REPORT OF THE EXPERT PANEL ON A DECLARED COMMERCIAL FISHING ACTIVITY:

FINAL (SMALL PELAGIC FISHERY) DECLARATION (NO. 2) 2013

March 2015

Letter of transmittal to the Minister

Dear Minister

I am pleased to present the report of the Expert Panel on a Declared Commercial Fishing Activity (*Final (Small Pelagic Fishery) Declaration (No. 2) 2013*).

The report assesses and advises on:

1. the likely nature and extent of direct interactions of the declared commercial fishing activities with species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), particularly seals, dolphins and seabirds
2. the potential for any localised depletion of target species (arising from the declared commercial fishing activities) to result in adverse impacts to the Commonwealth marine environment, including the target species' predators protected under the EPBC Act
3. actions that could be taken by operators of the declared commercial fishing activities or relevant regulatory authorities to avoid, reduce and mitigate adverse environmental impacts of the activities
4. monitoring or scientific research that would reduce any uncertainties about the potential for adverse environmental impacts resulting from the declared commercial fishing activities.

The panel's advice on these issues was informed by consultation with national and international experts in the relevant fields, by targeted, commissioned research and by broader stakeholder consultation.

The panel members hope that this report will assist your assessment of the environmental impacts of the declared commercial fishing activities and help inform future government decision making on the Small Pelagic Fishery.

Mary Lack
Chair
Expert Panel on a Declared Commercial Fishing Activity

Contents

Figures

Tables

Acknowledgements

The expert panel extends its sincere thanks to the members of its secretariat: Mr Nathan Hanna, Ms Genine Sutton, Dr Candace McBride and Ms Leila Bouhafs of the Sustainable Fisheries Section, and to Ms Carolyn Armstrong of the Environmental Resources Information Network, in the Department of the Environment. The panel appreciates and values the time and effort of the experts, researchers, fishing industry members, government agencies and advisory bodies, conservation groups, Indigenous groups and recreational fishing organisations that provided advice, data and their views to inform the panel's assessments of the first and second declarations.

Executive summary

Background

The *Final (Small Pelagic Fishery) Declaration (No. 2) 2013* prohibited mid-water trawl operations with storage capacity of 1600 tonnes (t) or more from fishing for or receiving quota species from other catching vessels in the area of the Small Pelagic Fishery (SPF) for up to two years while an expert panel (the panel) undertook an assessment of the potential for the declared commercial fishing activities (DCFAs) to cause adverse environmental impacts.

The panel has assessed the direct impacts of the DCFAs on species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act), particularly seals, dolphins and seabirds, and the adverse impacts of any localised depletion of SPF target species caused by the DCFAs on the Commonwealth marine environment, including on the target species' predators protected under the EPBC Act. Based on that assessment, advice has been provided on actions that could be taken to avoid, reduce and mitigate any adverse environmental impacts and scientific research and monitoring that could reduce uncertainties about those impacts. A synthesis of the panel's assessment and advice is presented in Chapter 7 and an overview of the key outcomes is provided below.

The DCFAs

The DCFAs are:

(a) The mid-water trawl activity (MTA), which is a commercial fishing activity that:

  i. is in the SPF
  ii. uses the mid-water trawl method
  iii. uses a vessel which has a storage capacity for fish or fish products of 1600 t or greater.

(b) The fish processing activity (FPA), which is a commercial fishing activity that:

  i. is in the SPF
  ii. uses a vessel which has storage capacity for fish or fish products of 1600 t or greater
  iii. consists of receiving or processing fish or fish products that are quota species that have been taken in the SPF.

Mid-water trawl activity

The MTA differs from the declared commercial fishing activity (DCFA1) under the *Final (Small Pelagic Fishery) Declaration 2012* only in that its storage capacity is reduced by 400 t. The panel found that the uncertainties around the pattern of fishing likely to be undertaken by the DCFA1 applied equally to the MTA. The panel considered that its assessment was not sufficiently sensitive to detect any differential impacts on the nature and extent of direct interactions with protected species arising from a 400 t reduction in capacity. In relation to localised depletion, the panel considered that the reduced storage capacity of the MTA may reduce the extent of localised depletion and the risks associated with adverse impact arising from such depletion. Conversely, the reduced capacity to stay at sea may provide an incentive to stay in a localised area for more extended periods, thereby increasing the extent of localised depletion, compared to the more wide-ranging activity possible under DCFA1. Given the uncertainties associated with the fishing pattern of the MTA, the panel considered that it was unlikely that it could detect any meaningful distinction between the likely impact of localised depletion caused by the MTA and DCFA1.

As a result, the panel's assessment of, and advice on, the MTA is the same as that of the DCFA1 reported in the panel's first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014, Executive Summary).

Fish processing activity

Assessment of direct interactions with protected species

There are 241 species protected under the EPBC Act that occur in the SPF area, including pinnipeds, cetaceans, dugong (possible but unlikely), seabirds, turtles, seasnakes, sharks and rays, syngnathids and other teleost fishes. The panel focussed its assessment on species considered at increased risk of interactions from mid-water trawling: three species of pinnipeds (Australian fur seal *Arctocephalus pusillus doriferus,* New Zealand fur seal *A. forsteri* and Australian sea lion *Neophoca cinerea*), 36 cetacean species, and seabirds as a group. Some common themes with respect to the likely nature and extent of direct interactions by the DCFA with these species are apparent across the taxa:

- It is inevitable that the FPA would have direct interactions with protected species of pinnipeds, cetaceans and seabirds and some interactions will result in mortalities regardless of the adoption of the best available mitigation and management measures; however, there remains uncertainty about the extent of those interactions.
- It is possible to identify the likely nature of the interactions and the species that are more likely to interact or are more vulnerable to interactions.
- The direct impact of the processing vessel on protected species is likely to be restricted to vessel strike with cetacean species.
- There remains considerable uncertainty about the level of direct interactions that would result in an adverse environmental impact on pinnipeds, cetaceans and seabirds, but there are opportunities for research and monitoring that could reduce the uncertainties associated with the FPA's interaction with protected species.
- Some progress has been made, domestically and internationally, on measures to manage the risks of direct interactions between fishing operations and pinnipeds and dolphins, but these mitigation measures need further development and testing before they could be applied with confidence.
- Substantial progress has been made on measures to manage the risks associated with direct interactions of fishing operations with seabirds in mid-water trawl gear.
- Risks to seabirds from purse seine fishing are considered to be generally low but there have been significant interactions with flesh-footed shearwaters in one Australian purse seine fishery, demonstrating that proximity to breeding and foraging sites as well as the time of day that fishing is conducted may be important factors to take into account when mitigating against seabird interactions in purse seine fisheries.
- Management and mitigation measures, individually and as a package, require testing and refinement to ensure their operation is optimised in the context of the fishery, the protected species, the vessel, its gear and the fishing plan.

Compared to the typical SPF fleet, the panel considered that:

- there would be more effort under the FPA and this would likely result in a greater number of interactions
- the FPA scenario would likely result in increased bycatch mortality of pinnipeds, dolphins and seabirds given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels
- if the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect a change in both the rate of interactions and the protected species involved, for example the FPA may result in interactions with all three pinniped species rather than just fur seals.

Compared to DCFA1, the panel considered that:

- The number of interactions with protected species under the FPA may be less, similar or more depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawlers in the wet boat catching fleet of the FPA need to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel, then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.
- The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). This may mean that the FPA fleet is more likely to fish closer inshore than DCFA1 and potentially have more interactions with protected central place forager (CPF) species of pinnipeds (such as the fur seals and sea lions), seabirds and cetaceans, especially short-beaked common dolphins *Delphinus delphis*.

Assessment and advice on localised depletion

The panel interpreted localised depletion as a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing. The central issue for the panel's assessment was whether the fishing activity of the FPA could be concentrated enough, both spatially and temporally, to cause a localised depletion of the target species sufficient to cause adverse environmental impacts to the Commonwealth marine environment. The panel assessed the potential impact of localised depletion arising from the FPA on the target species and on protected species of CPFs. The key points arising from that assessment are:

- The target species of the SPF are susceptible to capture but also have characteristics that are likely to reduce the temporal and spatial extent of localised depletion.
- The available evidence does not suggest that past extensive fishing activity for jack mackerel *Trachurus declivis* in the area of the SPF has significantly affected reproductive capacity or caused impacts on genetic diversity in that stock; nor does available evidence suggest an adverse impact on age or size structure of the other SPF target species.
- The dependency on near-colony prey resources at certain locations and times increases the vulnerability of protected species of CPFs to localised depletion of SPF target species, and the nature and extent of the impact will depend on the spatial and temporal scale of the depletion.
- Very few studies anywhere in the world have linked reduced foraging and reproductive performance of CPFs to the impacts of fishing, and even fewer to localised depletion. Active management of the potential impacts of localised depletion on CPF species is rare.
- The available data suggest that the CPF species at greatest risk from localised depletion in the SPF are the Australian fur seal, New Zealand fur seal, Australasian gannet *Morus serrato*r, short-tailed shearwater *Ardenna tenuirostris*, little penguin *Eudyptula minor*, crested tern *Thalasseus bergii* and shy albatross *Thalassarche cauta* and that key foraging areas for these species within the SPF are Bass Strait, Tasmania and South Australia.
- There remains uncertainty about the importance of SPF target species to other CPFs and predators, because diet information is poor or unavailable.
- The ecosystem modelling studies available indicate that the SPF target species are not as influential in the southern Australian ecosystem compared to small pelagic species in other more productive upwelling systems aound the world that support much larger biomasses of similar species.
- A recent review of the SPF Harvest Strategy suggests that current exploitation rates of target species in the SPF are unlikely to cause adverse environmental impacts to the broader ecosystem and that the 'ecological allocation' to predators and the broader ecosystem is adequate.
- The storage capacity of the processing vessel is not relevant to the assessment of the potential for the FPA to cause localised depletion.
- The ability to tranship at sea would potentially allow for the catching fleet to increase its effort and hence the extent of localised depletion compared to operations in the past but this would be constrained by the need for the catching fleet to regularly return to port to refuel.

The panel concluded that given the present management regime in place in the SPF, any localised depletion of SPF target species that might arise from the FPA was unlikely to affect the overall status of the target stocks in the SPF. The panel considered that localised depletion caused by the FPA has the potential to have adverse impacts on CPF species and that under the current monitoring regime it is unlikely that such impacts would be detected. It is possible to provide an indication of the CPF species most at risk from localised depletion but dietary data are lacking for many other CPF species. It is not possible, based on currently available data, to determine the degree of localised depletion that would result in adverse environmental impacts to protected CPFs.

The panel considered that, given the exploitation rates in place, it was unlikely that localised depletion arising from any of the fishing scenarios considered (DCFA1, MTA, FPA and typical SPF fleet) would affect the overall status of stocks of target species in the SPF. Compared to the typical SPF fleet, the FPA might have a higher potential for adverse impacts on protected CPF species but less potential than DCFA1 or the MTA.

Key advice

The panel has identified management and operational responses and opportunities for research and monitoring to address the risks associated with the impacts of the MTA and the FPA on the Commonwealth marine environment. The risks identified relate to the activities of the catching vessel or fleet rather than the processing vessel or the process of transhipment. The panel considers that the following actions and associated research are central to addressing those risks.

- Mid-water trawl
  - Mitigate bycatch mortality of the threatened Australian sea lion by implementing spatial closures and bycatch trigger limits that encompass foraging areas around all colonies off South Australia and Western Australia.
  - Mitigate bycatch mortality of fur seals by implementing spatial closures especially adjacent to breeding colonies.
  - Mitigate against the potential adverse impacts of localised depletion on protected CPF species by implementing closures that preclude the FPA from critical habitats at important times.
  - Develop and optimise an excluder device or devices for seal and dolphin bycatch mitigation.
  - Once the excluder device is operationalised, use underwater video to monitor the behaviour of marine mammals within the trawl net and in the vicinity of the excluder device to assess its efficacy and quantify levels of cryptic mortality.
  - Introduce a bycatch rate trigger limit for the fishery or fishing area, or a total mortality trigger for a fishing season and/or fishing areas, for fur seals and dolphins.
  - Management actions applied to dolphin interactions in the SPF should be consistent with the current spatial management zones and actions to mitigate dolphin bycatch in the gillnet sector of the Gillnet Hook and Trap Fishery off South Australia.
  - Ensure that move-on rules associated with trigger limits are evidence-based or implemented on a precautionary basis, where necessary.
  - Ensure that seabird vessel management plans reflect the best practice advice of the Agreement for the Conservation of Albatrosses and Petrels and are consistent with the *National recovery plan for threatened albatrosses and giant petrels 2011-2016*.
  - Ensure 100 per cent observer coverage of all mid-water trawl fishing operations to provide confidence that interactions are recorded accurately, the effectiveness of bycatch mitigation devices is monitored and that underwater interactions and mortalities are detected quickly enough to allow any move-on rules to be effected in a timely manner.
- Purse seine
  - Review and update the current SPF purse seine fishery code of practice to ensure it provides best-practice advice on avoiding interactions with, and the handling and release of, protected species.
- Research and monitoring
  - Identify critical habitats for protected species including key foraging areas for central placed foragers (seabirds and pinnipeds) and important habitats used by cetaceans that are at increased risk of interaction with the FPA.
  - Determine the cumulative fishery-related mortality of protected species in the SPF area that interact with the FPA, to ensure that this does not compromise the sustainability of their populations.
  - Confirm the integrity of the current management of SPF target stocks by clarifying the extent of sub-structuring of SPF target species in the Eastern and Western Zones.
  - Validate the reporting of interactions with protected species particularly seabirds and dolphins in all SPF fishing operations.

Concluding comments

The panel's assessment is based on specific MTA and FPA fishing scenarios and associated assumptions. These had a significant bearing on the outcome of its assessment and any changes to those would necessarily affect the validity of the panel's assessment and advice. Further, the panel's assessment should be considered in the context of the role of SPF target species in the southern Australian marine ecosystem, the management regime that controls the catch of those species, and of the cumulative impacts of fishing in the area of the SPF on protected species affected by the DCFA.

Given the distribution of protected species across the SPF it is inevitable that some interactions will occur with any fishing activity, including the MTA and the FPA, even with best-practice mitigation measures in place. The panel's assessment has confirmed that there are considerable uncertainties relating to whether these interactions would have adverse environmental impacts. As in other fisheries facing similar uncertainties, a precautionary and adaptive, risk-based approach to management of the potential impacts of the MTA and the FPA would be required.

1 Background

1.1 Introduction

In September 2012, the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) was amended to include Part 15B[1]. The amendment enabled the Environment Minister, with the agreement of the Fisheries Minister, to prohibit certain commercial fishing activities while an expert panel undertook an assessment of those activities.

The amendment of the EPBC Act was prompted by a proposal to use the *FV Margiris*, a 142 metre (m) Lithuanian-registered, mid-water trawl vessel, in Australia's Small Pelagic Fishery (SPF). The vessel had an on-board processing facility and storage capacity for fish and/or fish products of approximately 4500 tonnes (t). Vessels of this size and nature had not previously operated in the SPF although proposals to use freezer vessels in the fishery date back to 2004. On 5 September 2012, the *FV Margiris* was renamed the *FV Abel Tasman* and registered as an Australian-flagged boat under the *Shipping Registration Act 1981* (Cwlth).

After consideration of the environmental impacts of the proposal, the Environment and Fisheries Ministers concluded there were uncertainties surrounding the use of large mid-water trawl freezer vessels in the SPF. These uncertainties related to the impacts of such vessels on species protected under the EPBC Act, particularly seals and dolphins, and whether such vessels could cause localised depletion which might have an effect on predatory species. On 20 September 2012 the Environment Minister, after consultation with the Fisheries Minister, made the *Interim (Small Pelagic Fishery) Declaration 2012* which came into force on 21 September 2012. The Interim Declaration defined the Declared Commercial Fishing Activity (DCFA) as a commercial fishing activity which:

i. is in the area of the Small Pelagic Fishery
ii. uses the mid-water trawl method
iii. uses a vessel which is greater than 130 m in length, has an on-board fish processing facility and has storage capacity for fish or fish products in excess of 2000 t.

On 19 November 2012, the Environment Minister made the *Final (Small Pelagic Fishery) Declaration 2012* (the first declaration) which defined the DCFA in the same terms as the Interim Declaration and prohibited the DCFA for up to two years while an expert panel conducted an assessment and reported to the Environment Minister on the activity. The Minister received the Report of the Expert Panel on a Declared Commercial Fishing Activity in October 2014[2]. The report is referred to hereafter as the first declaration report.

Following the making of the first declaration the operators of the *FV Abel Tasman* put forward two proposals for alternative use of the vessel in the SPF. These proposals involved reducing the storage capacity of the vessel and (i) fishing with that vessel or (ii) using the vessel to receive fish from other catching vessels. After consideration of these proposals the Environment Minister, in consultation with the Fisheries Minister, determined on 25 February 2013 that there were uncertainties about the environmental impacts of these proposals and made the *Interim (Small Pelagic Fishery) Declaration (No. 2) 2013*. Following a period of consultation with declaration affected persons, the Environment Minister made the *Final (Small Pelagic Fishery) Declaration (No. 2) 2013* (the second declaration) on 26 April 2013. The second declaration prohibited the following two DCFAs for a period of two years while an expert panel conducted an assessment:

1. The mid-water trawl activity (MTA), which is a commercial fishing activity that:
   i. is in the SPF
   ii. uses the mid-water trawl method
   iii. uses a vessel which has a storage capacity for fish or fish products of 1600 t or greater.
2. The fish processing activity (FPA), which is a commercial fishing activity that:
   i. is in the SPF
   ii. uses a vessel which has storage capacity for fish or fish products of 1600 t or greater
   iii. consists of receiving or processing fish or fish products that are quota species that have been taken in the SPF.

1 The ability to make new declarations under Part 15B of the EPBC Act sunsetted 12 months after the day the *Environment Protection and Biodiversity Conservation Amendment (Declared Commercial Fishing Activities) Act 2012* commenced.
2 Available at http://www.environment.gov.au/marine/publications/report-expert-panel-small-pelagic-fishery.

The Expert Panel on a Declared Commercial Fishing Activity (the panel) was appointed on 2 September 2014 and comprised[3]:

- Ms Mary Lack (chair), Director, Shellack Pty Ltd
- Dr Catherine Bulman, Research Scientist, CSIRO Oceans and Atmosphere Flagship
- Professor Simon Goldsworthy, Principal Scientist, Threatened, Endangered and Protected Species Subprogram, South Australian Research and Development Institute
- Professor Peter Harrison, Director, Marine Ecology Research Centre, Southern Cross University.

The panel was supported by a secretariat provided by the Department of the Environment.

1.2 Terms of Reference

The panel's Terms of Reference (Appendix 1) require that the panel assess and advise on:

1. the likely nature and extent of direct interactions of the declared commercial fishing activities with species protected under the EPBC Act, particularly seals, dolphins and seabirds
2. the potential for any localised depletion of target species (arising from the declared commercial fishing activities) to result in adverse impacts to the Commonwealth marine environment, including the target species' predators protected under the EPBC Act
3. actions that could be taken by operators of the declared commercial fishing activities or relevant regulatory authorities to avoid, reduce and mitigate adverse environmental impacts of the activity
4. monitoring or scientific research that would reduce any uncertainties about the potential for adverse environmental impacts resulting from the declared commercial fishing activities
5. any other matters about the environmental impacts of the declared commercial fishing activities that the expert panel considers relevant to its assessment
6. other related matters that may be referred to it by the Minister.

The panel assessed each of the matters identified in Terms of Reference one to four and has not assessed any other matters under the fifth Term of Reference. The Minister did not refer any other related matters to the panel.

1.3 Structure of the report

Details of the panel's approach to the assessment of the two DCFAs and the panel's interpretation of the Terms of Reference are described in Chapter 2. The panel's assessment of the MTA is contained in Chapter 3. The panel's consideration of the key elements of the FPA is described in Chapter 4. This underpins the panel's assessment of the direct impacts of the FPA on species protected under the EPBC Act (Chapter 5) and of the potential for any localised depletion arising from that activity to result in adverse impacts on the Commonwealth marine environment (Chapter 6). A summary of the panel's assessment and advice on each of the Terms of Reference is provided in Chapter 7.

This report draws heavily on the panel's first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014) and the information obtained in conducting that assessment. Cross references to relevant background and supporting information in the first declaration report are made here and the outcomes of the panel's assessment presented in that report are used to inform the assessment of the second declaration where relevant.

3 Biographical details of the panel members can be found at http://www.environment.gov.au/marine/fisheries/commonwealth/small-pelagic/second-expert-panel

2 Approach and interpretation

2.1 Informing the assessment

The panel's Terms of Reference identified seven broad areas of activities that the panel would undertake in carrying out its assessment. A summary of the range of activities undertaken by the panel against each of these requirements is provided in Table 2.1.

Table 2.1 Approach and activities

REQUIREMENT	ACTIONS
1. Examine existing scientific literature, other relevant information and any ongoing research and monitoring projects relevant to the impacts of the Declared Commercial Fishing Activities (DCFAs)	Some relevant material was provided to the panel by the secretariat. This was augmented by research commissioned by the panel and by material identified by the panel members. The Fisheries Research and Development Corporation and the Australian Fisheries Management Authority (AFMA) provided advice on past, current and proposed research projects in Australia.
2. Consult with and seek submissions from experts in relevant scientific disciplines where the expert panel believes this is necessary to clarify areas of uncertainty about the environmental impacts of the DCFAs	A list of people consulted by the panel, and the nature of the consultation, is provided in Appendix 2. The panel's assessment of the mid-water trawl activity (MTA) relied heavily on the information gathered during its assessment of the first declaration (see Appendix 2, first declaration report). The panel's assessment of the second declaration has been informed by input from experts in relevant scientific and operational disciplines and the broader community of stakeholders. The panel sourced information and advice from: • Seafish Tasmania's submission to the interim declaration (with its agreement) • a meeting with AFMA and the written summary of that meeting • invited submissions from stakeholders.
3. Consider the fisheries management arrangements under which the DCFAs are proposed to operate and the extent to which those management arrangements address the relevant environmental impacts and uncertainties	The fisheries management arrangements that were proposed to apply to the DCFAs are summarised in Chapter 2. The extent to which these arrangements mitigate the impacts associated with the DCFAs is discussed in Chapters 3, 5 and 6.
4. Take account of the requirements of the EPBC Act as they relate to the operation of and accreditation of Commonwealth fisheries	The tests applied by the Department of the Environment in assessing the Small Pelagic Fishery (SPF) under Part 13 and Part 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) have been taken into account in describing the regulatory conditions under which the DCFAs might operate and in assessing the actions that could be taken by the operators of the DCFAs and/or the regulatory authorities to avoid, reduce and mitigate adverse environmental impacts of the activities.
5. Commission, through the Department of the Environment, new reviews, research projects, modelling or analyses which the expert panel believes are necessary to fill critical knowledge gaps and where the results of those projects and analyses will allow the expert panel to fulfil its Terms of Reference	The panel commissioned the following research: • a literature review on the impacts on EPBC Act protected species by purse seine vessels • a technical assessment of transhipping and mothershipping operations in small pelagic fisheries. The panel's assessment was also informed by research conducted during its assessment of the first declaration. The nature of the research commissioned by the panel was influenced by the timeframe and budget available to it and by the panel's assessment of the factors that it considered directly relevant to its assessment.

REQUIREMENT	ACTIONS
6. Consult with relevant experts and other stakeholders, including in the operations of the DCFAs, on the nature and effectiveness of the measures available to reduce direct interactions with EPBC Act protected species and the potential ecological effects of any localised depletion resulting from the DCFAs	The panel consulted with relevant experts including the Directors of Seafish Tasmania Pty Ltd (the proponents of the MTA and the fish processing activity (FPA)). Insights into the operations of mid-water trawl and purse seine vessels and their use of measures to reduce direct interactions with protected species were also gained from research commissioned by the panel, analysis of available literature and advice from fisheries managers.
7. Identify further necessary and practicable monitoring or research projects that would reduce critical uncertainties for decision making relevant to any future operations of the DCFAs	The need for additional research and monitoring that would reduce critical uncertainties for decision making relevant to any future operations of the DCFAs is identified in Chapters 3, 5 and 6 and summarised in Chapter 7. These needs have been informed by research projects commissioned by the panel and by the panel's assessment of critical knowledge gaps.

During the course of its assessment, the panel met in person on three occasions for a total of eight days and by teleconference on one occasion. All records of panel meetings, teleconferences, records of meetings with experts, invited submissions and commissioned research reports were uploaded to the secure Govdex site to facilitate record keeping and for access by panel members.

2.2 The Small Pelagic Fishery

An account of the history and management of the Small Pelagic Fishery (SPF) was provided as context to the panel's assessment of the DCFA in the first declaration (DCFA1) (Expert Panel on a Declared Commercial Fishing Activity 2014, see chapter 3). A summary of the key management features of the SPF as they relate to the panel's assessment of the second declaration is provided in Table 2.2.

