an observer program by the South Australian Research and Development Institute suggests that there are no direct seabird interactions with this fishery. Observations are undertaken intermittently two or three timers per year for one week at a time, however seabird interactions are not required to be recorded.

4 Current Management Requirements

Besides a limitation on the number of hooks and lines fishers are able to use, the only other restriction that applies is that fishers must attend their lines at all times. This arrangement prevents lines being in the water for prolonged periods, therefore minimizing any bycatch interactions.

S East Coast Demersal Longline Fishery (Queensland Government)

1 Fishery Characteristics

The east coast demersal longline fishery (also referred to as the east coast multiple hook fishery) operates in waters greater than 200 metres east of longitude 142°13'49"E out to the Queensland jurisdictional line. Operators are endorsed to use a maximum of six droplines, each with a maximum of 50 hooks, or a single trotline with a maximum of 300 hooks attached. The maximum number of hooks available for use at any one time is 300.

There are 13 boats currently licenced to engage in the fishery. Vessel lengths range from eight to 20 metres. Boats are restricted to a length of 20 metres by Regulation.
Data have not been collected on the number of hooks set to date. Updated data collection strategies involve the design of a targeted logbook to be implemented into the fishery.

[1] SeaNet is an environmental extension service to the Australian seafood industry and provides information and advice on improved fishing gear, technology and methods to minimise bycatch and encourage environmental best practice for industry. SeaNet is administered by Ocean Watch Australia Ltd.

Current practice in the fishery is to use around 20 hooks per line, each set to minimize predation of the catch by sharks.

Length of branch lines is not restricted, but is not critical with respect to capture of birds as the gear is bottom set. Depth lines are set from at least 50 metres and most commonly 200 metres or greater.

Principal species taken include, bar cod/seven bar groper (*Epinephelus ergastularius*), rosy jobfish (*Pristipomoides filamentosus*), pearl perch (*Glaucosoma scapulare*), blue eye trevalla (*H. antarctica*), ruby snapper (*Etelis carbunculus*), flame snapper (*E. coruscans*) and goldband snapper (*Pristipomoides multidens*).

2 Effort and Observer Coverage

There is no observer program in place in the east coast demersal longline fishery for seabirds. It would appear unlikely that any seabird bycatch would occur in this fishery. The gear is fished at considerable depths and as bait is potentially available to sharks at the shallower depths, which disrupts the fishing operation, heavy weights (variable) are used to ensure that baits reach the bottom or required depths quickly.

This fishery operates seasonally with most activity targeting large serranids occurring in the summer months. Ninety tonnes of fish were caught in 2001 with the total number of 323 days fished. Fishing effort is constrained by limited licensing of operators in this fishery, the significant travelling distance to the offshore location of this fishery and by inclement weather in unprotected waters.

3 Seabird Interactions

No data are available regarding seabird interactions. However, depth requirements for operations in this fishery effectively preclude the bycatch of seabirds in all but rare and exceptional circumstances.

The Queensland Fisheries Service is currently implementing a "Species of Conservation Interest" logbook for all Queensland-managed fisheries that will collect information on interactions with all species of conservation interest (including seabirds) during fishing operations. This logbook will be introduced to the east coast demersal longline fishery when the new fishery logbook is implemented.

4 Current Management Requirements

Gear controls are in place, which restrict the number of hooks. Finfish may only be taken using trotlines or droplines, and the person operating these lines must be within 100 metres of these lines while they are in use.

No more than six droplines can be used at a time, each having no more than 50 hooks.

No more than three trotlines can be used at a time, and no more than 300 hooks per vessel can be used at any one time. Trotlines and droplines cannot be used at the same time.

The Great Barrier Reef Marine Park Authority (GBRMPA) by regulation under Australian Government law has a restriction on the number of hooks per line that a person may use within the Great Barrier Reef Marine Park (six hooks per line). A permit is required from GBRMPA to use more than six hooks per line, however the GBRMPA has developed a policy not to issue such permits thus excluding the multiple hook fishery from the Marine Park waters.

T Ocean and Trap Line Fishery (New South Wales Government)

1 Fishery Characteristics

The ocean and trap line fishery extends from the New South Wales coastal baseline, seaward to the 4 000 metre isobath (approximately 60-80 miles offshore). The fishery is characterised by a variety of methods including demersal longline, setlines, trotlines and droplines.

There are currently 110 entitlements to operate in the deepwater line fishery and 497 in the inshore line fishery. Vessels range in length from seven to 20 metres. In the deepwater fishery, operators generally use three to six droplines with 150-600 hooks at any one time. These may be retrieved and reset within any one day.

Target species in the trap and line fishery are snapper (*Pagrus auratus*), yellowtail kingfish (*Seriola lalandi*), spanner crab (*Ranina ranina*) and morwong (*Nemadactylus douglasii*). The deepwater line fishery mainly targets blue eye trevalla (*Hyperglyphe antarctica*), gemfish (*Rexea solandri*), hapuka (*Polyprion oxygeneios*), pink ling (*G. blacodes*) and bass groper (*Polyprion americanus*).

2 Effort and Observer Coverage

In 2000/2001, 1 716 tonnes of fish were landed in this fishery. The main fishing methods ranked by 2000/2001 product value were fish trapping (38% of total), handline fishing (20%), dropline fishing (13%), spanner crab dillys (12%), with various other line fishing methods making up the remainder.

No observer program is in place for seabirds.

3 Seabird Interactions

No information exists on seabird interactions with this fishery. It is thought that seabirds would unlikely be caught during the setting of demersal droplines.

As part of the New South Wales Biodiversity Strategy, New South Wales Fisheries is undertaking a project to look at the broad-scale interactions between fishing and marine mammals, reptiles and avifauna in New South Wales marine waters.

Information from this study will be included in the preparation of Management Plans and Environmental Impact Statements on each commercial fishery in New South Wales. Findings from this study may also assist in the implementation of threat abatement plans and preparation of recovery plans for any threatened marine mammals, reptiles and avifauna.

4 Current Management Requirements

This fishery has been restricted since March 1997.

The fishery was declared a share management fishery under the *Fisheries Management Act 1995* in May 2001. Under this management regime, fishers will be provided with a longer-term access right and shares will become the main tool for managing effort in the fishery.

Management methods currently in place for this fishery include, gear controls, minimum size limits and trip limits for some species taken in this fishery.

An environmental assessment and fisheries management strategy is being developed to satisfy the requirements of the *Environmental Planning and Assessment Act 1979* and the EPBC Act.

No seabird mitigation measures are in place in New South Wales at this time. Risks to seabirds will be considered as part of the environmental assessment process for this fishery with management responses reflected in the fishery management strategy for the trap and line fishery where appropriate.

U Scalefish Fishery (Tasmanian Government)

1 Fishery Characteristics

The Tasmanian commercial scalefish fishery is a multi-species fishery involving a wide variety of fishing methods. Gear types such as, gillnet, hooks, traps, squid jigs and seine nets are used to target a diverse range of scalefish, shark and cephalopod species. Other gear types such as Danish seine nets, traps, dipnets, spears and demersal longlines are used less frequently, or are used to target specific species of scalefish.

Whilst school (*G. galeus*) and gummy (*M. antarcticus*) 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.

In the main, scalefish fishing occurs within three nautical miles of the Tasmanian coastline, however rock lobster (*Jasus edwardsii*) fishers are allowed to take scalefish out to 200 miles off the Tasmanian coast. There are particular regional differences in scalefish fishing operations statewide, and the types of fishing activities undertaken by fishers appears to be influenced by the level of exposure to poor weather and sea conditions.

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 one to 200 hooks.

There are 667 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% of the fishing operations.

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.

2 Effort and Observer Coverage

No observer program for seabirds exists for this fishery.

In 2001/2002, the overall catch of scalefish was 1319 tonnes. The demersal longline component was 622.4kg and the shark longline component was 865.2 kilograms. Therefore, scalefish caught using longlines represented 0.04% of the overall catch in 2002.

3 Seabird Interactions

No information exists on seabird interactions with these fisheries, although it is believed to be low. There is no mandatory observer coverage in this fishery.

4 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 nursery areas), whilst 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.

The scalefish fishery is managed predominantly by “input” controls which limits the amount and type of gear that can be used to take fish. Management arrangements include area closures and limits on the amount of gear permitted. The number of hooks for demersal longliners is limited in sensitive areas and shark nursery waters. Automatic hook-baiting and hook-setting gear is prohibited in Tasmanian waters unless the operator has an appropriate Australian Government authority.

V OTHER FISHING METHODS

Seabirds may interact with other fisheries besides those described above. The IPOA is to specifically deal with seabird interactions in longline fisheries, therefore a thorough assessment of seabird interactions with other fisheries will not be undertaken. Seabird interactions have been found or are thought to occur with trawl, troll, squid jig and line fishing methods. It is uncertain how serious these interactions are in Australia. Logbooks, however, allow for recording of seabird interactions in a number of Australian Government-managed fisheries using these fishing methods.

Trawl Fisheries

Overseas, there have been significant seabird mortalities recorded in some trawl fisheries. In New Zealand waters, for example, an estimated 644 birds were killed in the southern hoki (blue grenadier) fishery and 192 in the squid trawl fishery in 1997/1998 (Draft NZ NPOA). Nineteen black-browed albatrosses were killed in one haul on a trawl vessel operating at South Georgia in 1999/2000 (Kock 2001). In general, seabirds are killed more frequently in mid-water trawl fisheries (such as those targeting squid or blue grenadier) than in bottom trawls (such as for orange roughy). This is most likely because mid-water trawl vessels move faster and involve substantially larger nets which are more likely to strike a seabird. There are several classes of interaction which include, collision with vessel, collision with warps (rarely causes death), entanglement in the net itself (codend and wings) or in trawl gear such as the floatline or bellylines, provisioning (feeding on discards or fish meshed in nets), and landing on deck (lights etc.) (Bartle 1991; B. Wienecke and G. Robertson, unpublished; NZ Department of Conservation and Ministry of Agriculture and Fisheries 2000; Baker *et al.* 2002). Seabirds can also suffer injury or death from colliding with the headline netsonde monitor cables sometimes used on trawlers. Russian vessels fishing off New Zealand reported that white-capped (*Thalassarche steadi*) and other albatrosses and larger petrels regularly became entangled in net monitor cables (SC-CAMLR 1991; Kock 2001). Whilst not banned within Australian fisheries, very few (if any) Australian domestic trawlers still use them, preferring instead hull-mounted transducers or towing aquaplanes on which transducers are set to monitor trawling operations (AFMA logbook databases).

Few data exist on seabird interactions with trawl fisheries in Australia, however some seabirds have been recorded caught. No deaths or injuries were noted in 51 shots and 103 hauls observed around Macquarie Island (Weinecke and Robertson in press). At least one death of an albatross has been recorded during one research cruise trawling for orange roughy in the south-east trawl fishery (T. Reid pers obs.), though only one seabird death was recorded in over 1 800 observed hauls as part of the Integrated Scientific Management Program (Harris and Ward 1999).

A mid-water trawl fishery for blue grenadier has been observed by AFMA fisheries observers since 1997 (with observer coverage aimed to be 70%) as part of the south-east trawl fishery. During this time, one black-browed albatross (*T. melanophrys*) was observed caught and it was released alive. In a recent report on the south-east fishery, the bycatch of seabirds was described as close to non-existent, however this information was not quantified (Knuckey and Liggins 1999; Baker *et al.* 2002). It is assumed that because the warps go straight into the water and offal is discharged when the vessels are not trawling, interactions with seabirds are reduced (Towers, I. pers. comm).

In the Sub-Antarctic fisheries, which are subject to 100% observer coverage and are not permitted to discharge offal, incidental catch of seabirds appears to be limited (or remote). At Macquarie Island, 186 shots (34%) and 267 hauls (49%) were observed between 1997 and 1999. No seabird deaths or serious injuries were reported during observation periods. At Heard and McDonald Islands, 503 shots (43%) and 583 hauls (50%) were observed and one giant petrel species, and three to five cape petrels (*Daption capense*) were killed and another three suffered serious injury. Other seabirds also interacted with trawl gear although it is not known whether the birds subsequently died (Baker *et al*. 2002).

The low level of seabird mortality observed in trawl fisheries may be attributable to insufficient data, the latent nature of the interaction or may reflect the true nature of the situation.

Trolling

Trolling involves a vessel steaming along while towing lures or baited hooks. Most game fishing is performed by trolling, with lighter gear used than that for commercial trolling.

Commercial pole and line vessels that fished for southern bluefin tuna (*T. maccoyii*) the waters off the south coast of Western Australia often trolled lures to locate schools of southern bluefin tuna. Once schools were located, fishers then switched to pole and line fishing gear to catch the tuna. Most fishing was undertaken around inshore reefs and along the continental shelf break. Trolling operations were noted to catch flesh-footed shearwaters (*P. carneipes*) and the occasional yellow-nosed albatross (*Thalassarche* spp.) (Anthony de Fries pers. comm.). Catch rates of seabirds when trolling were not kept, however an estimate of the catch rate was about one flesh-footed shearwater (*P. carneipes*) every 50 to 100 hours trolling (these boats trolled two lures for about eight to ten hours each fishing day); therefore one flesh-footed shearwater (*P. carneipes*) per eight to 12 fishing days. Yellow-nosed albatross (*Thalassarche* spp.) were caught much less frequently. Birds were caught either by taking lures or less commonly following collision and entanglement with the gear (A. de Fries pers. comm.).

Due to the nature of the fishing operation, birds caught would be quickly retrieved and released. As is the case with longline fishing, the fate of birds released after being caught this way is unknown. Birds were most likely to be caught when offal and/or old bait were being discharged; at other times, they lost interest.

The surface fishery for southern bluefin tuna (*T. maccoyii*) off the Western Australia coast concluded in the late 1980s following the introduction of ITQs for this species.

Wedge-tailed shearwaters and Australian pelicans have also been caught, either by taking hooks or by colliding with gear and becoming entangled. Some birds have been observed to collide with gear resulting in them crashing into the sea without becoming tangled (A. de Fries pers. comm.).

Hook and Line Fishing

Line fishing with a single hook and sinker, the method most used by recreational fishers, would unlikely result in many interactions with threatened albatross and petrel species. Perhaps the greatest threat to these seabirds from this type of fishing is discarded fishing lines (Australian Bird and Bat Banding Scheme records, Barry Baker pers. comm.), which entangle or are ingested by seabirds sometimes leading to their death. Data on entanglement of birds are limited in Australia. Beach surveys conducted in Tasmania during 1990-1991 reported line entanglement of a shearwater, three pied cormorants, two gannets and a black currawong. These figures only reflect the numbers found in a beach litter survey, which was not a survey designed to record entangled birds.

Australian Seabird Rescue, a volunteer organisation dedicated to the recovery of seabirds, state that entanglement of coastal, estuarine and land-based birds in fishing tackle is quite common particularly in more populated coastal towns. The organisation attributes entanglement in fishing line as a key threat to the survival of pelicans, estimating that one-in-five birds is likely to have life-threatening injuries as a result of interactions with fishing tackle. These birds have a tendency to fly straight into lines whilst they forage around the shoreline. Smaller seabirds have been found to use tangled pieces of line as nesting material, which may lead to ingestion or entanglement (Australian Seabird Rescue 2002).

Squid Jigging

There has been a suggestion that seabird interactions may occur due to the use of squid jig operation’s strong lights to attract squid. The extent of this perceived problem is not yet fully known in the Southern Ocean, but is a known problem in other jig fisheries elsewhere (Kock 2001). Preliminary observer coverage in 2002 did not have adverse wildlife interactions recorded.

Part 2 – Evaluation of Mitigation Measures

VI SEABIRD CHARACTERISTICS

Life History Strategies

The life history strategies of albatrosses and petrels are a major factor influencing their conservation status. These species are characterised by a low natural adult mortality (in the order of 3-4%), deferred sexual maturity, low reproductive output (at most, one chick per year), relatively high breeding success, mate fidelity and a long lifespan. Consequently, populations may be imperiled by even small increases in the rate of mortality (Croxall *et al*. 1990). Furthermore, the breeding season of albatrosses and petrels are typically exceptionally long. For example, the shy albatross (*T. cauta*) begins breeding in September, and the young birds do not fledge until April. The breeding season for other species such as the wandering or light-mantled sooty albatrosses *(D. exulans* and *Phoebetria palpebrata* respectively) is longer, with wandering albatrosses only nesting every second year, while light-mantled sooty albatrosses breed every second or third year. An entire year is required from egg laying to chick fledging for the large *Diomedea* species. During breeding, the death of one parent may result in the death of the dependent offspring, further jeopardising population viability (Weimerskirch and Jouventin 1987; Croxall *et al*. 1990).

Distribution of Vulnerable Species in the AFZ

Twenty-one species of albatross have been recorded in the AFZ. Thirteen of these species of albatross have been caught on longlines in the AFZ (see table 2 in Appendix 1), while two other species (Salvin's, *Thalassarche salvini*, and Chatham, *T. eremita*) have been observed to interact with longlines in the AFZ. All species have been observed caught on longline hooks in some part of their geographic range. Thirteen other species of seabirds have been observed killed on longlines in the AFZ, including petrels, gannets and skuas. Generally, the albatross and petrel species that have been recorded caught on longline fisheries in the AFZ occur in southern waters (see table 7 in Appendix 1) and the northern limits vary between species. Their distribution also varies seasonally, with some species occurring further north in winter, while some species only occur within the AFZ at certain times of year.

Five species of albatross breed in the AFZ, namely the wandering (*D. exulans*), black-browed (*T. melanophrys*), shy (*T. cauta*), grey-headed (*T. chrysostoma*) and light-mantled sooty (*P. palpebrata*) albatrosses. The shy albatross occurs most commonly off waters of southeastern Australia, but also occurs north to Shark Bay in Western Australia and occasionally to northern Queensland waters. Young birds move further afield than adults, with some pre-breeders from the Mewstone (off Tasmania) dispersing to waters off South Africa. The other four albatross species breed on sub-Antarctic islands. Away from these islands, these species range extensively, their pelagic distribution including southern Australian waters. Ten species of albatross breed only on New Zealand islands, and many of these birds forage in the AFZ. Eight of these species are predominantly observed off southeast Australia or off the sub-Antarctic Macquarie Island, seldom ranging to southwest Australian waters. The Indian yellow-nosed albatross (*T. bassi*) breeds on remote Indian Ocean islands but is common throughout southern Australian waters, particularly off southwest Australia.