Table 2.2 Features of the Small Pelagic Fishery

<table>
<tr><th>FEATURE</th><th>DESCRIPTION</th></tr>
<tr><td>Area</td><td>


Figure 2.1 Area and sub-areas of the SPF. Source: AFMA (2014a), reproduced with permission from AFMA.
</td></tr>
</table>

<table>
<tr><th>FEATURE</th><th>DESCRIPTION</th></tr>
<tr><td>Management</td><td>Output control through total allowable catches (TACs) for target species, individual transferable quotas (ITQ) issued in the form of Statutory Fishing Rights (SFRs) and fishing permits (70 in 2012–13).

Minimum mesh size in mid-water trawl net of 30 millimetres.

Seal, dolphin and seabird vessel management plans (VMPs) must be in place on mid-water trawl vessels.

VMPs must contain measures to minimise and avoid where possible, the discharge of biological material while fishing gear is in the water and to use physical mitigation devices in a particular manner to avoid interactions with seabirds, seals and dolphins (AFMA 2014b).

Seal excluder devices (SEDs) must be used in mid-water trawl gear.

Operational vessel monitoring systems are required on all vessels.

Vessels must be nominated to quota SFRs.</td></tr>
<tr><td>Approved fishing methods</td><td>Purse seine and mid-water trawl.

Purse seine fishing is mainly used to catch fish species that swim in large schools near the ocean surface. In a purse seine the top of the net is floated at the ocean's surface and the bottom of the net has weights attached that pull the walls of the net downwards. The bottom of the net has a wire threaded through it which is pulled and tightens the net like a purse trapping the fish inside. The net is then pulled in toward the boat and the catch is either pumped or lifted out with small nets or the whole net is brought aboard. The size of purse seine nets can be varied, depending on what species is being targeted.

Mid-water trawls fish in the water column and are used to catch a variety of pelagic fish species. Mid-water trawl nets may incorporate acoustic technology to tell the skipper the position of the net in the water column, the opening/spread of the net and the volume of fish entering the net. Mid-water trawling involves towing a net behind a boat to catch fish species. The net is connected to the boat by the warp wires and the opening to the net is spread using two large boards known as otter boards. The net is towed off the bottom in depths ranging from just off the bottom to near the surface. Mid-water trawl nets are usually shaped like a cone or a funnel with a wide opening to catch fish and a narrow end called a codend where fish are collected (AFMA 2015).</td></tr>
<tr><td>Target species</td><td>Blue mackerel Scomber australasicus (Eastern and Western Zone stocks).

Jack mackerels (jack mackerel Trachurus declivis and Peruvian jack mackerel T. murphyi) (Eastern and Western Zone stocks).

Redbait Emmelichthys nitidus (Eastern and Western Zone stocks).

Australian sardine Sardinops sagax (Eastern Zone stock).</td></tr>
<tr><td>Main byproduct species</td><td>The main byproduct species taken in the fishery are barracouta Thyrsites atun, silver warehou Seriolella punctata, silver trevally Pseudocaranx georgianus and yellowtail scad Trachurus novaezelandiae (Tuck et al. 2013).</td></tr>
<tr><td>Status of stocks</td><td>None of the stocks are classified as overfished or subject to overfishing. The Western Zone stock of redbait is classified as uncertain (Moore and Stephan 2014).</td></tr>
<tr><td>Recent catch levels</td><td>Total catches in the SPF have declined from just over 5000 tonnes (t) in 2008–09 (Moore et al. 2011) to less than 20 t in 2013–14 (Moore and Stephan 2014). The TACs totalled 34,170 t in 2013–14 (AFMA 2014c).</td></tr>
<tr><td>Recent effort</td><td>
<table>
<tr><th rowspan="2"></th><th colspan="2">EFFORT</th><th colspan="2">ACTIVE VESSELS</th></tr>
<tr><th>PURSE SEINE SEARCH HOURS</th><th>MID-WATER TRAWL SHOTS (TRAWL HOURS)</th><th>PURSE SEINE</th><th>MID-WATER TRAWL</th></tr>
<tr><td>2006–07</td><td>791.5</td><td>Confidential <5 vessels</td><td colspan="2">6*</td></tr>
<tr><td>2007–08</td><td>655.5</td><td>92 (736)</td><td>5</td><td>1</td></tr>
<tr><td>2008–09</td><td>871.2</td><td>85 (468)</td><td>3</td><td>1</td></tr>
<tr><td>2009–10</td><td>517</td><td>29 (164)</td><td>3</td><td>2</td></tr>
<tr><td>2010–11</td><td>205</td><td>3 (30)</td><td>4</td><td>1</td></tr>
<tr><td>2011–12</td><td>135</td><td>0</td><td>3</td><td>0</td></tr>
<tr><td>2012–13</td><td>65</td><td>0</td><td>2</td><td>0</td></tr>
</table>
*gear type unspecified
Sources: Hobsbawn et al. 2009, Hobsbawn et al. 2010, Moore et al. 2011, Moore and Skirtun 2012, Moore and Stephan 2014.
</td></tr>
</table>

FEATURE	DESCRIPTION
Fishers	Quota SFRs are held by 30 owners. Over the three fishing seasons to 2012–13 a maximum of 4 purse seine vessels and 1 mid-water trawl vessel operated in any season (Moore *et al.* 2013, Moore and Stephan 2014).
Observer coverage targets	Purse seine boats: observer coverage target of 10 per cent of shots. For new boats entering the fishery or existing boats moving into significantly new areas, observer coverage of the first five trips is required. Mid-water trawl boats: observer coverage target of 20 per cent of shots. For new boats entering the fishery or existing boats moving into significantly new areas, observer coverage of the first 10 trips is required. (AFMA 2014d)
Recent observer coverage	See table below
Threatened, endangered and protected species	Operators in the SPF have an obligation to take all reasonable steps to avoid interactions with cetaceans, listed threatened species, listed migratory species, listed marine species and listed threatened ecological communities and to record any such interactions.
Main management documents	SPF Management Plan SPF Harvest Strategy (AFMA 2008) SPF Bycatch and Discarding Workplan 2014-2016 (AFMA 2014b) SPF Management Arrangements Booklet 2014–15 (AFMA 2014d) Ecological risk assessment and ecological management reports for the purse seine and mid-water trawl sectors of the SPF (Daley *et al.* 2007a and b, AFMA 2010a and b) Commonwealth Small Pelagic Fishery Purse Seine Code of Practice (Anon 2008a)

Recent observer coverage:

	PURSE SEINE (SHOTS OBSERVED AND % OF TOTAL SHOTS)	MID-WATER TRAWL (TRAWL HOURS OBSERVED AND % OF TOTAL HOURS TRAWLED)
2006–07	3 (1.9%)	4.3%
2007–08	0 (0%)	122 (16.6%)
2008–09	0 (0%)	6.1 (1.4%)
2009–10	14 (12%)	0 (0%)
2010–11	0 (0%)	0 (0%)
2011–12	0 (0%)	0 (0%)
2012–13	4 (14%)	0 (0%)

Sources: Hobsbawn *et al.* 2009, Hobsbawn *et al.* 2010, Moore *et al.* 2011, Moore and Skirtun 2012, Moore and Stephan 2014.

2.3 Small pelagic species

The panel interpreted references to target species in its Terms of Reference to mean jack mackerels *Trachurus declivis and T. murphyi*, blue mackerel *Scomber australasicus* redbait *Emmelichthys nitidus* and Australian sardine *Sardinops sagax* (see Chapter 4 and Appendix 4, first declaration report for a description of these species and their role as low trophic level or forage fish).

As in the first declaration report the panel excluded Australian sardine as a target species of the mid-water trawl catching fleet in either the mid-water trawl activity (MTA) or the fish processing activity (FPA). The panel noted that purse seine is the main method used to take Australian sardine. However, the panel noted the relatively low total allowable catch (TAC) for this species (around 500 t) and advice from Seafish Tasmania Pty Ltd (Mr G. Geen, Seafish Tasmania *in litt.* 8 April 2013 and 17 October 2014) that this species was unlikely to be included in the FPA and concluded that Australian sardine would not be included as a target species of the purse seine catching fleet in the FPA. Australian sardine is therefore not included in the assessment of the DCFAs.

The panel did not consider the main byproduct species explicitly in its assessment. Both silver warehou *Seriolella punctata* and silver trevally *Pseudocaranx georgianus* are subject to quota in the Southern and Eastern Scalefish and Shark Fishery and SPF operators are required to hold quota to retain these species. While there are no restrictions on the catch of barracouta *Thyrsites atun* or yellowtail scad[4] *Trachurus novaezelandiae* in the SPF the panel considered that the low catch rates of these species (Tuck *et al.* 2013) together with their low productivity-susceptibility analysis rating (Daley *et al.* 2007a, b) meant that they did not warrant further explicit assessment.

2.4 Scope and approach

The scope of the panel's assessment was dictated by its Terms of Reference. The panel's Terms of Reference require the panel to "assess the declared commercial fishing activities, particularly the potential for the activities to result in adverse environmental impacts". Terms of Reference one to four each relate to various aspects of adverse environmental impacts. Consistent with the approach taken in the first declaration report, the panel considered that its Terms of Reference did not require an assessment of the adequacy of overall management of the SPF, including the process for setting TACs, the sustainability of TACs, the quality or scientific rigor of the daily egg production method that underpins stock assessment and TAC setting, the Australian Fisheries Management Authority's (AFMA) consultation and advisory processes, or resource allocation issues across sectors and jurisdictions. The rationale for this approach is available in Chapter 2 of the first declaration report.

2.5 The declared commercial fishing activities

2.5.1 The mid-water trawl activity (MTA)

The MTA is a commercial fishing activity which:

i. is in the area of the SPF

ii. uses the mid-water trawl method

iii. uses a vessel which has a storage capacity for fish or fish products of 1600 t or greater.

The impacts of the DCFA on the marine environment will be influenced not only by the specifications of the vessel and gear but by the operational and fishing strategy employed. Information available to the panel on fishing operations similar to those specified in the MTA indicates that operating practices vary across fleets, among skippers and according to the owner's requirements. In addition, these practices are influenced by seasons, weather and oceanographic conditions that affect the availability of target fish species. Fishing plans will also be influenced by market conditions.

As a result, the panel's assessment of the MTA required development of an indicative scenario of how the activity might operate in the SPF (see Box 2.1). The panel adopted the same fishing scenario as in its assessment of the first declaration except that here the length of the vessel is not specified, the storage capacity of the vessel is reduced and the length of time that the vessel could remain at sea without returning to port to unload product is reduced accordingly. These amendments were based on the definition of the MTA and advice from the proponents of the MTA (Mr G. Geen, Seafish Tasmania *in litt.* 17 October 2014).

4 A 200 t TAC for yellowtail scad was removed upon the introduction of ITQs in the SPF on 1 May 2012 (AFMA 2012).

The MTA had not been assessed by the Department of the Environment against Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) prior to the implementation of the second declaration. It is not known what, if any, conditions would have been imposed on the activity had that assessment been conducted. However, given that the only difference between the MTA and the first declaration is a reduced storage capacity, the panel assumed that the proposed management measures would have been the same as those that applied to the DCFA in the first declaration. Those measures include the routine management measures that apply to the SPF and to mid-water trawl fishing in particular, together with the conditions that had been imposed for large-scale mid-water trawl operations under the EPBC Act and AFMA's proposed implementation of those conditions.

Box 2.1 The indicative MTA scenario

Fishing operations

- The operators of the DCFA hold ITQs for each stock of jack mackerel, redbait and blue mackerel and can operate throughout the area of the SPF. It is the intention to catch the full extent of that quota in any fishing year and to maximise efficiency within the management constraints imposed.
- The fishing season extends year round from 1 May to 30 April.
- The species targeted at any time reflects behavioural and seasonal patterns of the species and commercial considerations.
- The length of tows is likely to be variable but may last six hours or more.
- Fishing trips are between three and four weeks.
- The MTA does not involve receiving catch from other vessels operating in the SPF.

Gear

- The net has headline length of approximately 80 metres (m) with a headline height of at least 35 m. The net is up to 370 m in length.
- Mesh size is up to 20 m knot-to-knot at the front end of the trawl, progressively declining to the codend but not less than 30 millimetres in the codend. Catch is pumped from the codend to storage tanks on the vessel and during the pumping operation the bag and codend of the trawl net are fully submerged to a depth of around 50 m. The fish pump operates at approximately 250 t per hour.
- Net electronics: sensors at the codend to detect level of catch; headline trawl sonar to assist in positioning the net with respect to the school; drop sensors to monitor the door spread; auto trawl to ensure the net stays in an open position even when the vessel is turning.
- Sonar is used to detect schools.

Vessel

- Trawl speed is between 3 and 5 knots.
- Frozen storage capacity is greater than 1600 t and up to 4500 t.
- There is only one mid-water trawl fishing activity operating in the SPF.

Processing/freezing

- Fish are pumped into reception tanks and chilled quickly.
- Fish are pumped to the factory deck and onto the roller grader where they are graded for size and then transported by conveyers to the freezer plant where they are sorted.
- Whole fish are contact frozen into 20 kilogram blocks which are bagged, boxed, strapped and weighed and stacked in the refrigerated hold.
- Approximately 250 t per day can be contact frozen.
- The extent of processing onboard is confined to the grading of fish and packaging of frozen whole fish.
- No discarding[5] of catch or processing waste occurs in any form (i.e. no discards of biological material).

5 This excludes captured protected species which must be reported and returned to the sea.

2.5.2 The fish processing activity (FPA)

The FPA is defined in the panel's Terms of Reference as a commercial fishing activity that:

i. is in the SPF
ii. uses a vessel which has storage capacity for fish or fish products of 1600 t or greater
iii. consists of receiving or processing fish or fish products that are quota species that have been taken in the SPF.

According to the Terms of Reference, the processing vessel, i.e. the vessel receiving the fish, does not catch fish but receives SPF quota species that have been caught by other vessels using unspecified gear. The two currently approved fishing methods in the SPF are purse seine and mid-water trawl and the panel assumed that either or both these methods could be used by the catching vessels.

The nature of the fish processing conducted under the FPA is not specified. The panel assumed that this would be identical to that assessed in the first declaration, i.e. grading, packaging and freezing of whole fish.

The indicative FPA scenario assessed by the panel is described in Box 2.2 (further consideration of the operation of the FPA is provided in chapter 4). This scenario has been informed by research conducted on behalf of the panel (Hamer 2015), advice from the proponents of the use of the FPA in the SPF (Mr G. Geen, Seafish Tasmania *in litt.* 8 April 2013 and 17 October 2014), advice from AFMA and information contained in the panel's first declaration report.

The management measures under which the FPA would have operated are less clear than for the MTA. The FPA had not been assessed by the Department of the Environment against Parts 13 and 13A of the EPBC Act prior to the implementation of the second declaration. It was not known what, if any, conditions would have been imposed on the activity had that assessment been conducted. The panel assumed that the routine management measures that apply to the SPF would have applied to the catching vessels involved in the FPA. The panel considered that the FPA would have facilitated the expansion of the existing fleet into new areas of the fishery and assumed that the observer requirements triggered by fishing in 'significantly new areas' would apply (see Table 2.2).

Box 2.2 The indicative FPA scenario

Fishing operations

- The catching fleet holds ITQs for each stock of jack mackerel, redbait and blue mackerel and can operate throughout the area of the SPF. It is the intention to catch the full extent of that quota in any fishing year and to maximise efficiency within the management constraints imposed. Quota is transferable and leasable and it is feasible that the catching fleet could hold all the quota and catch the full extent of the TAC for each species.
- The fishing season extends year round from 1 May to 30 April.
- The species targeted at any time reflects behavioural and seasonal patterns of the species and commercial considerations.
- Fishing trips of the catching vessels are around one week.
- The catching vessels are not re-supplied (fuel, provisions, crew) by the processing vessel.
- The processing vessel assists the catching fleet to locate fish.
- The catching fleet comprises five wet boats (i.e. cannot freeze catch), three using purse seine and two using mid-water trawl gear and the fishing plan of these vessels is not dictated by the processing vessel.
- The FPA is the only fishing activity occurring in the SPF.

Mid-water trawl operations

- The mid-water trawl net has a headline height of around 35 m and width of around 65 m.
- Hold capacity of each vessel is about 100 t (Hamer 2015).
- Sonar is used to detect schools.
- The length of mid-water trawl tows is likely to be variable but may last six hours or more.
- Shots commonly average up to 30 t (AFMA unpublished data).
- Trawl speed is between 3 and 5 knots (Lyle and Wilcox 2008).

Box 2.2 The indicative FPA scenario (continued)

- Fishing occurs mainly in late afternoon and evening targeting redbait, blue mackerel and sub-surface schools of jack mackerel.
- Seal, dolphin and seabird VMPs are in place for each vessel and a SED is used.

Purse seine operations

- Nets are up to 800 m in length (AFMA unpublished data).
- Shots commonly average up to 25 t (AFMA unpublished data).
- Sonar is used to detect schools.
- Hold capacity of each vessel is about 80 t (Hamer 2015).
- Fishing occurs mainly during the day for surface schools of jack mackerel and blue mackerel.

Processing vessel

- Frozen storage capacity is greater than 1600 t and up to 4500 t.
- Catch is pumped from the net or the hold of the catching vessels to storage tanks on the receiving vessel and chilled quickly.
- During the pumping operation from trawl nets, the bag and codend of the trawl net are fully submerged to a depth of around 50 m. During the pumping operation from purse seine nets, the nets would be at the surface of the water.
- The fish pump operates at approximately 250 t per hour.
- Fish are pumped from reception tanks to the factory deck and onto the roller grader where they are graded for size and then transported by conveyers to the freezer plant where they are sorted.
- The extent of processing onboard is confined to the grading of whole fish and packaging of frozen whole fish.
- Approximately 250 t per day can be contact frozen.
- The vessel can remain at sea for three to six weeks before returning to port to offload catch.

In addition to the assessment of the FPA, the panel has conducted a qualitative analysis of the impacts of the FPA fishing scenario relative to the typical SPF fishing fleet and the DCFA in the first declaration (DCFA1). These relative impacts are discussed in Chapters 5 and 6 in relation to impacts on protected species and from localised depletion taking into account the differential impacts of gear types in use under each scenario.

2.6 Direct interactions with EPBC Act protected species

2.6.1 Direct interactions

The panel is required to assess the "likely nature and extent of direct interactions of the declared commercial fishing activities with species protected under the EPBC Act, particularly seals, dolphins and seabirds".

For the purposes of its assessment the panel agreed that 'direct interactions' include:

- any interactions with fishing operations or gear (including net feeding, feeding on discards or waste)
- any physical contact (including collisions on trawl warps)
- bycatch (netted or entangled) which can result in injury or mortality
- acoustic disturbance from fishing operations
- any behavioural changes in these species brought about by habituation to fishing operations.

The fishing scenario of the MTA precludes the discarding of catch or processing of waste at sea. As a result, the panel did not consider direct interactions from feeding on discards or waste in its assessment of the MTA. For the purposes of the assessment of the MTA, direct interactions included net feeding, physical contact, bycatch, acoustic disturbance and/or behavioural change.

For the purposes of the assessment of the FPA direct interactions included net feeding, feeding on discards or waste, physical contact, bycatch, acoustic disturbance and/or behavioural change.

2.6.2 Protected species

Species protected under the EPBC Act[6] include:

1. listed nationally threatened species identified as critically endangered, endangered, vulnerable or conservation dependent
2. cetaceans (whales, dolphins, porpoises)
3. listed migratory species, including some species of
   i. birds[7]
   ii. cetaceans
   iii. sharks and rays
   iv. marine turtles
   v. crocodiles
   vi. dugong
4. listed marine species, including some species of
   i. seasnakes
   ii. pinnipeds (fur seals, sea lions and phocid seals)[8]
   iii. crocodiles
   iv. dugong
   v. marine turtles
   vi. seahorses, sea-dragons and pipefish
   vii. birds

Species in group one (listed threatened species except for conservation dependent species) and group three (listed migratory species) above are matters of 'national environmental significance' under the EPBC Act. A species may fall into more than one of these groups, for example, a species may be a listed threatened species and a listed migratory species.

A full list of the EPBC Act protected species occurring in the SPF area and therefore considered relevant to this assessment is provided in Appendix 3. The list was developed by panel members and the Environmental Resources Information Network of the Department of the Environment.

2.7 Localised depletion of target species[9]

The panel adopted the following working definition of localised depletion:

> 'a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing'.

The panel considered that localised depletion is an inevitable consequence of fishing and that the issue of relevance to this assessment was the potential for adverse environmental impacts as a result of localised depletion caused by the DCFAs.

6 Species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are not protected species for the purposes of the EPBC Act. However, some species otherwise protected under the EPBC Act are also listed in CITES.

7 For the purposes of its assessment the panel has referred to all species of relevant birds as 'seabirds'.

8 References by the panel to 'seals' refer to all pinnipeds, that is otariids and phocids (noting that odobenids (walrus) are also pinnipeds but do not occur in the Southern Hemisphere); 'fur seals' refer to otariids in the genera *Arctocephalus* and *Callorhinus*; 'sea lions' refer to otariids in the genera *Neophoca*, *Eumetopias*, *Zalophus*, *Otaria* and *Phocarctos* (this follows the terminology detailed in Kirkwood and Goldsworthy (2013)).

9 Details of the panel's consideration of localised depletion can be found in Chapter 6 of the first declaration report.

3 Assessment of the mid-water trawl activity

3.1 Introduction

The assessment of the mid-water trawl activity (MTA) differs from the panel's assessment of the declared commercial fishing activity in the first declaration (DCFA1) in relation to the available storage capacity and the unspecified length of the vessel.

The MTA involves a fishing vessel with a storage capacity of more than 1600 tonnes (t) whereas DCFA1 related to a fishing vessel with a storage capacity of more than 2000 t. In each case the panel assumed that the upper limit of capacity is 4500 t, based on that of the *FV Abel Tasman*. The MTA differs from the first declaration in that its storage capacity is reduced by 400 t in comparison to the minimum of the first declaration. The panel's assessment of the MTA focused on assessing how, if at all, this reduced storage capacity might alter the outcomes of its assessment of the first declaration.

In its first declaration report, the panel noted that "the length of a vessel was, in itself, less likely to be of specific relevance to the assessment, since length is essentially a function of the presence and scale of the fish processing facility and the storage and freezer capacity on the vessel" (Expert Panel on a Declared Commercial Fishing Activity 2014). The panel remains of the view that it is the storage capacity rather than the length of the vessel that is relevant to its assessment and has therefore not made any assumption about the length of the vessel involved in the MTA.

In conducting its assessment of the MTA the panel assumed that Condition 1 specified in the Schedule to the accreditation of the SPF made by the Environment Minister on 3 September 2012, in relation to the operations of 'large-scale mid-water trawl operations' in the SPF applies to the MTA. Condition 1 is as follows:

Large-scale mid-water trawl operations must:

(a) "Prior to fishing, have in place demonstrably effective and scientifically proven mitigation approaches and devices to the satisfaction of AFMA [the Australian Fisheries Management Authority] to minimise interactions with dolphins, seals and seabirds, including gear handling and net setting rules. These mitigation devices must, as a minimum, include best practice seal excluder devices with top opening escape hatches or equivalent mechanisms

(b) In the event of one or more dolphin mortalities as a result of the mid-water trawl fishing activities:

i. suspend fishing;
ii. consult with any AFMA observer onboard and review the effectiveness of mitigation measures; and
iii. not recommence fishing within 50 nm [nautical miles] of the mortality event.

(c) Prior to fishing, have a seabird management plan in place that has been approved by AFMA in consultation with DSEWPaC [the Department of Sustainability, Environment, Water, Population and Communities]. The seabird management plan must:

i. contain appropriate physical mitigation measures and requirements to manage offal discharge; and
ii. be complied with by the vessel operator and crew during all mid-water trawl fishing activities.

(d) Prior to fishing, have a seal[10] management plan in place that has been approved by AFMA in consultation with DSEWPaC. The seal management plan must:

i. contain gear handling and net setting rules to minimise the level of seal mortalities;
ii. be complied with by the vessel operator and crew during all mid-water trawl fishing activities;
iii. in the event of three seal mortalities in any one fishing shot, require the operator to consult with any AFMA observer onboard and review the effectiveness of mitigation measures before recommencing fishing; and
iv. in the event of:
   A. three or more seal mortalities in each of three consecutive shots; or
   B. more than 10 seal mortalities within a 24 hour period of fishing; or
   C. more than 10 seal mortalities in one shot

10 On advice from the Department of the Environment, the panel interprets this reference to seals to include only fur seals.

require the operator to

D. suspend fishing;

E. consult with any AFMA observer onboard and review the effectiveness of mitigation measures; and

F. not recommence fishing within 50 nm of the mortality event.

(e) Not fish in areas of the SPF on the continental shelf which are in the Australian sea lion closure area. The area of the Australian sea lion closure is the part of the exclusive economic zone adjacent to the coast of Australia bounded by a notional line beginning at the intersection of the meridian of longitude 129°00'E and the coast of southern Australia, and running progressively:

i. south along that meridian to the intersection with the 150 m depth contour of the continental shelf;

ii. generally easterly along the 150 m depth contour to the point of intersection with the meridian of longitude 140°05'E;

iii. north along that meridian to the intersection with the coastline of South Australia; and

iv. generally westerly along the coastline to the point where the line began.

(f) Ensure that there is an on-board observer at all times with 24 hour monitoring of mid-water trawl fishing activities and there is an underwater camera record of the operation of any bycatch excluder device at all times, and reviewed by an observer each day. The requirements under this Condition will apply to 1 November 2013 with monitoring arrangements to apply after this date to be determined following a review by AFMA and the Department.

(g) When fishing, report daily to AFMA on the level of protected species interactions, including mortalities."

Condition 1 was to be applied by AFMA through variations to conditions on Statutory Fishing Rights (Seafish Tasmania Pty Ltd *in litt.* 16 October 2012) and parts (c) and (d) of the condition were to be implemented through seabird, seal and dolphin vessel management plans (VMPs). In addition, it was proposed that a further condition (Condition 2) would apply to AFMA in the event that a vessel such as the *FV Abel Tasman* operated in the fishery. Condition 2 was specified in a 'Draft – Two Year Instrument' sent to AFMA by the Environment Minister on 3 September 2012 and read as follows.

"In order to manage potential impacts on protected species in the Small Pelagic Fishery, by mid-water trawl operators with a large scale, on-board processing facility on their vessel and the capacity to remain fishing at sea for an extended period, AFMA is to:

a. if protected species interactions occur, report the interaction(s) to the Department within 24 hours of AFMA receiving the report from the vessel.

b. make publicly available on a monthly basis summary reports of protected species' interactions, including mortalities, within the first three months of this instrument being made, and on a quarterly basis thereafter.

c. consider further management responses to mitigate protected species interactions as appropriate.

d. in consultation with relevant scientific experts, the Marine Mammal Working Group or other fora as appropriate and community and non-government organisations, review on a quarterly basis the observed interactions with protected species by Large Scale Mid-Water Trawl Operators in the Fishery, and the appropriateness of the management response.

e. drawing on the outcomes of existing or new research as appropriate and in consultation with the Department and relevant experts, assess and take into account any risk of more concentrated fishing activity disrupting the feeding behaviour of dependant predatory species, particularly protected species."

The panel assumed, for the purposes of its assessment, that the provisions of Conditions 1 and 2 above would have been implemented should the MTA have commenced operation in the SPF. These conditions are, therefore, included in the panel's interpretation of the fisheries management arrangements under which the MTA is proposed to operate.

In addition, the panel assumed that the VMPs proposed to apply under DCFA1 would have been applied to the MTA (see Boxes 5.1 and 5.2 in Chapter 5 of the panel's first declaration report).

3.2 Direct interactions

The panel considered that compared to historical fishing operations in the Small Pelagic Fishery (SPF), the MTA would be able to remain at sea for significantly longer periods. However, compared to DCFA1, the reduced storage capacity of the MTA would reduce the time the MTA could stay at sea without unloading. This might reduce the capacity of the MTA to fish more broadly in the SPF compared to DCFA1, with possible implications for the nature and extent of interactions with protected species.

The panel considered that the uncertainties around the pattern of fishing likely to be undertaken by DCFA1 applied equally to the MTA. These uncertainties necessarily constrained the precision with which the panel could assess the impacts of DCFA1 and the MTA. Given this, the panel considered that the nature of its assessment was not sufficiently sensitive to detect any differential impact on the nature and extent of direct interactions with protected species arising from a 400 t reduction in storage capacity. As a result, the panel found that its assessment of DCFA1 was equally applicable to the MTA. Details of the panel's assessment of the nature and extent of the direct interactions of DCFA1 with protected species can be found in Chapter 5 of the panel's first declaration report. A summary of that assessment is repeated here in the context of the MTA.

3.2.1 Pinnipeds

Nature and extent of interactions

Australian fur seals *Arctocephalus pusillus doriferus*, New Zealand fur seals *A. forsteri* and Australian sea lions *Neophoca cinerea* occur throughout the area of the SPF and are highly susceptible to interactions with trawl fisheries. In southern Australia, pinniped interactions with fishing operations have occurred predominantly with demersal trawl wet boats and freezer trawlers using mid-water trawl gear in the Southern and Eastern Scalefish and Shark Fishery (SESSF), and with mid-water trawlers in the SPF. Most mid-water and demersal trawl operations that have occurred in the SPF area have been in the south-east of Australia and most interactions in that area have been with Australian fur seals.

Seals will be attracted to any fishing activity that occurs within their foraging range and the nature of interactions with these activities are likely to include net feeding, entering the trawl net (during shooting/fishing/hauling), habituation to fishing activities and bycatch. The greater the level and frequency of fishing activity and the more predictable the presence and timing of fishing activity in areas where seals forage, the greater the number of seals likely to be attracted to, and interact with, fishing activity. If a pattern of fishing persists and provides nutritional benefits to seals, parts of the population can become habituated to fishing operations and interactions may increase over time.

While it is not possible to quantify the extent of direct interactions between seals and the MTA, the panel considered that such interactions would occur and that some would result in mortalities. Given the broad distribution of fur seals within the SPF, the MTA would inevitably have direct interactions with fur seals, some of which would be fatal. In areas of high fur seal abundance, interactions and mortalities are likely to be common even with current best practice mitigation devices and fishing behaviour. The Australian sea lion occurs in the area of the SPF in waters off South Australia (SA) and Western Australia (WA). If the MTA operated within those waters, direct interactions with and bycatch mortality of this species would be likely.

New Zealand fur seal and Australian sea lion populations off SA and WA have not been exposed to the same level of bycatch mortality from trawl fisheries experienced by Australian fur seals elsewhere in the SPF, so there is uncertainty about the impacts of bycatch on those populations. This is especially important for the threatened Australian sea lion.

Actions to avoid, reduce and mitigate adverse environmental impacts

The panel considered that the following actions could be used to manage the risk of adverse environmental impacts arising from direct interactions between the MTA and pinniped species:

- Use a seal excluder device (SED), only after its operation has been optimised for the vessel, fishery and bycatch species under a scientific permit, with the required level of performance of the SED developed in consultation with experts
  - for example, the panel noted that neither the soft mesh-grid, top-opening SED with hood, nor the auto trawl system proposed to be used by the *FV Abel Tasman* to mitigate pinniped bycatch has undergone trials in the SPF.
- Use underwater video to monitor SED efficacy and cryptic mortality.
- Reduce the daily and per shot trigger limits on fur seals from the proposed limit of up to 10 per day and replace the associated 50 nautical mile (nm) move-on rule with a requirement to move to an area where interactions with seals are less likely, based on available data on estimated at sea density distributions.

- Introduce a bycatch rate trigger limit for fur seals for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas.
- Ensure 100 per cent observer coverage of fishing operations and if daily or per shot trigger limits are used in conjunction with move-on rules or with a requirement to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.
- Require 'stickers' to be removed from the net before shooting, noting that this was a requirement of the proposed seabird VMP.
- Prohibit the discard of any biological waste (excluding the release of any protected fauna) noting that this was a requirement of the proposed seabird VMP.
- Implement spatial closures that mitigate bycatch interactions with fur seals, especially in regions adjacent to breeding colonies where there is high transit and foraging activity by central-place foraging lactating adult females.
- Review the proposed Australian sea lion closure area off SA (out to 150 m depth) so as to provide consistency with management arrangements for the Gillnet Hook and Trap Fishery (out to 183 m depth).
- Implement a similarly designed closure for the Australian sea lion colonies occurring within the SPF off WA.

Research and monitoring to reduce uncertainties

The following research and monitoring could reduce uncertainties about the potential for adverse environmental impacts arising from direct interactions between the MTA and protected pinniped species:

- Determine the individual and cumulative fishery-related impacts on pinniped species.
- Establish what levels of fishery-related mortality the pinniped species can sustain.
- Identify regions of critical foraging habitat for the pinniped species where the management of direct interactions with the MTA may be most needed.
- Investigate modifications to fishing gear and fishing behaviour that can reduce the potential for direct interactions by the MTA with pinnipeds.

3.2.2 Cetaceans

Nature and extent of interactions

Nearly all cetaceans recorded to occur in Australian waters have ranges that overlap to some extent with the SPF area. The nature and likelihood of interactions between cetaceans and mid-water trawl fisheries varies substantially among these species. Bottlenose dolphins *Tursiops* spp. and short-beaked common dolphins *Delphinus delphis* are likely to be at higher risk of interaction based on reported interactions with trawls and bycatch mortality in Australia and internationally.

Direct interactions with fishing operations include net feeding, foraging behind trawlers, and feeding on discards and fish escaping from nets. Vessel collisions resulting in injury or death of whales and some other cetaceans are thought to be relatively common in Australian waters but are not well documented. Most severe or fatal injuries to whales from vessel strike are caused by collisions with vessels greater than 80 metres in length, and higher speed increases the risk of serious injury or death.

Fisheries bycatch mortality, including from trawl gear, is the major threat to many smaller cetacean species in Australian waters and internationally. Differences in the type of fishing operations also influence the risk of bycatch, with cetaceans more often caught in mid-water trawls than in bottom trawls, and in trawls of longer duration. The risk of bycatch increases where prey species are also targeted by fisheries and where fishing grounds overlap with important habitats used by cetaceans for aggregating, feeding, breeding and migratory routes. Acoustic disturbance can be important for cetaceans because they have a very highly developed acoustic sense and sounds are vitally important for their ecology and survival. Cetaceans that frequently interact with trawlers and other fisheries can become habituated, leading to increased risk of bycatch.

The lack of information on the distribution and abundance, population trend, genetic structure, and location and timing of use of important habitats for most cetacean species, greatly increases the uncertainties about the likelihood of direct interactions occurring and whether such interactions would result in significant environmental impacts for these protected species.

It is highly likely that there will be some direct interactions between the MTA and cetaceans. The MTA would enable fishing to occur more extensively in the SPF area than has been the case historically, which would increase the range of cetacean species likely to be encountered. The nature and extent of direct interactions by the MTA with cetaceans is uncertain but some cetacean mortality is likely. The panel concluded that species such as bottlenose dolphins and short-beaked common dolphins, that are known to prey on small pelagic fish, and interact extensively with trawl fisheries, are at increased risk of being taken as bycatch by the MTA, whereas some larger whale species may be at higher risk from vessel strike or acoustic disturbance.

Actions to avoid, reduce and mitigate adverse environmental impacts

The panel considered that the following actions could be taken to manage the risk of adverse environmental impacts arising from direct interactions of the MTA with cetaceans:

- Use an excluder device only after its operation has been optimised for the vessel, fishery and for different dolphin species including both bottlenose and short-beaked common dolphins under a scientific permit with the required level of performance developed in consultation with experts, noting that excluder designs tested to date have not been consistently effective in reducing cetacean bycatch in trawls, and at present there is no solution to filter or deter cetaceans from entering the net opening.
- Use underwater video to monitor dolphin behaviour within the net and around the excluder device to determine the efficacy of the excluder device and levels of cryptic mortality.
- Introduce a bycatch rate trigger limit for dolphin species for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas on a precautionary rather than evidentiary basis.
- Replace the 50 nm move-on rule, in response to a single dolphin mortality, with a requirement to move to an area where interactions with cetaceans are less likely, based on available data on estimated at sea density distributions.
- Assess the efficacy of acoustic deterrent pingers (with using rigorous controlled trials under a scientific permit with the required level of performance developed in consultation with experts), and temporal and spatial closures, that have been shown elsewhere to have potential to reduce the risk of interactions for some cetacean species, including some dolphins.
- Prohibit the discard of any biological waste (excluding the release of any protected fauna) noting that this was a requirement of the proposed seabird VMP.
- Ensure 100 per cent observer coverage of fishing operations and, if trigger limits are used in conjunction with move-on rules or with a requirement to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.
- In addition to the above actions to mitigate impacts on dolphins, ensure that monitoring and agreed management responses are in place to allow a timely management response if other cetacean species interact with the MTA.

Research and monitoring to reduce uncertainties

The following research and monitoring could reduce uncertainties about the potential for adverse environmental impacts arising from direct interactions between the MTA and protected cetacean species:

- Identify regions in the SPF area that are important habitats for cetaceans where the management of direct interactions with the MTA may be most needed.
- Determine the level of mortality arising from interactions with the MTA that could be sustained by cetacean populations in the SPF area.
- Investigate modifications to the proposed fishing gear and operations of the MTA that could reduce the potential for, or the impacts of, interactions with cetaceans.
- Collect, analyse and publish observer data on all cetacean interactions.

3.2.3 Seabirds

Nature and extent of interactions

The panel concluded that the past rate of interactions of SPF mid-water trawl operations with seabirds was likely to have been low and this could be at least partly explained by the low level of discharge of biological material in the fishery. Nevertheless, interactions have occurred and the SPF is an area that is known to be important to many seabird species.

Direct interactions between trawl vessels and seabirds include collisions with net-monitoring cables, warp cables and paravanes, net entanglements and habituation to fishing operations. Each of these interactions could be expected to occur with the MTA. However, given that the MTA fishing scenario precludes the discard of any biological material, the panel expected that the likelihood of habituation and, as a result, other forms of direct interactions, was likely to be lower than in many other trawl operations.

Since it was not possible to predict with any certainty the location, timing or intensity of fishing by the MTA the panel could not quantify the likely extent of direct interactions with seabirds.

Actions to avoid, reduce and mitigate adverse environmental impacts

The panel considered that the following actions could be taken to manage the risk of adverse environmental impacts arising from direct interactions of the MTA with seabirds:

- The requirements in the proposed seabird VMP regarding discharge of biological material, the removal of stickers and warp maintenance be consistent with or equivalent to the advice of the Agreement on the Conservation of Albatrosses and Petrels (ACAP 2013a, 2013b and 2013c).
- Adopt the ACAP advice regarding net binding, bird scaring lines and the use of a snatch block noting that the use of bird scaring lines and net binding are part of the seabird VMP for Australia's winter blue grenadier fishery.
- If bird bafflers and warp deflectors are to be used, develop and optimise the design under scientific permit and in consultation with experts, noting that seabird captures in the SESSF have been reduced by 75 per cent using 'pinkies'.
- Direct deck lighting inboard and keep to the minimum level necessary for the safety of the crew.
- Develop advice on the correct interpretation of 'interactions' with seabirds in consultation with the Department of the Environment to ensure that it is consistent with the intent of the memorandum of understanding between the Department and AFMA and ensure that MTA operators and crew are familiar with this advice.
- Ensure that the seabird VMP for the MTA meets the requirements of the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016.
- If unacceptable levels of interactions with protected seabird species occur, suspend fishing immediately and adopt one of the following options
  - time and area closures, noting that these will rely on knowledge of spatial and temporal uses of bird habitats that overlap with the fishery
  - trigger limits and move-on rules.
- Consistent with the measures suggested above for pinnipeds and cetaceans, ensure 100 per cent observer coverage of all fishing activity.

Research and monitoring to reduce uncertainties

The following research and monitoring could reduce uncertainties about the potential for adverse environmental impacts arising from direct interactions between the MTA and protected seabird species:

- Identify ecologically sensitive seabird species, areas and times where spatial management strategies may be appropriate to mitigate direct interactions if required.
- Collect, analyse and publish observer data on all seabird interactions, including on the levels and causes of seabird bycatch, focusing especially on recording of warp interactions and trawl entanglements.
- Use electronic monitoring via video camera(s) to assist in quantifying warp strikes.
- Ensure crews are properly trained in the use of the required seabird mitigation and on reporting requirements.

3.2.4 Summary

The MTA is defined in terms of the fishery in which it operates, the type of fishing gear used and its storage capacity. The fishing scenario developed by the panel assumed that the freezer capacity of the MTA would enable it to stay at sea for longer periods (up to three to four weeks before needing to unload product) and to fish more extensively in the SPF area than has been the case in the past.

To date, mid-water trawling in the fishery has been concentrated around Tasmania. The MTA would most likely focus its fishing effort on the shelf and slope areas of the SPF, where the target species are predominantly distributed, but would likely fish these areas more extensively and might fish in slightly deeper water off the shelf than previous fishing operations in the SPF. Historical fishing patterns and interaction data do not, therefore, necessarily provide a good guide to the likely fishing patterns or protected species interactions of the MTA. Further, it is not possible to predict with certainty the species composition, the spatial/temporal pattern of fishing or the intensity of fishing by the MTA because the fishing plan will be dictated by the prevailing environmental and economic conditions.

The panel concluded that if the MTA operated in areas or at times of the year that have not been fished previously by mid-water trawl vessels, it is reasonable to expect that rates of interaction, the species involved and the risk profile of those species may differ from those of the past. This results in considerable uncertainty about the likely extent of direct interactions by the MTA with protected species. Nevertheless, the panel concluded that it is inevitable that the MTA would interact with species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) particularly pinnipeds, cetaceans and seabirds.

There is considerable uncertainty about the level of direct interactions resulting in injury or mortality of protected species that could occur without causing an adverse environmental impact. This level would vary within and among the pinniped, cetacean and seabird groups assessed in accordance with their abundance, population trend and the resilience of the species. Some of the protected species at risk of interacting with the MTA are listed as threatened and/or migratory species under the EPBC Act and are therefore matters of national environmental significance that are afforded a higher level of protection and require assessment of significant impacts against criteria. For example, of the pinniped species assessed, the threatened Australian sea lion, currently listed as Vulnerable under the EPBC Act, can sustain less mortality without risk of adverse environmental impacts than the more plentiful Australian and New Zealand fur seals where populations have undergone recent recovery. Similarly, while many protected seabird species occur within the area of the SPF, some of these are known to have depleted populations and are listed as threatened and/or migratory species.

For many protected species, such as most cetaceans in the SPF area, there is a lack of information about population size and trends, location of important habitats and other biological and ecological characteristics. In the absence of such information it is not possible to establish evidence-based benchmarks for direct interactions by the MTA with protected species that would avoid adverse environmental impacts.

The panel noted the SPF, and generally all fisheries, are managed in similarly uncertain environments. In relation to the MTA, the panel considered that there are actions that could be taken to avoid, reduce and mitigate the risks of adverse environmental impacts occurring and that research and monitoring could be undertaken to reduce the uncertainties.

3.3 Localised depletion

The panel considered that the reduced storage capacity of the MTA may reduce the extent of localised depletion and the risks associated with adverse impacts arising from that. Conversely, the reduced capacity to stay at sea may provide an incentive to stay in a localised area for more extended periods compared to the more wide ranging fishing activity possible under DCFA1. Again, given the uncertainties associated with predicting the fishing pattern of the MTA, the panel considered that it was unlikely that it could detect any meaningful distinction between the likely impact of localised depletion caused by the MTA on target species or central place foragers (CPFs)[11] and that of DCFA1. Details of the panel's assessment of the likely adverse environmental impacts of localised depletion arising from DCFA1 can be found in Chapter 6 of the panel's first declaration report. A summary of that assessment is repeated here in the context of the MTA.

3.3.1 SPF target species

The panel found that SPF target species have some inherent characteristics that make them potentially susceptible to localised depletion; they are susceptible to capture as a result of their aggregating or schooling behaviour and associations with oceanographic features e.g., eddies and temperature and chlorophyll fronts. However, the panel also noted that other characteristics, such as being proficient swimmers, having a schooling behaviour that is dynamic and difficult to predict, and being productive and fecund, are likely to reduce the temporal and spatial extent of any such depletion.

Impacts of localised depletion on target species could result in changes in reproductive capacity and genetic diversity. However the available genetic evidence for jack mackerel *Trachurus declivis* did not suggest that past, apparently high, levels of fishing had significantly affected their reproductive capacity. Similarly, there have been no significant changes in age or size composition of redbait *Emmelichthys nitidus* in recent years that might indicate a potential impact on reproductive capacity. There are too few data available for the Australian sardine *Sardinops sagax* in the Eastern Zone or blue mackerel *Scomber australasicus* to determine if there have been significant changes to age or size structure or reproductive capacity, but the low levels of effort and catch suggest little likelihood that changes have occurred. Further, there is no evidence to suggest that localised depletion has caused any impacts on genetic diversity in the SPF stocks. Additional research into stock structure would be required in order to inform management of the potential risks of localised depletion at the subpopulation level and the appropriate spatial scale at which to manage effort and catch.

11 CPFs are land breeding species of pinnipeds and seabirds (see Section 6.7 of the first declaration report)

Given that the exploitation rates in the SPF are considered to be conservative against international benchmarks for small pelagic fisheries and that concerns about the basis for spawning stock biomass estimates and the SPF Harvest Strategy Policy are being addressed, the panel considered that any localised depletion of SPF target species that might arise from the MTA was unlikely to affect the overall status of stocks of those species in the SPF.

Research and monitoring to reduce uncertainties

Research and monitoring in the following areas could reduce uncertainties associated with stock structure and hence with the adverse impacts of localised depletion arising from the MTA on target species:

- well-designed and targeted research to clarify the extent of sub-structuring of SPF target species within the Eastern and Western Zones specifically, and the SPF more broadly
- ongoing monitoring of the length frequency of catch taken by the MTA at a statistically appropriate sampling intensity.

3.3.2 Central place foragers

The dependency on near-colony prey resources at certain locations and times increases the vulnerability of CPF species to localised depletion of prey. Although CPF species have been shown to be highly responsive to changes in prey availability within their key foraging areas, very few studies have linked reduced foraging and reproductive performance to the impacts of fishing, and even fewer to localised depletion.

The nature and extent of impact of localised depletion will depend on the spatial and temporal scale of the depletion. Short-term impacts may reduce foraging efficiency resulting in longer foraging trips and/or reduced rates of provisioning to offspring (chicks/pups). If these persist they can result in reduced offspring growth rates and fledging/weaning mass and reduced offspring survival and adult breeding success. Longer-term impacts, over years and decades, can affect major demographic factors such as survival, recruitment and reproductive rates that drive population age structure, growth rates and ultimately population size.

There are few examples where the potential impacts on CPF species of localised depletion caused by fishing are actively managed. Only the case study on Peruvian boobies found compelling evidence for localised depletion. In three other case studies, in the North Sea, Benguela and Alaska, where declines in population size and reproductive success in CPFs have been identified, spatial closures have been introduced as a precautionary measure to mitigate potential adverse impacts of localised depletion even though the causes of the declines are uncertain.

CPFs that forage in the SPF, and for which SPF target species comprise or have comprised more than 10 per cent of the diet, are Australian fur seal, New Zealand fur seal, Australasian gannet *Morus serrator*, short-tailed shearwater *Ardenna tenuirostris*, little penguin *Eudyptula minor*, crested tern *Thalasseus bergii* and shy albatross *Thalassarche cauta*. Key foraging areas for these species within the SPF are Bass Strait, Tasmania and SA. However, there remains some uncertainty about the importance of SPF species to other CPFs because diet information is poor or unavailable.

Since the overall catch of the MTA is likely to be higher than that of the current SPF fleet, it is possible that the extent of localised depletion might be greater than for a single wet boat but not necessarily greater than for a fleet of wet boats. The key distinguishing feature between the MTA and current and historical fishing operations in the SPF is that it can stay at sea longer and so fish more broadly in the area of the SPF. While this may mean that the MTA could stay in an area for a protracted time, the need to maintain an economically viable catch rate suggests that it is more likely to move on thereby reducing the potential for localised depletion arising from its operations to have adverse impacts on CPF species.

The panel concluded that the MTA has the potential to have adverse impacts on CPF species through localised depletion. Whether that potential is realised depends on where, when and how intensively the MTA fishes. In addition, the panel noted that there is very limited monitoring of CPF populations and the chance of detecting any indirect fishery related impact on CPFs within the SPF area is extremely low.

Actions to avoid, reduce and mitigate adverse environmental impacts

Spatial closures are the most common form of precautionary management used to mitigate the potential adverse impacts of localised depletion on CPFs; however, the effectiveness of spatial closures for this purpose has not been clearly demonstrated. Their value depends heavily on the ability to determine the scale of spatial closures that would be appropriate for particular species at particular locations and at particular times.

The panel concluded that the risks to the key CPF species identified above from localised depletion caused by the MTA could be addressed proactively by separating the fishing activity from their critical foraging areas. Determining the appropriate temporal or spatial scale of the closures will be challenging but reasonable datasets exist for at least some CPF species in some areas of the SPF. It may be necessary to extrapolate from this information in order to define appropriate spatial closures elsewhere in the SPF. Closures would need to be modified adaptively to reflect new information from fishing or targeted research.