Likewise, petrels and shearwaters show variable distribution within the AFZ. White-chinned petrels (*Procellaria aequinoctialis*) occur between Cape Leeuwin in Western Australia and Green Cape in New South Wales during the summer months and were commonly killed in the Japanese pelagic tuna longline fishery. The similar grey petrel (*Procellaria cinerea*) occurs in comparable waters, but only during winter. Four species of shearwater that breed in large numbers in the AFZ have been caught on longlines within the AFZ. The short-tailed and sooty shearwaters (*Puffinus tenuirostris* and *Puffinus griseus* respectively) breed predominantly in southeastern Australia during the summer, and depart to the Bering Sea and adjacent waters during winter. During the Australian summer, these birds forage as far south as Antarctica. The flesh-footed shearwater (*P. carneipes*) also only occurs in the AFZ in summer, but breeds (and occurs) commonly from southern Western Australia to southern Queensland. This species is only rarely observed in Tasmanian waters. The wedge-tailed shearwater (*P. pacificus*) occurs all year round in the northern parts of its range in the AFZ, from Montague Island (NSW) north around to Bunbury (WA).

The Australasian gannet (*Morus serrator*) occurs off southern Australia between Shark Bay and Fraser Island and has been observed killed in longline fisheries. In addition, there are four related species that breed and occur in tropical waters of the AFZ. These have not been observed to interact with longline fishing, but occur in areas where there has been relatively little observing.

Over half of the seabird species taken incidentally in longline fishing are assigned to various threatened categories (see table 2 in Appendix 1).

Foraging Behaviour

An understanding of the flight behaviour of seabirds, the way they locate food, the way in which they feed, and what they feed on is important in trying to solve the problem of seabird bycatch. Flight varies with body size and wing shape. Larger wings are used for gliding, whereas smaller broader wings allow more maneuverability through the use of flapping. Wandering albatrosses (*D. exulans*) can average flight speeds in the order of 60 kilometres/hour and move continuously in windy conditions, almost never flying to windward. Other species however, including the medium-sized shy albatross (*T. cauta*), make much less use of wind-assisted flight, with shorter and slower flights (rarely in excess of 30 kilometres/hour).

Albatrosses and petrels spend most of their lives traversing the sea in search of prey. Whilst searching for food is generally a solitary behaviour, seabirds tend to congregate in specific areas for foraging (e.g. Hunt and Schneider 1987). Two foraging strategies are commonly used by albatrosses and petrels: one is to move long distances searching for food, while the other is to commute to areas of high primary productivity where the prey is likely to be found. Once one bird has found a source of food, it is easier for other birds to join that bird rather than to find an alternate food source (Haney *et al*. 1992; Veit *et al*. 1993; Nevitt and Veit 1999; Reid and Hindell 2000). Because of this, when seabirds find a rich source of food, such as that associated with fishing vessels (i.e. discards and/or baited hooks), flocks of several hundred birds often congregate (Barton 1979; Harper 1987; Ryan and Moloney 1988; Vaske 1991).

Many seabird species (but not all) fly vast distances (500–1 000 kilometres) to forage and stay within certain ranges, for example, circumpolar or within a restricted ocean section (e.g. Jouventin and Weimerskirch 1990; Weimerskirch *et al*. 1999). Different populations of the same species may feed in different areas, and the at-sea distribution of a population may vary also with age and sex. For example, breeding shy albatrosses (*T. cauta*), from three different breeding locations favour mutually exclusive feeding zones, as do the non-breeders and young birds.

Often areas of high productivity correspond to areas of fishing. It is not clearly understood how birds find their food, but albatrosses and petrels are thought to use cues such as celestial navigation and magnetic fields in their long-distance searching for food. These seabirds are assisted by well-developed olfactory systems and are thought to use their sense of smell to detect food. Odour cues are used for area-restricted searches whilst visual cues of prey, and other birds and mammals feeding, are thought to be the last cues used in prey detection (Nevitt and Veit 1999). Smaller, more cryptic species usually have better developed olfactory systems than other species, which likely assists their feeding at night when a sense of smell is especially useful. Whilst albatrosses are active predominantly during the day (Weimerskirch and Wilson 1992), some of the smaller albatross species are also active at night (e.g. Light-mantled sooty albatross, *P. palpebrata*, Weimerskirch and Robertson 1994), especially during periods of full moon (Hedd *et al.* 1998).

The largest albatrosses are generally surface feeders but smaller species are proficient divers. Shy albatrosses (*T. cauta*) generally make plunge dives to about three metres for five seconds, occasionally staying submerged for up to 19 seconds. They also actively propel themselves underwater during longer swim dives. The smaller petrels, including sooty shearwaters (*P. griseus*), excel underwater, diving to depths of 70 metres.

Albatrosses are generally described as opportunistic feeders; their prey includes squid, fish and, to a lesser extent, crustaceans (Cherel and Klages 1998). The ratios of these different food types vary depending upon local abundance and seasonal variations in prey availability. Most quantitative studies of the diets of albatrosses are based upon food regurgitated to chicks at the nest. Hence, the foods of albatrosses and giant petrels are poorly known outside the chick-rearing period (Cherel and Klages 1998). Indeed, the diet of several species remains almost entirely unstudied. Albatrosses and petrels actively catch live food, as well as scavenge dead prey, fishery discards and baits. In the southern bluefin tuna longline fisheries off Australia, the baits on the longline hooks are very often the same size and sometimes the same species as the natural prey of the birds.

VII SEABIRD-FISHERY INTERACTIONS

How Birds are Killed

The foraging strategy of seabirds leads to interactions with many fisheries. Areas where seabirds congregate to forage are likely to be rich in prey, which also attracts fishers. Often the timing and distribution of highest seabird numbers corresponds with that of greatest fishing effort. Many seabirds use olfactory landscapes (smell) to locate food sources; fishing vessels either placing baited hooks over the side during line setting, or offal during processing, present highly attractive sites for seabirds to forage (Vaske 1991). Once a food source such as this is detected, many seabirds will be attracted to it. Within the assemblages of seabirds congregating behind fishing boats, it is the smaller species, such as sooty shearwaters (*P. griseus*) and light-mantled sooty albatrosses (*Phoebetria fusca*), that search out and retrieve the prey from depth, but often then lose it to more aggressive seabirds at the surface. It is the more aggressive and larger seabirds which compete more successfully for the baits, and these generally larger seabirds are more likely to swallow the baited hook. Alternatively, if bait being fought over suddenly comes off the hook, the attached branch line suddenly is released and may become tangled around seabirds involved in the fighting. Interestingly, data from the southern Indian Ocean suggests that there is a skewed sex ratio of the birds caught, with male grey-headed albatross (*T. chrysostoma*), yellow-nosed albatross (*Thalassarche* spp) and white-chinned petrels (*P. aequinoctialis*) caught in significantly higher numbers than females (Ryan and Boix-Hinzen 1999). The seabird species attending vessels varies seasonally (and regionally) and so the nature of seabird interactions with fishery operations also varies.

The likelihood of seabirds being caught on longlines depends on the type of fishing activity and gear used. For example, the availability of baited hooks to seabirds depends upon the interaction of a number of operational factors including; the buoyancy of the line and bait, the weight on the end of the line, the speed of deployment, and the boat speed and degree of shielding of the line from bird attacks.

The nature of seabird mortality arising from interactions with longline vessels, include: hooked during line setting; hooked during line hauling; entanglement in gear; ingestion of hooks in discards; reduced breeding success due to death of parent bird; and shooting of birds.

1 *Hooked During Line Setting*

The most common form of incidental mortality is the seabirds becoming hooked during the setting (Murray *et al.* 1993). Brothers (1991) documented this mortality in seabirds on Japanese longline vessels operating in the AFZ and indicated 97% of birds caught in that fishery were caught in this way. The figure is lower in the Australian domestic pelagic longline fishery, with 89% of birds caught during line setting and 11% caught during line hauling (DPIWE unpublished data). Birds caught during line setting generally drown and remain hooked during the line soak. The level of mortality arising from line setting is usually assessed by counting birds that are on hooks when the line is hauled. Brothers (1991) indicated that this can underestimate the rate of bycatch by approximately 30% because:

- birds can be hooked and then be eaten by sharks or other fish or fall off the hooks
- longline operators can cut dead birds off the line before they are hauled aboard the vessel and recorded by the observer.

These two potential sources of error may be significant, but are difficult to quantify and serve to reduce the accuracy of bycatch data (Gales *et al.* 1998). Consequently, estimates of mortality assessed from hooked birds which are landed can only be considered as minimums. Greater accuracy can be achieved by observing the number of birds hooked during the set (at least on day-set lines), and requiring all hooks to be landed.

In the Australian domestic pelagic longline fishery, 19% of birds caught during line setting are still alive at the time of hauling (Brothers *et al*. 1999b). The increased survival rate is due to the lighter gear used allowing them to remain at the surface during the soak. These birds are generally released alive, but their ultimate fate is unknown. These birds should be included in assessments of bycatch rates.

2 *Hooked During Line Hauling*

Seabirds have been recorded hooked and entangled during line hauling (being attracted to unspent baits) and either escape or are released alive (Brothers and Foster 1997). In the Australian domestic pelagic longline fishery, 11% of birds were caught during line hauling and released alive (though it is not known what the ultimate fate of these birds is) (DPIWE unpublished data). Injuries sustained may account for the injured birds found dying at breeding colonies by Weimerskirch and Jouventin (1987).

3 *Entanglement in Gear*

In addition to becoming caught on hooks, seabirds can become entangled in the gear. Seabirds will sometimes get caught on hooks or branchlines adjacent to the one they are trying to obtain the bait from (Brothers 1995). This type of bycatch is most likely to occur during fighting over baits, and may lead to more than one bird being caught on a hook. This may occur through collisions with the mainline before it enters the water during line setting. In addition, a higher mortality is associated with birds entangled in rough seas namely because of the greater difficulty in resisting drowning in the agitated waves (Vaske 1991).

Seabirds can also become entangled in gear that is dumped at sea, which can potentially lead to mortality. A study conducted at sub-Antarctic Marion Island found that during the 1997/1998 toothfish longline season, three seabirds—a southern giant petrel (*Macronectes giganteus*), a northern giant petrel (*Macronectes halli*), and a sub-Antarctic skua (*Macronectes giganteus*)—were found entangled in fishing gear. One bird was found with a hook through its leg, another with a monofilament nylon snood sticking out of its beak, and the other bird had one hook lodged in its oesophagus and another hook embedded in its wing (Nel and Nel 1999).

Injuries to birds caused by entanglement in fishing line commonly occur. For example, the Victorian Wader Study Group report that 14% of the recoveries of Crested terns were specifically reported as 'found tangled in fishing gear' (Minton 1992). Hooks are usually embedded in the bird's mouth and fishing line is commonly tangled around the bird's legs and feet. Many birds die if the hooks, lines or both are not removed (Minton 1998).

4 Ingestion of Hooks in Discards

Regurgitated longline hooks have been recorded near albatross nests at South Georgia (Huin and Croxall 1996). It is possible that these hooks come from either:

- baits caught by a bird during line hauling which are cut off to release the bird
- hooks which are left in discarded baits and fish heads and are then consumed by seabirds.

Brothers (1995) recorded hooks in 9.4% of grenadier discarded as fish bycatch from the south Atlantic toothfish (*Dissostichus* spp.) fishery. Hooks remained in the discarded heads of 23% of the target species in that fishery.

A study conducted at Marion Island from May 1996 to April 1998 discovered that five seabird carcasses—three wandering albatross chicks (*D. exulans*), one white chinned petrel chick (*P. aequinoctialis*) and a southern giant petrel adult (*M. giganteus*)—contained ingested fishing gear from the toothfish fishery (Nel and Nel 1999).

Death may follow due to the release of harmful chemicals into their systems from the corrosion of hooks by digestive fluids. These chemicals may lead to indirect effects on body condition, and thus survival. Large pollutant loads can also impair feeding activity, which can lead to mortality (Ryan 1998).

5 Reduced Breeding Success Due to Death of Parent Bird

As described, seabird breeding strategies involve high parental investment in raising a chick, therefore it is likely that the death of a breeding adult would also result in the death of the egg or chick. In addition, in *Procellariifomes* there is often a considerable delay before new partnerships are formed and lower reproductive success in new pairings (Bradley *et al*. 1995). The remaining parent is therefore less likely to breed successfully in the years following the death of their mate. For wandering albatrosses (*D. exulans*), loss of a mate reduces the life-time reproductive potential by up to 15% (Jouventin *et al.* 1999).

6 Shooting of Birds

There have been reports of seabirds being shot by crew on longline vessels and by recreational fishers (Adams 1992; Tomkins 1985; DPIWE data unpublished). The rate or incidence of mortality from shooting and other executions is not known but is likely to be significant in some regions. This deliberate take of seabirds is illegal under the EPBC Act and equivalent State/Territory legislation.

Where Birds are Killed

Given the highly mobile nature of albatrosses, petrels and shearwaters, seabird bycatch needs to be addressed at two levels:

- those that are killed within the AFZ
- those that breed in Australia, but are killed in fisheries in other countries.

1. Seabirds Killed on Hooks Set in the AFZ

Within the AFZ, initial concerns were over the extent of bycatch of the charismatic albatrosses. Only in later years was equivalent attention extended to the less conspicuous species.

In the AFZ, the seabird species affected by longlining operations occur more commonly in southern Australian waters, with breeding sites predominantly located in sub-Antarctic waters, i.e. around Macquarie Island and the Heard and McDonald Islands (see table 7 in Appendix 1). During the period when the TAP was developed, only one bird had been observed killed in the AFZ north of 25°S in over 700 000 observed hooks (Brothers *et al*. 1998a). Consequently, the area south of the latitude of 30°S was identified as the area with a greater bycatch potential (e.g. Blakers *et al*. 1984; Brothers 1991; Klaer and Polacheck 1995; Environment Australia 1998; Gales *et al*. 1998). Data collected by the Japanese pelagic longline fishery over the period 1991-1997 confirmed that potential, as significantly higher catch rates were recorded in waters south of 30°S than north of that latitude. No birds have been observed killed in waters north of 30°S off the west coast of AFZ, though only a small amount of observing has occurred in the area.

However, recent data collected as part of the underwater-setting chute trial in the domestic tuna fishery indicate that seabird bycatch north of 30°S may be unacceptably high in that fishery, in contrast to the situation observed previously in the Japanese fleet. These data record three birds taken on 19 250 hooks observed. All birds caught were flesh-footed shearwaters (*P. carneipes*), which were caught between 25°S to 30°S and taken during the day when boats were fishing without other mitigation measures employed. Whilst these data indicate that there may be greater potential for seabirds to interact with longline fisheries north of that latitude in the AFZ than initially envisaged when the TAP was prepared, caution needs to be applied in placing too much emphasis on the results at this stage. The number of hooks observed was small and it may be premature to adjust the TAP prescriptions at the present time. Also, during the line weighting/twin bird-scaring line trial (April to November 2002), no seabirds were observed caught north of 30°S during the night and day sets, however only 31 274 hooks were observed north of that latitude. Nonetheless, the results do indicate that this situation should be closely monitored over the next 12 months.

Observations also indicate that there are marked seasonal differences in seabird bycatch, with catch rates in southern waters higher in summer than winter (most fishing occurred in winter) (Gales *et al.* 1998). This reflects the seasonal changes in pelagic distribution of the vulnerable species, and the interactions between these species. For example, white-chinned petrels (*P. aequinoctialis*) and shearwaters (*Puffinus spp.*) are present in high numbers during summer months and, being proficient divers, retrieve baits that may otherwise be inaccessible to the larger attendant albatrosses. In contrast, north of 30ºS, 88% of birds observed killed in the Japanese longline fishery were caught during September with none killed during summer (October to March). However, this is most likely because very few, if any, boats were fishing during these months north of 30ºS.

Catch rates are greater in summer than winter for Tasmania and southern New South Wales. From the data collected during the recent chute and line weighting/twin bird-scaring line trials, it appears that seabird bycatch is more prevalent between 30-33°S on the east coast of Australia particularly in the spring/summer months. Also, the data indicate that the most common species caught during the summer months is the flesh-footed shearwater *(P. carneipes*), particularly adjacent to Lord Howe Island (see table 2 in Appendix 1). Insufficient observing has occurred off south-west Western Australia to make a confident assessment, but based on observations of foreign vessels, the area is likely to have a catch rate at least as high as that around Tasmania.

2. Other Areas Where Australian Range Populations are Killed

From a national perspective, in addition to being concerned about the fate of all species visiting the AFZ, Australia must also be concerned with longline fishing occurring beyond the AFZ, as many Australian breeding populations migrate or forage beyond the AFZ and hence are vulnerable in those waters. Many pre-breeding shy albatross (*T. cauta*) disperse to waters off South Africa for the first few years of their life (Brothers *et al.* 1997). In these waters they interact with wide-scale longline fisheries targeting hake and tuna (Barnes *et al*. 1997).

Four species of albatross breed on Macquarie Island. Banding and satellite studies have shown them to have a wide distribution throughout the Southern Ocean, from the

Antarctic ice north to Australia, and at least from Prydz Bay in the west to the Ross Sea in the east. In all of these waters there is a high likelihood for these albatrosses to overlap with longline fisheries, including those for Patagonian toothfish (*Dissostichus eleginoides*)—both legal and illegal—and with tuna fisheries. Two species of albatross and one species of giant-petrel breed on Heard Island and McDonald Islands, and probably move over much of the Indian and Southern Oceans, and so are equally likely to encounter many longline fisheries. Both northern and southern giant-petrels (*M. halli* and *M. giganteus* respectively) breed on Macquarie Island. Banded birds have been recorded from a wide area, from the Atlantic Ocean, Australia and New Zealand. Many of these records are from bands retrieved from hooked birds. Short-tailed and sooty shearwaters (*P. tenuirostris* and *P. griseus*) breed in Australia and migrate to the North Pacific Ocean where they are killed on longline vessels operating in the Bering Sea and Gulf of Alaska. These birds are also killed in drift net fisheries in the Sea of Okhotsk. The flesh-footed shearwater (*P. carneipes*) also breeds in Australia and migrates to the North Pacific, where it is likely killed in longline fisheries. Australian interest and responsibility in seabird bycatch and mitigation extends to all major ocean sectors, especially in the high latitudes (greater than 30^{o} north and south).

VIII MITIGATION MEASURES

In the context of seabird bycatch, a mitigation measure is defined as "a modification to fishing practices and/or equipment that reduces the likelihood of seabird incidental catch" (Brothers *et al.* 1999a). A range of mitigation measures have been developed or proposed to lower seabird bycatch, each measure having different attributes, costs and levels of potential to successfully reduce seabird catch (see table 8 in Appendix 1). Some measures have been consistently successful in a number of longline fisheries, while the effectiveness of other measures has varied between vessels and seabird species. The use of these measures has been extensively described and assessed by Brothers *et al*. (1999a, b).