Research and monitoring to reduce uncertainties

Many of the uncertainties that were identified in relation to the panel's ability to assess the extent of localised depletion likely under a MTA reflect the dynamics of fishing operations and the economics of fishing. These types of uncertainties cannot be reduced through monitoring and research. However, research and monitoring that could reduce the uncertainties associated with the adverse impacts of localised depletion arising from the MTA on CPF species include:

- dietary studies to determine which key CPFs or other commercially or ecologically important predators are most reliant on SPF species
- studies to better understand the critical foraging areas, habitats and times for key CPFs
- examination of the biological response of CPFs to changes in prey availability
- investigation of potential ecological performance indicators.

3.3.3 Summary

The panel interpreted localised depletion as a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing. As a result, localised depletion is an inevitable consequence of fishing by the MTA and of any fishing activity. The central issue for the panel's assessment was, therefore, whether the fishing activity of the MTA could be concentrated enough, both spatially and temporally, to cause a localised depletion of target species sufficient to cause adverse environmental impacts to the Commonwealth marine environment.

The panel found no conclusive evidence of historical localised depletion that caused adverse environmental impacts in the SPF. However, the high level of dependence by some predators, particularly CPFs, highlights the need to manage for the risk of such impacts.

4 The fish processing activity

4.1 Introduction

The fish processing activity (FPA) described in the second declaration involves a processing vessel that does not fish but receives fish from vessels fishing in the Small Pelagic Fishery (SPF). The panel conducted a comprehensive assessment of the potential impacts of a large-scale mid-water trawl freezer vessel on protected species and localised depletion in its assessment of the declared commercial fishing activity in the first declaration (DCFA1) (Expert Panel on a Declared Commercial Fishing Activity 2014). However, there are five main points of differentiation between the DCFA1 and FPA fishing scenarios. Under the FPA:

- the processing vessel would not fish
- the processing vessel would have reduced storage capacity
- there would be potential for the processing vessel to provide 'mothershipping' services to the catching fleet in addition to receiving fish
- catch could be taken by a fleet of vessels using both purse seine and mid-water trawl rather than a single freezer trawler using mid-water trawl
- the catching fleet would tranship catch to the processing vessel.

The second declaration makes no mention of:

- the configuration of the catching fleet
- whether the processing vessel provides other services to the catching fleet
- the method by which the catch is transhipped from the catching vessels to the processing vessel.

The panel's consideration of these issues and the basis for its assumptions made in developing the FPA fishing scenario (see Box 2.2) is provided below. This underpins the panel's assessment of the likely interactions of the FPA with protected species (Chapter 5) and the potential for any adverse environmental impacts to arise from localised depletion caused by the FPA (Chapter 6).

4.2 The processing vessel

Since the processing vessel in the FPA does not fish, the processing vessel itself has limited capacity to interact with protected species. The panel considered that such interactions would largely be restricted to vessel strike with cetaceans while the vessel was transiting between the fishing grounds and ports to unload/refuel. The storage capacity (and fuel capacity) of the processing vessel will influence how long it can remain at sea before returning to port to unload and/or refuel. The fuel carrying capacity of the processing vessel is unlikely to vary from the large-scale mid-water trawl vessel assessed in DCFA1. In the FPA, the minimum storage capacity of the processing vessel is reduced (400 tonnes (t) less than DCFA1), however, the maximum storage capacity of the FPA and DCFA1 scenarios remains the same at 4500 t. As a result the panel did not consider that there was any significant difference between the number of transit trips made by the processing vessel under the FPA and that of the vessel in DCFA1. The potential for vessel strike is therefore not considered to be any higher under the FPA than under DCFA1. However, it may be higher than under SPF fleet operations to date. This is considered in more detail in Section 5.3.

The panel considered that the processing vessel would have no direct impact on localised depletion and that any direct impact would be incurred through the catching fleet (see Chapter 6).

4.3 Mothershipping

The panel was aware that mothershipping operations that include re-supply of the catching fleet are common in the South Pacific fishery for small pelagic species and that such operations might have significant impacts on the length of time that catching vessels can remain at sea and the extent of the fishery that they can access. In addition, the panel noted that there was potential for fuel spills during refuelling that could have impacts on protected species.

The panel noted that the definition of the FPA referred to receiving or processing fish but did not refer to mothershipping activities. Advice from Seafish Tasmania Pty Ltd (Mr G. Geen, Director, Seafish Tasmania *in litt.* 17 October 2014), the proponents of the proposal to use a processing vessel in the SPF, confirmed that its proposal did not include the re-supply of the catching fleet with fuel, provisions or crew but did include assistance with finding fish.

The panel's research failed to find any relevant information that would allow it to assess the impact of refuelling and reprovisioning in a meaningful way and discussions with the Australian Fisheries Management Authority (AFMA) indicated that it did not regard mothershipping as posing any specific management issues (Dr J. Findlay, Chief Executive Officer, AFMA pers. comm. 5 December 2014). After consideration of the information available, the panel agreed that re-supply, refuelling and re-crewing would not be included in its assessment.

The panel considered the possibility that the processing vessel would assist the catching fleet in finding fish. It concluded that the assistance in finding fish provided to the catching fleet by the processing vessel would increase the fishing efficiency of the fleet. However, research conducted for the panel did not provide any conclusive advice as to whether this was likely to affect the extent of localised depletion. The panel could not quantify the likely impact of any assistance provided by the processing vessel to find fish. For the purposes of its assessment the panel assumed that this assistance was unlikely to be a significant determinant of interactions with protected species or of the extent of localised depletion under the FPA.

4.4 The catching fleet and target species

4.4.1 Fleet configuration

The panel relied on data on previous fishing activity by wet boats in the SPF to inform its consideration of the likely configuration of the FPA catching fleet. Data on active vessels by gear type in the SPF were available to the panel for the period 2007–08 to 2012–13 (see Table 2.2). Very little fishing and no mid-water trawl fishing has been conducted in the SPF since 2010–11, so the panel relied on data for 2007–08 to 2010–11 to identify a typical configuration of the SPF wet boat fleet. During that period an average of four purse seine vessels and one mid-water trawl vessel operated. The panel considered that under the FPA there was likely to be increased mid-water trawl effort and lower purse seine effort and assumed that the wet boat fleet under the FPA comprised three purse seine vessels and two mid-water trawl vessels. The assumption of increased use of mid-water trawl gear under the FPA reflects:

- the exclusion of Australian sardine *Sardinops sagax*, which is taken by purse seines, from the assessment of the FPA
- the shift from surface to subsurface schooling behaviour by jack mackerel *Trachurus declivis* making them less susceptible to purse seines and more susceptible to mid-water trawls
- the greater propensity to take targeted catch of redbait *Emmelichthys nitidus* using mid-water trawls
- that more than 70 per cent of the total allowable catches (TACs) for the fishery in 2014–15 is comprised of jack mackerel and redbait.

4.4.2 Fishing effort

Between 2000 and 2013 the highest number of shots recorded in the SPF in any year was 298 mid-water trawls in 2006 and 204 purse seine shots in 2009 (Table 19.4 in Tuck *et al.* 2013). Since 2009 the number of mid-water trawl shots was less than 100 and since 2011 it has been zero. Purse seine effort also decreased markedly from 517 search hours in the 2009–10 fishing year to less than 65 hours in the 2012–13 fishing year (see Table 2.2). Effort in the mid-water trawl fishery was mostly distributed off the east, south-east and south-west coasts of Tasmania with some effort spread throughout the Great Australian Bight (GAB). Purse seine effort was located closer to shore in the eastern GAB and off southern NSW (see Figure 4.1).

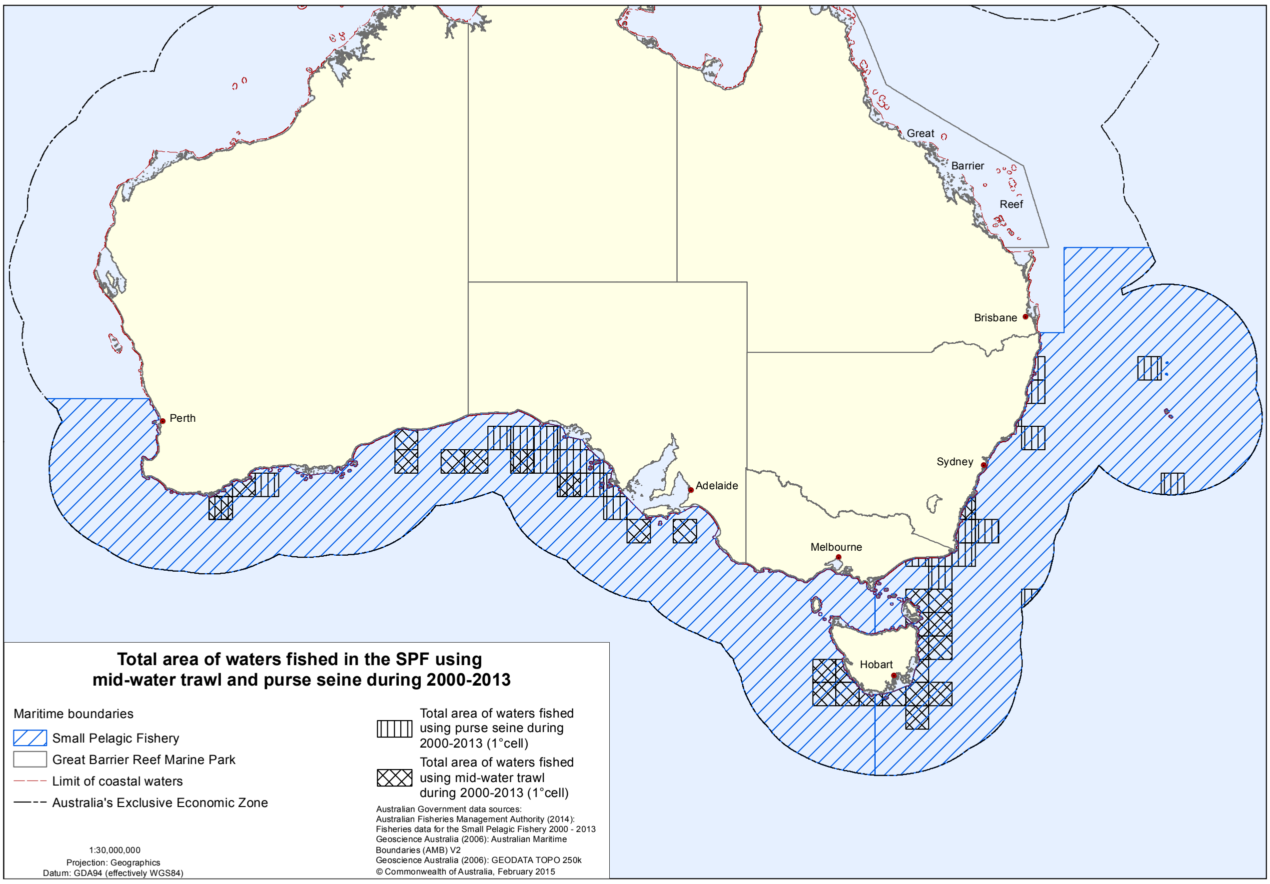

Figure 4.1 Total area of waters fished in the SPF using mid-water trawl and purse seine during 2000–2013.

Source: Map produced by the Environmental Resources Information Network, Department of the Environment using unpublished AFMA data.

The highest annual catch by fishing year of the three main target species (blue mackerel *Scomber australasicus*, jack mackerel and redbait but not Australian sardine) taken by mid-water trawling since 2000 was more than 8000 t in 2003 (AFMA unpublished data). Catches were between 6500 t and 8000 t for the next few years and then declined rapidly to around 1200 t in 2010. Since then, there has been no mid-water trawl catch in the fishery. The purse seine fishery targets blue mackerel mostly and catches varied from 150–200 t to a maximum of more than 2000 t in 2008 but declined rapidly to less than 100 t in 2014 (AFMA unpublished data). Total catch of the three main target species over the past 15 years was less than 9000 t for the purse seine sector and about 52,000 t for the mid-water trawl sector.

The introduction of a processing vessel would reduce the need of the catching fleet to return to port to unload fresh catch, therefore enabling the fleet to stay at sea for longer periods. This could: increase the capacity of the catching fleet to fish areas of the fishery that have not been previously accessible due to their distance from ports; provide an opportunity for increased returns by delivering catch for human consumption; increase the capacity of the catching vessels to fish to the TACs; and thus provide an economic incentive to increase fishing effort.

The panel concluded that compared to the typical and, particularly the recent, SPF fleet, the FPA would most likely result in increased effort in both the purse seine and mid-water trawl sectors. However, the panel could not quantify this increase. The impact of any increased effort on interactions with protected species and on localised depletion is examined in Chapters 5 and 6 respectively.

4.4.3 Spatial and temporal pattern of fishing

The panel believed that the spatial pattern of fishing under the FPA would be likely to differ from that of previous fishing activities in the SPF. In the first declaration report the panel concluded that "the limited range of the wet-boat fleet of vessels that has fished in the SPF to date has restricted the fishery's ability to catch the available TACs in an economically efficient way" (Expert Panel on a Declared Commercial Fishing Activity 2014, p. 163). A panel-commissioned project to investigate the fleet dynamics of a range of FPA scenarios supported the view that a fleet supported by a processing vessel would be less operationally constrained than the typical SPF wet boat fleet (Hamer 2015). The panel accepted that, in theory, the processing vessels could allow the catching fleet to fish further from ports than previous SPF fishing operations. The panel noted that the seasonal pattern of fishing would be influenced largely by the distribution of the target species across the fishery during the fishing year. A less-constrained FPA catching fleet may have more capacity to follow the seasonal movement of fish than the typical SPF fleet. As a result, both the temporal and spatial distribution of effort of the SPF catching fleet might be extended under the FPA. However, in reality, the skippers of the catching fleet would be more likely to use their prior knowledge on where yields are likely to be greatest and balance the trade-offs between catch rate and length of stay in a patch to determine when and where they fish (Dorn 2001, Wise *et al*. 2012). In addition, the natural inter-annual variability of the distribution of SPF target species means that spatial distribution of effort will necessarily vary as found in the fishery for Peruvian anchovy *Engraulis ringens* (Bertrand *et al*. 2007, Joo *et al*. 2014) across years. The panel also noted that the catching fleet would remain constrained by its fuel-carrying capacity and would be required to make regular trips to port to refuel and reprovision the vessels. As a result, transhipping catch is likely to extend the time that the wet boat fleet could remain at sea but only by a few days (Mr G. Geen, Director, Seafish Tasmania *in litt*. 8 April 2013). In the panel's view this constraint would reduce the potential offered by the processing vessel for the catching fleet to fish more broadly in the SPF.

Overall, the panel considered that it was not possible to predict whether the FPA would result in a broader distribution of fishing effort or greater effort in areas fished previously by the SPF fleet. This will depend on the availability of fish, the fuel-carrying capacity of the catching fleet and skippers' knowledge of the fishing grounds, all of which may vary over time. Nevertheless, the panel noted that any change in the spatial and temporal distribution of effort may have implications for interactions with and/or indirect impacts on protected species. The potential implications for interactions with protected species and localised depletion are discussed in Chapters 5 and 6 respectively.

4.5 Transhipment

The method by which the processing vessel 'receives' the fish from the catching fleet is not specified in the second declaration. The panel was advised by Seafish Tasmania (Mr. G. Geen, Director, Seafish Tasmania *in litt*. 17 October 2014) that fish would be pumped from either the net of the catching vessel or the hold of the catching vessel and these methods were confirmed as being standard practice (Finley *et al*. 2015a). The panel assumed that both methods were likely to be utilised and included each in the fishing scenario of the FPA.

Fish have routinely been pumped from the net to vessel holds in the Jack Mackerel Fishery (JMF) and in the SPF. In the mid-1980s, prior to the creation of the SPF, the JMF comprised a fleet of fishing vessels from 85 to 500 t carrying capacity (Williams *et al*. 1986, 1987). Up to six vessels fished in the 1985–86 season (Williams *et al*. 1986) and seven vessels fished and one vessel of small capacity acted as carrier boat to the fleet in the 1986–87 (Williams *et al*. 1987). The numbers of vessels in following years varied from four to six until the mid-1990s (Pullen 1994). Transhipping between the catching fleet vessels was a common practice in the late 1980s and early 1990s fishery if a vessel was full but still had fish pursed. However, the transfer could only occur during fair weather (Mr G. Pullen, Department of Primary Industries, Parks, Water and the Environment pers. comm. 11 December 2014). The panel assumed that the process of transhipment for purse seine vessels fishing under the FPA, i.e. the pumping of a catch onboard the receiving vessel from another vessel's net, would be similar to that which occurred in the historical JMF fleet.

With regard to the mid-water trawl operations of the first declaration, the panel was informed that pumping has been used in previous mid-water trawl and purse seine operations in the SPF. The panel was advised that, during pumping from mid-water trawl nets, the bag and codend of the net hang vertically beneath the vessel and the net is fully submerged to a depth of 50 to 70 m (Seafish Tasmania *in litt*. 16 October 2012 and Seafish Tasmania pers. comm. 23 April 2013) and that the higher pumping capacity likely in DCFA1, compared to the typical SPF fleet, would reduce the time taken for the codend to be emptied. The panel assumed the pumping operation and capacity of the FPA would be similar (Box 2.2). As in DCFA1, the panel assumed that the pumping capacity of the FPA would be faster and more efficient than those of the early JMF and typical SPF purse seine and mid-water trawl operations.

The panel assumed that in transfers of fish from mid-water trawl vessels to the processing vessel that the net remained fully submerged. However, catches of purse seine vessels fishing under the FPA are at the surface and readily available to predators while the catch is transhipped/pumped to the processing vessel. The panel noted that such pumping had occurred previously in the JMF and SPF without any significant interactions with protected species and that any such species attracted to feed on fish in the purse seine net would be able to escape given that the net is open at the surface. Despite there being no management requirement for purse seine vessels to have vessel management plans (VMPs) to deal with interactions with protected species, the panel formed the view that the transhipment process was unlikely to result in any significant interactions with protected species.

Uncertainty remains about the level of accidental loss of fish during transhipment, which might attract protected predator species to the fishing operations and increase the risk of interaction. Observer reports from the 2002–03 pair trawl trials in the SPF stated that up to 100 kilograms of fish could be lost during these operations (McKinley unpublished (a) and (b)). However, despite an extensive literature review (Finley *et al*. 2015a) no information was identified that would inform an assessment of whether the pumping operation would have any direct effects on protected species. In addition, the panel considered that any risks to protected species arising from pumping operations to a processing vessel would not be different to those posed under a non-transhipment fishing operation where the catch was pumped on-board the catching vessel. In addition, the panel assumed that the mandatory mid-water trawl VMPs would prohibit the discarding of any biological material while gear (including the pump) was in the water, thus avoiding potentially increasing the risk of interaction with and fatality of protected species. The panel assumed that since the processing vessel would not be fishing and AFMA's management arrangements only require VMPs for mid-water trawl vessels, there would be no VMP for the processing vessel.

Summary: panel consideration of the FPA

- *Interactions between the processing vessel and protected species would largely be restricted to vessel strike with cetaceans while the vessel was transiting between the fishing grounds and ports to unload/refuel. The potential for vessel strike is not considered to be any higher under the FPA than under DCFA1. However, it may be higher than under SPF fleet operations to date.*
- *The panel considered that the processing vessel would have no direct impact on localised depletion and that any direct impact would be incurred through the catching fleet.*
- *The panel has not considered the potential impacts of resupply, refuelling and re-crewing of the catching fleet by the processing vessel in its assessment.*
- *Fish-finding capability provided to the catching fleet by the processing vessel was considered unlikely to be a significant determinant of interactions with protected species or of the extent of localised depletion under the FPA.*
- *Under the FPA there was likely to be increased mid-water trawl effort and lower purse seine effort compared to typical SPF operations. The panel assumed that the wet boat fleet under the FPA comprised three purse seine vessels and two mid-water trawl vessels.*
- *Compared to the typical and, particularly the recent, SPF fleet, the FPA would most likely result in increased effort in both the purse seine and mid-water trawl sectors. However, the panel could not quantify this increase.*
- *It was not possible to predict whether the FPA would result in a broader distribution of effort or greater effort in areas fished previously by the SPF fleet. This will depend on the availability of fish, the fuel-carrying capacity of the catching fleet and skippers' knowledge of the fishing grounds, all of which may vary over time. Nevertheless, any change in the spatial and temporal distribution of effort may have implications for interactions with and/or indirect impacts on protected species.*
- *Under the FPA, transhipment will occur through pumping fish from the nets or the holds of the catching fleet to the processing vessel.*
- *Experience of pumping fish from the net to, or between, purse seine vessels (in the JMF and SPF), and from the net to mid-water trawl vessels (in the SPF) does not suggest that transhipment poses any specific threat to protected species. The requirement to have a VMP in place on mid-water trawl vessels provides an avenue to further reduce any risk posed by the transfer of fish from these vessels.*
- *The existing management arrangements for the SPF do not require VMPs for the purse seine fleet and the panel has assumed that the processing vessel would not be required to have a VMP since it does not fish.*

5 Assessment of the fish processing activity - direct interactions with protected species

5.1 Introduction

There are 241 species (see Appendix 3) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) that occur in the area of the Small Pelagic Fishery (SPF). These are comprised of:

- 10 pinniped species
- 44 cetacean species
- Dugong *Dugong dugon*
- 89 species of seabirds
- six marine turtle species
- nine seasnake species
- 13 shark and ray species
- 69 teleost species, of which 66 are syngnathids.

The data compiled by Tuck *et al.* (2013) have been used as the primary source to inform the panel's understanding of the nature and extent of the direct interactions of mid-water trawling and purse seine in the SPF with protected species to date. As discussed in Chapter 5 of the first declaration report the panel considers that the data contained in Tuck *et al.* (2013) understate the level of 'direct interactions' because the definition excludes some elements of what the panel considers constitute 'direct interactions'. However, in the absence of any more comprehensive assessment of historical interaction data, the panel has used those data as indicative of the nature and extent of direct interactions with protected species by previous fishing activities in the SPF.

The panel's Terms of Reference specified the need to assess the likely nature and extent of direct interactions of the fish processing activity (FPA) with seals, dolphins and seabirds. The panel has considered each of these groups and has identified species of particular interest within each. The panel considered the need to assess direct interactions between the FPA and protected species of dugong, turtles, seasnakes, sharks and teleosts, and formed the view that this was not necessary. The rationale for this decision is provided in Appendix 3.

5.2 Pinnipeds

5.2.1 Species assessed

There are three resident pinnipeds that breed in coastal areas and islands off southern Australia in the area of the SPF. These are the Australian fur seal *Arctocephalus pusillus doriferus*, New Zealand fur seal *A. forsteri* and Australian sea lion *Neophoca cinerea*. In addition to the resident species, there are a further seven pinniped species whose ranges are circumpolar throughout the subantarctic and Antarctic regions of the Southern Ocean. These include the Antarctic fur seal *A. gazella,* the subantarctic fur seal *A. tropicalis*, the southern elephant seal *Mirounga leonina*, leopard seal *Hydrurga leptonyx*, crabeater seal *Lobodon carcinophagus*, Weddell seal *Leptonychotes weddelli* and Ross seal *Ommatophoca rossii*. All of these have been recorded as vagrant within the area of the SPF, but the most commonly sighted vagrant pinnipeds include the subantarctic fur seal, southern elephant seal and the leopard seal. The overlap in purse seine and mid-water trawl effort in the SPF (2000–2013) with the distribution of the three resident pinnipeds, and in relation to pinniped species richness is detailed in Figures 5.1 and 5.2 respectively.

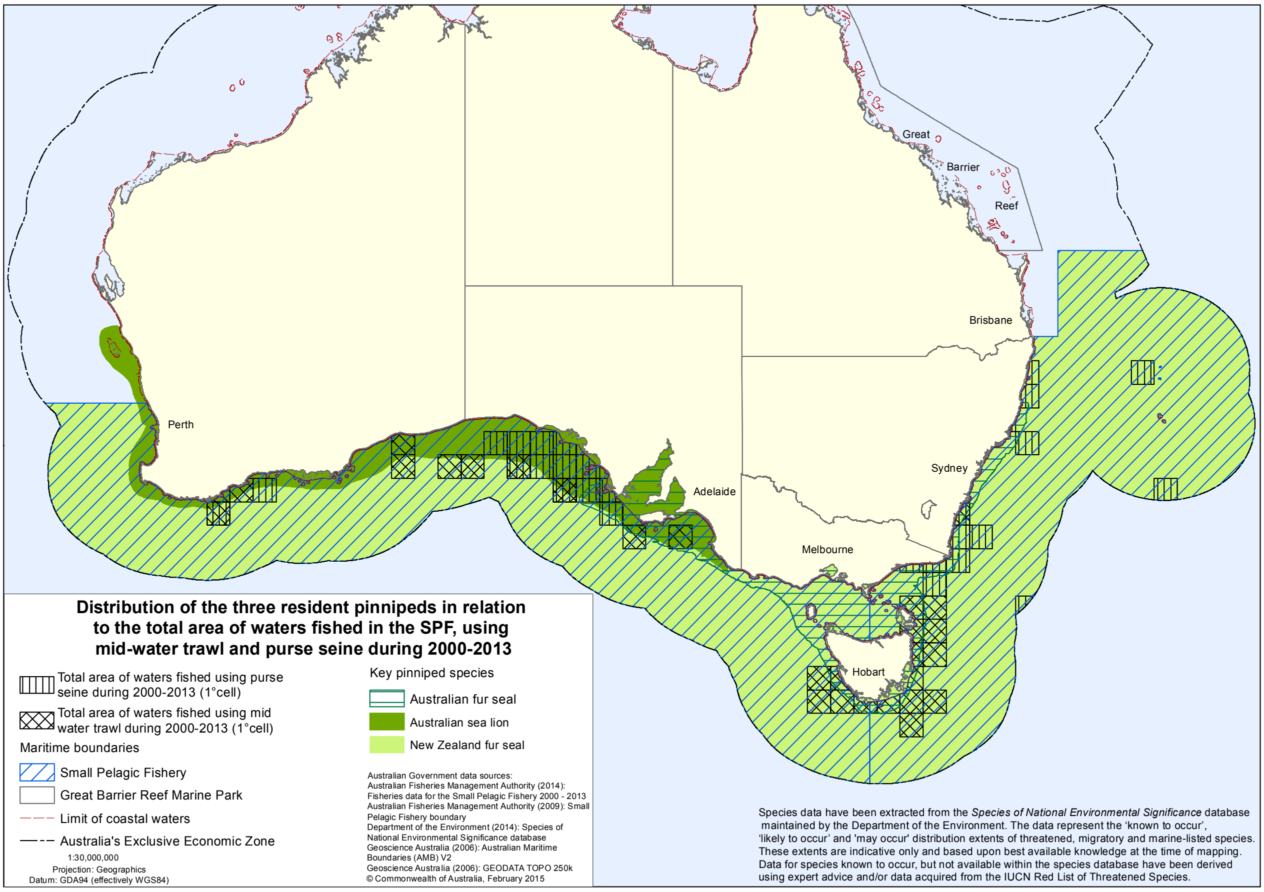

Figure 5.1 Distribution of the three resident pinnipeds in relation to the total area of waters fished in the SPF using purse seine and mid-water trawl during 2000–2013.

Source: Map produced by the Environmental Resources Information Network (ERIN), Department of the Environment, using unpublished Australian Fisheries Management Authority (AFMA) data.

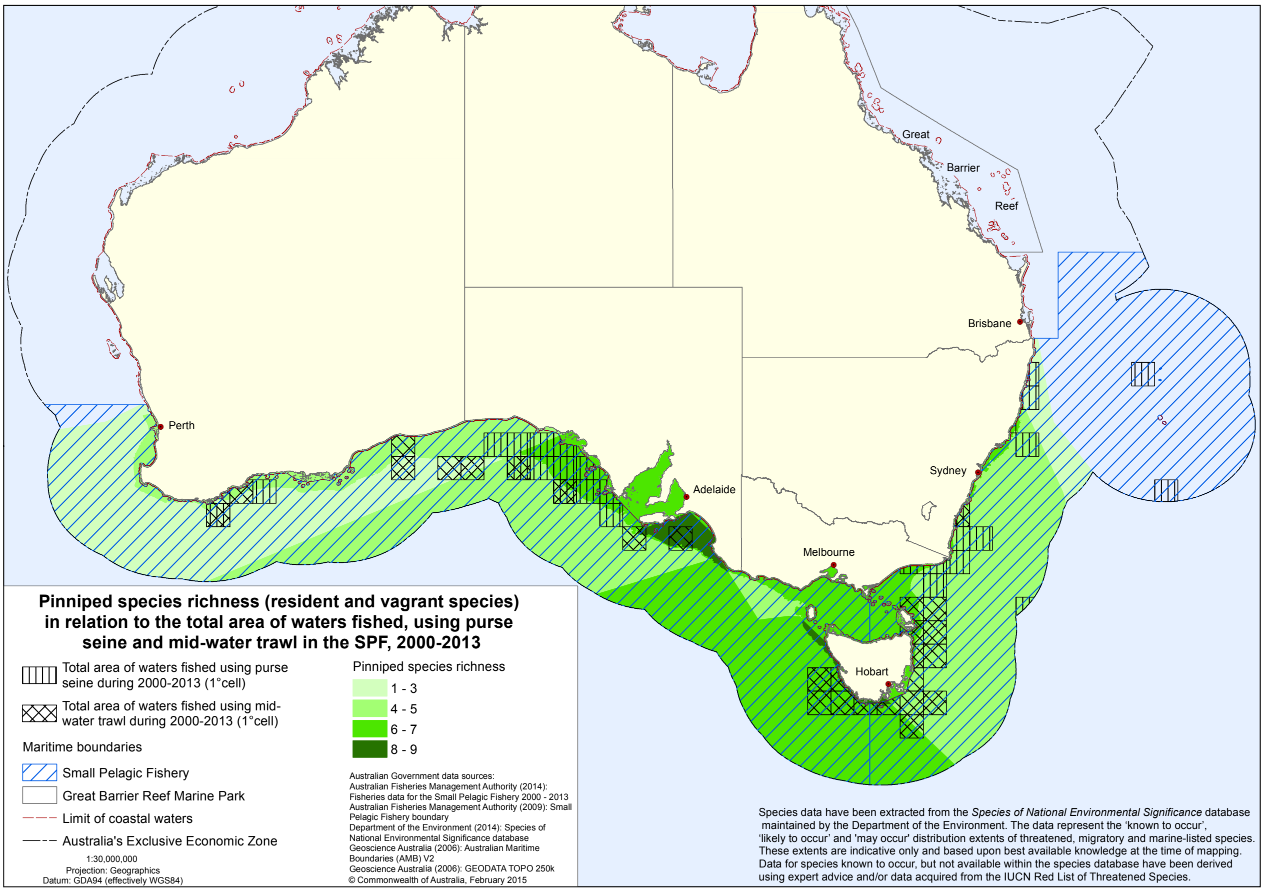

Figure 5.2 Pinniped species richness (resident and vagrant species) in relation to the total area of waters fished in the SPF using purse seine and mid-water trawl during 2000–2013.

Source: Map produced by ERIN, Department of the Environment using unpublished AFMA data.

The Australian Fisheries Management Authority's (AFMA's) ecological risk management reports for the purse seine and mid-water trawl sectors of the SPF (AFMA 2010a, 2010b respectively) identified the six pinniped species in Table 5.1 as either high or medium risk (full details for all pinnipeds are summarised in Appendix 3). The distribution, abundance, status and trends and conservation status of the Australian sea lion, Australian fur seal and New Zealand fur seal were detailed in the first declaration report. This information is provided for the most common vagrant species, the subantarctic fur seal, southern elephant seal and leopard seal. Even though the latter three species are profiled below, the panel notes that interactions between these species and the SPF are likely to be extremely rare. The subsequent assessment therefore focuses on the nature, extent, mitigation and management of interactions between the fish processing activity (FPA) and the Australian sea lion, Australian fur seal and New Zealand fur seal.

Table 5.1 Pinniped species identified at high or medium risk after residual risk assessment

COMMON NAME/S	EPBC ACT LISTING STATUS	RESIDUAL RISK (MID-WATER TRAWL)	RESIDUAL RISK (PURSE SEINE)
Australian sea lion	Vulnerable, Marine	Medium	Medium
Australian fur seal	Marine	High	High
New Zealand fur seal	Marine	Medium	Medium
Subantarctic fur seal	Vulnerable, Marine	Medium	Medium
Southern elephant seal	Vulnerable, Marine	Medium	High
Leopard seal	Marine	Medium	High

Source: AFMA 2010a and 2010b.

Subantarctic fur seal *Arctocephalus tropicalis* (Level 2 Productivity-Susceptibility Analysis (PSA) Residual Risk – Medium)

Distribution and range

Subantarctic fur seals are widely distributed throughout the Southern Ocean and principally breed on subantarctic islands north of the subantarctic front, including: Amsterdam and Saint Paul Islands, Isles Crozet, the Prince Edward Islands, Gough Island, Tristan du Cunha and Macquarie Island (Goldsworthy *et al*. 2009). Macquarie Island represents the only Australian breeding population of the species (Goldsworthy *et al*. 2008, Goldsworthy *et al*. 2009), though three pups have been recorded at Heard Island (Goldsworthy and Shaughnessy 1989, Page *et al*. 2003, Goldsworthy pers. comm. in Woinarski *et al*. 2014). Vagrants are not uncommonly sighted along southern Australia's coasts throughout the SPF area (Tasmania, New South Wales (NSW), Victoria, South Australia (SA) and Western Australia (WA)) and along the Antarctic coastline (Shaughnessy *et al*. 2014). Analyses of 86 records (49 specimens and 37 sightings) of vagrant subantarctic fur seals in South Australia from 1982 to 2012 based primarily on records from the South Australian Museum, indicated that most (83 per cent) were juveniles with the peak sighting period from July to October (77 per cent) (Shaughnessy *et al*. 2014).

Population size and trends

The global population of the subantarctic fur seal was estimated to exceed 400,000 in the early 2000s, with most of the population occurring at three sites: Gough Island (63 per cent), the Prince Edward Islands (25 per cent) and Amsterdam/Saint Paul Islands (11 per cent) (Scientific Committee for Antarctic Research Expert Group on Seals (SCAR EGS) 2008, Hofmeyr in press). The estimated abundance of these three main subpopulations has increased over the last few decades, and in recent years considered largely stable or decreasing (Hofmeyr in press). At Macquarie Island sealers extirpated fur seals in the early 1800s (Ling 1999). Following the elimination of the endemic population by 19th century sealers, the Macquarie Island population has had a complex recolonisation history, and now consists of three species that hybridise (Antarctic, subantarctic and New Zealand fur seals) although only breeding populations of the Antarctic and subantarctic fur seal have established (Lancaster *et al*. 2006, Goldsworthy *et al*. 2009). Establishment and growth of these small breeding populations has been slow and complex due to their distance from major population centres, differences in the colonisation times of males and females of each species, and extensive hybridisation among all three species (Goldsworthy *et al*. 2008, 2009).

In the 2007–08 breeding season an estimated 43 subantarctic fur seal pups were born at Macquarie Island, but it is likely that many of these will be hybrid (Goldsworthy *et al*. 2008, 2009). Between 1986 and 2007 it is estimated that subantarctic fur seal pup production increased by 8 per cent per year (Goldsworthy *et al*. 2009).

Biology and feeding ecology

Pups are born from November to early January with a peak around 20 December. Males compete for territories prior to the commencement of the breeding season, then fast and defend territories until all females are mated (Goldsworthy 2008). Males hold territories containing up to 20 females who come into oestrus and are mated about a week after giving birth. Females then leave the colony a day or two later to feed, alternating between periods of shore attendance (when they nurse their pup) and foraging trips at sea (Goldsworthy 1999). Foraging trip lengths generally increase throughout lactation and appear to vary in length depending on the availability of food (Goldsworthy 1999). Foraging behaviour and diet vary among breeding sites; at Macquarie Island they feed almost exclusively on myctophids, foraging at night, usually at very shallow depth (10–20 metres (m)), but occasionally dive to about 80 m (Goldsworthy *et al*. 1997, Robinson *et al*. 2002). Dives during twilight hours (dusk and dawn) tend to be deeper than those during darker hours, behaviour consistent with predation on myctophid fish that show marked nocturnal vertical migration (Goldsworthy *et al*. 1997, Robinson *et al*. 2002). Pups are weaned when approximately 300 days old (10 months).

Risks and threatening processes

Most threats to the subantarctic fur seal operate off or adjacent to the breeding colonies (Woinarski *et al*. 2014). At Macquarie Island, pup production, pup growth and diet are correlated with sea surface temperatures (SST) north of the island in a region where fur seals forage (Goldsworthy *et al*. 2008). Cool SSTs in March/April (when the placental phase of pregnancy commences) are correlated with increased natality (percentage of females giving birth) in the following breeding season, whereas cool SSTs during the summer/autumn period are correlated with an increase of one myctophid species *Electrona subaspera* in the diet and increased pup growth rates (Goldsworthy *et al*. 2008). Climate and oceanographic variability may be important in regulating populations of subantarctic fur seals. Pups of the small population at Macquarie Island are subject to predation by New Zealand sea lions *Phocarctos hookeri*, accounting for 50 per cent of all pup deaths to three months, and higher mortality rates (27 per cent) than typical for small low-density populations (3–6 per cent) (Robinson *et al*. 1999, Goldsworthy *et al*. 2008). Subantarctic fur seals have been entangled in fishing gear at Macquarie and Heard Islands, with two deaths from entanglements recorded in WA (Mawson and Coughran 1999, Shaughnessy 1999, Shaughnessy *et al*. 2003).

Prey depletion is a potential threat if fisheries continue to increase, but it is considered unlikely to be an important threat to the Macquarie Island population (Goldsworthy *et al.* 2001, Woinarski *et al.* 2014). Subantarctic fur seals are vulnerable to oil spills and chemical and plastics pollution (Shaughnessy 1999, Evans 2003, Woinarski *et al.* 2014). Disturbance at breeding colonies can cause temporary displacement (Woinarski *et al.* 2014). Hybridisation with Antarctic and New Zealand fur seals at Macquarie Island is likely to be reducing the rate of recovery of the population, reduced fitness of males has been demonstrated and is suspected for females; however, hybridisation levels are declining (Lancaster *et al.* 2006, Lancaster *et al.* 2007, Goldsworthy *et al.* 2008, Goldsworthy *et al.* 2009).

Conservation and listing status

The subantarctic fur seal is listed as Vulnerable based on the low number of individuals breeding in the Australian region, with immigration from extra-limital secure subpopulations, and as a marine species under the EPBC Act. The species was recently assessed as Endangered in Australian waters by Woinarski *et al.* (2014), based on the small population size. This species is listed as Endangered in Tasmania and SA and Vulnerable in Queensland. It is not listed in NSW, Victoria or WA. Globally, the subantarctic fur seal was assessed as Least Concern for the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List in 2012 (Hofmeyr and Kovacs 2008, Hofmeyr in press), and is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Summary: subantarctic fur seal

- *Subantarctic fur seals are widely distributed throughout the Southern Ocean. The main breeding colonies are Amsterdam and Saint Paul Islands, the Prince Edward Islands and Gough Island.*
- *Macquarie Island represents the only Australian breeding population of the species.*
- *Recovery of the Macquarie Island subantarctic fur seal population post-sealing has been slow and complex due to its isolation, sympatry and hybridisation with other fur seal species.*
- *An estimated 43 subantarctic fur seal pups were born at Macquarie Island in the 2007–08 breeding season. The population is estimated to be increasing at 8 per cent per year.*
- *Vagrants are not uncommonly sighted along southern Australia's coasts throughout the SPF area, although interactions with fisheries within the SPF are likely to be rare.*

Leopard seal *Hydrurga leptonyx* (Level 2 PSA Residual Risk – High)

Distribution and range

Leopard seals are principally distributed in pack-ice habitats off Antarctica between 50°S and 80°S. Like southern elephant seals (below), they range throughout the Southern Ocean and northwards to all continents of the Southern Hemisphere (Kirkwood and Goldsworthy 2013). They are the most commonly seen phocid seal on southern Australian shorelines, and are occasionally seen resting on beaches, often in poor condition (Shaughnessy *et al.* 2012). Such sightings are most frequent in late winter and spring (peak in August in SA), with the number of sightings fluctuating between years, peaking periodically, possibly in relation to episodic northward extensions of Antarctic water and seasonal changes in sea-ice distribution (Kirkwood and Goldsworthy 2013, Shaughnessy *et al.* 2012). Individuals may remain ashore for several hours to several days. Some may traverse around the coast for several months, feeding on fish, squid, little penguins *Eudyptula minor* and shearwaters, hauling-out occasionally to rest (Kirkwood and Goldsworthy 2013, Shaughnessy *et al.* 2012). Although the species' breeding range does not overlap with the SPF, their extra-limital distribution and sighting records off southern Australia would suggest they occur regularly throughout the SPF area.

Population size and trends

Leopard seals are considered to be in low density over most of the range, with aerial survey methods being used to estimate abundance. Southwell *et al.* (2008) estimated leopard seal abundance off east Antarctica between longitudes 64°E and 150°E in the 1999–2000 summer. Abundance estimates were 7300 definite to 12,100 definite plus probable leopard seal sightings (95 per cent confidence intervals (CI) of 3700–14,500 and 7100–23,400 individuals). These estimates were considered to be a minimum given their likely negative bias (Southwell *et al.* 2008). The global population abundance has been estimated between 222,000 and 440,000 individuals (Erickson and Hanson 1990).

Biology and feeding ecology

Leopard seals are largely solitary animals, breeding, moulting and resting on pack ice. They breed on the Antarctic pack ice in spring with pups being born between October and December (Siniff and Stone 1985). Females give birth to a single pup which they nurse for about 30 days. Both sexes 'sing' to attract mates and mating events occur in the water soon after the pup is weaned, gestation lasts around nine months (Kirkwood and Goldsworthy 2013, Shaughnessy 1999). Females become sexually mature at around four years, males at around four-and-a half-years (Shaughnessy 1999). Female leopard seals are slightly larger than males (up to 600 kilograms (kg) compared with up to 400 kg) (Kirkwood and Goldsworthy 2013).

Leopard seals are opportunistic, Antarctic top-order predators that feed on a wide range of vertebrate and invertebrate prey including other seals, birds, fish and krill (Green and Williams 1986, Hall-Aspland *et al.* 2004). Krill was the most frequent and numerous prey and also constituted the bulk of the diet; penguins and fish followed in importance by mass (Casaux *et al.* 2009). Stomach and faecal samples from leopard seals hauled-out in SA have mainly contained bird remains including little penguins, cormorant and gull feathers, and some fish (Shaughnessy *et al.* 2012).

Risks and threatening processes

Given proximity of populations to fishing activity, entanglement in marine debris is expected to be uncommon, as is incidental bycatch in fisheries gear (Shaughnessy 1999). If krill fisheries expand prey depletion could become a threat (Siniff and Stone 1985). Changes in climate and oceanographic conditions in the Southern Ocean may influence population trends through altering food webs (Shaughnessy 1999).

Conservation and listing status

The leopard seal is a listed marine species under the EPBC Act (Woinarski *et al.* 2014). Globally, the leopard seal was assessed as Least Concern for the IUCN Red List in 2012 (Southwell and IUCN Species Survival Commission (SSC) Pinniped Specialist Group 2008), and is not listed in any Appendix of CITES.

Summary: leopard seal

- *Leopard seals are widely distributed throughout pack-ice habitats off Antarctica between 50°S and 80°S, and range throughout the Southern Ocean and northwards to all continents of the Southern Hemisphere, including Australia.*
- *They are the most common phocid seals sighted along Australia's southern coast, where they are mostly commonly sighted in late winter and spring.*
- *Although their extra-limital range encompasses the SPF, interactions with fishing activities are likely to be uncommon.*

Southern elephant seal *Mirounga leonina* (Level 2 PSA Residual Risk – High)

Distribution and range

Southern elephant seals breed on sand and shingle beaches on subantarctic islands mostly north of the seasonal pack ice (Kirkwood and Goldsworthy 2013). They range throughout the Southern Ocean and northwards to the coastlines of all Southern Hemisphere continents. Two large breeding subpopulations occur in Australian territory at Heard and Macquarie Islands. Breeding colonies existed on the north-west coast of Tasmania (perhaps eliminated by Aboriginal hunters approximately 2000 years ago), and more recently on King Island, Bass Strait (eliminated by sealers in the early 1800s) (Kirkwood and Goldsworthy 2013). Elephant seals routinely haul-out to moult at sites across their range, including on the coast of Antarctica. This species has been recorded from NSW to Tasmania, SA and WA (Shaughnessy *et al.* 2012, Woinarski *et al.* 2014). Pups are occasionally born along Australia's southern shores, including four records from Tasmania, two from SA, two from Victoria and two from WA (Shaughnessy *et al.* 2012). Its southern Australian range overlaps with the area of the SPF.

Population size and trends

Global southern elephant seal abundance was estimated at 757,000 prior to the 1970s (McCann 1985), declining to 664,000 in 1990 (Laws 1994), and then increasing to 739,000 in 2002 (McMahon *et al.* 2005). Four breeding stocks are recognised: Macquarie Island, Isles Kerguelen (including Heard Island), South Georgia and Peninsula Valdez, Argentina (Campagna 2008, Hindell and Perrin 2009).

At Macquarie Island, the pre-exploitation population has been estimated between 93,000 and 110,000 seals, with an estimated 70 per cent of these killed as a consequence of commercial sealing between 1810 and 1919 (Hindell and Burton 1988). By 1949, the population had fully recovered to 183,000, but declined to 76,000 in 2001 (Hindell and Burton 1988, McMahon *et al.* 2003). The causes of this decline are uncertain but it appears it is associated with juvenile survival and food availability (McMahon *et al.* 2000, McMahon and Burton 2005, McMahon *et al.* 2005). Trend analysis from 1988–1999 estimated an annual decline of 2.1 per cent, changing to a barely positive trend (0.09 per cent) between 1999 and 2004 (van den Hoff *et al.* 2007). The Macquarie Island population has continued to decline at a rate of less than 1 per cent per year (Woinarski *et al.* 2014).

At Heard Island, the population had recovered to between 80,500 and 110,000 seals (of one plus years) by 1949, but by 1985 had declined by about 50 per cent (Burton 1986, Slip and Burton 1999). The population has been relatively stable between 1985 and 1992 (Slip and Burton 1999) but has not been assessed since (Woinarski *et al*. 2014).

Biology and feeding ecology

Southern elephant seals are largely solitary at sea, but aggregate ashore annually to breed in colonies made up of harems which spread along the coast (Campagna 2008, Hindell and Perrin 2009). Southern elephant seals are the largest pinnipeds, with breeding-sized adult males termed 'beachmasters' weighing up to 3800 kg (more than 10 years old, 3.5–4.5 m in length and 2000–3800 kg). They are up to nine times larger than adult females (more than three years, between 2 and 3 m, 250–800 kg) (Hindell and Perrin 2009). Beachmasters gather at breeding beaches prior to the arrival of the adult females, which come ashore to give birth to a single pup between September and November. Harems may exceed 100 females (Hindell and Perrin 2009). Pups weigh about 45 kg at birth, are nursed for around 23 days and wean at about 110 kg. Prior to leaving their pups, adult females are mated by the beachmaster or opportunistic challengers (Kirkwood and Goldsworthy 2013). After weaning, pups remain ashore fasting for a further five weeks. During this time they moult and convert stored fat into lean tissue (Hindell and Perrin 2009). After the breeding season, there is a constant progression of animals coming ashore to moult through spring, summer and autumn: first juveniles, then subadult males, adult females, and lastly adult males, each taking 30–40 days to complete their moult (Kirkwood and Goldsworthy 2013). During this period they avoid entering the water and do not feed.

The diet of southern elephant seals consists mainly of deep-water squid, and myctophid fish which they forage on at depths usually exceeding 200 m (Kirkwood and Goldsworthy 2013). This species undertakes the deepest (2 kilometres (km)) and longest duration dives (more than 2 hours) of any pinniped, however most dives are less than 500 m and last around 25–30 minutes (Kirkwood and Goldsworthy 2013).

Risks and threatening processes

Southern elephant seals are recorded infrequently as incidental bycatch in fishing gear in the Australian region. Mortalities have occurred in trawl nets, longline gear, and aquaculture nets (Burton and van den Hoff 2002, van den Hoff *et al*. 2002, Shaughnessy *et al*. 2003, Kemper *et al*. 2003, Patterson and Skirtun 2014). Depletion of prey species as a consequence of fishing has been identified as a potential threat (Woinarski *et al*. 2014).

Research has indicated that the species is highly sensitive to small (five per cent) changes in survival and fecundity rates, which appear largely responsible for the major declines recorded in the latter stages of the 20th century (McMahon *et al*. 2005b). Such demographic changes can be strongly influenced by changes in climate and oceanographic conditions in the Southern Ocean, which impact population trends through changes to food webs and foraging and breeding success (McMahon *et al*. 2005a, b).

Conservation and listing status

Under the EPBC Act, Australian populations of the southern elephant seal are listed as Vulnerable (Criterion 1: estimated decline of 45–55 per cent within three generations; and Criterion 5: current rate of decline would cause extinction within Australian territories within 100 years). However, the Action Plan for Australian Mammals 2012 recently assessed the species as Near Threatened in Australian waters (approaches A2ab, B2ab(v)) (Woinarski et al. 2014). This species is listed as Endangered in Tasmania and Rare in SA. It is not listed in NSW, Victoria or WA. Globally, the southern elephant seal was assessed as Least Concern for the IUCN Red List in 2012 (Campagna 2008) and is listed in Appendix II of CITES.