An important consideration in the use and effectiveness of any mitigation measure is the seasonal and regional variation in both the species composition and abundance of seabird species. For example, in Australia south of 30^{o}S there are large numbers of petrels and shearwaters that dive for bait and albatrosses that fight for the bait. Therefore it is important to sink the baits as rapidly as possible, and in these cases a combination such as weighted lines and a bird line may be appropriate. Alternately, in waters off Norway where surface-feeding northern fulmars (*Fulmarus glacialis*) are most commonly caught, during experimental trials, bird scaring lines were found to reduce the bird bycatch rate by 99% (Lokkeborg 1998).

It is now widely recognised that a combination of measures is required to mitigate seabird bycatch, as many of the currently identified measures are not sufficient in isolation. The principles and attributes of the currently recognised measures are briefly described below.

Operational Measures

1 Night Setting

The setting of lines at night can virtually eliminate seabird mortality in some seasons in certain fishing grounds, as most of the seabirds that are caught are active during the day. Darkness also affords baited hooks additional protection by concealing them from birds, which is particularly beneficial if slow sinking baits are being set and if bird-scaring lines are not in use. The efficacy of night setting in reducing bird catch has been estimated as between 60%-96% (Murray *et al.* 1993; Klaer and Polacheck 1995; Cherel *et al.* 1996; Brothers *et al.* 1999a, b). Within the AFZ, data have shown that all species are less likely to be caught on night-set hooks than day-set hooks (Gales *et al*. 1998), though the effectiveness was reduced on nights of full moon, with all species being more likely to be caught. Excessive deck lighting can also increase the number of birds caught during night sets (Ryan and Boix-Hinzen 1998).

The effectiveness of this measure can vary between fishing grounds and also seasonally within a fishing ground. This reflects the seasonal and regional changes in seabird assemblages both in species composition and abundance. For example, during summer in the AFZ, breeding birds are likely to forage at all times where there is sufficient light, so night catch rates tend to increase during periods of full moon. Furthermore, white-chinned petrels (*P. aequinoctialis*) are more active than other species at night. Hence, for areas frequented by this species, night setting alone is not sufficient as a mitigation tool (Ashford *et al.* 1995, Barnes *et al*. 1997; Kock 2001). Subtle refinements may be required in some areas to improve existing measures. Barnes (1997), for example, found that birds are more susceptible to being caught in the period two to five hours before sunrise. Modified requirements of night setting, along with combinations of other strategies (bird lines, line weighting) are therefore required to reduce the bycatch of some species.

Fisheries management regulations under the TAP require that night setting is compulsory for all pelagic longline vessels operating south of 30^{o}S in the AFZ. Although it was used as a voluntary mitigation measure by some fishers prior to this, especially the tuna fishery around Tasmania, it has not been widely used in the AFZ. Reasons for this include concerns over reduced fishing opportunities, since smaller domestic vessels may only be able to leave port for small gaps in the weather. Operators also indicate that targeted tuna species usually feed during daylight hours and during the full or half moon. Probably because of these concerns, recent investigations have shown that there is a low level of compliance with this regulation amongst fishers. In the near future, however, setting of vessels will be monitored through vessel monitoring systems (VMS) and drum monitoring. Despite this potential operational downside, given its effectiveness as a mitigation measure in the AFZ, and the current absence of alternatives, night setting remains an appropriate measure under the TAP.

In the southern parts of the south-east fishery there may not be sufficient hours of night during summer for this method to be applied. There is therefore the potential to restrict fishing to certain times of year (i.e. area/season closures) as occurs in CCAMLR sub-areas which have high bird bycatch potential (e.g. South Georgia longline fishery restricted to night-set operations during winter months).

2 Bait Thawing

Seabird bycatch rates in pelagic longline fisheries have proven to be higher when frozen baits are used, than when thawed baits are used (Klaer and Polacheck 1995; Brothers *et al*. 1999). Frozen baits and baits with swim bladders sink more slowly than thawed ones, and hence remain visible and available to seabirds for longer (Brothers 1995). Bait thaw state has no effect on the sink rates of baits in demersal longline fisheries because the lines are weighted. These restrictions were applied because in autoline fishing, the baits are cut into small pieces, while in other methods the gear is sufficiently heavy that the buoyancy of the bait has negligible effect on sink performance. Currently the TAP requires that all pelagic longline fishing operations in AFZ waters south of 30°S use thawed bait.

3 Spatial/Temporal Closures

Seabirds have specific feeding areas where they congregate at particular times of the year. High bycatch rates have also been recorded in some of the same areas (e.g. Croxall and Prince 1996). Prohibition of fishing operations during the periods of high seabird abundance has been used in some fisheries in particular circumstances, typically in the vicinity of colonies during the breeding season when foraging ranges are restricted. This strategy is used extensively in CCAMLR-managed longline fisheries. In Australia, fishing restrictions have been implemented in the sub-Antarctic fisheries around Heard/McDonald and Macquarie Islands, where only trawling has been permitted until recently (though illegal, unreported and unregulated longline fishing does occur). These restrictions were put in place because of the potential for high levels of seabird bycatch interactions with longlines in these areas. Recently, one vessel has been authorised to longline around Heard/McDonald Islands commencing in May 2003, however it will be subject to 100% observer coverage, required to night set and subject to offal discharge conditions. The conservation implications of seabird bycatch around Macquarie Island—where only ten pairs of wandering albatrosses (*D. exulans*) breed each year—are so extreme that it is unlikely that any hook fishing would be allowed until the development of methods, which have zero catch potential. Regional gear restrictions also form the basis of the TAP, with more extensive mitigation measures being required in waters south of 30°S.

Whilst appropriate spatial/temporal closures are an important element in bycatch mitigation, a concern results from the lack of understanding of the overall extent of the effect on bycatch. It is likely that the fishing effort that would have occurred in the closed area will instead occur in another area. There is therefore a need for greater understanding of the dynamics of fishery effort, seabird vulnerability and the implications of bycatch at different times of the year. An increased understanding of seabird distributions would enable more specific area/season risk assessments within the AFZ. This knowledge in turn would enable more informed guidance to fishers on mitigation expectations.

4 Offal Discharge

During fishing operations, a large amount of fish waste is produced, including both bait returned when the fishing line is retrieved, and discarded parts of fish when they are processed (e.g. heads and guts). When thrown overboard, this provides an attractive source of food for seabirds, and serves to attract foraging birds to the fishing vessels. When birds are attracted to vessels they are more likely to be caught on baited hooks. Therefore, limiting or eliminating offal discharge has the potential to lower seabird bycatch by lowering the number of birds present during line setting.

If dumping of offal is unavoidable then it should be done in such a way as to minimise its availability to seabirds. In all cases there should be avoidance of dumping of discarded fish (or fish heads) that may contain embedded hooks. During early negotiations of TAP provisions, prohibition of offal discharge during trips was raised, but this option was rejected by industry as being impractical. The TAP requires that all Australian Government-managed pelagic longline, demersal longline (including trotline) and dropline vessels are prohibited from discharging offal during line setting. Vessels are also required to manage offal discharge during line hauling to reduce the attractiveness of the vessel to seabirds. In CCAMLR waters, if offal is discharged it must be from the opposite side of the vessel to line hauling. This measure proved to significantly drop the catch of seabirds during hauling in 1996/1997 (SC-CAMLR 2000; Kock 2001).

Strategic offal discharge has been suggested in other fisheries as a means to dump offal in large single bursts (especially during line setting), so that the seabirds are distracted from the baited hooks (Cherel *et al*. 1996; Brothers 1998; McNamara *et al*. 1999). Recent studies have demonstrated an increasing dependence of seabirds on fishery discards. In southern New Zealand, discards from fishing vessels seemed to have a beneficial effect on the population of southern Buller's albatrosses breeding (*Thalassarche bulleri*) on the Snares (James and Stahl 2000). While offal dumping may distract birds for short periods on occasions, in the long term it contributes to reinforcing the positive association for birds with fishing activities. If retention/processing of offal was possible then fishing vessels would ultimately become much less attractive to seabirds and result in a corresponding decrease in the likelihood of interactions between seabirds and hooks (Brothers 1998). Currently, while the association between birds and longlines remains strong, and offal dumping persists, further effective mitigation measures are required to eliminate seabird access to baited hooks.

5 Live Bait

In some domestic tuna fisheries, live fish are used as bait. While these are used for increasing catch rates of target species, it is uncertain what effect this practice has regarding seabird bycatch. Some reports indicate that the use of live bait may be effective at reducing seabird bycatch (Environment Australia 1997). Some fishers have suggested that as the live bait swim downwards to avoid the seabirds, fewer seabirds are hooked. However, observations undertaken as part of the underwater-setting chute trial indicate that live bait tends to attract more seabirds. During 1997, 2 100 hooks with live bait were observed set during the day off the New South Wales coast. Three birds were observed caught on these hooks (Brothers *et al.* 1998b). While only a few live fish baited hooks have been observed, information suggests that it is unlikely that use of live bait is effective as a mitigation measure.

Technical Measures

1 Bird-Scaring Line (or Tori Line)

Details of design and effectiveness of bird-scaring lines are given in greater detail in previous reports (Brothers 1995; Brothers *et al*. 1999a). In principle, a bird-scaring line trails from a raised pole and hangs over the areas of water that baited hooks are landing.

Bird-scaring lines have attached streamers, and as the bird-scaring line and the streamers contact the water and are blown by the wind, they bounce randomly and act to distract seabirds that otherwise would take the baits. In some fisheries, paired bird-scaring lines are recommended to provide additional protection.

Bird-scaring lines are a relatively simple but effective method for reducing seabird bycatch that has been in use since the 1980's (Brothers 1991). Used in isolation, they have been shown to reduce seabird bycatch by 30-70% in pelagic fisheries in the AFZ (Brothers 1991; Klaer and Polacheck 1995), and should be even more effective in demersal fisheries (Lokkeborg 1998). Paired steamer lines have been proven highly effective at reducing seabird bycatch in the North Pacific (Anon. 2000). The effectiveness of tori lines depends on their configuration and deployment, and is also influenced by the direction and speed of the wind (Duckworth 1995; Ashford *et al*. 1995; Brothers *et al*. 1999b). Tori lines are likely to be most successful when a restricted area of bait protection is required, i.e. when baited hooks are sunk rapidly.

While compliance checks indicate that vessels carry bird-scaring lines, the number of vessels deploying lines at sea is uncertain. Deploying a bird-scaring line at the beginning of line setting presents an additional task for fishers, and entanglement with the mainline can be an issue for inadequately configured/deployed lines. In the future, the mandatory use of bird-scaring lines in combination with other mitigation measures may require review. For example, if underwater-setting devices are highly successful, bird-scaring line use may no longer be necessary.

2 Bait-Casting Machines

When baits are hand thrown from vessels during pelagic longline setting, many get caught in the propeller turbulence and remain close to the sea surface for longer. Bait-casting machines throw baits clear of the propeller turbulence so that they sink more readily. They can also be thrown either to port or to starboard, and therefore confuse birds because the bait recovery position is no longer consistent.

When used in combination with a bird-scaring line, 40-80% reductions in seabird bycatch may be achieved (Brothers 1991). The original machines had a low arc of throw, were gimbaled, and had facilities to vary the distance and side of the throw. Since then, cheaper, less flexible machines have been used which can only throw at a single distance, direction and angle so that the baited hooks are more likely either to not land under the bird-scaring line, or to tangle with it. They are therefore less likely to be as effective as the original models. Both currently available machines are more suitable for larger longline vessels (such as the Japanese fleet) but disputes over patents have limited their availability.

3 Underwater-Setting Chutes

Most seabirds are caught on longline hooks during line setting. Therefore, setting hooks underwater, out of reach and sight of seabirds has the potential to reduce bycatch. However, the success of underwater-setting as a mitigation measure is determined by the seabird species mix and their relative diving ability. Available devices to achieve underwater-setting are either a chute or a capsule method.

One type of underwater-setting chute is currently commercially available for use with demersal longlining. The Mustad underwater-setting funnel is available for use in single line demersal fisheries using the autoline method. This device allows the mainline and baited hooks to be set at approximately 1.5m below the surface, setting depth varying with swell conditions and the load of the vessel. The Mustad funnel also sets the line above propeller turbulence, which may result in hooks being pushed back toward the surface (CCAMLR 2000).

Tests conducted in the northern hemisphere found the Mustad funnel to lower seabird bycatch rates by 70-92%, but in the same tests, bird lines were found to be more effective (90-99%) (Lokkeborg 1998). Catch rates as high as 0.49 birds/1 000 hooks were recorded when the funnel was in use (Lokkeborg 2000). Further trials using this funnel have been carried out in southern waters but these results are currently unavailable.

An underwater-setting chute suitable for use in pelagic fisheries was recently developed by a consortium of Australian and New Zealand industry and government agencies. The device consists of about an eight metre long tube with a slot in one side so that only the baited hook is deployed underwater, with the mainline set straight over the side, similar to conventional operations. This chute generally sets the baited hooks at a mean depth of 5.7 metres (Brothers *et al*. 2000) and generally below the area of propeller turbulence. O'Toole and Molloy (2000) discuss the findings of a New Zealand trial using the device on a 30 metre domestic tuna fishing vessel, which compared the sink rates of branch lines set using the underwater-setting chute with those that were hand-thrown. Baited branch lines set using the device were significantly deeper than those that were hand-thrown. The mean depth that the baits emerged from the chute was 6.5 metres, with a range of 2.5 to 10 metres. The report concluded that the chute showed promise in preventing bycatch of many albatross species as it sets the baits beyond the diving depths of these species.

In Australia, a 10-vessel trial of the device took place from September 2001 to March 2002 in the domestic tuna pelagic longline fishery on the eastern seaboard. While the device proved to consistently release baited hooks at a minimum depth of five metres, many baited hooks were retrieved by flesh-footed shearwaters (*P. carneipes*) (97% of the seabird bycatch), a deep-diving, aggressive feeder. Setting underwater alone did not prove to be suitable to avoid captures in the presence of these birds.

There were initial complications in trialing the device and as a result there were mixed reactions by the operators involved in the trial. Participants were generally unaware at the beginning of the trial of the unavoidable impacts on their operations by using the chute and some operators were unwilling to alter their fishing activities to accommodate the device. Also, the differences in fishing practices, methods and vessels used on the east coast were not fully understood at the commencement time of the trial. These included differences in weights, setting equipment, number of bins, setting positions, setting speeds, baits, techniques and behaviours, different installations on the vessels and the use of the chute. It appears that that the chute was not sufficiently ready for testing in the broader trial. However, the chute has shown some promise and a further trial is planned to modify and further refine the chute and test it in conjunction with other mitigation measures.

4 Line Weighting

Changes in fishing gear used in longline operations influences their potential for capturing seabirds. During the 1990's, Japanese tuna vessels operating in the AFZ were increasingly using lightweight, monofilament gear. This gear sunk more slowly than the more traditionally used rope gear, and was found to have a higher observed seabird bycatch rate (Brothers *et al*. 1999b). Most domestic pelagic vessels operating within the AFZ use a monofilament mainline.

Increased line weighting has shown to be important in decreasing seabird bycatch rates in demersal longline fisheries (Ashford *et al*. 1995; Barnes *et al*. 1997), as it increases the sink rate of baited hooks so that they are out of reach of seabirds more rapidly. Sink rates of greater than 0.3 metres/second have been suggested to adequately decrease catch rates for demersal longliners (Robertson 2000). Under the TAP, line weighting has been included as a measure whereby exemption from night setting may be granted when using lines that are sufficiently weighted to cause baits to sink out of reach of diving seabirds immediately after they are set. The amount of weight will be determined by experimental trials.

In pelagic longlining, 60 gram weights placed on the branchline one metre from the hook can double the sink rate (Draft NZ NPOA). Brothers *et al.* (2000) found 40 gram weights placed within one metre, or 80 gram weights placed within five metres, of the hook could achieve a sink rate of a baited hook of 0.3 metres/second. In demersal longlining, this sink rate can be attained with four kilogram weights every 40 metres along the mainline (Robertson 2000). CCAMLR Conservation Measure 29/XVI requires six kilogram weights to be placed every 20 metres along the mainline, as less than this was not certain to prevent bird bycatch. Up until 2000, no vessel had complied with this requirement (CCAMLR 2000). Consequently it was proposed that this measure be modified to require

8.5 kilogram weights spaced at 40 metre intervals (CCAMLR 2000), as this configuration was found to reduce bycatch without affecting the target catch (Agnew *et al*. 2000).

Some pelagic longline fishermen are not prepared to use this method due to concerns about safety risks from the weights (Draft NZ NPOA). Occasionally, during hauling, if a weighted line breaks free of a fish while under tension, it may shoot back to the side of the vessel and strike a fisher. For this safety reason, the use of a prescribed line weighting regime was rejected by industry as a potential mandatory measure under the TAP. However in recent times, a number of operators have approached AFMA with proposals to trial weighting as seabird mitigation measures.

In April 2002, AFMA facilitated a seabird bycatch mitigation trial, which tested the effectiveness of a double bird-scaring line in combination with a 38 gram swivel placed no further than seven metres from the hook during daylight hours. The trial took place in the domestic tuna pelagic longline fishery on the eastern seaboard during daylight hours. A 26 seabird trigger limit was set to test its effectiveness (based on the TAP objective of less than 0.05 birds/1 000 hooks), at which the trial was to cease. This maximum limit was reached (28 birds were caught in total) and the trial canceled in November 2002 between 30° and 33°S. Various configurations were tested using time/depth recorders to determine the sink rate. Observers were onboard vessels to verify the results of various weight configurations and their effectiveness in reducing the bycatch rate to that required in the TAP. The results indicated that the trial appeared to be effective south of 33°S (<0.05 seabirds/1 000 hooks), but did not achieve its objective in the 30°-33°S latitudinal band (0.39 seabirds/1 000 hooks). The main species caught was the flesh-footed shearwater (*P. carneipes*) (see table 2 in Appendix 1).

A further trial is underway which will test 60 gram swivels not more than 5.5 metres from the hook, in conjunction with twin bird-scaring lines during daylight hours south of 30°S

4 Magnetic Deterrent

A magnetic deterrent device was trialed in 1993/1994 by Japanese vessels operating within the AFZ. It was said to interfere with magnetic field receptors but was found to have no effect on seabird bycatch rates (Brothers *et al*. 1999b). When it was tested in an albatross breeding colony, birds pecked at it inquisitively (Brothers 1998).

This device was not used widely in the Japanese fleet after the trials, indicating it did not show much success.