Summary: southern elephant seal

- *Southern elephant seals are widely distributed throughout the Southern Ocean, breed on subantarctic islands and are regularly sighted ashore on all continents of the Southern Hemisphere including Australia.*
- *They are recorded infrequently as incidental bycatch in fishing gear, mostly in Southern Ocean fisheries.*
- *Although their extra-limital range encompasses the SPF, interactions with fishing activities are likely to be uncommon.*

5.2.2 Nature and extent of interactions

Marine mammals and commercial fisheries often target the same food resource, leading to 'operational interactions' between animals and fisheries when they come into direct contact with fishing gear. Globally, the bycatch of marine mammals in fisheries is estimated to be in the hundreds of thousands of individuals per year (Read *et al*. 2006) and currently represents the dominant, recognised threat to global pinniped populations (Kovacs *et al*. 2012). Pinnipeds are readily attracted to, and interact with, trawl fisheries. This can lead to significant levels of pinniped bycatch where pinniped populations overlap with trawl fisheries. Where purse seine fisheries overlap with the range of pinnipeds species, interactions can be common.

The nature and extent of interactions of mid-water trawl fisheries with pinnipeds was addressed in the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014, Section 5.2.2). Interactions in global and Australian fisheries are each summarised below.

With respect to purse seine fishing methods, seal interactions can be common where purse seine fisheries overlap with the foraging range of seal populations, but it is rare for these interactions to result in injury or mortality because seals can readily move in and out of the net over the float line and are not usually impeded in accessing the surface to breathe. The nature of purse seine fishery interactions would likely involve seals being attracted to fishing activity, entering the pursed net and feeding on encircled fish. Some seals may become trapped in a purse net as it is being pumped, or clamber onto vessels when the net is being hauled requiring them to be released. On rare occasions some seals could become entangled in the purse seine net and drown, or suffer serious injury or death if they become stuck in the fish pump or pass over the power block. The nature and extent of interactions of purse seine fisheries with pinnipeds in global and Australian fisheries is also considered below.

Nature and extent of trawl fishery interactions: global

- Pinnipeds are readily attracted to and interact with trawl fisheries; they will take fish floating free from the net, 'stickers' (meshed fish) protruding through the net mesh, and discarded fish and offal, and enter trawl nets to feed on fish inside the net.
- Globally, otariids (fur seals and sea lions) are highly susceptible to interactions with trawl fisheries. Key examples include:
  - Cape fur seal *Arctocephalus pusillus pusillus* in South African trawl fisheries
  - South American sea lion *Otaria flavescens* in trawl fisheries off south-central Chile and factory/freezer mid-water and demersal trawl fisheries off northern and central Patagonia (Argentina)
  - Antarctic fur seal in Antarctic krill *Euphausia superba* fisheries
  - Steller sea lion *Eumetopias jubatus* and mid-water freezer trawlers in United States of America (US) Alaskan fisheries
  - New Zealand sea lion and New Zealand fur seal and New Zealand mid-water and demersal trawl fisheries.
- Documentation and enumeration of the extent of interactions (including bycatch mortality) varies greatly. In many instances this is limited to short-term studies where interaction rates (usually only bycatch) have been reported and analysed based on independent fishery observer programs. Annual reporting and estimation of bycatch impacts is most consistent in US and New Zealand fisheries.

Nature and extent of trawl fishery interactions: Australia and the SPF

As noted in the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014, Section 5.2.2), all of the breeding distribution of the Australian and New Zealand fur seal in Australia, and most of the breeding distribution of Australian sea lion, occurs within the area of, or adjacent to, the SPF. Seals are common marine predators in southern Australia; they are intelligent and curious animals and will be attracted to any fishing activity that occurs within their foraging range. The greater the level and frequency of fishing activity, or predictability in where and when fishing activity will occur within an area where seals forage, the greater the number of seals that are likely to be attracted to, and interact with fishing operations. This is especially the case if such interactions provide some reward. If fishing is persistent over time and fishing activities provide opportunities for seals to gain nutritional benefits, then sections of the population can become habituated to fishery interactions. The first declaration report noted that the likely nature of direct pinniped interactions with mid-water trawl fisheries includes net feeding, entering the trawl net (during shooting, fishing and hauling), and habituation to fishing activities (Expert Panel on a Declared Commercial Fishing Activity 2014). With these interactions, some level of bycatch mortality is inevitable and in areas of high seal abundance and/or high fishing activity, likely to be common, even with best practice management. The following summary of the nature and extent of trawl fishery interactions with pinnipeds in Australia and the SPF is drawn from Section 5.2.2 of the first declaration report.

- Pinniped interactions with fishing gear appear ubiquitous in southern Australia where their populations overlap with trawl fisheries.
- Pinniped interactions occur predominantly with demersal trawl wet boats and factory/freezer trawlers using mid-water trawl gear in the Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) and with mid-water trawlers of the SPF.
- The longest time series of data on bycatch interactions (1993–2010) exists for the wet boat CTS where available Integrated Scientific Monitoring Program data indicate persistent and significant ongoing bycatch mortality of fur seals. Extrapolation of these data suggests bycatch mortality in the order of 600 fur seals per year, or approximately 12,000 over the past 20 years (around 1.9 seals per 100 tows).

- Most research into the nature and extent of interactions (and their mitigation) has occurred in the winter factory/freezer mid-water trawl fishery for blue grenadier *Macruronus novaezelandiae* (in the SESSF) off western Tasmania. Results indicate a subpopulation of fur seals habitually interacting with and foraging in association with fishing operations for many months of the year.
- Information on the nature and extent of pinniped bycatch in the SPF mid-water trawl fishery is restricted to observations between 2006 and 2007, when underwater video monitoring of trawls and seal excluder devices (SEDs) occurred. On-board observers significantly under-reported interactions because all seal mortalities were ejected from the SED opening and were undetectable by observers. Based on 151 observed interactions with a SED in place, bycatch mortality was an order of magnitude higher (19.4 seals per 100 tows) than that observed in non-SED CTS wet boat vessels.
- Seals were observed to enter mid-water trawl SPF nets at every stage of trawling. Numerically, most net entries occurred during fishing (62 per cent), which accounted for most (73 per cent) of the trawl duration. As most fishing occurred in less than 150 m of water, the net was available to seals at all stages of trawling.
- In the US and New Zealand, annual reporting of marine mammal interactions includes routine analysis of the data on protected species interactions to provide an estimated take of these species. No such analysis is available for fisheries interacting with pinnipeds in southern Australia.

Nature and extent of purse seine fishery interactions with pinnipeds: global

Documentation of interactions between purse seine fisheries and pinnipeds is generally limited to short-term studies (most in South America and South Africa) where interaction rates have been reported and analysed based on independent fishery observer programs. Examples are given below by region.

South America

Chilean industrial fishery for jack mackerel

Hückstädt and Antezana (2003) reported on interactions between the purse seine fishery for jack mackerel *Trachurus symmetricus* off central Chile and South American sea lions. They recorded interactions during 31 purse seine sets in October 1999. The main interaction was feeding, with purse seining making the fish more accessible to the sea lions and providing an easy and abundant food source that can be gained with little energetic cost. Sea lions were observed to approach fishing vessels as soon as net-setting began. The number of sea lions observed per net set ranged from 0–50 (mean of 21) and there was no relationship between the number of sea lions and school size of jack mackerel, number of fishing vessels on the fishing ground, whether fishing occurred at night or day, the presence of killer whales *Orcinus orca*, or the fish species being targeted by the fishery. Sea lions were estimated to consume 0.39 per cent of the vessel's catch during the study period or 0.45 per cent of the entire fleet's catch. These are similar to values of fish consumption estimated for interactions between Cape fur seal and purse seine fisheries off South Africa (Shaughnessy *et al.* 1981, Wickens *et al.* 1992, Wickens 1994). The presence of sea lions did not appear to cause the fish to disperse or dive, as reported in other purse seine fisheries (Shaughnessy *et al.* 1981).

Sea lions are regularly caught in purse seine nets, with animals becoming trapped when the net contents are pumped aboard (Hückstädt and Antezana 2003). Most are subsequently released alive, but some mortalities occur. During the study of Hückstädt and Antezana (2003), 20 sea lions were caught or injured (0.64 sea lions per set), two were killed (mortality rate of 0.03 sea lions per set) and 18 captured alive. One of the captured animals suffered serious injuries (dislocated lower jaw and fractured left fore-flipper), which would likely have led to its death (Hückstädt and Antezana 2003).

Chub mackerel purse seine fishery, northern Argentina

Pon *et al.* (2012) assessed the extent of seabird and marine mammal attendance in the Chub mackerel *Scomber japonicus* semi-industrial coastal purse seine fishery in northern Argentina. They observed 82 fishing operations (net hauls) between late spring 2007 and early summer 2008. The most prevalent marine mammal species observed was the South American sea lion (2 per cent of overall individuals and 8 per cent of occurrence). No sea lions were observed to be incidentally taken.

South Africa/Namibia

Off South Africa and Namibia, large purse seine fisheries have existed since the late 1940s and target anchovy *Engrualis capensis*, sardine *Sardinops sagax*, round herring *Etrumeus whiteheadi* and Cape horse mackerel *Trachurus capensis* (Shaughnessy *et al.* 1981, David and Wickens 2003). Cape fur seals eat fish being caught during the purse seine fishery operations. Shaughnessy *et al.* (1981) undertook a study of interaction between fur seals and purse seine fisheries in Namibia (mainly targeting anchovy) and recorded up to 500 seals attending nets at a time, with mean numbers ranging from 149 to 209 between throwing, setting, pursing and pumping the net (Figure 5.3). They recorded a range of impacts on fishing operations including chasing fish from the net after being set but before it is pursed and consuming fish. Seals easily moved in and out of the net by depressing the float line and sliding over it, and some fish may be lost from the net this way. Consumption of fish was not considered a major problem. Shaughnessy *et al.* (1981) reported one seal being caught in a fish pump, blocking it and finally dying; several seals were also recorded clambering up the net and climbing on board, two being chased away but a third dived into the hold and could not be removed until the vessel reached port.

Another study investigated interactions between Cape fur seals and the Cape Horse mackerel purse seine fishery in Namibia, principally with respect to overlap in the utilisation of the mackerel by the fur seals and the purse seine fishery. The study found little overlap between seals and the purse seine fishery but did not indicate if interactions and bycatch were an issue for this fishery (Mecenero *et al.* 2007).

Wickens (1994) studied the operational interactions between Cape fur seals and purse seine fisheries off South Africa where a maximum of 90 seals was seen in any one haul, with mostly between one and five seals being seen. As with the fishery in Namibia, the main issue with seal interactions from a fisher perspective was causing the fish to dive resulting in loss or partial loss of catch. Wickens (1994) estimated that detectable loss of target catch due to fur seals occurs on approximately 5 per cent of hauls, with smaller quantities of fish being lost as seals depress the net float line while moving into and out of the net. Wickens (1994) estimated the cost of the lost fish to be between 1.6 and 4.1 per cent of the landed value of the fishery. Most seals caught in a net are released alive (93 per cent) but incidental mortalities occur by drowning or animals being caught in fish pumps. Wickens (1994) estimated that with 14,221 hauls, 89 seals would die per year. She recorded significant deliberate killing of animals that are brought aboard and are clubbed due to the confines of the vessel and potential danger to crew, and estimated that these may account for 825 seals per year. Wickens (1994) noted that additional animals are shot when they are no threat to crew safety, but was unable to quantify this. At the time of the study it was estimated that probably fewer than 1000 seals a year die interacting with the fishery (Wickens 1994, David and Wickens 2003).

Figure 5.3 Cape fur seals interacting with a purse seine fishery off Namibia.

Source: Reproduced with permission from P.D. Shaughnessy.

Other locations

There is limited information on the interactions between pinniped and purse seine fisheries outside of South America and South Africa. Based on fishery-dependent data collected in the Alaska salmon purse seine fishery since 1990, there is a record of two harbour seal mortalities in 1993, but no further details (Allen and Angliss 2014).

Nature and extent of purse seine fishery interactions: Australia and the SPF

Most mid-water trawl and purse seine operations that have occurred in the SPF area have been in the south-east of Australia (principally Tasmania and Bass Strait area) where the most common seals are Australian fur seals. The major centre of the New Zealand fur seal population in Australia is off SA, with approximately 80,000 occurring in a relatively small geographic area between Kangaroo Island and the south-western Eyre Peninsula (Figure 5.4). It is the panel's view that any mid-water trawl or purse seine fishery operating in shelf waters adjacent to these areas is likely to encounter high levels of interactions. Furthermore, the other main population centre of fur seals is in the Recherche Archipelago off the south coast of WA (Figure 5.4). Again, in the panel's view, seal interactions with fishing activities would be common if a trawl or purse seine fishery was to operate in this region.

a)
b)
c)
d)

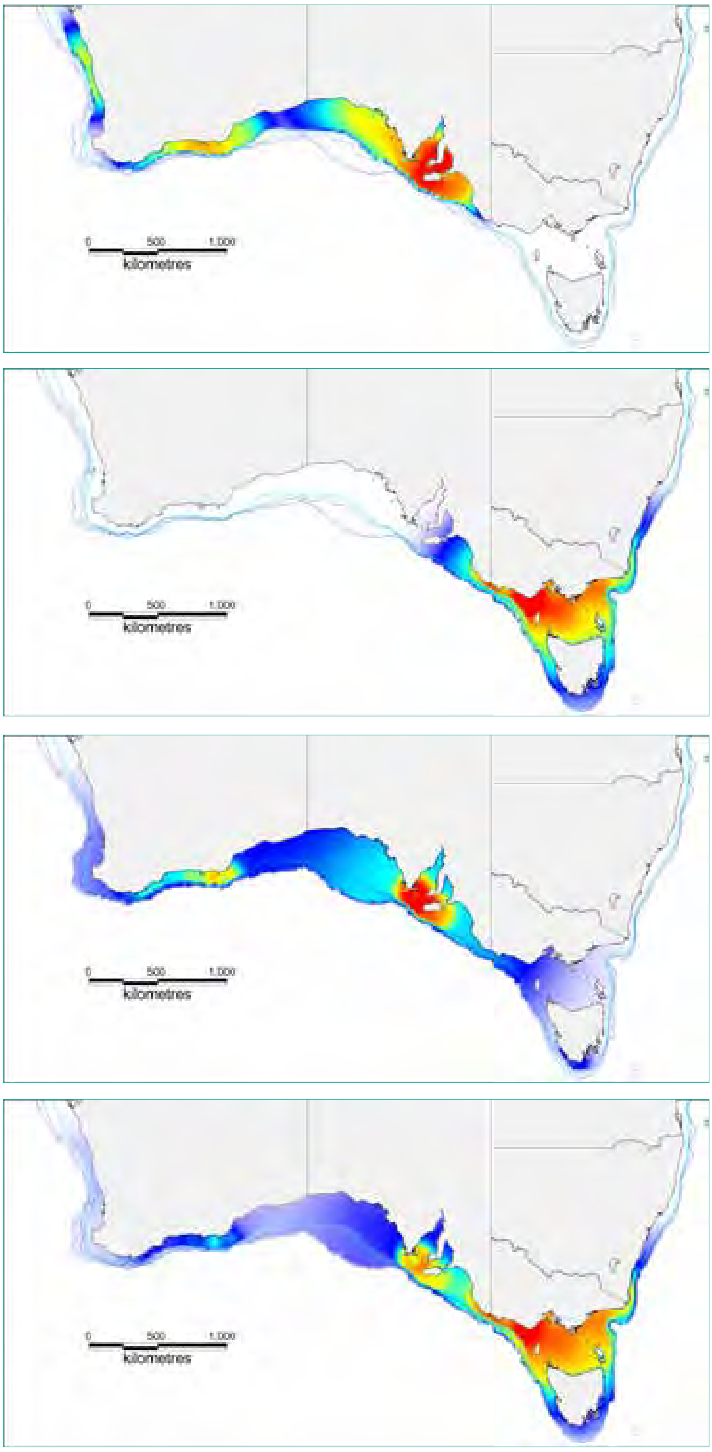

Figure 5.4 Heat plots representing the estimated spatial distribution of consumption effort by Australian sea lion (a), Australian fur seal (b) and New Zealand fur seal (c) populations, and all species combined (d). New Zealand fur seal estimates are only for consumption on shelf waters (oceanic consumption not modelled).

Source: S. Goldsworthy, South Australian Research and Development Institute, unpublished, redrawn from data presented in Goldsworthy *et al.* (2003).

South Australian Sardine Fishery

Australian sea lions have been recorded to be taken in purse seine nets in the South Australian Sardine Fishery (SASF) (D. Farlam *in litt.* April 2001 in Shaughnessy *et al.* 2003). Shaughnessy *et al.* (2003) provide anecdotal reports that the sea lions are attracted to fishing activity and sometimes appear within the perimeter of the purse seine net before fish are encircled, and that firearms have been used to discourage marine mammals, with some being shot in the water, some being killed on deck, while others escape from the net as it is retrieved from the vessel's deck.

Since July 2007, Primary Industries and Regions South Australia (PIRSA) Fisheries has implemented new arrangements requiring licence holders to record and report interactions with threatened, endangered and protected species (TEPS) in all SA commercial fisheries (Tsolos and Boyle 2014). Therefore, interactions with TEPS in the SASF are available for six years; those that pertain to pinnipeds are summarised in Table 5.2. Overall there are 140 records of seal interactions with the fishery, although the species breakdown is ambiguous as 133 (95 per cent) interactions were recorded as 'common seal', four (3 per cent) as Australian sea lions, two (1 per cent) as New Zealand fur seals and one (1 per cent) as an Australian fur seal. It is unclear as to which pinniped the 'common seal' refers to; the most numerous in the area of the fishery would be New Zealand fur seals and Australian sea lions, although it is unclear if the term is universally applied to one species or both. The term 'common seal' should not be confused with the common seal (or harbour seal) *Phoca vitulina*, which is a northern hemisphere species. The panel suspects the 'common seal' referred to by SASF licence holders is principally the New Zealand fur seal.

Most interactions (60 per cent) are classed as 'other' (animals circling the vessel, interacting with fishing gear, discovering dead animals in transit) (Tsolos and Boyle 2014), 39 per cent classed as 'caught' (presumably remaining in the net as it is being pumped), and one per cent 'entangled' (Table 5.2). About 96 per cent of animals are alive after their interaction, 2 per cent are dead and 1 per cent injured (Table 5.2). The overall interaction rate for the six years to 2012–13 is 0.024 seals per shot; the overall mortality rate is 0.001 seals per shot. There was an 11-fold decline in mean interaction rates for the periods 2007–2010 and 2010–2013 from 0.047 to 0.004 seals per shot, respectively (Table 5.2). It's unclear whether this represents a real decline or reflects a change in reporting behaviour among licence holders.

Although seal interactions are common in this fishery, it is rare for these to result in injury or mortality.

Table 5.2 Summary of pinniped interactions in the SASF between 2007–08 and 2012–13

YEAR	EFFORT (SHOTS)	TOTAL INTERACTIONS	INTERACTION RATE	NATURE OF INTERACTION			STATUS			FATE			
				CAUGHT	ENTANGLEMENT	OTHER	ALIVE	ALIVE/INJURED	DEAD	RELEASED	RETAINED	DISCARDED	OTHER
2007–08	876	39	0.045	24	2	13	35	1	3	32	3		4
2008–09	902	75	0.083	11		64	75			21			54
2009–10	1070	14	0.013	14			14			14			
2010–11	1014	1	0.001	1				1		1			
2011–12	1107	5	0.005	4		1	5			4			1
2012–13	857	6	0.007			6	6			6			

Source: Data from Tsolos and Boyle 2014.

Small Pelagic Fishery

Observations on purse seine vessels targeting surface schools of jack mackerel off the east coast of Tasmania in 1986 indicated that fur seals would follow vessels and interact with fishing activities in a manner similar to interactions between Cape fur seals and purse seine fisheries in South Africa (Shaughnessy *et al.* 1981, 2003). Fur seals are reported to cause encircled fish to dive and escape the net before it is pursed, with fur seals readily escaping over the float line (Shaughnessy *et al.* 2003).

No interactions between fur seal and purse seine fisheries have been recorded in observer or Commonwealth logbook databases. However, these reports are based on observer coverage of less than 15 per cent purse seine shots (per annum) since 2001 (Tuck *et al.* 2013). There have been no recorded interactions with TEPS in the purse seine sector of the SPF in the 2011–12 or 2012–13 fishing seasons (Moore *et al.* 2013, Moore and Stephen 2014).

Other Australian purse seine fisheries

The main Australian purse seine fisheries operating in the area of the SPF are the Southern Bluefin Tuna Fishery (SBTF), the Western Australian South Coast Purse Seine Managed Fishery (SCPSMF) and the purse seine sector of the NSW Ocean Haul fishery.

In 2013, AFMA reported that there had been some anecdotal reports of seals interacting with tow pontoons and lightly with the purse seine nets in the SBTF and there had been one logbook report of an interaction with a seal (species unidentified) being entangled in a boat propeller. The seal was reported as being alive. Up to 2013 there were no observed fatalities or injuries associated with fishing operations (AFMA 2013). There have been no reported pinniped interactions with the SBTF in the period 2013–14 (AFMA 2014e, Patterson *et al.* 2014). While the purse seine component of the SBTF is regarded as highly selective, resulting in minimal interactions with non-target species, the absence of verified independent observer data on the level of TEPS interactions is noted as an issue (Baker and Finley 2013 cited in Finley *et al.* 2015a).

The SCPSMF targets sardines. There are no records of the fishery having interactions with pinnipeds (Finley *et al.* 2015a).

Three assessments of the NSW Ocean Haul Fishery by the Department of the Environment (in 2003, 2008 and 2013) did not identify any concerns about the interactions of the fishery with any protected species. The 2013 submission to the Department of the Environment (NSW Department of Primary Industries 2013) noted that there were no observer data available but did not report any interactions with pinnipeds.

Summary: nature and extent of direct interactions between pinnipeds and purse seine fisheries

- *Fur seals and sea lions commonly interact with purse seine fisheries in the Southern Hemisphere, especially in Southern Africa (South Africa and Namibia) and South America (Chile and Argentina).*
- *Seals can impact purse seine fisheries by reducing catch by causing fish to dive before they can be pursed. Seals within the net eat some fish but this is typically a very small fraction of the catch.*
- *Seals typically move in and out of a pursed net with ease by depressing the float line and sliding over it. Some fish may be lost from the net this way.*
- *The vast majority of interactions are non-lethal, with seals taking advantage of purse seine fisheries that provide an abundant and easy food source that can be gained with little energetic cost compared to normal foraging.*
- *Interactions between seals and purse seine fishing in the SPF are rare, but are more common in the SASF.*

5.2.3 Management of pinniped interactions

Management of operational interactions with pinnipeds in mid-water trawl fisheries

Management and mitigation of pinniped interactions with trawl vessels can include modifications to fishing gear (such as incorporating SEDs in the trawl net), modifications to fishing behaviour, bycatch trigger limits, move-on rules and spatial closures. Management and mitigation methods used in both global and domestic mid-water trawl fisheries, including the SPF, were assessed in detail in the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014, Section 5.2.3). A summary of these assessments is provided below.

Seal excluder devices

- Although excluder devices are commonly used in trawl fisheries globally as a means to mitigate bycatch of marine megafauna, with the exception of one Antarctic fishery, SEDs are mostly used in New Zealand and Australian fisheries.
- SEDs are typically tailored to individual fisheries, fishing vessels and bycatch species because a single design is not suitable for all circumstances.
- A SED functioning under optimal operating conditions should reduce the incidence of bycatch mortality of pinnipeds, but will not eliminate it.
- SEDs leave on-board observers effectively blind to the extent of interactions and to the effectiveness of the devices in ejecting seals in a healthy state from the net. Underwater video monitoring of SEDs is therefore necessary to monitor interaction levels and cryptic mortality and to optimise SED design and efficacy.
- Innovations in SED design are emerging from the winter blue grenadier fishery in the SESSF. These include a hydrostatic net release, an acoustic transponder release grid gate and installation of smaller-sized mesh on the hood. The acoustic SED shows promise for demersal trawling activities that take place below the normal diving range of seals. They are less likely to be effective in shallower, mid-water trawling where seals can access the net at any stage.
- SED trials in the mid-water trawl fishery of the SPF indicated lower seal mortality with a larger SED opening (in a bottom-opening SED). Top-opening SEDs could not be fully evaluated due to operational difficulties.