5 Education

Ultimately, fishers must take responsibility for sound sustainable fishing practices. Consequently, it is important to educate fishers on why mitigation measures are necessary, and how to use them. This can be done through the dissemination of handbooks and videos (e.g. Brothers 1995; Leadbitter 1999), or through extension work. Handbooks describing the need for, and use of, mitigation measures in pelagic and demersal longline fisheries have been produced in English, Spanish, Japanese, Taiwanese, Vietnamese, Korean, French, Russian and Afrikaans (Brothers *et al*. 1999a). Videos have also been produced for the Australian and North Pacific longline fishery. The provision of information to fishers has brought about an improvement in bird-conscious fishing practices by operators in some fisheries, with a number eager to participate in seabird mitigation trials to discover a solution to the seabird bycatch problem. However, some fisheries have a high turnover in crew and so there is loss of awareness of seabird bycatch issues.

In most fisheries, further extension work is required, which may include the involvement of appropriate fishery bycatch advisors who accompany fishers to sea and educate them about seabird bycatch issues. This could also allow the harnessing and refinement of the fishers' own initiatives conceived to reduce bycatch. Further focused education and training could be provided to fishers at currently established training courses (e.g.

Australian Maritime College). The integration of bycatch and mitigation issues at all levels of fishery operations is required if a sustained reduction in catch rates is to be achieved.

New Measures Under Development or Not Currently Used in AFZ

1 Underwater-Setting Capsule

An underwater-setting capsule has also been devised and trialed by a New Zealand and Australian collaboration. This cigar-shaped device transports baits to a predetermined depth. The device is attached by a rope to a winch for retrieval after the hooks have been set. A weight attached to a rope at the seaward end of the device pulls it to the desired depth. The capsule is capable of setting hooks with a six second cycling time and, in trials in Tasmanian waters, to a mean depth of 6.7 metres (Brothers *et al.* 2000). During development trials, bait losses to birds were reduced by 81% and most losses that did occur were the result of tangling, an issue that remains to be resolved. Potentially, this device has advantages over underwater-setting chutes because it not only can set hooks at comparable depths but can also be easily moved to set on any part of a vessel's stern, and is more readily moved out of the way when other fishing activities are employed. If the tangling problem can be solved, this device can increase fishing efficiency in a similar manner to the underwater-setting chutes.

Whilst still in the development stage, the capsule shows great potential as an effective measure to reduce bycatch. A trial is to commence mid 2003 off eastern Australia.

2 Bait Dyeing

Bait dying trials have been conducted in Hawaii (McNamara *et al*. 1999). These involved thawing the baits and then dying them using food dyes. A number of colours were used (green, red, blue, yellow), of which blue was found to be the most effective. Bait dying was found to reduce bird interactions during line setting by 49%, while an increase in the catch rates for the target species (both tuna and swordfish) were observed. The rationale for this technique is that by darkening the bait it is less visible from above (and so reducing bird interactions) but more contrasting from below (hence the increased catch rate for fish).

This strategy shows promise as a short-term measure in combination with other solutions. However, because seabirds have become adapted to subtle operational changes in the past, there is potential for them to become accustomed to the dyed bait. The observed reduction in interactions would then, it is expected, diminish over time.

4 Laser Gun

A laser gun developed in France has been used successfully to disturb unwanted roosting flocks of birds such as cormorants (*Phalacrocorax* spp.) or corvids (crows and ravens). It relies on firing a laser light at the birds, which causes them discomfort and is only effective after sunset. Trials of its use in New Zealand longline fishing operations were consistently unsuccessful (CCAMLR 2000).

5 Artificial Bait

The use of artificial baits is extremely attractive as a potential way to ultimately eliminate seabird bycatch. If successful baits could be developed, the association between fishing operations and food would diminish and consequently the likelihood of bycatch would diminish. If seabirds forage by using smell, and many pelagic species of fish use sight, the use of artificial baits that look but do not smell like bait may be successful. Synthetic baits or lures are known to be used in pelagic fisheries, either as hooks, or in combination with baited hooks (Brothers *et al.* 1999a). Japanese pelagic longline vessels have quite extensively used squid lures, sometimes as frequently as one every six baits. However, information on the influence of lures or artificial baits on seabirds and target species has not been reported. One Japanese vessel was observed off Tasmania, which set some hooks using artificial baits. These consisted of clear plastic tubes filled with water and with a fish or squid drawn on their sides. The trial was not considered a success and, after one shot, their use was discontinued. However, it is likely that less naïve artificial baits would be more successful. In New Zealand, a small number of foam squid/nautilus shaped artificial baits have been trialed. Results are preliminary at this stage, but catch per unit effort of the target tuna species increased with the artificial baits, and bird interest in the baits was minimal, with no bird bycatch reported.

A further advantage of the use of artificial bait relates to the bait fishing industry. The overlap between the use of bait fish for the longline industry, and the use of the same bait fish as prey by seabirds and other marine species, as fish meal in aquaculture and for human consumption, brings further conflicts between longline fishery and general utilisation of keystone fish species. In addition, the bait fish are likely to be prey of the fish (e.g. tuna) being targeted. The use of artificial baits thus would further improve the sustainability of the fishery.

To be most effective, artificial baits need to look (or smell for demersal species) and behave like the food of the target species. Artificial bait will only be successful with fishers if they do not compromise the catch rate of the target species. The development of "smart bait" commenced in Australia in the late 1990s but has stalled due to lack of funds. Continued commitment to the development of this concept remains a high priority.

IX EMERGING ISSUES

Multiple Species Considerations

Central to any consideration of bycatch mitigation is the potential for adverse impacts on other species. For example, it has been suggested that night setting, while reducing albatross catch rates, acts to increase levels of petrel and shark bycatch. However, the claims of increased petrel catch are misleading as, whilst petrels are still caught on hooks set at night, the catch rates are still lower than day set lines. Additional measures are required to adequately reduce the levels of bycatch of these birds.

The influence of night setting on sharks, being more difficult to assess, is not known. As the duration of the soak time means that most hooks are in the water for periods of night and day, it is difficult to judge the time of hooking. The use of sensors on the hooks could allow the detection of capture time. This concept should be pursued, as fisheries must consider impacts on all bycatch species to achieve ecological sustainability.

Turtles are occasionally caught on tuna longlines in several ocean sectors. Many of those caught likely result from collisions with the longline and becoming entangled in the line rather than actively becoming hooked by taking the bait (AFMA data). For those turtles that are hooked, examination of the records would show that the nature of capture is species-specific. In some cases, turtle capture could result from changes in fishing operations. These potential interactions must be considered in the deployment of artificial baits.

Currently, longlining is reliant upon large quantities of bait fish. The fisheries used to supply this bait fish should be managed with the same degree of diligence as the target fisheries, in order for both fisheries to be sustainable. The true sustainability of longline fishing is, in reality, decreased by their reliance upon large-scale bait fisheries. In addition, these bait fish are a critical component of the marine ecosystem, typically being keystone prey species for high level predators. Higher predators that may be the basis of a more valuable fishery (e.g. tuna) may be deleteriously affected if prey stocks are depleted. Additionally, if the prey stocks of other high order predators, such as seals, are depleted, the interactions of these predators with fisheries may escalate (e.g. seals interactions with fish farm interactions).

Ensuring the collection, analysis and review of comprehensive information on bycatch events is essential for the development and deployment of effective mitigation regimes. Innovative and long-term strategies are urgently required.

Illegal and Unregulated Fisheries

In the Southern Ocean, extensive longline fisheries operate for a number of species of fish, including the Patagonian toothfish. While much of this fishery operates under the management of the CCAMLR, there is also a large illegal and unregulated fishery. It has been estimated that between 273 000 and 423 000 seabirds have been killed by unregulated vessels operating in the Convention area in the last five years (CCAMLR 2001). These levels of loss, when partitioned by species most likely killed, are consistent with the deterioration of conservation status of these taxa. Indeed, these taxa are facing potential extinction as a result of longline fishing (CCAMLR 2001). This is of serious concern to Australia, as species breeding on Australia’s sub-Antarctic islands almost certainly overlap with these unregulated fisheries and are amongst the impacted taxa.

There is an urgent need for Australia to pursue actions to reduce and minimise the extent of seabird bycatch in unregulated fisheries, including those targeting toothfish and tuna species.

Seabird Interaction Risk Assessments

Assessments of the potential risk of interaction between seabirds and longline fisheries on a regional basis are necessary in efforts to understand and reduce seabird bycatch. In the

CCAMLR Convention Area, such assessments for relevant sub-areas and divisions are undertaken in relation to the:

- timing of fishing seasons
- need to restrict fishing to night time
- magnitude of general potential risk of bycatch of albatrosses and petrels.

Information on at-sea distribution of seabirds, both breeding and visiting populations, and their vulnerability to fishing interactions are considered in the assessments. Advice is then provided regarding the timing of fishing and mitigation prescriptions.

A risk assessment under the TAP in the pelagic longline fisheries indicated that 30^{o}S parallel was the northern boundary of seabird species that were most often caught on longline hooks (Blakers *et al*. 1984; Reid *et al.* in press). Observed data from the Japanese longline fishery in the AFZ also indicated that the catch rate north of this latitude was very low (Gales *et al*. 1998). The TAP therefore required a suite of mitigation methods (night setting, offal handling requirements and compulsory bird-scaring line use) to be used when longline fishing south of 30^{o}S.

Between 1994 and 1999, no birds were observed caught north of 30^{o}S in the domestic pelagic longline fishery, although less observing was conducted than that occurring in the Japanese fishery (73,000 hooks) (Brothers *et al*. 1999b). The limited data collected during mitigation trials recently in the domestic tuna longline fishery suggests that seabird bycatch north of 30^{o}S may be unacceptably high and should be a focus of future observer coverage (for AFMA observer coverage between 1988 and 1998 see Appendix 4). Differences in seabird bycatch rates between the Japanese and domestic fleet north of 30^{o}S is most likely linked to different targeting practices in different seasons.

An ecological risk assessment in the tuna and billfish fisheries is currently being undertaken by the CSIRO and AFMA. This assessment will cover all bycatch species taken in the fisheries and will then enable a more focused approach to bycatch reduction. The data collected through observer coverage will input into this process. There is a need for such risk assessments in the AFZ to take into account important seabird areas, fishing effort distributions, likely levels of interactions and use and effectiveness of mitigation measures. These assessments should include specific area analyses and seasonal considerations. Regular review and updating of the assessments are also required such as the process, which occurs annually in the CCAMLR region.

X CONCLUSIONS AND RECOMMENDATIONS

Seabird bycatch in longline fisheries was first reported as a problem in the late 1980’s. Co-operation between biologists, managers, engineers and industry has assisted in the development of methods for reducing seabird bycatch, including the use of bird-scaring lines, bait casting machines, line weighting and night setting. These methods, when used effectively, have been found to substantially address seabird bycatch in a range of longline fisheries throughout the world. In Australia, some operators have had success in substantially lowering the bycatch rate, however for various reasons, the currently used mitigation methods currently used have not been proven to reduce seabird bycatch to the TAP objective of less than 0.05 birds/1000 hooks. This has generally been due to the measures not being adequately evaluated and applied. Therefore, it remains imperative to conduct comprehensive and on-going evaluation and review of measures.

All Australian Government and State fisheries with an export component are currently undergoing environmental assessments under the EPBC Act against a set of ecological sustainable guidelines. Actions outlined in BAPs will be considered during these assessments. As an accreditation under the EPBC Act is directly linked to the provision of export permits, the environmental assessment process is likely to increase awareness of bycatch issues in these fisheries.

At this stage, State/Northern Territory fisheries do not need to comply with TAP prescriptions, as these only apply to Australian Government-managed longline fisheries. The States/Northern Territory fisheries are therefore encouraged to start considering the issue of seabird bycatch, where they have not done so already. Particular consideration should be given to data collection to determine whether seabird bycatch is an issue in these fisheries. Education programs provide an additional option to increase awareness of the issue among fishers. Further, the adoption of some or all of the other current TAP prescriptions could be considered, such as night setting and the use of bird-scaring lines, where a problem is suspected or known to occur.

The aim of reducing seabird bycatch in longline fisheries is to arrest the decreases in bird populations that have been affected by fishery interactions, and to allow for their recovery. Ultimately, the only way the efficacy of mitigation efforts over large-scale fisheries can be assessed is by long-term studies of seabird population trends and survival rates. It is therefore important to continue those long-term studies of albatrosses and petrels that are currently being conducted. It must also be a priority to identify any other impacted species and populations for which survival information is vitally required. The establishment of similar studies of populations under other jurisdictions must also be encouraged.

There is the on-going need to ensure effective communication between fishers, researchers and managers. In terms of seabird bycatch, this information transfer, education approach needs to include explanations of the seriousness of bycatch to seabird populations, the best methods to be adopted for reducing seabird bycatch, and how reducing bycatch can benefit fishers. Integration of bycatch issues in education courses attended by fishers (through fishers organisations or maritime colleges) would also assist in efforts to reduce bycatch. Attendance at such courses is compulsory for some sectors of the USA longline fishery. In Australia, a precedent has been set by mandatory attendance at endangered species awareness courses for Queensland Master fishers who operate in areas with potential for interactions with these species. Extension officers working with the various sectors of the longline industry can also be an effective mechanism for integrating new mitigation approaches. Such an extension program should therefore be supported.

Accreditation provides scope as a way of providing positive incentives for sectors of industry that prove to fish in a sustainable way. While this would require demonstration of ecological sustainability, if achieved it would secure the top end of the market for high quality and sustainably-fished product. Credibility remains an issue in some accreditation schemes, as it would be inappropriate, for example, to endorse a bird friendly fishery that has a high level of interaction with other non-target species. The Marine Stewardship Council represents the first certification program developed specifically for fisheries. Accreditation of fisheries through strategic assessments under the EPBC Act and BAPs may also provide a useful tool, if advertised, to endorse a bird-conscious fishery.

In efforts to overcome problems with seabird bycatch, it is important to gain the full co-operation of fishers. Australia has been at the forefront of developing new methods that both reduce seabird bycatch and increase fishing efficiency. In addition to completion of partially developed technologies (e.g. underwater-setting capsule) and rigorous evaluation and assessment of other novel measures, there continues to be a requirement for the development of other innovative mitigation measures that are simple, effective and attractive for fishers to use. The underwater-setting chute and capsule assist fishers by not requiring them to throw the baited hooks during line setting, which benefits fishing efficiency in two ways. Not only are birds less likely to gain access to the baits, but the baits are also more likely to remain on the hooks (they often fall off the hook when thrown). Effective artificial baits could also have considerable benefits, including lowering fishing operating costs. The gains in efficiency provided by these devices provide benefits to the fishers such that their use will be adopted, irrespective of mitigation effects. Modified vessel design with integrated underwater-setting is also promoted as a new generation of longline fishing, which could achieve a zero seabird bycatch rate.

Development and testing of new mitigation methods needs to be encouraged. The need for new, innovative measures remains, as it is unlikely that any single mitigation method will solve all bycatch problems, or solve them for all fishing methods. Therefore new mitigation methods, including but not limited to artificial baits and smart hooks, should be actively pursued.

In the future, it is important to be aware of bycatch issues before they become a serious problem, and hence before conservation and resource issues emerge. To achieve this, there is a need for a proactive, not reactive approach. Industry could be assisted through observers working with individual operators on solutions and enabling cross-fertilization of approaches between fisheries.

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Appendix 1 Tables

Table 1. Summary of observed hooks, bycatch rate and estimated number of birds killed each year by Japanese longline fishing vessels, 1988 - 1997. Data from Brothers *et al*. 1998b. The bolded figures are very high relative bycatch rates. The table also shows that the observer coverage in winter is also much higher.

		Total			Summer			Winter	
Year	**Observed hooks**	**Bycatch rate (/1000 hooks)**	**Estimated number of birds caught**	**Observed hooks**	**Bycatch rate (/1000 hooks)**	**Estimated number of birds caught**	**Observed hooks**	**Bycatch rate (/1000 hooks)**	**Estimated number of birds caught**
1988	119 886	0.70	14 359	26,166	1.26	8 808	93,720	0.40	5 551
1989	212 931	0.10	2 608	63,201	0.01	64	149,730	0.11	**2 534**
1990	507 086	0.03	682	0	0.00	0	507,086	0.04	651
1991	1 339 962	0.06	883	273,242	0.17	312	1,066,720	0.04	571
1992	1 420 194	0.17	3 160	449,034	0.44	2 619	971,160	0.04	541
1993	2 170 296	0.17	3 537	566,060	0.48	2 788	1,530,235	0.05	749
1994	1 384 650	0.18	3 288	368,345	0.45	2 647	1,016,305	0.05	641
1995	**706 995**	**0.10**	**1 064**	**137,656**	**0.26**	**271**	**569,339**	**0.08**	**793**
1996	**848 730**	**0.14**	**854**	**12,100**	**0.53**	**73**	**836,630**	**0.13**	**781**
1997	720 261	0.02	160	0	0.01	1	720,261	0.02	160

Table 2. Species, and numbers, of seabirds that forage in Australia observed caught during line setting in the Japanese and Australian pelagic longline fisheries from 1988 to 2003, during the chute trial (Sept 2001-March 2003) and line-weighting/twin tori line trial (April 2002-Nov 2003). Also listed is their breeding distribution and their national and international conservation status (Latin names in table 7).