Other management measures

- Codes of practice have been used to reduce the level of interactions with seals. The most relevant elements of these include:
  - removing all 'stickers' before shooting the trawl
  - undertaking shooting and trawling as quickly as possible
  - suspension of trawling and moving away if seals are observed prior to trawling
  - no discarding of fish, offal or domestic waste on fishing grounds.
- Spatial closures can provide an effective means of reducing or removing fishing activity in locations or at times where direct interactions with seals are likely to be common, or present unacceptable risks to threatened or protected species' populations.
- Bycatch trigger limits are generally utilised to ensure that bycatch levels of protected species do not exceed a threshold that places the species or population at risk of further declines. They have been used to cap incidental mortality of the threatened New Zealand sea lion in the Auckland Island squid trawl fishery, and in Australia, AFMA uses bycatch trigger limits to limit the bycatch of the threatened Australian sea lion in the Gillnet, Hook and Trap (GHAT) Fishery.

Management of operational interactions with pinnipeds in purse seine fisheries

Shaughnessy *et al.* (1981) report that purse seine fisheries off south-west Africa in the 1970s used firearms and weighted firecrackers ('Thunderflashes', 'Belugas' and 'Seal Deterrents') that exploded underwater to scare seals away from purse seine nets. They undertook a range of deterrent trials during fishing operations in the late 1970s to test the effectiveness of firecrackers, killer whale vocalisations, 0.303 rifle shots (fired over the heads of seals and in the water) and an arc-discharge transducer that was designed to produce an underwater shock wave at similar levels to firecrackers and 0.303 bullets. Although seals responded to firecrackers they soon returned. Seals moved away from 0.303 rifle shots fired into the water but not overhead and they responded to killer whale vocalisation and arc-discharge but did not leave the purse seine net. The general conclusion of these trials was that the deterrents tested were ineffective in reducing interactions between seals and purse seine fisheries (Shaughnessy *et al.* 1981).

Wickens (1994) reported that seals that managed to get onto vessels in the South African purse seine fishery when nets were pumped and hauled (and become a potential threat to the safety of the crew), were generally clubbed and dumped. Many others were shot in the water despite no threat to crew safety (Wickens 1994). The panel could not find any recent information to indicate if these practices are continued today.

The panel could not locate any relevant information in relation to the management of seal interactions with purse seine fisheries in South America.

Management of direct interactions with pinnipeds in the SPF

Mid-water trawl

Part 13 accreditation of the SPF under the EPBC Act requires that:

- Prior to fishing, mid-water trawl vessels must have in place effective mitigation approaches and devices to the satisfaction of AFMA to minimise interactions with dolphins, seals and seabirds.
- AFMA requires that at least one observer be deployed on each new mid-water trawl vessel for the first 10 fishing trips with additional observer coverage or other monitoring implemented as appropriate, following scientific assessment of the SPF.

AFMA enforces this by requiring the development and implementation of an approved Vessel Management Plan (VMP) that sets out operational and management approaches to minimise and mitigate interactions with marine mammals and seabirds. These plans are developed by AFMA in consultation with the Department of the Environment and industry and all SPF mid-water trawl operators are required to comply with and enforce them onboard. With respect to onboard-observer coverage, AFMA has an observer coverage target of 20 per cent of shots and, in accordance with the Part 13 accreditation above, observer coverage of the first 10 trips is required for new boats entering the fishery or existing boats moving into significantly new areas.

An AFMA-approved SED is compulsory for all mid-water trawl vessels in the SPF (AFMA 2014d) and management actions under the SPF Bycatch and Discarding Workplan include implementing upward-opening SEDs and developing VMPs for each mid-water trawl vessel operating in the fishery to minimise the risk of interactions with seabirds, seals and dolphins (AFMA 2014b).

Purse seine

AFMA considers that the risk of bycatch of TEPS when using purse seine gear is low noting that there have been no reported purse seine gear interactions with TEPS since the first SPF Bycatch and Discarding Workplan commenced in 2009, and very low levels of reported interactions before that (AFMA 2014b). The observer coverage target for purse seine in the SPF is 10 per cent of shots or the first five trips for new boats entering the fishery or existing boats moving into significantly new areas (AFMA 2014b).

In contrast to mid-water trawl, use of the purse seine fishing method in the SPF does not require a VMP. Instead, the Commonwealth Small Pelagic Fishery Purse Seine Code of Practice (SPF CoP) (Anon. 2008a) includes voluntary operating practices to minimise impacts on the environment, particularly to TEPS. With respect to pinnipeds, Clauses 3.3, 3.4 and 3.5 are most relevant:

"3.3 Fishers will make every reasonable endeavour to return any captured individual of a Threatened, Endangered, or Protected Species (TEPS) alive:

- having priority of consideration for the safety of the vessel crew members engaged in the release of the animal; and
- in a manner that, where appropriate, utilises techniques outlined in the "Protected Species Handling Manual" produced by Ocean Watch Australia Ltd.

3.4 Recognising the wide range of vessel sizes, gear configurations, style, and operational practices of the purse seine fleet, each such vessel shall employ one or more of the following TEPS Mitigation Practices.

3.4.1 Where a TEPS is captured by the fishing operation, when any such TEPS cannot be released by the application of 3.3 and the TEPS exhibits unreasonable distress, the vessel Master shall terminate the shot and release one end of the net to enable release of the contents of the net by towing the net open whilst maintaining tension on the net wall to minimise entanglement opportunities until such time that TEPS have exited the net.

3.4.2 Where a TEPS is observed within the deployed purse seine net the TEPS Mitigation action relevant to the circumstances is undertaken consistent with the premise that early detection and action is the key to successful mitigation of TEPS interactions.

3.5 Purse seine operations are not required to undertake the mitigation actions contained in Clause 3.4 and its sub-clauses above where Marine Birds and/or Seals and Sea Lions are the only TEPS interactions experienced and the animals are not displaying undue distress:

- noting with respect to Seals and Sea Lions that they exhibit rapid habituation with fishing operations and both enter and exit purse seine nets of their own free will, skilfully without difficulty, and with minimal/insignificant mortality as identified in the historical experience of the NSW, S.A. and Tasmanian purse seine industry and independent observations of purse seine operations in the S. Aust Pilchard fishery, as well as the Department of Environment, Water, Heritage & the Arts (DEWHA) risk assessment for the purse seine gear method;
- should a Seal or Sea Lion exhibit undue distress whilst in a purse seine net appropriate action will be undertaken to mitigate the interaction consistent with 3.3 and/or 3.4;
- further noting that access to the air/water interface is available at all times during purse seine operations to any seal or Sea Lion as an inherent nature of purse seine operations; and
- noting that any interactions with seabirds will be consistent with Clause 3.3 above." (Anon. 2008a)

The panel found that the "Protected Species Handling Manual" (Anon. 2008b) referred to in the SPF CoP outlined procedures for handling seals, mainly in relation to disentangling them from fishing gear, and does not provide information that would be most useful for fishermen having to deal with removing live seals from nets that have been pursed or 'dried-out', or for removing them from the decks of vessels.

5.2.4 Nature and extent of direct interactions of the FPA with pinnipeds

The likely nature and extent of pinniped interactions with the FPA, considering the particular impact of fishing methods, fishing effort and transhipment is provided below.

Fishing method

As detailed above and in Section 5.2.2, most pinniped interactions (particularly bycatch mortality) in the SPF have occurred in the mid-water trawl sector of the fishery. Given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels than the typical SPF fleet, it would likely result in more interactions and greater pinniped bycatch mortality compared with those of the SPF to date.

Fishing effort

As discussed in Section 4.4.2 the panel considered that compared with the typical and particularly the recent SPF fleet, the ability to tranship fish under the FPA would result in increased effort and catch in both the purse seine and mid-water trawl sectors. The panel could not quantify this increase nor could it determine whether fishing effort and catch would be more or less concentrated (see Section 4.4.3). Factors that could influence the number and/or the rate of interactions with pinnipeds under the FPA include the configuration of the fleet in terms of fishing method, any change in the spatial and temporal pattern of fishing, and the process of transhipment.

Spatial and temporal pattern of fishing

The extent of the change in the rate of interaction with pinnipeds will largely be determined by whether the FPA fleet fishes in areas or at times of the year that have not been fished previously. As noted above, the particular potential for mid-water trawl activities to fish in areas of high pinniped density, or in regions that significantly overlap with the distribution of the Australian sea lion, not previously fished could have significant implications on the nature and extent of interactions (including bycatch mortality), of protected and threatened pinnipeds.

The introduction of a processing vessel would extend the range of the catching fleet and thus there is scope for a change in the spatial and temporal pattern of fishing. If this occurred, there may be a change in the number of interactions, the species encountered and the risk profiles of these species from that of the past. The panel believes that the FPA will enable the catching fleet to fish more broadly in the SPF than in the past. However, as discussed in Chapter 4, it is not possible to predict with any certainty the spatial and temporal pattern of fishing under the FPA. As a result there is some uncertainty about the potential rate of direct interactions with pinnipeds under the FPA.

Transhipment

Catches of purse seine vessels fishing under the FPA are at the surface, and therefore more readily available to pinnipeds, while the catch is transhipped/pumped to the processing vessel. The panel noted that such pumping had occurred previously in the earlier Jack Mackerel Fishery (JMF) and the SPF without any significant pinniped interactions and that any pinnipeds attracted to feed on fish in the purse seine net would be able to escape given that the net is open at the surface.

The panel assumed that discarding from purse seine vessels would be allowed under the FPA. This has been the case in the SPF to date and in the earlier JMF where transhipment occurred. Since interactions with pinnipeds in the purse seine sector of the SPF and the JMF have been low, the panel considered that any accidental loss of fish during transfer from purse seine vessels to the processing vessel under the FPA would pose no additional risk to pinnipeds.

As noted in Chapter 4, the panel assumed that the VMPs for mid-water trawl vessels would prohibit the discarding of any biological material while gear (including the pump) was in the water, thus avoiding any increased risk of interaction with, and fatality of, pinnipeds.

The panel concluded that the transhipment of fish to the processing vessel via pumping was unlikely to pose a greater risk to pinnipeds than pumping operations to transfer fish from the net to the vessel in the declared commercial fishing activity assessed under the first declaration (DCFA1) and in the typical SPF, or in the earlier JMF where fish were routinely 'transhipped' between fishing vessels.

Panel assessment: likely nature and extent of direct interactions of the FPA with pinnipeds

- *The extent of interactions of the FPA with pinnipeds will depend on the actual fleet configuration, the fishing practices adopted, the level of fishing effort, the spatial and temporal pattern of fishing and the pinniped mitigation measures used.*
- *While there remains some uncertainty about the possible loss of fish during transhipment and the potential for such loss to increase pinniped interactions, there is no evidence to suggest that the practice of transhipment poses a specific risk to pinnipeds.*
- *Seal interactions with mid-water trawl activities are more likely to result in bycatch mortality compared with interactions with purse seine fisheries, where seals can readily move in and out of the net over the float line and are not usually impeded in accessing the surface to breathe.*
- *Historically, mid-water trawl and demersal trawl operations that have occurred in the SPF area have been in the south-east of Australia where most interactions are with Australian fur seals.*
- *If the presence of the processing vessel allows fishing to extend into areas not previously fished, this could result in a difference in the rate of interactions and the species involved.*

- *If mid-water trawl fishing under the FPA were to operate in areas where threatened Australian sea lions occur, some level of direct interactions with this species, including bycatch mortality, is inevitable.*
- *There is uncertainty about the extent of interactions with pinnipeds if the FPA catching fleet and particularly the mid-water trawl vessels fished off SA and WA. In these regions, New Zealand fur seals and Australian sea lions are most common. Neither species has been exposed to the level of bycatch mortality from trawl fisheries experienced by Australian fur seals, so there is uncertainty about the differential impacts of bycatch on their populations. This is especially significant for the threatened Australian sea lion.*
- *The extent of interactions with the FPA would likely be higher than the DCFA1 and the typical SPF fleet, but while interactions in the purse seine fleet may be higher, mortality in that sector of the FPA is likely to remain low.*
- *Compared to the typical SPF fleet:*
  - *there would be more effort under the FPA and this would likely result in a greater number of interactions*
  - *the FPA scenario would likely result in an increase in pinniped bycatch mortality given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels*
  - *if the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect that the rate of interactions with pinnipeds might change and potentially involve interactions with all three pinnipeds rather than just fur seals.*
- *Compared to DCFA1:*
  - *The number of interactions with pinnipeds under the FPA may be less, similar or more, depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel, then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.*
  - *The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). This may mean that they are more likely to fish closer inshore than DCFA1 and potentially have more interactions with protected central place forager (CPF) species such as fur seals and sea lions.*

5.2.5 Assessment of the effectiveness of the proposed measures to mitigate impacts

Mid-water trawl

No specific measures had been proposed for the FPA, but it is assumed that the routine management arrangements for the SPF (AFMA 2014e) would be applied to all purse seine and mid-water trawl vessels in the FPA catching fleet. VMPs would be required for mid-water trawl vessels. The most important element of VMPs, with respect to reducing bycatch mortality of pinnipeds, is the requirement for nets to be fitted with an AFMA-approved SED. The panel notes that while the SPF Bycatch and Discarding Workplan (AFMA 2014b) refers to implementation of upward-opening SEDs, the SPF Management Arrangements Booklet (AFMA 2014d) does not specify that the SED must have an upward-opening escape hatch. In addition, the panel is unable to determine which type of SED would be used. As the VMPs are vessel specific, the type of SED used (e.g. soft-grid vs hard metal grid) may depend on the type of fishing vessel used (see Expert Panel on a Declared Commercial Fishing Activity 2014). With respect to mitigating impacts to pinnipeds using the mid-water trawl method, the panel has identified four key differences between DCFA1 and the FPA/typical SPF fleet. These are discussed below.

Hooded SED with underwater monitoring

Top-opening SEDs enhance the escape of pinnipeds but reduce the incidence of bycatch observed by on-board observers because dead seals typically fall out of the escape hole while fishing, hauling or pumping the net. A hooded SED increases the retention of seal mortalities but is not 100 per cent effective, leading to unobserved 'cryptic' mortality. The first declaration report identified that the underwater video monitoring proposed in the DCFA1 would be essential to monitoring SED efficacy and cryptic mortality, so that overall pinniped mortality rates could be monitored (Expert Panel on a Declared Commercial Fishing Activity 2014). The panel notes that under the FPA, there would be no mandatory requirement for hooded-SEDs or underwater video monitoring, and as such, potentially no capacity to monitor cryptic mortality or assess SED efficacy.

Observer coverage

Under the DCFA1 scenario there was a requirement for 100 per cent observer coverage, whereas under the FPA scenario there is only a target of 20 per cent observer coverage. The panel notes that the reduced level of observer coverage would significantly reduce the capacity to independently verify pinniped interactions. This would be particularly problematic if underwater monitoring was implemented, since it would reduce the ability to monitor cryptic mortalities in near real time.

Bycatch trigger limits and move-on rules

Under the DCFA1, Part 13 accreditation (Condition 1, see Section 3.1) seal bycatch trigger limits were imposed (three or more seals in each of three consecutive shots; or more than 10 seals within a 24-hour period of fishing; or more than 10 seals in one shot), which if exceeded, resulted in a suspension of fishing activity and implementation of move-on rules. Trigger limits are not part of the routine AFMA management arrangements for the SPF and would not necessarily be applied to the FPA catching fleet.

Australian sea lion closures

Under the DCFA1 Part 13 accreditation (Condition 1), fishing was not permitted within the SPF area on the continental shelf that overlapped with the Australian sea lion closure area between 129° 00' E and 140° 05'E out to the 150 m depth contour. This is not part of the routine AFMA management arrangements for the SPF and would not necessarily be applied to the FPA catching fleet.

Purse seine

AFMA does not require VMPs for purse seine vessels nor does the SPF CoP address the issue of discards of biological material. The panel assumed that purse seine vessels operating under the FPA would be permitted to discard fish. As noted above, the panel found that the protected species handling manual referred to in the SPF CoP does not provide information for fishermen on how to safely remove live seals from nets that have been pursed or 'dried-out', or for removing them from the vessel deck.

Panel assessment: effectiveness of proposed measures

- *SEDs are required as part of mid-water trawl VMPs. The implementation of upward-opening SEDs under the SPF Bycatch and Discarding Workplan will, if implemented, enhance the escape of pinnipeds, but reduce the incidence of bycatch observed by on-board observers because dead seals typically fall out of the escape hole while fishing, hauling or pumping the net.*
- *Hooded SEDs increase the retention of seals but are not 100 per cent effective, leading to unobserved 'cryptic' mortality.*
- *The panel notes that, unlike DCFA1, under the FPA and in the typical SPF fleet, there are no mandated requirements for:*
  - *upward-opening SEDs*
  - *100 per cent observer coverage*
  - *hooded-SEDs or underwater video monitoring, and as such, potentially no capacity to monitor cryptic mortality or assess SED efficacy*
  - *bycatch rates/trigger limits and move-on rules*
  - *limiting and managing Australian sea lion mortality through a specific area closure.*
- *The panel notes that the protected species handling manual referred to in the SPF CoP does not provide information for fishermen on how to safely remove live seals from nets that have been pursed or 'dried-out', or for removing them from the vessel deck.*

5.2.6 Actions to avoid, reduce and mitigate adverse environmental impacts of the FPA on pinnipeds

Panel advice: actions to avoid, reduce and mitigate adverse environmental impacts on pinnipeds

The panel considered that the following actions could be taken to manage the risk of adverse environmental impacts arising from direct interactions of the FPA's purse seine and mid-water trawl catching fleet with pinnipeds:

Mid-water trawl

- *VMPs for mid-water trawl vessels should stipulate the use of an upward-opening SED, with hood, with the requirement for underwater monitoring of SED efficacy and cryptic mortality to assess and improve performance.*
- *VMPs should include daily and per-shot trigger limits on fur seals and stipulate move-on rules requiring a vessel to move to an area where interactions with seals are less likely.*
- *Introduce a bycatch rate trigger limit for fur seals for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas.*
- *Ensure 100 per cent observer coverage of all mid-water trawl fishing operations and, if daily or per shot trigger limits are used in conjunction with move-on rules or with a requirement to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.*
- *Require 'stickers' to be removed from trawl nets before shooting.*
- *Implement spatial closures for mid-water trawl that mitigate bycatch interactions with fur seals, especially in regions adjacent to breeding colonies where there is high transit and foraging activity by central place foraging lactating adult females.*
- *Implement Australian sea lion closures off SA, as specified in Condition 1 (e) for the DCFA1 (see Section 3.1) amended to include waters out to 183 m depth, consistent with the outer extent of the gillnet component of the GHAT fishery.*
- *If such closures off SA are not implemented, bycatch trigger limits and management arrangements for Australian sea lion in the mid-water trawl sector of the SPF should be introduced consistent with those in the Australian sea lion Management Zones in the GHAT fishery.*
- *Implement mid-water trawl closures and bycatch trigger limits for Australian sea lion colonies occurring within the SPF off WA.*

Purse seine

- *Review the protected species handling manual referred to in the SPF CoP to ensure it provides information on how to safely remove live seals from purse seine nets that have been pursed or 'dried-out', and for removing them from the vessel deck.*

5.2.7 Research and monitoring to reduce uncertainties

For global pinniped populations, as for those in Australia, the most significant source of anthropogenic mortality is from fishery interactions (Shaughnessy 1999, National Seal Strategy Group and Stewardson 2007, Kovacs *et al.* 2012). In Australia, the most significant source of fishery-related pinniped bycatch is from trawl fisheries. A fishery targeting the key prey taxa of pinnipeds in their foraging grounds and within their foraging depth range will inevitably attract many animals, and potentially (as demonstrated in the mid-water trawl fishery of the SPF to date) result in significant levels of bycatch mortality. The panel has proposed a number of ways in which direct interactions of the FPA with pinnipeds might be mitigated. The panel also identified four key uncertainties (questions) relating to potential adverse impacts on pinnipeds resulting from the FPA that could be addressed through further monitoring and research. They essentially follow those detailed in the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014).

1. What are the individual and cumulative fishery-related bycatch impacts on pinniped populations?

Seals interact with and potentially suffer incidental mortality from a range of different fisheries. A key uncertainty in assessing the potential adverse impacts resulting from any one fishery (such as the FPA in the SPF), is the extent to which that fishery contributes to the total impacts across all fisheries. The panel considered that improved independent monitoring of pinniped bycatch and a requirement for annual reporting of estimated take of pinnipeds by all Australian fisheries is needed. This would enable the estimation of overall cumulative impacts on pinniped populations, and enable assessment of the relative contribution of individual fishery impacts.

2. What levels of fishery-related mortality can pinniped populations sustain?

Improved pinniped population models and ongoing monitoring of status and trends in abundance would provide a means to better evaluate what levels of bycatch mortality are sustainable, and reduce uncertainties about the potential for adverse environmental impacts. It would provide essential biological context to estimates of individual and cumulative fishery impacts (addressed in question one, above), and provide a direct quantitative measure to directly assess a fishery against Part 13 of the EPBC Act which requires that "the fishery does not, or is not likely to adversely impact the conservation status of protected species or affect the survival and recovery of listed threatened species". Such information would not only inform what bycatch levels are sustainable, but also assist in apportioning and setting allowable take and maximum bycatch rate trigger limits for individual fisheries.

3. Where are the regions of critical foraging habitat for pinniped populations where the management of direct interactions with the FPA may be most needed?

The panel considered that research to better understand the foraging distributions and critical habitat of pinnipeds could help identify regions where management of the potential adverse environmental effects of fishing may be most needed. There are two key components to such work.

(a) Knowledge of the locations of key foraging areas where adult females may be particularly vulnerable to bycatch mortality in near-colony waters. Adult female fur seals and sea lions spend most of their lives raising pups. The need to return regularly ashore to nurse a dependent pup requires that females make regular foraging trips to sea to forage. Bycatch of females has a disproportionate effect on populations (loss of mother, pup on teat and one in utero and future reproductive potential) compared to males. Reducing female bycatch can help reduce uncertainties about the potential for adverse impacts on pinniped populations. Such information may inform the location and timing of spatial closures to mitigate bycatch.

(b) Knowledge of the locations of foraging hot-spots (areas of high-density foraging) used by one or more populations of seals could provide important information on which areas could be avoided to reduce the incidence and rate of bycatch.

4. Are there additional modifications to fishing gear and behaviour that can reduce the potential for direct interactions by the FPA with pinnipeds?

The panel considered that additional research and fishing trials could be undertaken to optimise the SED design, or trial alternate SED designs appropriate to different fishing vessel and gear used by mid-water trawl vessels in the FPA. This would include testing of appropriateness of soft vs hard grids, optimising the slope of the grid and configuration of the escape hole, hood and kites with the objective of improving the exit of healthy seals.

On-board observers should be required to monitor seal activity both on the surface and within the net via underwater video monitoring, so that a data base can be developed to improve the understanding of the circumstances under which seal activity and interaction increase and decrease. This would help inform and promote codes of practice to further reduce interactions and maximise survival.

Panel advice: research and monitoring to reduce uncertainties

Research that addresses the following questions could reduce uncertainties about the potential for adverse environmental impacts of the FPA on protected pinniped species:

- *What are the individual and cumulative fishery-related bycatch impacts on pinniped populations?*
- *What levels of fishery-related mortality can pinniped populations sustain?*
- *Where are the regions of critical foraging habitat for pinniped populations where the management of direct interactions with the FPA may be most needed?*
- *Are there additional modifications to fishing gear and behaviour that can reduce the potential for direct interactions by the FPA with pinnipeds?*

5.3 Cetaceans

5.3.1 Species assessed

A total of 47 cetacean species are recorded to occur in Australian waters (Bannister *et al.* 1996, Ross 2006, Woinarski *et al.* 2014), and of these, 44 species are known or are likely to occur in the SPF area (Appendix 3). Of these 44 species, 42 species were assessed in the Ecological Risk Assessment for the Effects of Fishing (ERAEF) process for the purse seine and mid-water trawl sectors of the SPF (Daley *et al.* 2007a, b). The two additional cetacean species recorded to occur in the SPF region (but not assessed in the ERAEF) are Omura's whale *Balaenoptera omurai* and spectacled porpoise *Phocoena dioptrica* (Woinarski *et al.* 2014).

The ERAEF Level 2 productivity-susceptibility analysis (PSA) for the mid-water trawl sector of the SPF identified a total of 20 threatened, endangered and protected cetacean species as High risk, a further 21 cetacean species as Medium risk, and one cetacean species as Low risk (Appendix 3). After Level 2 Residual Risk Guidelines were applied, seven cetacean species remained at High risk for the mid-water trawl sector of the SPF (AFMA 2010b). These are:

- Risso's dolphin *Grampus griseus*
- Fraser's dolphin *Lagenodelphis hosei*
- hourglass dolphin *Lagenorhynchus cruciger*
- southern right whale dolphin *Lissodelphis peronii*
- striped dolphin *Stenella coeruleoalba*
- Indo-Pacific bottlenose dolphin *Tursiops aduncus*
- common bottlenose dolphin *Tursiops truncatus.*

Species summaries of these seven species and 14 other cetacean species known to occur in the SPF and recorded to have interacted with mid-water trawl vessels in Australia and/or internationally, can be found in Section 5.3.1 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014) which focused exclusively on interactions with mid-water trawl vessels.