* International conservation status according to Birdlife International (in press: for IUCN criteria definitions see Appendix 4)
** Preliminary species identification (to be confirmed)

Species	Japan	Aust.	Chute	Line weight/ twin tori lines	Breeds within the AFZ	Aust. endemic breeder	Listing on EPBC Act	International Conservation Status (criteria)*
Wandering albatross	38	0	0	2	Y		Vulnerable	Vulnerable (A1b, d; A2b, d)
Gibson's albatross	2	0	1**	0			Vulnerable	Vulnerable (D2)
Antipodean Albatross	0	0	0	0			Vulnerable	Vulnerable (D2)
Wandering/Gibson's/ Antipodean/ Tristan/Amsterdam albatross (could not distinguish)	27	1	0	0	Only wandering		Tristan and Amsterdam endangered	Endangered B1+2e (Dristan); Critically endangered D1 (Amsterdam)
Northern royal albatross	4	0	0	0			Endangered	Endangered (A2c; B1+B2c, e)
Southern royal albatross	14	1	0	0			Vulnerable	Vulnerable (D2)
Northern/Southern royal albatross (could not distinguish)	6	0	0	0			As above	As above
Black-browed albatross	22	0	1**	6	Y			Lower risk – near threatened (A2d)
Campbell albatross	52	1	0	0			Vulnerable	Vulnerable (A1a, d; D2)
Black-browed/Campbell albatross	126	0	1	0	Only Black-browed		As above	As above
Shy albatross	41	1	1**	0	Y	Y	Vulnerable	Lower risk – near threatened (D2)
White-capped albatross	19	7	0	0			Vulnerable	Vulnerable (D2)
Shy/White-capped albatross	29	14	0	0	Only Shy	Only Shy	As above	As above

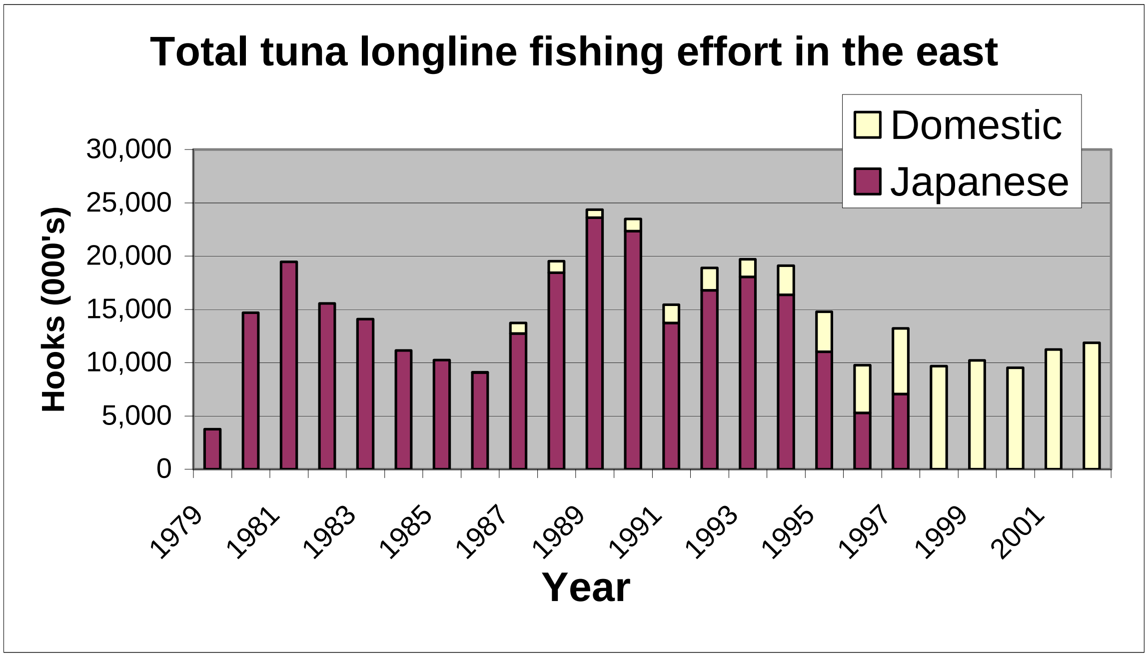
Species	Japan	Aust	Chute	Line weight/ twin tori lines	Breeds within the AFZ	Aust. endemic breeder	Listing on EPBC Act	International Conservation Status (criteria)*
Grey-headed albatross	92	0	0	1	Y		Vulnerable	Vulnerable (A1b, d; A2b, d)
Indian yellow-nosed albatross	81	0	0	0			Vulnerable	Vulnerable (A1b)
Atlantic yellow-nosed albatross	0	0	0	0				Lower risk - near threatened (A1d; A2d)
Indian/Atlantic yellow-nosed albatross	1	0	0	0			As above	As above
Buller's albatross	1	0	0	0			Vulnerable	Vulnerable (D2)
Pacific albatross	0	0	0	0			Vulnerable	Vulnerable (D2)
Buller's/Pacific albatross	1	0	0	0			As above	As above
Light-mantled sooty albatross	9	0	0	0	Y		Data deficient	Lower risk – near threatened (A1d; A2d)
Sooty albatross	8	0	0	0			Vulnerable	Vulnerable (A1b)
Salvin's albatross	0	0	0	0			Vulnerable	Vulnerable D2
Chatham albatross	0	0	0	0			Endangered	Critically endangered (B1+2c)
albatross sp.	0	2	0	1	Some	Only shy	Varies	Varies
Northern giant-petrel	8	0	0	0	Y			Lower risk – near threatened (A2c,d,e)
Southern giant-petrel	20	1	0	0	Y			Vulnerable (A1a,b,d,e; A2b,d,e)
Great-winged petrel	0	3	2**	5	Y			
Grey petrel	20	0	0	0	Y			Lower risk – near threatened (A1d; A2d)
White-chinned petrel	56	2	0	0				Vulnerable (A1b,c,d,e; A2b,c,d,e)
Westland petrel	1	0	0	1				Vulnerable (D2)
Cape petrel	0	0	0	0				
Wedge-tailed shearwater	0	1	1**	0	Y			
Flesh-footed shearwater	62	0	203**	19	Y			
Short-tailed shearwater	0	1	1**	1	Y	Y		
Sooty shearwater	2	0	0	0	Y			

Species	Japan	Aust	Chute	Line weight/ twin tori lines	Breeds within the AFZ	Aust. endemic breeder	Listing on EPBC Act	International Conservation Status (criteria)*
Shearwater spp.	0	6	0	0		Y		
Australasian gannet	0	1	0	0	Y			
Great skua	9	0	1**	0				
TOTAL	**750**	**42**	**211**	**28**				

Aust. = Australia

Table 3. Total number of hooks (in 1 000s) set by Japanese longline vessels and Australian domestic tuna longline vessels east of 141ºE (South Australia/Victorian border) in the AFZ from 1979 to 2002 (AFMA data).

Year	Japanese	Domestic
1979	3 767	
1980	14 699	
1981	19 446	
1982	15 544	
1983	14 078	
1984	11 136	
1985	10 226	13
1986	9 059	31
1987	1 725	985
1988	18 436	1 089
1989	23 600	758
1990	22 334	1 147
1991	13 720	1 720
1992	16 772	2 109
1993	18,038	1 665
1994	16 375	2 739
1995	11 013	3 768
1996	5 273	4 493
1997	7 045	6 177
1998		9 657
1999		10 202
2000		9 506
2001		11 232
2002		11 849



Total tuna longline fishing effort in the east
Domestic
Japanese
Hooks (000's)
30,000
25,000
20,000
15,000
10,000
5,000
0
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
Year

Table 4. Total number of hooks (1 000s) set by Japanese longline vessels and Australian domestic tuna longline vessels west of 141ºE (South Australia/Victorian border) in the AFZ from 1979 to 2001 (AFMA data).

Year	Japanese	Domestic
1987	4 375	
1988	1 045	
1989	637	
1990	939	
1991	155	
1992	1 154	
1993	3 296	
1994	2 478	387
1995	2 416	531
1996	759	282
1997	610	502
1998		1 042
1999		3 529
2000		5 575
2001		6 174

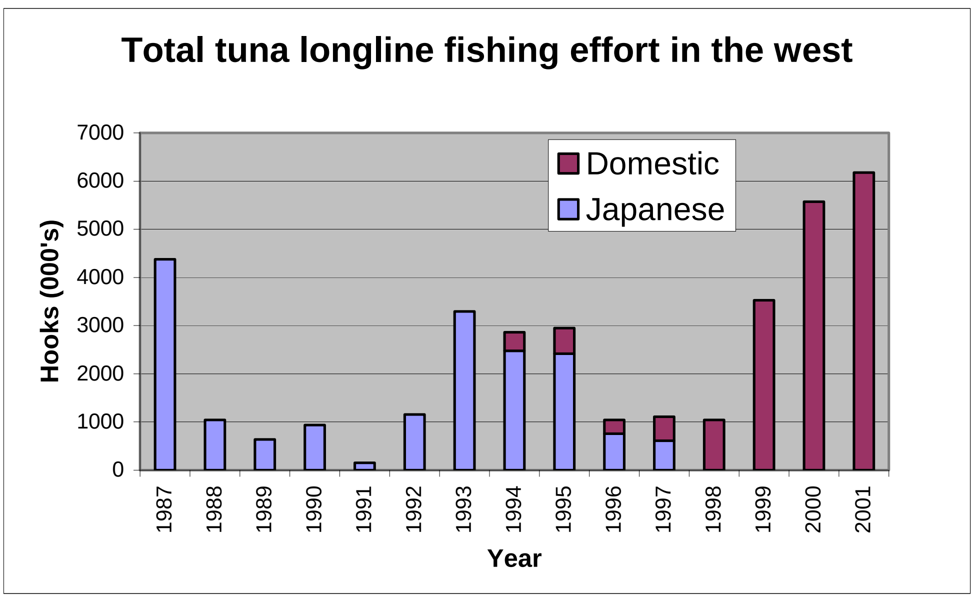


Table 5. Summary of observations (effort, birds caught, and bycatch rate) by domestic tuna longline (Australian Government managed) vessels in the AFZ, 1994-1999. (Data from Brothers *et al*. 1999c, unpublished) and 2000-2002 (Data from AFMA, unpublished).

Year	Area	Summer			Winter		
		Birds caught	Observed hooks	Bycatch rate	Birds caught	Observed hooks	Bycatch rate
1994	Tasmania	3	6 445	0.47			
	NSW	2	830	2.41	0	1 000	0.00
	S.Qld						
	N.Qld	0	5 620	0.00			
1995	Tasmania	9	17 237	0.52	0	2 450	0.00
	NSW						
	S.Qld						
	N.Qld	0	22 721	0.00			
1996	Tasmania	1	11 182	0.09			
	NSW				0	850	0.00
	S.Qld						
	N.Qld				0	20 493	0.00
1997	Tasmania				1	13 500	0.07
	NSW	7	6 600	1.06	0	2 500	0.00
	S.Qld	0	10 900	0.00	0	5 200	0.00
	N.Qld				0	5 570	0.00
1998	Tasmania	11	13 700	0.80			
	NSW						
	S.Qld						
	N.Qld						
1999	Tasmania	0	1 000	0.00	0	3 000	0.00
	NSW						
	S.Qld						
	N.Qld						
	S.WA				1	3,400	0.29
	N.WA				0	13,000	0.00
2000	*	*	*	*	*	*	*
2001	NSW	*	*	*	88	45 784	0.02
2002	NSW	60	239 827	0.25	92	290 932	0.76
Total	**Tasmania**	**24**	**49 564**	**0.48**	**1**	**18 950**	**0.05**
	NSW	**9**	**7 430**	**1.21**	**0**	**4,350**	**0.00**
	S.Qld	**0**	**10 900**	**0.00**	**0**	**5 200**	**0.00**
	N.Qld	**0**	**28 341**	**0.00**	**0**	**26 063**	**0.00**
	S.WA				**1**	**3 400**	**0.29**
	N.WA				**0**	**13 000**	**0.00**

* Denotes no information

Table 6. Bird species identified by Victorian-licensed respondents to questionnaires mailed out in August 1996 (first mail-out; 25 of 175 valid responses) and February 1997 (second; 17 of 130) as bycatch caught in fishing gear within the previous month, within the previous 12 months or earlier. Details are summarized for each recorded instance (i.e. multiple captures of a particular taxon, on one occasion, are considered as a singe record).

Bird species	No. of instances caught
Little penguin	8
Cormorant	10
Black cormorant	2
Black and white cormorant	1
Large pied cormorant	1
Black shag	1
Diving shag	1
Shag	3
Australasian gannet	1
Mollymawk	1
Albatross (small)	1
Muttonbird	1
Seagull	3
Fairy tern	1
Tern	1

Table 7. Distribution of seabirds recorded caught in Australian Government-managed tuna longline fisheries in the AFZ.

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Wandering albatross *Diomedea exulans*	Moderate	Offshore in southern waters from the NSW/Qld border in the east to Fremantle in the west. Vagrant to Qld. Off Macquarie Island, Heard Island and the McDonald Islands	Australia: France: South Africa: U.K.:	Macquarie Island Kerguelen Island, Crozet Islands (Ile de la Possession, Ile aux Cochon, Ile de l'Est) Marion Island, Prince Edward Island South Georgia
Tristan albatross *Diomedea dabbenena*	Low	One record off Wollongong, NSW	U.K.:	Gough Island, Tristan da Cunha (Inaccessible Island)
Antipodean albatross *Diomedea antipodensis*	Low	Offshore central NSW. Extent of range not yet defined	New Zealand:	Antipodes Island, Campbell Island
Gibson's albatross *Diomedea gibsoni*	Low	Offshore in southern waters from Coffs Harbour south to Wilsons Promontory. Extent of range not yet defined	New Zealand:	Auckland Islands (Adams Island, Disappointment Island, Auckland Island)
Southern royal albatross *Diomedea epomophora*	Low	Offshore in southern waters from Coffs Harbour in the east to Fremantle in the west; especially around Tasmania. Off Macquarie Island	New Zealand:	Campbell Island, Enderby Island, Auckland Islands (Adams Island, Auckland Island)

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Northern royal albatross *Diomedea sanfordi*	Low	Offshore in southern waters from Coffs Harbour in the east to Fremantle in the west; especially around Tasmania	New Zealand:	South Island (Taiaroa Head), Chatham Islands (Big Sister Island, Little Sister Island, Forty-fours Island)
Amsterdam albatross *Diomedea amsterdamensis*	Low	Vagrant in waters south of Tasmania	France:	Amsterdam Island
Black-browed albatross *Thalassarche melanophrys*	High	Offshore in southern waters from the NSW/Qld border in the east to Shark Bay in the west. Off Macquarie Island, Heard Island and the McDonald Islands	Australia: Chile: France: New Zealand: U.K.:	Heard Island, McDonald Islands, Macquarie Island (incl. Bishop and Clerk Islets) Diego Ramirez Island, Ildefonso Isla, Isla Diego de Almagra Crozet Islands, Kerguelen Island Bollons Island, Campbell Island, Snares Island South Georgia, Falkland islands (Steeple Jason Island, South Jason Island, Elephant Jason Island, Beauchene Island, Bird Island, Grand Jason Island, West Point Island, New Island, North Island, Saunders Island, Keppel Island, Grave Cove)
Campbell albatross *Thalassarche impavida*	High	Offshore in southern waters from the NSW/Qld border in the east to Ceduna, S.A. (134^{o}E) in the west	New Zealand:	Campbell Island

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Buller's albatross *Thalassarche bulleri*	Low	Offshore in south-eastern waters from Coffs Harbour in the east to Eyre Peninsula in the west; around Tasmania	New Zealand:	Snares Island, Solander Island, Little Solander Island
Pacific albatross *Thalassarche nov. sp.*	Low	Vagrant in south-eastern waters; not yet seen around Tasmania. Extent of range not yet defined	New Zealand:	Three Kings Island, Chatham islands (Big Sister Island, Little Sister Island, Forty-fours Island)
Shy albatross *Thalassarche cauta*	Moderate	Offshore in waters south of Fraser Island in the east to Barrow Island (20^{o}S) in the west	Australia:	Tasmania (Albatross Island, Mewstone, Pedra Branca)
White-capped albatross *Thalassarche steadi*	Moderate	Offshore in south-eastern waters, especially around Tasmania. Off Macquarie Island. Extent of range not yet defined	New Zealand:	Auckland Islands (Adams Island, Auckland Island, Disappointment Island), Bollons Island
Chatham albatross *Thalassarche eremita*	Low	Rare in south-eastern waters around Tasmania	New Zealand:	Chatham Island
Salvin's albatross *Thalassarche salvini*	Low	Offshore in south-eastern waters, especially around Tasmania	France: New Zealand:	Crozet Islands (Ile des Pingouins) Bounty Island, Snares Island

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Atlantic yellow-nosed albatross *Thalassarche chlororhynchos*	Low	Vagrant in south-eastern waters	U.K.:	Gough Island, Tristan da Cunha (Tristan da Cunha Island, Nightingale Island, Inaccessible Island, Middle Island, Stoltenhoff Island)
Indian yellow-nosed albatross *Thalassarche carteri*	Moderate	Offshore in southern waters from NSW/Qld border in the east to Barrow Island (20^{o}S) in the west	France: South Africa:	Amsterdam Island, St Paul Island, Kerguelen Islands (Ile de Croy), Crozet Islands (Ile des Pingouins, Ile des Apotres) Prince Edward Island
Grey-headed albatross *Thalassarche chrysostoma*	Moderate	Offshore in southern waters from Coffs Harbour in the east to Fremantle in the west; especially around Tasmania. Off Macquarie Island	Australia: Chile: France: South Africa: New Zealand: U.K.:	Macquarie Island Diego Ramirez Island, Isla Iledefonso Kerguelen Islands, Crozet Islands Marion Island, Prince Edward Island Campbell Island South Georgia
Laysan albatross *Phoebastria immutabilis*	Low	One or two sightings at Norfolk Island	Hawaii: Japan: Mexico:	Hawaiian Leeward Islands (Necker Island, French Frigate Shoals, Gardner Pinnacles, Laysan Island, Liainnski Island, Pearl and Hermes Reef, Midway Atoll, Kauai Island, Niihau Island, Kaula Island, Oahu Island) Bonin Islands (Mukojima) Isla Guadalupe, Isla Benedicto, Isla Clarion

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Sooty albatross *Phoebetria fusca*	Low	Offshore in seas south of Australia; off Tasmania	France: South Africa: Island UK:	Amsterdam Island, St Paul Island, Kerguelen Island, Crozet islands (Ile de la Possession, Ile de l'Est, Ile aux Cochon, Ile des Pingouins, Ile des Apotres) Prince Edward Island, Marion Gough Island, Tristan da Cunha (Nightingale Island, Inaccessible Island, Stoltenhoff Island)
Light-mantled albatross *Phoebetria palpebrata*	Low	Offshore in seas south of Australia; off Tasmania. Off Macquarie Island, Heard Island and the McDonald Islands	Australia: France: New Zealand: South Africa: U.K.:	Heard Island, McDonald Islands, Macquarie Island Kerguelen Island, Crozet Islands (Ile de la Possession, Ile de l'Est, Ile aux Cochons, Ile des Pingouins, Ile des Apotres) Auckland Island, Campbell Island, Antipodes Island Prince Edward Island, Marion Island South Georgia
Southern Giant Petrel *Macronectes giganteus*	Low	Offshore in southern waters from Fraser Island in the east to Shark Bay in the west. Off Macquarie Island, Heard Island and the McDonald Islands	Australia: France: Norway: South Africa: U.K.:	Heard Island, McDonald Islands, Macquarie Island, Australian Antarctic Territory Crozet Islands, Kerguelen Islands South Sandwich, South Orkney, Bouvet Island Prince Edward Island, Marion Island South Georgia

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Northern Giant Petrel *Macronectes halli*	Low	Offshore in southern waters from Fraser Island in the east to Shark Bay in the west. Off Macquarie Island	Australia: France: New Zealand: South Africa:	Macquarie Island Crozet Islands, Kerguelen Islands Antipodes Islands, Auckland Island, Campbell Islands, Chatham Island, Stewart Island Prince Edward Island, Marion Islands
Great-winged Petrel *Pterodroma macroptera*	Moderate	Offshore in southern waters from Fraser Island in the east to Geraldton (28°S) in the west	Australia: France: New Zealand: South Africa: U.K.:	Western Australia (Recherche Arch., Bald Island, Coffin Island, Gull Island, Rabbit Island, Remark Island, Breaksea Island, Eclipse Island, Mistaken Island) Kerguelen Islands, Crozet Islands (Ile de l'Est, Ile des Pinguoins, Ile des Apotres) North Island (north-east coast) Prince Edward Island, Marion Islands Gough Island, Tristan da Cunha Islands
White-chinned Petrel *Procellaria aequinoctialis*	Moderate	Offshore waters along the southern edge of the mainland and around Tasmania	France: New Zealand: Islands South Africa: U.K.:	Kerguelen Island, Crozet Islands (Ile de la Possession, Ile de L'Est,, Ile des Pinguions, Ile des Apotres) Antipodes Island, Campbell (Campbell Island, Dent Island, Jaquemart Island), Auckland Islands (Auckland Island, Adams Island, Disappointment Island) Prince Edward Island, Marion Islands South Georgia

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas
Westland Black Petrel *Procellaria westlandica*	Low	Oceanic waters off southern NSW coast and east coast of Tasmania	New Zealand: South Island (Punakaiki River)
Grey Petrel *Procellaria cinerea*	Moderate	Offshore to southern waters from Ballina (29^{o}S) in the east to Bunbury (34^{o}S) in the west; Slightly more common around south and west coasts of Tasmania	Australia: Macquarie Island France: Crozet Islands, Kerguelen Islands, Amsterdam Island New Zealand: Campbell Island, Antipodes Islands South Africa: Prince Edward Island U.K.: Tristan da Cunha Islands
Wedge-tailed shearwater *Puffinus pacificus*	Moderate	Waters off the east coast from Torres Strait in the north to Montagu island in the south; Waters off the west coast from King's Sound in the north to Bunbury (34^{o}S) in the south; Vagrant off northern and southern coasts. Off Lord Howe Island. Off Norfolk Island	Australia: Numerous islands off NSW and Western Australia, Lord Howe Island, Norfolk Island, Cocos-Keeling Islands (North Keeling Island), Christmas Island New Zealand: Kermadec Island
Flesh-footed shearwater *Puffinus carneipes*	High	Coastal in southern waters from Fraser Island in the east to Shark Bay in the west. Off Lord Howe Island	Australia: Lord Howe Island, South Australia (Smith Island), Western Australia (Seal Island, Sandy Island, Chatham Island, Saddle Island, /Stanley Island, Mutton-bird Island, Eclipse Island, Breaksea Island, Michaelmas Island, Doubtful Island, Recherche Arch., Cape Hamelin Islet) France: St Paul Island New Zealand North Island (north-east and west coasts), Cook Strait

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Sooty shearwater *Puffinus griseus*	Low	Waters south of the NSW/Qld border in the east and Bunbury (34°S) in the west. Off Macquarie Island	Australia: Chile: New Zealand: U.K.:	NSW (Broughton Island, Little Broughton Island, Cabbage Tree Island, Boondelbah Island, Bird Island, Lion Island, Bowen Island, Montague Island, Tollgate Island), Tasmania (Tasman Island, Hippolyte Rocks, Courts Island, Flat Witch Island, Flat Island, Breaksea Island, Green Island), Macquarie Island Cape Horn North Island (north-east coast), South Island (south coast), Cook Strait, Solander Island, Snares Island, Antipodes Island, Auckland Island, Campbell Island, Chatham Island Falkland Islands
Short-tailed shearwater *Puffinus tenuirostris*	Low	Waters south of Fraser Island in the east to Bunbury (34°S) in the west	Australia:	Numerous islands off NSW, Victoria, Tasmania, South Australia and Western Australia
Australasian Gannet *Morus serrator*	Moderate	Eastern and southern coasts from Mackay (22°S) in the east to Shark Bay in the west. Off Lord Howe Island. Off Norfolk Island.	Australia: New Zealand:	Victoria (Port Phillip Bay, Lawrence Rocks), Tasmania (Cat Island, Black Pyramid, Pedra Branca, Eddystone Rock), Norfolk Island (Phillip Island, Nepean Island) North Island (west, north-east and south-east coasts), South Island (south-west and north-east coasts)

Species	Likely incidence in longline bycatch	Pelagic distribution in Australia	Jurisdiction and location of breeding areas	
Southern Skua *Catharacta antarctica*	Low	Offshore in southern waters from Fraser Island in the east to Geraldton (28^{o}S) in the west. Off Macquarie Island and Heard Island	Australia:	Macquarie Island, Heard Island, Antarctic Peninsula: Elephant Island
			Argentina:	Cape Horn
			France:	Kerguelen Islands, Crozet Islands, Amsterdam Island
			New Zealand:	Chatham Island, Auckland Island, Snares Island, Campbell Island, Antipodes Island, Stewart Island
			Norway:	Bouvet Island
			South Africa:	Prince Edward Island, Marion Islands
			U.K.:	South Georgia, Gough Island, Tristan da Cunha Islands, Falkland Islands, South Sandwich Islands, South Shetland Islands, South Orkney

Table 8. Mitigation measures that have been adopted, or suggested, for the tuna fisheries in the AFZ.

Measure	Stage of development	Methods of monitoring use	Operational use (safety implications for crew)	Nature of cost (fixed or ongoing)	Relative cost to fishers in the AFZ	Impact on target catch per unit effort	Relative effectiveness of mitigation measure	Impact on bycatch of non–seabird species
Line weighting	Testing	Observations	Caution required	Fixed and maintenance	Med	Unknown	High (if weight sufficient)	Not known
Bait thawing and swim bladder puncturing	Developed and tested	Observations	Safe	Ongoing	Low	Reduced bait loss to birds. Increased setting preparation.	Med	Not known
Line setting machine	Developed and tested	Observations	Safe	Fixed and maintenance	Med	None	Low	None
Underwater setting chute	Partly developed and tested	Observations	Caution required	Fixed and maintenance	Low-High depending on method	Reduced bait loss to birds. Improved bait condition.	High if baits are set deep enough so as to not resurface in turbulence	Unknown
Underwater setting capsule	Partly developed and tested	Observations	Caution required	Fixed and maintenance	Low-High depending on method	Reduced bait loss to birds. Improved bait condition.	High if baits are set deep enough so as to not resurface in turbulence	Unknown
Bird scaring lines	Testing	Aerial, Observations	Safe	Fixed and maintenance	Low	Reduced bait loss to birds.	Med-High	None
Bait casting machines	Developed and partially tested	Observations	Safe	Fixed and maintenance	Med	Reduced bait loss to birds, increased setting preparation.	Med (increased with use of bird scaring line)	None

Measure	Stage of development	Methods of monitoring use	Operational use (safety implications for crew)	Nature of cost (fixed or ongoing)	Relative cost to fishers in the AFZ	Impact on target catch per unit effort	Relative effectiveness of mitigation measure	Impact on bycatch of non–seabird species
Bird scaring curtain	Developed and partially tested	Observations	Safe	Fixed and maintenance	Low	None	Low	None
Lures and artificial baits	Not developed	Observations	Safe	Initial equipment cost + replacement of lost equipment	Med	Unknown	Unknown	Unknown
Smart hooks	Not developed	Observations	Safe	Initial equipment cost + replacement of lost equipment	Med	Unknown	Unknown	Unknown
Sound deterrents	Limited testing	Observations	Unknown	Fixed	Med	Unknown	Very limited	Very limited
Water cannon	Partially developed	Observations	Wet crew	Fixed	Med	Unknown	Low	Unknown
Magnetic deterrents	Tested	Observations	Unknown	Fixed	Med	Unknown	None	None

Measure	Stage of development	Methods of monitoring use	Operational use (safety implications for crew)	Nature of cost (fixed or ongoing)	Relative cost to fishers in the AFZ	Impact on target catch per unit effort	Relative effectiveness of mitigation measure	Impact on bycatch of non–seabird species
Dyes	Partly developed and tested	Observations	Safe	Ongoing	Med	Reduced bait loss to birds. Increased setting preparation.	Med -High (low if birds become adapted)	Unknown
Night setting	Developed and tested	Observations	Safe provided lighting is adequate	Ongoing	Potentially high for domestic vessels as restricts species they can target (i.e. BBL) and limits opportunities to fish when weather permits.	Reduced bait loss to birds	High	Increased bycatch of other species e.g. sharks
Offal discharge	Developed and partially tested	Observations	Safe	Fixed	Low	Reduced bait loss to birds	Low	Not known. Impacts include artificial food provision.
Area closures	Partially developed	VMS, Aerial, Observations	None	Ongoing	Potentially high if the area significantly restricts access to fish and results in greater travel time.	Reduced access to stock	High	No bycatch in the closed area
Deck lighting	Partially developed	Observations	Safety needs to be considered in planning	Fixed	Low-Med	Reduced bait loss to birds	Low (High in combination with night setting)	Reduced bycatch of species attracted to vessels by lights

Appendix 2. Acronyms and Abbreviations

AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
BAP	Bycatch Action Plan
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIWE	Tasmanian Department of Primary Industries, Water and Environment
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DEH	Australian Government Department of the Environment and Heritage
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ETBF	Eastern Tuna and Billfish Fishery
FAO	United Nations Food and Agriculture Organisation
GBRMPA	Great Barrier Reef Marine Park Authority
IPOA	International Plan of Action
ISMP	Integrated Scientific Monitoring Program
ITQ	Individual Transferable Quota
NMFS	United States of America National Marine Fisheries Service
NPOA	National Plan of Action
NSW	New South Wales
OCS	Offshore Constitutional Settlement
Qld	Queensland
TAP	Threat Abatement Plan for the Incidental catch (or by-catch) of seabirds during oceanic longline fishing operations
WA	Western Australia

Appendix 3. Seabird and Fish Species

Latin names of seabird and fish species used in text.

Species	Latin name
Seabirds	
Abbots booby	*Papasula abbotti*
Amsterdam albatross	*Diomedea amsterdamensis*
Antipodean albatross	*Diomedea antipodensis*
Atlantic yellow-nosed albatross	*Thalassarche chlororhynchos*
Australasian gannet	*Morus serrator*
Barn owl	*Tyto alba*
Black-browed albatross	*Thalassarche melanophrys*
Buller's albatross	*Thalassarche bulleri*
Campbell albatross	*Thalassarche impavida*
Cape petrel	*Daption capense*
Chatham albatross	*Thalassarche eremita*
Christmas Island frigatebird	*Fregata andrewsi*
Cormorant	*Phalacrocorax* spp.
Flesh-footed shearwater	*Puffinus carneipes*
Gibson's albatross	*Diomedea gibsoni*
Great skua	*Catharacta skua*
Great-winged petrel	*Pterodroma macroptera*
Grey petrel	*Procellaria cinerea*
Grey-headed albatross	*Thalassarche chrysostoma*
Indian yellow-nosed albatross	*Thalassarche bassi*
Laysan albatross	*Phoebastria immutabilis*
Light-mantled sooty albatross	*Phoebetria palpebrata*
Little penguin	*Eudyptula minor*
Northern fulmar	*Fulmarus glacialis*
Northern giant-petrel	*Macronectes halli*
Northern royal albatross	*Diomedea sanfordi*
Pacific albatross	*Thalassarche* nov.spp. (platei)
Pacific gull	*Larus pacificus*
Salvin's albatross	*Thalassarche salvini*
Short-tailed shearwater	*Puffinus tenuirostris*
Shy albatross	*Thalassarche cauta*
Sooty albatross	*Phoebetria fusca*
Sooty shearwater	*Puffinus griseus*
Southern giant-petrel	*Macronectes giganteus*
Southern royal albatross	*Diomedea epomophora*
Tristan albatross	*Diomedea dabbenena*
Wandering albatross	*Diomedea exulans*
Wedge-tailed shearwater	*Puffinus pacificus*
Westland petrel	*Procellaria westlandica*
White-capped albatross	*Thalassarche steadi*
White-chinned petrel	*Procellaria aequinoctialis*

Species	Latin Name
Fish	
Arrow squid	*Nototadarus gouldi*
Australian salmon	*Arripis trutta*
Bar cod	*Epinephelus ergastularius*
Bigeye tuna	*Thunnus obesus*
Blacktip shark	*Carcharinus tilstoni* and *C. sorrah*
Blue eye trevalla	*Hyperoglyphe antarctica*
Blue grenadier	*Macruronus novaezelandiae*
Blue wharehou	*Seriolella brama*
Bony fish	*Class Osteichthyes*
Broadbill swordfish	*Xiphias gladius*
Bronze whalershark	*Family Carcharhinidae*
Calamari	*Sepioteuthis australis*
Cod	*Family Serranidae*
Commercial scallop	*Pectin furnatus*
Deep sea trevalla	*Hyperoglyphe antarctica*
Doughboy scallop	*Mirnachlarnys asperrimus*
Dusky shark	*Carcharhinus obscurus*
Flame snapper	*Etelis coruscans*
Gemfish	*Rexea solandri*
Goldband snapper	*Pristipomoides multidens*
Grey mackerel	*Scomberomorus semifasciatus*
Gummy shark	*Mustelus antarcticus*
Hammerhead shark	*Family Sphyrnidae*
Hapuka	*Polyprion oxygeneios*
Marlin spp.	*Maikaira* spp.
Moorwong	*Nemadactylus gouglasii*
Orange roughy	*Hoplostethus atlanticus*
Patagonian toothfish	*Dissosticchus eleginoides*
Pearl perch	*Glaucosoma scapulare*
Pink ling	*Genypterus blacodes*
Queen scallop	*Equichlarnys bifrons*
Rays	*Class Chondrichthyes*
Red emperor	*Lutianus sebae*
Red snapper	*Lutjanus erythropterus*
Rosy jobfish	*Pristipomoides filamentosus*
Ruby snapper	*Etelis carbunculus*
Sandbar shark	*Carcharhinus plumbeus*
School shark	*Gaeorhinus galeus*
Snapper	*Pagrus auratus*
Southern bluefin tuna	*Thunnus maccoyii*
Southern rock lobster	*Jasus edwardsii*
Spanner crab	*Ranina ranina*
Tiger shark	*Galeocerdo cuvier*
Western rock lobster	*Panulirus cygnus*

Species	Latin Name
Fish (cont.)	
Whiskery shark	*Furgaleus macki*
Yellowfin tuna	*Thunnus albacares*
Yellowtail kingfish	*Seriioli lalandi*

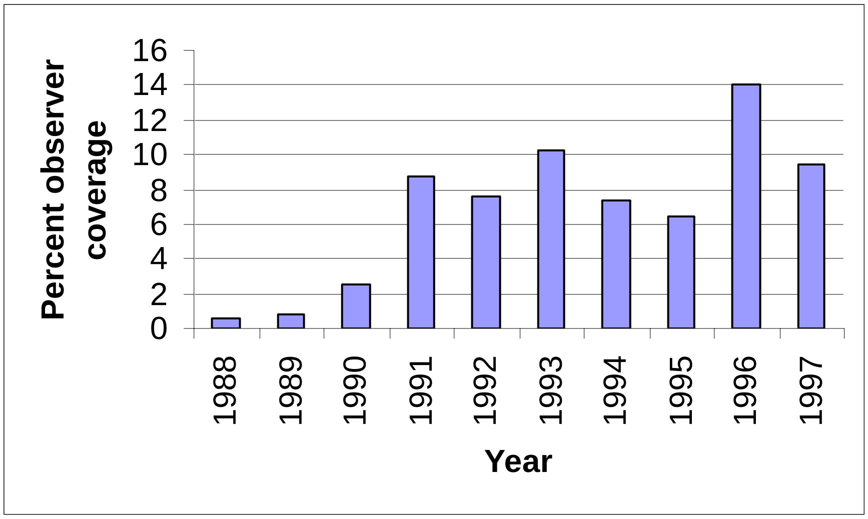
Appendix 4. IUCN Conservation Category

Summary of IUCN Conservation Criteria (2001).

	Criteria	Main Numerical Thresholds		
		Critically Endangered (CR)	*Endangered* (EN)	*Vulnerable* (VU)
A	**Rapid decline**	≥90% over the last 10 years over 3 generations where causes are clearly reversible and understood and ceased. ≥80% over 10 years or 3 generations where causes may not have ceased or may not be understood or may not be reversible	≥70% over the last 10 years over 3 generations where causes are clearly reversible and understood and ceased. ≥50% over 10 years or 3 generations where causes may not have ceased or may not be understood or may not be reversible	≥50% over 10 years or 3 generations where causes are clearly reversible and understood and ceased. ≥30% over 10 years or 3 generations where the causes may not have ceased or may not be understood or may not be reversible
B	**Small range: Fragmented, declining or fluctuating**	Extent of occurrence <$100km^2$ or area of occupancy <$10km^2$	Extent of occurrence <$5,000km^2$ or area of occupancy <$500km^2$	Extent of occurrence <$20,000km^2$ or area of occupancy <$2000km^2$
C	**Small population: Declining**	<250 mature individuals	<2,500 mature individuals	<10,000 mature individuals
D1	*Very small population*	<50 mature individuals	<250 mature individuals	<1000 mature individuals
D2	*Very small range*	N/A	N/A	<$20km^2$ or ≤5 locations
E	**Unfavourable population viability analysis**	Probability of extinction ≥50% within 10 years or 3 generations	Probability of extinction ≥20% within 20 years or 5 generations	Probability of extinction ≥10% within 100 years

Appendix 5. AFMA Observer Coverage Graph

AFMA observer coverage on Japanese vessels given as percentage of hooks observed out of total hooks set 1988-1997 (Gales *et al*. 1998; Brothers *et al*. 1998b, c).



Appendix 6. Chapter 6 of the Recovery Plan for Albatross and Giant Petrels

Chapter 6 of the Recovery Plan for Albatrosses and Giant-petrels (Commonwealth Government, 2001)

6 RECOVERY

This section states the Overall Objective of the Recovery Plan and the criteria to be used to determine if this objective has been achieved. It should be noted that the Overall Objective is a long-term goal, and may not be achieved in the five-year life of this Recovery Plan. Consequently, Specific Objectives that are achievable within the life of this Plan have also been set.

The Recovery Actions (including both Management *Actions and* Research *Actions) considered necessary to achieve the Specific Objectives are described. The Recovery Criteria, Estimated Costs, Recovery Schedule and managers responsible for each action are also identified in this section.*

6.1 Overall Objective

6.1.1 Recovery Objective

Rationale

The most common Overall Objective for a Recovery Plan is to achieve the downgrading of the threatened status of the species within a specified time frame (e.g.

see Appendix 2[1], section 2a). However, such an Overall Objective is not appropriate for this multi-species Recovery plan.

Seventeen of the 23 albatross and giant-petrel species covered by this Recovery Plan are deemed threatened according to IUCN Red List criteria (Table 1.1[2]). Ten of these species are listed as Vulnerable in keeping with IUCN criterion D2. That is, they are characterised by an acute restriction in their area of occupancy (typically less than 100km^2) or in the number of breeding locations (typically less than five). This means that species that are naturally restricted in their breeding range will, by definition, always be classed as Vulnerable. For example, Shy Albatrosses are listed as Vulnerable according to the EPBC Act (1999) as they are naturally restricted to breeding on only three small islands (Croxall and Gales 1998). Hence, their listing as Vulnerable *cannot* be improved upon[3], irrespective of any increase in population size. For these reasons, the downlisting of the threatened status of these species is an unachievable goal and therefore inappropriate as an Overall Objective for this Recovery Plan.

Five albatross species occurring within the AFZ are listed as threatened species in accordance with IUCN Red List criterion A1, that is their populations have been significantly reduced over the last ten years or three generations (whichever is longer). Two of these species, Grey-headed Albatrosses and Wandering Albatrosses breed within the AFZ (Table 1.1). For both species the Australian breeding populations represent less than 0.1 per cent of the total global populations. Therefore, it is not feasible to improve the international conservation status of these species, solely by increasing the size of the Australian populations. To achieve this goal, international action is required. This is not to say that these small populations are of a lower conservation priority in any way. To the contrary, this Recovery Plan recognises the central importance of small populations in maintaining genetic diversity, which is essential for the long-term viability of a species.

Populations decline whenever mortality rates consistently exceed recruitment rates. Thus, to ensure that all breeding populations within areas under Australian jurisdiction are maintained and that population growth is established, those factors causing mortality and/or limiting reproductive success must be reduced.

[1] Appendix refers to an Appendix in the Recovery Plan, not the Seabird Assessment Report
[2] Table refers to a table in the Recovery Plan
[3] Unless their range expands, which is considered highly unlikely.

Overall Objective

The Overall Objective of this Recovery Plan is:

Overall Objective
To minimise (or eliminate) threats due to human activity to albatrosses and giant-petrels to ensure their recovery in the wild.

It is important to note that this Overall Objective will only be achieved by:

(i) minimising (or eliminating) all human-induced threats occurring on Australian breeding islands and within Australian waters; and

(ii) minimising human-induced threats occurring outside of the AFZ via international action.

Both are vital to the recovery of all albatross and giant-petrel species.

6.1.2 Recovery Criteria

The Recovery Plan will be deemed successful when the following Recovery Criteria have been met:

Recovery Criteria	
(i)	**Incidental by-catch during longline fishing operations is consistent with the criteria specified in the Longline Fishing Threat Abatement Plan for all albatross and giant-petrel species within the AFZ; and**
(ii)	**all human induced threats to albatrosses and giant-petrels have been minimised (or eliminated); and**
(iii)	**no breeding population within areas under Australian jurisdiction declines due to human activities; and**
(iv)	**all albatross and giant-petrel breeding populations within areas under Australian jurisdiction that have declined exhibit a sustained increase in population size.**

As noted above, the Overall Objective is a long-term goal, and may not be achieved in the five-year time frame of this Plan. Under the EPBC Act guidelines, Specific Objectives and Recovery Actions that are to be achieved within the life of this Recovery Plan have been prescribed.

6.2

Specific Objectives

The Specific Objectives of this Recovery Plan are to:

(A) ***Quantify and reduce the threats to the survival of albatrosses and giant-petrels within areas under Australian jurisdiction; and***

(B) ***Quantify and reduce the threats to the reproductive success of albatrosses and giant-petrels breeding within areas under Australian jurisdiction; and***

(C) ***Quantify and reduce the threats to the foraging habitat of albatrosses and giant-petrels within areas under Australian jurisdiction; and***

(D) ***Maintain existing population monitoring programs for albatrosses and giant-petrels breeding on Macquarie Island, Albatross Island, Pedra Branca, the Mewstone, and within the Australian Antarctic Territory, and develop population monitoring programs for other representative breeding populations under Australian jurisdiction; and***

(E) ***Educate fishers and promote public awareness of the threats to albatrosses and giant-petrels; and***

(F) ***Achieve substantial progress towards global conservation of albatrosses and giant-petrels in international conservation and fishing fora; and***

(G) ***Assess and revise the Albatross and Giant-Petrel Recovery Plan as necessary.***

6.3

Recovery and Management Actions

This Recovery Plan seeks to minimise (or eliminate) all human-induced threats to albatrosses and giant-petrels to ensure their recovery in the wild. The Recovery and Management Actions detailed in this section are derived from the Threats and Issues discussed in Section 5.

One of the key issues to emerge from Section 5 is that longline fishing has been globally identified as the most serious and immediate threat currently facing albatrosses and giant-petrels (Gales 1998). This Recovery Plan acknowledges and emphasises the central importance of the Longline Fishing Threat Abatement Plan in the recovery of albatrosses and giant-petrels. Successful implementation of the Longline Fishing Threat Abatement Plan is pivotal to the success of this Recovery Plan.

Another fundamental issue to emerge from Section 5 is that albatrosses and giant-petrels are threatened by numerous other factors. Unequivocal empirical evidence of a negative impact is simply not available for some of these potential threats. This emphasises the need for further research into the factors affecting albatross and giant-petrel survival and reproduction. This lack of quantitative evidence should not prevent the implementation of Recovery Actions that may ameliorate preventable threats to albatrosses and giant-petrels.

The EPBC Act requires that a Recovery Plan "must provide for the research and management actions necessary to stop the decline of, and support the recovery of, the listed threatened species or ecological community concerned so that its chances of long-term survival in nature are maximised" (see Appendix 2).

Consequently, many actions within the Recovery Plan will be *research* actions that are essential aids both in ensuring Recovery Actions are appropriately directed, and assessing the efficacy of the recovery process. Hence, the Recovery Actions prescribed below take one of three forms:

(i) to minimise or eliminate the factors that are *known* to threaten albatrosses and giant-petrels; or

(ii) to quantify the effects of factors that *potentially* threaten albatrosses and giant-petrels; or

(iii) to monitor the efficacy of the Recovery Process.

The Recovery and Management Actions listed below (Tables 6.1-6.3) follow the same order as the Threats and Issues discussed in Section 5. The actions are grouped according to subject matter and are not listed according to order of significance or impact.

Table 6.1: Recovery and Management Actions, Managers and Criteria

Action	Description	Managers	Performance Criteria
Specific Objective A: Quantify and reduce the threats to the survival of albatrosses and giant-petrels within areas under Australian jurisdiction			
	1: Longline fisheries		
A 1.1	Implement the *Threat Abatement Plan for the Incidental Catch (or By-catch) of Seabirds During Oceanic Longline Fishing Operations*.	AFMA/EA	The incidental catch of seabirds within the AFZ is reduced to below 0.05 birds per 1000 hooks (set across all seasons, strata and fisheries at the 1998 fishing effort) by August 2003, and ultimately reduced to zero via implementation of the Longline Fishing Threat Abatement Plan.
A 1.2	Determine the foraging range and at-sea distribution of: • adult and juvenile Shy Albatrosses from Pedra Branca • adult and juvenile Shy Albatrosses from the Mewstone • juvenile Shy Albatrosses from Albatross Island using minimal weight equipment and proven techniques of attachment, as approved by the Albatross and Giant-Petrel Recovery Team.	TASPAWS /EA	The foraging range and at-sea distribution of Shy Albatrosses is determined.
A 1.3	For Macquarie Island populations: (i) Continue studies into the foraging ranges and at-sea distributions of: • Wandering Albatrosses • Light-mantled Albatrosses • Grey-headed Albatrosses • Black-browed Albatrosses; and (ii) in the longer term, determine the foraging ranges and at-sea distributions of: • Northern Giant-Petrels • Southern Giant-Petrels using minimal weight equipment and proven techniques of attachment, as approved by the Albatross and Giant-Petrel Recovery Team.	TASPAWS /EA	Knowledge of the foraging ranges and at-sea distributions of Macquarie Island populations of the following species are substantially increased: • Wandering Albatrosses • Light-mantled Albatrosses • Grey-headed Albatrosses • Black-browed Albatrosses. In the longer term, studies into the foraging ranges and at-sea distributions of Macquarie Island populations are initiated for the following species: • Northern Giant-Petrels • Southern Giant-Petrels.

Action	Description	Managers	Performance Criteria
A 1.4	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca, the Mewstone and the AAT also monitor the frequency of fishing equipment ingestion / entanglement at breeding colonies. *Note: implementation of the Longline Fishing Threat Abatement Plan will significantly reduce the possibility for fishing hook ingestion by albatrosses and giant-petrels via the introduction of by-catch mitigation measures.*	TASPAWS /EA	Fishing equipment ingestion / entanglement at breeding colonies is monitored and quantified.
	2: Trawl fisheries		
A 2.1	Continue to collect, collate and analyse data regarding incidental mortality of albatrosses and giant-petrels associated with sub-Antarctic trawl fisheries	AFMA/ EA	The incidental mortality of albatrosses and giant-petrels associated with trawl fishing operations around Macquarie Island and Heard and McDonald Islands, and within the South East Fishery is monitored and quantified.
A 2.2	Continue to collect, collate and analyse data regarding incidental mortality of albatrosses and giant-petrels associated with the South East Fishery.	AFMA/ ISMP/ EA	The incidental mortality of albatrosses and giant-petrels associated with trawl fishing operations around Macquarie Island and Heard and McDonald Islands, and within the South East Fishery is monitored and quantified.
A 2.3	Quantify the current levels of incidental mortality of albatrosses and giant-petrels associated with trawl fishing operations occurring within the AFZ south of 30˚S (other than the sub-Antarctic and South East Fishery trawl fisheries) through assessment of logbooks and current observer programs.	AFMA	The incidental mortality of albatrosses and giant-petrels associated with trawl fishing operations occurring within the AFZ south of 30˚S (other than the sub-Antarctic and South East Fishery trawl fisheries) is quantified.
A 2.4	Design and implement an education strategy aimed at commercial trawl fishers to encourage the implementation of simple by-catch mitigation measures.	AFMA/EA	An effective education strategy is developed and in operation.
	3: Intentional shooting / killing		
A 3.1	EA to investigate the capacity of the Commonwealth to regulate to prohibit the carrying of firearms on fishing vessels operating within the AFZ.	EA	The carrying of firearms on fishing vessels within the AFZ is prohibited.
A 3.2	Design and implement an education strategy aimed at commercial and recreational fishers to discourage the intentional killing of albatrosses and giant-petrels.	AFMA/EA	An effective education strategy is developed and in operation.

Action	Description	Managers	Performance Criteria
	4: Trolling vessels		
A 4.1	Design and implement an education strategy aimed at commercial and recreational troll fishers to encourage them to set their fishing lines at least 2m below the surface of the water.	AFMA/EA	An effective education strategy is developed and in operation.
Specific Objective B: Quantify and reduce the threats to the reproductive success of albatrosses and giant-petrels breeding within areas under Australian jurisdiction			
	5: Feral pest species		
B 5.1	Continue the integrated vertebrate pest management program on Macquarie Island targeting: • feral cats • rabbits • rodents	TASPAWS /EA	On Macquarie Island, feral cats have been eradicated and rabbit and rodent numbers are maintained at a significantly reduced level or eradicated.
B 5.2	Maintain the current guidelines preventing the introduction of feral species to all albatross and giant-petrel breeding islands.	TASPAWS /AAD	Current guidelines preventing the introduction of feral species to all albatross and giant-petrel breeding islands within areas under Australian jurisdiction are maintained.
	6: Human disturbance at the nest		
B 6.1	Maintain the existing 25m minimum approach limit around Wandering Albatrosses on Macquarie Island.	TASPAWS	The existing 25m minimum approach limit around Wandering Albatrosses on Macquarie Island is maintained.
B 6.2	Continue to manage the seasonal area closures around albatross breeding colonies around Caroline Cove and the Featherbeds on Macquarie Island.	TASPAWS	Seasonal area closures around Caroline Cove and the Featherbeds on Macquarie Island are closely managed.
B 6.3	Educational material regarding the impacts of wildlife disturbance should: (i) continue to be provided to all tourists and ANARE expeditioners prior to arrival on Macquarie Island and the AAT. (ii) be designed, developed and provided to all visitors to Heard Island.	TASPAWS /AAD	Education material is prepared and distributed as appropriate.
B 6.4	Continue to manage access to all albatross and giant-petrel breeding islands under Australian jurisdiction.	TASPAWS /AAD	Access to breeding islands within areas under Australian jurisdiction is restricted to appropriate permit holders only.

Action	Description	Managers	Performance Criteria
B 6.5	Maintain the current guidelines restricting the construction of further infrastructure on albatross and giant-petrel breeding islands under Australian jurisdiction in accordance with the relevant management plans for each island.	TASPAWS /AAD	Guidelines restricting the construction of further infrastructure on breeding islands within areas under Australian jurisdiction are maintained.
	7: Avian parasites and diseases		
B 7.1	Conduct an investigation into the parasites and diseases causing mortality of Shy Albatrosses at Albatross Island.	TASPAWS /EA	An investigation into the parasites and diseases causing mortality of Shy Albatrosses at Albatross Island is completed.
B 7.2	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca and the Mewstone also monitor the presence or absence of avian parasites and diseases at breeding colonies.	TASPAWS /EA	The presence or absence of avian parasites and diseases at breeding colonies is monitored.
	8: Interspecific competition for nest space		
B 8.1	Ensure that the existing population monitoring program on Pedra Branca also monitors the relative distribution and abundance of Shy Albatrosses and Australasian Gannets.	TASPAWS /EA	The relative distribution and abundance of Shy Albatrosses and Australasian Gannets at Pedra Branca is monitored.
	9: Dependence upon discards		
B 9.1	Continue to monitor the effects of offal discharge on the reproductive success of albatrosses and giant-petrels.	TASPAWS /EA	The effects of offal discharge on the reproductive success of albatrosses and giant-petrels are monitored.
B 9.2	Investigate the foraging ranges of albatrosses and giant-petrels. *Note: specific studies determining the foraging ranges of sensitive breeding populations are prescribed under Actions A 1.3 and A 1.4.*	TASPAWS /EA	*See entries under Actions A 1.3 and A 1.4*
B 9.3	IAATO to regulate to prohibit the intentional provisioning of seabirds during tourist operations.	IAATO/EA	The intentional provisioning of food sources to seabirds during tourist operations is prohibited.

Action	Description	Managers	Performance Criteria
Specific Objective C: Quantify and reduce the threats to the foraging habitat of albatrosses and giant-petrels within areas under Australian jurisdiction			
	10: Competition with fisheries for marine resources		
C 10.1	As required by the EPBC Act, AFMA will strategically assess the ecological sustainability of each fishery that overlaps with any albatross and giant-petrel species by taking into account the total dietary requirements of each albatross and giant-petrel population.	AFMA/EA	The total dietary requirements of albatrosses and giant-petrels have been taken into account when AFMA: (i) strategically assesses the ecological sustainability of each fishery that overlaps with any albatross and giant-petrel species (under the EPBC Act); and (ii) develops or revises management arrangements (e.g. the setting of TACs) for fisheries overlapping with any albatross and giant-petrel population.
	11: Marine pollution		
C 11.1	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca and the Mewstone also monitor the incidence of: (i) hatching failure due to egg-shell thinning; and (ii) oiled birds at the nest; (iii) marine debris egestion / entanglement at the nest.	TASPAWS /EA	(i) Hatching failure due to egg-shell thinning; and (ii) the presence of oiled birds at the nest; and (iii) marine debris egestion / entanglement at the nest, at breeding colonies is monitored and quantified.
C 11.2	Design and implement an education strategy aimed at the general public to increase understanding of the environmental consequences of using industrial, agricultural and domestic chemicals.	WWF/EA	An effective education strategy is developed and in operation.

Action	Description	Managers	Performance Criteria
Specific Objective D: Maintain existing population monitoring programs for albatrosses and giant-petrels breeding on Macquarie Island, Albatross Island, Pedra Branca and the Mewstone, and develop population monitoring programs for other representative breeding populations under Australian jurisdiction.			
	12: Population monitoring programs		
D 12.1	Maintain existing population monitoring programs on Macquarie Island measuring demographic and breeding parameters of: • Wandering Albatrosses • Black-browed Albatrosses • Grey-headed Albatrosses • Light-mantled Albatrosses • Northern Giant-Petrels • Southern Giant-Petrels.	TASPAWS /AAD/EA	Existing population monitoring programs on Macquarie Island are continued.
D 12.2	Maintain existing population monitoring programs measuring demographic and breeding parameters of Shy Albatrosses breeding on: • Albatross Island • Pedra Branca • the Mewstone.	TASPAWS /EA	Existing population monitoring programs on Albatross Island, Pedra Branca and the Mewstone are continued.
D 12.3	Maintain Aid's existing program of opportunistically estimating the population size and breeding success of Southern Giant-Petrels breeding within the AAT.	AAD/EA	Aid's existing program of opportunistically estimating the population size and breeding success of Southern Giant-Petrels breeding within the AAT is continued.
D 12.4	For Heard Island populations, representative population monitoring programs using non-intrusive techniques should be conducted whenever the island is visited (during the breeding season) or every ten years (whichever is sooner) in order to determine the population status of: • Black-browed Albatrosses • Light-mantled Albatrosses • Wandering Albatrosses (if present) • Southern Giant-Petrels.	AAD/EA	On Heard Island, representative, non-intrusive population monitoring programs are conducted for: • Black-browed Albatrosses • Light-mantled Albatrosses • Wandering Albatrosses (if present) • Southern Giant-Petrels.
D 12.5	For McDonald Island populations, representative population monitoring programs using non-intrusive techniques should be conducted whenever the island is visited (during the breeding season) or every ten years (whichever is sooner) in order to determine the population status of: • Black-browed Albatrosses • Light-mantled Albatrosses • Southern Giant-Petrels.	AAD/EA	On McDonald Island, representative, non-intrusive population monitoring programs are conducted for: • Black-browed Albatrosses • Light-mantled Albatrosses • Southern Giant-Petrels.

Action	Description	Managers	Performance Criteria
D 12.6	Continue investigations into remote population-monitoring techniques to enable rapid assessment of isolated albatross and giant-petrel populations.	TASPAWS /EA	Effective remote population-monitoring techniques are developed.
	13: Reduced genetic variability		
D 13.1	Complete the genetic profiling of the three Shy Albatross populations and the closely related White-capped Albatross from NZ. These data are to be used to assess the impact of Longline Fishing operations.	TASPAWS /ANU /EA	The genetic profiling of all Shy Albatross and White-capped Albatross populations is completed, and the data are used in assessing the impact of Longline Fishing operations.
D 13.2	Initiate genetic profiling programs of populations breeding on Macquarie Island for: • Wandering Albatrosses • Black-browed Albatrosses • Grey-headed Albatrosses • Light-mantled Albatrosses.	TASPAWS /ANU/EA	Genetic material of Macquarie Island populations of the following species are collected: • Wandering Albatrosses • Black-browed Albatrosses • Grey-headed Albatrosses • Light-mantled Albatrosses.
Specific Objective E: Educate fishers and promote public awareness of the threats to albatrosses and giant-petrels			
	14: Education strategies		
E 14.1	Design and implement education strategies aimed at: (i) commercial and recreational fishers; • to encourage longline and trawl fishers to employ effective by-catch mitigation measures (TAP Actions 6.1 & 6.2; Action 2.4) • to discourage intentional shooting (Action 3.2) • to encourage troll fishers to employ effective by-catch mitigation measures (Action 4.1) (ii) visitors to breeding colonies (Action 6.3); and (iii) the general public (Action 11.2).	AFMA/EA	Effective education strategies are developed and in operation.

Action	Description	Managers	Performance Criteria
Specific Objective F: Achieve substantial progress towards global conservation of albatrosses and giant-petrels in international conservation and fishing fora			
	15: International conservation agreements		
F 15.1	Promote seabird by-catch mitigation with foreign fishers through international fora including CCAMLR, CCSBT, COFI, IOTC, FFC and other applicable international conventions to which Australia is a signatory (as prescribed in the Longline Fishing Threat Abatement Plan Action 7.1).	EA	The efficacy of seabird by-catch mitigation measures is promoted through international fora.
F 15.2	Develop an effective regional agreement for the conservation of albatrosses and giant-petrels in the Southern Hemisphere through CMS via: (i) conducting second meeting of the working group to continue development of albatross regional agreement (Australia to host); and (ii) continuing to facilitate development and implementation of the albatross regional agreement.	EA	A regional agreement is developed and in operation.
Specific Objective G: Assess and revise the Albatross and Giant-Petrel Recovery Plan as necessary.			
	16: Assess the efficacy of the Recovery Plan		
G 16.1	The Albatross and Giant-Petrel Recovery Team will meet annually or as required to assess the progress of the Recovery Plan and to revise the actions and priorities of the Plan as necessary. *Note: actions specified in the Longline Fishing Threat Abatement Plan will be taken into consideration when assessing the progress of the Recovery Plan.*	Recovery Team / EA	Implementation and progress of the Recovery Plan is assessed annually.
G 16.2	Evaluate the efficacy of the Recovery Plan after five years of operation and make revisions where necessary.	Recovery Team / EA	The Recovery Plan is reassessed and progress is measured against the recovery criteria, actions, timeframe and objectives.

6.4

Recovery Costs and Schedule

Table 6.2: Priority, Feasibility and Estimated Costs (x $1000) of Recovery Actions

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	1: Longline fisheries								
A 1.1	Implement the *Threat Abatement Plan for the Incidental Catch (or By-catch) of Seabirds During Oceanic Longline Fishing Operations*.	High	High		N/A: Included in Longline Fishing TAP				
A 1.2	Determine the foraging range and at-sea distribution of:								
	• adult and juvenile Shy Albatrosses from Pedra Branca	• High	• High	0	50	0	0	0	50
	• adult and juvenile Shy Albatrosses from the Mewstone	• High	• High	50	0	0	0	0	50
	• juvenile Shy Albatrosses from Albatross Island	• Mod.	• High	0	0	25	0	0	25
	using minimal weight equipment and proven techniques of attachment, as approved by the Albatross and Giant-Petrel Recovery Team.	- High	- High						

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
A 1.3	For Macquarie Island populations: (i) Continue studies into the foraging ranges and at-sea distributions of: • Wandering Albatrosses • Light-mantled Albatrosses • Grey-headed Albatrosses • Black-browed Albatrosses; and (ii) in the longer term, determine the foraging ranges and at-sea distributions of: • Northern Giant-Petrels • Southern Giant-Petrels using minimal weight equipment and proven techniques of attachment, as approved by the Albatross and Giant-Petrel Recovery Team.	(i) High (ii) Low (possibly occurring outside the life of this plan) - High	(i) High (ii) Mod.	0 N/A	50	50	50	50	200
A 1.4	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca, the Mewstone and the AAT also monitor the frequency of fishing equipment ingestion / entanglement at breeding colonies. *Note: implementation of the Longline Fishing Threat Abatement Plan will significantly reduce the possibility for fishing hook ingestion by albatrosses and giant-petrels via the introduction of by-catch mitigation measures.*	Moderate	High	N/A: Included in Actions D 12.1, D 12.2 & D 12.3 (Population Monitoring Programs)					

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	2: Trawl fisheries								
A 2.1	Continue to collect, collate and analyse data regarding incidental mortality of albatrosses and giant-petrels associated with sub-Antarctic trawl fisheries.	Moderate-High	High	500	500	500	500	500	2500#
A 2.2	Continue to collect, collate and analyse data regarding incidental mortality of albatrosses and giant-petrels associated with the South East Fishery.	Moderate-High	High	500	500	500	500	500	2500#
A 2.3	Quantify the current levels of incidental mortality of albatrosses and giant-petrels associated with trawl fishing operations occurring within the AFZ south of 30˚S (other than the sub-Antarctic and South East Fishery trawl fisheries) through assessment of logbooks and current observer programs.	Moderate-High	High	200	200	200	200	200	1000# †
A 2.4	Design and implement an education strategy aimed at commercial trawl fishers to encourage the implementation of simple by-catch mitigation measures.	Moderate	High	N/A: Included in Action E 14.1 (Education)					

Fishing effort can vary markedly inter-annually. Therefore, it is difficult to project monitoring costs over the next five years with full confidence.
† The monitoring program in the Great Australian Bight Fishery is a pilot program and coverage in other fisheries has been largely opportunistic. It is difficult to project monitoring costs over the next five years with full confidence.

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	3: Intentional shooting / killing								
A 3.1	EA to investigate the capacity of the Commonwealth to regulate to prohibit the carrying of firearms on fishing vessels operating within the AFZ.	High	High	1	0	0	0	0	1
A 3.2	Design and implement an education strategy aimed at commercial and recreational fishers to discourage the intentional killing of albatrosses and giant-petrels.	High	High	N/A: Included in Action E 14.1 (Education)					
	4: Trolling vessels								
A 4.1	Design and implement an education strategy aimed at commercial and recreational troll fishers to encourage them to set their fishing lines at least 2m below the surface of the water.	Low-Moderate	High	N/A: Included in Action E 14.1 (Education)					
	5: Feral pest species								
B 5.1	Continue the integrated vertebrate pest management program on Macquarie Island targeting: • feral cats • rabbits • rodents	High	High	N/A: Included in Invasive Species Program					

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
B 5.2	Maintain the current guidelines preventing the introduction of feral species to all albatross and giant-petrel breeding islands.	High	High	0	0	0	0	0	0
	6: Human disturbance at the nest								
B 6.1	Maintain the existing 25m minimum approach limit around Wandering Albatrosses on Macquarie Island.	Moderate	High	0	0	0	0	0	0
B 6.2	Continue to manage the seasonal area closures around albatross breeding colonies around Caroline Cove and the Featherbeds on Macquarie Island.	Moderate	High	0	0	0	0	0	0
B 6.3	Educational material regarding the impacts of wildlife disturbance should: (i) continue to be provided to all tourists and ANARE expeditioners prior to arrival on Macquarie Island and the AAT.	Moderate	High	0	0	0	0	0	0
	(ii) be designed, developed and provided to all visitors to Heard Island.	Moderate	High		N/A: Included in Action E 14.1 (Education)				
B 6.4	Continue to manage access to all albatross and giant-petrel breeding islands under Australian jurisdiction.	Moderate	High	0	0	0	0	0	0

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
B 6.5	Maintain the current guidelines restricting the construction of further infrastructure on albatross and giant-petrel breeding islands under Australian jurisdiction in accordance with the relevant management plans for each island.	Moderate	High	0	0	0	0	0	0
	7: Avian parasites and diseases								
B 7.1	Conduct an investigation into the parasites and diseases causing mortality of Shy Albatrosses at Albatross Island.	High	Moderate	0	0	0	0	20	20
B 7.2	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca and the Mewstone also monitor the presence or absence of avian parasites and diseases at breeding colonies.	High	High	N/A: Included in Actions D 12.1, D 12.2 & D 12.3 (Population Monitoring Programs)					
	8: Interspecific competition for nest space								
B 8.1	Ensure that the existing population monitoring program on Pedra Branca also monitors the relative distribution and abundance of Shy Albatrosses and Australasian Gannets.	Moderate	High	N/A: Included in Action D 12.2 (Population Monitoring Program)					

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	9: Dependence upon discards								
B 9.1	Continue to monitor the effects of offal discharge on the reproductive success of albatrosses and giant-petrels.	Moderate	Low-Moderate	N/A: Included in Actions D 12.1 & D 12.2 (Population Monitoring Programs)					
B 9.2	Investigate the foraging ranges of albatrosses and giant-petrels. *Note: specific studies determining the foraging ranges of sensitive breeding populations are prescribed under Actions A 1.3 and A 1.4.*	High	Moderate - High	N/A: Included in Actions D 12.1 & D 12.2 (Population Monitoring Programs)					
B 9.3	IAATO to regulate to prohibit the intentional provisioning of seabirds during tourist operations.	Moderate	High	0	0	0	0	0	0
	10: Competition with fisheries for marine resources								
C 10.1	As required by the EPBC Act, AFMA will strategically assess the ecological sustainability of each fishery that overlaps with any albatross and giant-petrel species by taking into account the total dietary requirements of each albatross and giant-petrel population.	High	Moderate	0	30	60	30	0	120

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	11: Marine pollution								
C 11.1	Ensure that existing population monitoring programs on Macquarie Island, Albatross Island, Pedra Branca and the Mewstone also monitor the incidence of: (i) hatching failure due to egg-shell thinning; and (ii) oiled birds at the nest; (iii) marine debris egestion / entanglement at the nest.	(i) Mod. (ii) Mod. (iii) Mod.	(i) High (ii) High (iii) High	N/A: Included in Actions D 12.1, D 12.2 & D 12.3 (Population Monitoring programs)					
C 11.2	Design and implement an education strategy aimed at the general public to increase understanding of the environmental consequences of using industrial, agricultural and domestic chemicals.	High	High	N/A: Included in Action E 14.1 (Education)					

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	12: Population monitoring programs								
D 12.1	Maintain existing population monitoring programs on Macquarie Island measuring demographic and breeding parameters of: • Wandering Albatrosses • Black-browed Albatrosses • Grey-headed Albatrosses • Light-mantled Albatrosses • Northern Giant-Petrels • Southern Giant-Petrels.	High	High	100	100	100	100	100	500
D 12.2	Maintain existing population monitoring programs measuring demographic and breeding parameters of Shy Albatrosses breeding on: • Albatross Island • Pedra Branca • the Mewstone.	High	High	10	10	10	10	10	50

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
D 12.3	Maintain AAD's existing program of opportunistically estimating the population sizes and breeding success of Southern Giant-Petrels breeding within the AAT.	High	Moderate	15	15	15	15	15	75
D 12.4	For Heard Island populations, representative population monitoring programs using non-intrusive techniques should be conducted whenever the island is visited (during the breeding season) or every ten years (whichever is sooner) in order to determine the population status of: • Black-browed Albatrosses • Light-mantled Albatrosses • Wandering Albatrosses (if present) • Southern Giant-Petrels.	Moderate	Moderate	5	0	5	0	5	15
D 12.5	For McDonald Island populations, representative population monitoring programs using non-intrusive techniques should be conducted whenever the island is visited (during the breeding season) or every ten years (whichever is sooner) in order to determine the population status of: • Black-browed Albatrosses • Light-mantled Albatrosses • Southern Giant-Petrels.	Moderate	Moderate	5	0	5	0	5	15

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
D 12.6	Continue investigations into remote population-monitoring techniques to enable rapid assessment of isolated albatross and giant-petrel populations.	High	High	5	5	0	0	0	10
	13: Reduced genetic variability								
D 13.1	Complete the genetic profiling of the three Shy Albatross populations and the closely related White-capped Albatross from NZ. These data are to be used to assess the impact of Longline Fishing operations.	High	High	10	10	0	0	0	20
D 13.2	Initiate genetic profiling programs of populations breeding on Macquarie Island for: • Wandering Albatrosses • Black-browed Albatrosses • Grey-headed Albatrosses • Light-mantled Albatrosses.	Moderate	Moderate	0	0	30	0	0	30

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	14: Education strategies								
E 14.1	Design and implement education strategies aimed at: (i) commercial and recreational fishers; • to encourage longline and trawl fishers to employ effective by-catch mitigation measures (TAP Actions 6.1 & 6.2; Action 2.4) • to discourage intentional shooting (Action 3.2) • to encourage troll fishers to employ effective by-catch mitigation measures (Action 4.1) (ii) visitors to breeding colonies (Action 6.3); and (iii) the general public (Action 11.2).	(i) • High • High • Low (ii) Mod. (iii) Mod.	(i) • High • High • High (ii) High (iii) High	10	10	10	10	10	50

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	15: International conservation agreements								
F 15.1	Promote seabird by-catch mitigation with foreign fishers through international fora including CCAMLR, CCSBT, COFI, IOTC, FFC and other applicable international conventions to which Australia is a signatory (as prescribed in the Longline Fishing Threat Abatement Plan Action 7.1).	High	High	N/A: Included in Longline Fishing TAP					
F 15.2	Develop an effective regional agreement for the conservation of albatrosses and giant-petrels in the Southern Hemisphere through CMS via:								
	(i) conducting second meeting of the working group to continue development of albatross regional agreement (Australia to host); and	High	High	100	0	0	0	0	100
	(ii) continuing to facilitate development and implementation of the albatross regional agreement.	High	High	0	20	20	20	20	80

Action	Description	Priority	Feasibility	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	16: Assess the efficacy of the Recovery Plan								
G 16.1	The Albatross and Giant-Petrel Recovery Team will meet annually or as required to assess the progress of the Recovery Plan and to revise the actions and priorities of the Plan as necessary. *Note: actions specified in the Longline Fishing Threat Abatement Plan will be taken into consideration when assessing the progress of the Recovery Plan.*	High	High	5	5	5	5	5	25
G 16.2	Evaluate the efficacy of the Recovery Plan after five years of operation and make revisions where necessary.	High	High	0	0	0	0	5	5
			Total (x $1000)	1516	1505	1535	1440	1445	7441

Table 6.3: Timetable for Recovery Actions

Action	Description	Year 1	Year 2	Year 3	Year 4	Year 5
A 1.1	Longline Fishing Threat Abatement Plan	→	→	→	→	→
A 1.2	Satellite telemetry - Shy Albatrosses	→	→	→		
A 1.3	Satellite telemetry - Macquarie Island populations		→	→	→	→
A 1.4	Monitor fishing equipment ingestion / entanglement	→	→	→	→	→
A 2.1	Quantify mortality in trawl fisheries - sub-Antarctic	→	→	→	→	→
A 2.2	Quantify mortality in trawl fisheries - SEF	→	→	→	→	→
A 2.3	Quantify mortality in trawl fisheries - Other	→	→	→	→	→
A 2.4	Education strategy – safe trawling practices			→		
A 3.1	Investigate prohibition of firearm carriage	→				
A 3.2	Education strategy – discourage intentional killing	→				
A 4.1	Education strategy – safe trolling practices			→		
B 5.1	Feral species eradication / control – Macquarie Island	→	→	→	→	→
B 5.2	Prevention of feral species to breeding islands	→	→	→	→	→

Action	Description	Year 1	Year 2	Year 3	Year 4	Year 5
B 6.1	Approach limit - Macquarie Island	→	→	→	→	→
B 6.2	Seasonal area closures - Macquarie Island	→	→	→	→	→
B 6.3	Education strategy – visitors to breeding islands			→		
B 6.4	Manage access to breeding islands	→	→	→	→	→
B 6.5	Restrict construction on breeding islands	→	→	→	→	→
B 7.1	Investigate avian parasites and disease	→	→	→	→	→
B 7.2	Monitor avian parasites and disease	→	→	→	→	→
B 8.1	Monitor Australasian Gannets on Pedra Branca	→	→	→	→	→
B 9.1	Monitor effects of offal discharge	→	→	→	→	→
B 9.2	Investigate foraging ranges	See specific entries under Actions A 1.3 and A 1.4				
B 9.3	Prohibit feeding of seabirds during tourist operations	→				
C 10.1	Assess dietary requirements	→	→	→	→	→
C 11.1	Monitor egg-shelling thinning, oiled birds, and marine debris at nest	→	→	→	→	→
C 11.2	Education strategy – chemical contamination			→		

Action	Description	Year 1	Year 2	Year 3	Year 4	Year 5
D 12.1	Population monitoring - Macquarie Island	→	→	→	→	→
D 12.2	Population monitoring - Albatross Island, Pedra Branca and the Mewstone	→	→	→	→	→
D 12.3	Population monitoring - AAD			Opportunistic		
D 12.4	Population monitoring - Heard Island	→		→		→
D 12.5	Population monitoring - McDonald Islands	→		→		→
D 12.6	Investigate remote population-monitoring techniques	→	→			
D 13.1	Genetic profiling - Shy Albatrosses	→	→			
D 13.2	Genetic profiling - Macquarie Island albatrosses			→		
E 14.1	Education strategies	See specific entries under Actions A3.2, A4.1, B6.3, B9.2 & C11.2				
F 15.1	Promote by-catch mitigation via international fora	→	→	→	→	→
F 15.2	Develop a regional agreement through CMS	→				
G 16.1	Revision of the Recovery Plan	◖	◖	◖	◖	
G 16.2	Evaluation of the Recovery Plan after five years					→