The ERAEF Level 2 PSA analysis for the purse seine sector of the SPF identified a total of 27 threatened, endangered and protected cetacean species as High risk and a further 15 cetacean species at Medium risk (Appendix 3). After Level 2 Residual Risk Guidelines were applied, 26 species remained at High risk for the purse seine sector of the SPF (AFMA 2010a). Species summaries for 11 of those species can be found in Section 5.3.1 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014) since these were included in the 21 cetacean species recorded to remain at High risk for the mid-water trawl sector and/or to have interacted with trawl fisheries in Australia and/or internationally. Summaries of the remaining 15 species are provided below. The first 14 species are odontocete species and the common minke whale *Balaenoptera acutorostrata* is the sole mysticete whale in the group. The area of waters fished by purse seine in the SPF during 2000–2013 in relation to the species richness of the 26 cetacean species assessed as at High risk from purse seine is shown in Figure 5.5.

Across both mid-water trawl and purse seine gear types, the panel has assessed a total of 36 cetacean species (82 per cent of cetacean species known or likely to occur in the SPF area). The total area of waters fished by purse seine and mid-water trawl effort in the SPF during 2000–2013 in relation to the species richness of these 36 species, based on the available distribution data for these species held by the Department of the Environment, is shown in Figure 5.6.

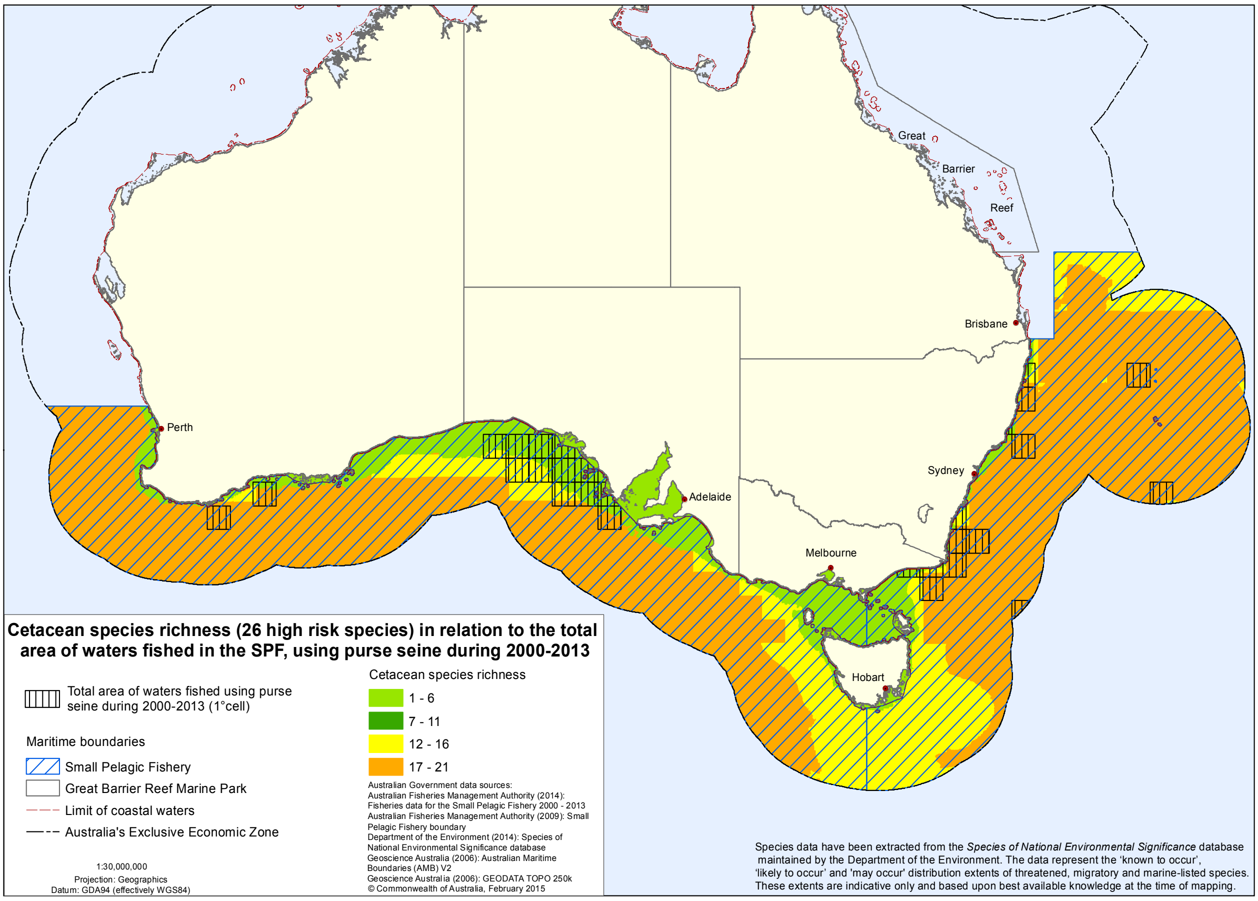

Figure 5.5 Cetacean species richness (26 High risk species) in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN, Department of the Environment using unpublished AFMA data.

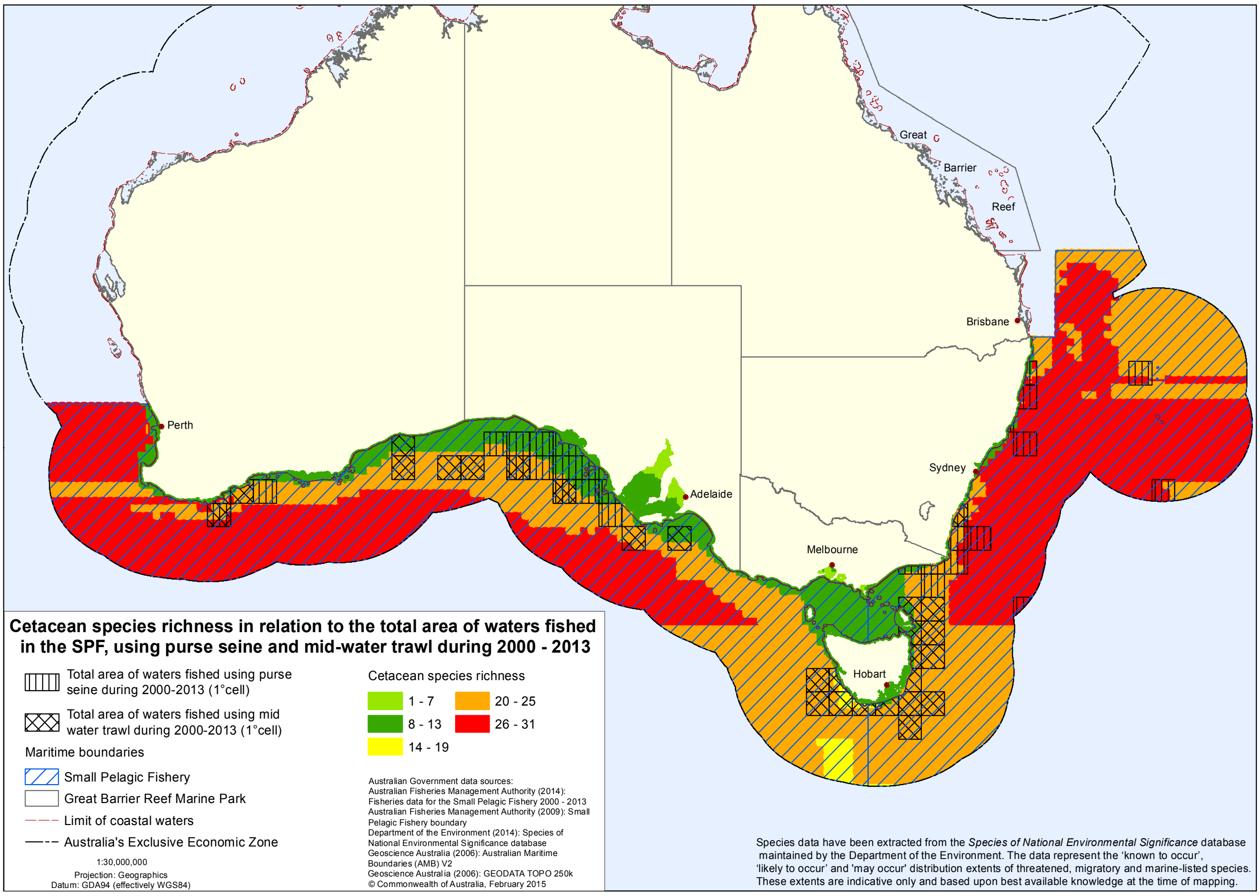

Figure 5.6 Cetacean species richness (36 species) in relation to the total area of waters fished in the SPF using purse seine and mid-water trawl during 2000–2013. **Source:** Map produced by ERIN, Department of the Environment using unpublished AFMA data.

Dwarf sperm whale *Kogia sima* (Level 2 PSA Residual Risk – High)

Distribution and range

Dwarf sperm whales have a broad cosmopolitan distribution in warm temperate to tropical regions of the Pacific, Indian and Atlantic Oceans (Nagorsen 1985, McAlpine 2009). They have also been recorded from the Persian Gulf and the Sea of Japan, with one extra-limital record from the Mediterranean Sea (Taylor *et al.* 2008a, Jefferson *et al.* 2008). They are not commonly observed at sea and their distribution is largely unknown, with most records from stranded animals (Jefferson *et al.* 2008, McAlpine 2009). Molecular analyses have demonstrated that two distinct clades occur within *K. sima,* with one occurring only in the Indo-Pacific region and the other only occurring in the Atlantic Ocean (Chivers *et al.* 2005).

Around Australia, dwarf sperm whales have been recorded as stranded animals from NSW, Tasmania, SA, WA, the Northern Territory, and at Scott Reef off north-western Australia, with one live individual sighted in SA waters (Bannister *et al.* 1996, Chatto and Warneke 2000, Ross 2006). Their southern Australian range overlaps extensively with the SPF area.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of dwarf sperm whales and the Australian and global population trends are unknown (Ross 2006, Taylor *et al.* 2008a, Woinarski *et al.* 2014). There are estimated to be about 19,170 (coefficient of variation (CV = 66 per cent)) dwarf sperm whales off Hawai'i and about 11,200 (CV = 29 per cent) in the eastern tropical Pacific (Wade and Gerrodette 1993, Taylor *et al.* 2008a).

Biology and feeding ecology

Dwarf sperm whales grow to about 2.5–2.7 m long and can weigh up to 272 kg, and males may be slightly larger than females (Jefferson *et al.* 2008). They occur primarily offshore in deep water over continental shelf edge and slope areas, with older individuals occurring in deeper water habitats (Plön 2008). Relatively little is known about their biology and ecology as they are rarely observed alive and most records are from stranded individuals (Jefferson *et al.* 2008, McAlpine 2009). Dwarf sperm whales tend to be solitary, or occur as mother and calf pairs, with some larger group sizes reported that usually consist of less than six and sometimes up to 10 individuals (Plön 2008, Jefferson *et al.* 2008).

Dwarf sperm whales prey on a wide range of deep-water squid and small continental shelf cuttlefish species, and on some mesopelagic fish and pelagic crustaceans (Ross 1979, Nagorsen 1985, West *et al*. 2009, McAlpine 2009, Staudinger *et al*. 2014). Few data are available on dive times, with a maximum-recorded dive duration of 53 minutes (Plön 2008). There are no known breeding or calving grounds in Australian waters; waters off the southeast coast of South Africa are thought to be a calving ground (Plön 2008). Age at sexual maturity is estimated to be about three years for males and about five years for females; gestation is estimated to be 11 months, with a calving interval of one to two years (Ross 2006, Plön 2008). Males may compete primarily by sperm competition rather than direct aggression (Jefferson *et al*. 2008). In southern African waters, annual ovulation is thought to occur in a high percentage of females, with a seasonal peak in births observed from December to March (Ross 2006, Plön 2008). Maximum age estimates are 17 years for males and 22 years for females (Plön 2008), and generation length is estimated to be 11.7 years (Taylor *et al*. 2007).

Risks and threatening processes

Dwarf sperm whales were occasionally harpooned by whalers during the 1800s, and some are taken in harpoon fisheries in the Caribbean, Japan, Indonesia, Sri Lanka and Taiwan (Reeves *et al*. 2003, Taylor *et al*. 2008a). This species is also occasionally reported as bycatch mortality in fisheries throughout their range and as bushmeat in Ghana (McAlpine 2009, Weir and Pierce 2013, Reeves *et al*. 2013). Segniagbeto *et al*. (2014) reported one stranding in the Gulf of Guinea that was thought to have resulted from capture in a drift gillnet by local fishers.

Dwarf sperm whales have been recorded to ingest plastic debris resulting in intestinal blockage and death, and high levels of anthropogenic noise and acoustic disturbance have been associated with mass stranding of this species (Taylor *et al*. 2008a). Other threats include vessel strikes that have caused mortality, pollution resulting in high levels of contaminants in tissues, and climate and oceanographic variability and change (Taylor *et al*. 2008a, Woinarski *et al*. 2014).

Conservation and listing status

The dwarf sperm whale is listed as a cetacean species (as *Kogia simus*) under the EPBC Act, Rare in SA, Data Deficient in the Northern Territory, but is not listed in other States within its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al*. 2014), and similarly in previous Australian conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, the dwarf sperm whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al*. 2008a) and is listed in Appendix II of CITES.

Southern bottlenose whale *Hyperoodon planifrons* (Level 2 PSA Residual Risk – High)

Distribution and range

Southern bottlenose whales have an extensive circumpolar Southern Hemisphere distribution extending from about 30°S southward to the edge of the Antarctic pack ice (Warneke 2008a, Gowans 2009, Van Waerebeek *et al*. 2010). Most records are between 57°S to 70°S, with known areas of concentration between 58°S and 62°S in the eastern Indian and Atlantic oceans (MacLeod *et al*. 2006, Jefferson *et al*. 2008a). The species description was based on a skull collected in the Dampier Archipelago WA at 20°S (Warneke 2008a), which suggests some occasional dispersal of individuals to warmer waters beyond their main range (Woinarski *et al*. 2014).

The distribution of southern bottlenose whales in Australian waters is poorly known, with stranding records including the type specimen from WA, SA, Victoria, Tasmania, NSW and subantarctic Heard Island (Bannister *et al*. 1996, Kemper *et al*. 2005, Ross 2006, Groom *et al*. 2014). Their Australian range overlaps extensively with the SPF area from NSW across to WA.

Population size and trends

There are no reliable estimates of the abundance of southern bottlenose whales in Australian waters, and Warneke (2008a) noted that they were possibly abundant. Their global abundance is unknown but they are the most commonly sighted beaked whale in Antarctic waters and one estimate of abundance of about 500,000 south of the Antarctic Convergence in January is likely to be an underestimate (Taylor *et al*. 2008b). Australian regional and global population trends are unknown (Taylor *et al*. 2008b, Woinarski *et al*. 2014).

Biology and feeding ecology

Southern bottlenose whales grow to about 6–7.5 m long and are estimated to weigh up to 3.5–4 tonnes (t) (Warneke 2008a, Jefferson *et al*. 2008). They occur primarily offshore in deep oceanic waters in polar to temperate regions beyond the continental shelf and over submarine canyons in habitats deeper than 1000 m (Warneke 2008a, Taylor *et al*. 2008b). These beaked whales can occur as solitary animals or in pairs, or in small social groups of three to ten individuals with some groups containing up to 40 animals (Bastida and Rodriguez 2003, Warneke 2008a).

Southern bottlenose whales are considered to be powerful and active predators of deepwater squid, and can dive for longer than an hour and probably to depths exceeding 1000 m (Warneke 2008a, Jefferson *et al*. 2008). They are also recorded to eat fish including Patagonian toothfish *Dissostichus eleginoides*, and possibly some crustaceans (Jefferson *et al*. 2008). Stomachs of the whales found in Australian waters contained several types of squid beaks. Small amounts of krill in stomachs of subantarctic and Antarctic individuals may have been swallowed incidentally (Ross 2006, a 2008). Bioenergetic models developed to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales indicate that beaked whale reproduction requires energy dense prey, with poorer resource availability being likely to lead to an extension of the inter-calving interval and lower lifetime reproductive output of females (New *et al*. 2013). The models predict that beaked whales require relatively high quality habitat for successful reproduction, hence disturbances that halt energy acquisition over shorter periods or even small but consistent non-lethal disturbances resulting in displacement from higher-quality habitats could impact on populations (New *et al*. 2013).

Age at sexual maturity is estimated to be about nine–11 years, gestation is about 12 months with calving in spring to early summer, and the interbirth interval is two years (Taylor *et al*. 2007, Warneke 2008a). Maximum age is estimated to exceed 37 years for females and 50 years for males (Ross 2006), and generation length is estimated to be 24 years (Taylor *et al*. 2007).

Risks and threatening processes

Some southern bottlenose whales have been killed during whaling and some have been incidentally killed in driftnets, with several recorded as bycatch in Tasman Sea driftnet fishing (Taylor *et al*. 2008b). These beaked whales are likely to be vulnerable to loud anthropogenic noise and acoustic disturbance (Cox *et al*. 2006). Potential threats include prey depletion from expanding commercial fisheries, ingestion of plastic debris and bioaccumulation of persistent toxic pollutants (Bannister *et al*. 1996, Woinarski *et al*. 2014).

Conservation and listing status

The southern bottlenose whale is listed as a cetacean species under the EPBC Act, Rare in SA, but is not listed in other states within its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Least Concern in Australian waters but its conservation status is poorly resolved (Woinarski *et al*. 2014). This species was assessed as 'No category assigned but possibly secure' in the previous Australian conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, the southern bottlenose whale was assessed as Least Concern for the IUCN Red List in 2008 (Taylor *et al*. 2008b) and is listed in Appendix I of CITES.

Andrews' beaked whale *Mesoplodon bowdoini* (Level 2 PSA Residual Risk – High)

Distribution and range

The global distribution of Andrews' beaked whales is not known, and remarkably this species has not been sighted alive at sea (Pitman 2009). Information on this species is limited to about 40 Southern Hemisphere stranding records, occurring between 32°S from Western Australia and south to 54°30'S, mostly from temperate regions of the Pacific and Indian Oceans with a few records from the Falkland Islands and Tristan da Cunha (Baker 2001, MacLeod *et al*. 2006, Kemper 2008a, Van Waerebeek *et al*. 2010, Otley *et al*. 2012, Groom *et al*. 2014). More than half of the confirmed stranding records are from New Zealand, with 14 from southern Australia (Bannister *et al*. 1996, Baker 2001, Kemper 2008a, Thompson *et al*. 2013, Groom *et al*. 2014).

Within Australian waters, Andrews' beaked whales have been recorded as stranded individuals from NSW, Victoria, Tasmania, SA, WA and from subantarctic Macquarie Island (54°30'S) (Bannister *et al*. 1996, Baker 2001, Kemper *et al*. 2005, Ross 2006, Groom *et al*. 2014). Their Australian range overlaps extensively with the SPF area from southern NSW across to southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of Andrews' beaked whales and the Australian and global population trends are unknown (Bannister *et al*. 1996, Ross 2006, Taylor *et al*. 2008c, Woinarski *et al*. 2014). These beaked whales are thought to be relatively rare, with population centres likely to occur offshore (Pitman 2009). Based on their stranding records, New Zealand may be a region of higher abundance (Baker 2001, Thompson *et al*. 2013).

Biology and feeding ecology

Andrews' beaked whales grow to at least 4.5 m long with females slightly larger (4.6 m) and maximum weight is estimated to be about 1 t (Baker 2001, Ross 2006). Very little information is available about the biology and ecology of these beaked whales and their habitat is unknown. However, beaked whales typically occur in deep offshore waters greater than 2000 m depth or over continental slopes (MacLeod and D'Amico 2006, Jefferson *et al*. 2008, Pitman 2009). Southern Australia and New Zealand stranding records are from areas where the continental shelf is relatively narrow or where underwater canyons are present (Baker 2001, Kemper 2008a). The diet of Andrews' beaked whales is not known but they are assumed to be deep divers that prey on mesopelagic and deep-water benthopelagic squid and some fish species occurring between 200 to 2000 m depths, similar to other beaked whale species (Bannister *et al*. 1996, MacLeod *et al*. 2003, Jefferson *et al*. 2008). New *et al*. (2013) developed bioenergetic models to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales. The models indicate that beaked whales require energy-dense prey and relatively high-quality habitat to meet their requirements for successful reproduction (New *et al*. 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher-quality habitats could negatively affect their populations (New *et al*. 2013).

Very little is known about the life history of Andrews' beaked whales. Baker (2001) noted that there is some evidence for a summer-autumn breeding season around New Zealand. Heavy scarring on males probably results from intraspecific fighting possibly using the pair of triangular tusk-like teeth as weapons in agonistic encounters (Kemper 2008a, Dalebout *et al*. 2008). Two pregnant females were 4.2 m in length, whereas one 4.3 m stranded male appeared to be sexually immature (Kemper 2008a, Jefferson *et al*. 2008). The age at sexual maturity, gestation, calving interval, longevity and generation length for these beaked whales are unknown.

Risks and threatening processes

Taylor *et al*. (2008c) considered that some fisheries bycatch was likely to occur from gillnet and longline fisheries throughout the range of Andrews' beaked whales, and concluded that even low levels of bycatch may not be sustainable for these naturally rare beaked whales. This species is thought likely to be vulnerable to anthropogenic noise and acoustic disturbance from naval active sonar and seismic surveys that are known to cause stress and in some cases are associated with strandings of other deep-diving beaked whales (Taylor *et al*. 2008c). Climate change and oceanographic variability are predicted to be unfavourable for the range of this species (MacLeod 2009). Other potential threats include prey depletion from expanding fisheries, particularly for pelagic squid, ingestion of plastic debris and bioaccumulation of persistent toxic pollutants (Bannister *et al*. 1996, Woinarski *et al*. 2014).

Conservation and listing status

Andrews' beaked whale is listed as a cetacean species under the EPBC Act, Rare in SA, but is not listed in other states within its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al*. 2014), and similarly in the previous Australian conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, Andrews' beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al*. 2008c) and is listed in Appendix II of CITES.

Blainville's beaked whale *Mesoplodon densirostris* (Level 2 PSA Residual Risk – High)

Distribution and range

Blainville's beaked whales are the most widely distributed *Mesoplodon* species and are probably the most widely distributed beaked whale species, with a circumglobal distribution in all tropical to warm temperate ocean regions and occasional records in cold-temperate regions (MacLeod *et al*. 2006, Pitman 2009). They have also been recorded from deep-water habitats within some enclosed seas including the Sea of Japan, Gulf of Mexico and Caribbean Sea, with rare vagrant records in the Mediterranean Sea (Taylor *et al*. 2008d). Strandings and sighting records in the eastern Pacific region range from 37°N to 41.5°S (MacLeod *et al*. 2006).

Within Australian waters, these beaked whales are recorded from stranding records from all States and the Northern Territory, with sightings off Point Lookout in southern Queensland (Bannister *et al*. 1996, Ross 2006, Warneke 2008b, Taylor *et al*. 2008d, Groom *et al*. 2014). Blainville's beaked whales have also been recorded from subtropical Lord Howe Island (Hutton and Harrison 2004), and the southernmost stranding record is from northwest Tasmania at 40° 50'S (Warneke 2008b). Their Australian range overlaps extensively with the SPF area from Queensland across to WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of Blainville's beaked whales and the Australian and global population trends are unknown (Bannister *et al*. 1996, Ross 2006, Taylor *et al*. 2008d). Blainville's beaked whales are considered to be relatively common in tropical oceans and seas and are possibly the most abundant beaked whale species (Pitman 2009). Abundance of these beaked whales in waters around Hawai'i was estimated to be about 2100 (Taylor *et al*. 2008d).

Biology and feeding ecology

Blainville's beaked whales grow to about 4.7 m long and can weigh up to 1033 kg, with females larger than males (Jefferson *et al.* 2008). These beaked whales typically occur in offshore deep water habitats or over continental slope or undersea canyon habitats with high bathymetric relief from about 140 to 1000 m depths where nutrient-rich deep currents interact with underwater topography resulting in increased productivity and concentrated prey (MacLeod *et al.* 2004, MacLeod and Zuur 2005, Warneke 2008b). These beaked whales prefer habitats within the 700–1000 m depth range around Hawai'i (Baird *et al.* 2006), and movements of satellite-tagged individuals from Hawai'i showed strong site fidelity (Schorr *et al.* 2009). Groups of four to six Blainville's beaked whales have been sighted closer to shore off Point Lookout on North Stradbroke Island in southern Queensland (Ross 2006). Long-term studies of these beaked whales in the Bahamas have recorded singles or pairs most commonly, with some groups of three to seven individuals (Jefferson *et al.* 2008). Claridge (2006) reported some evidence for age-class specific habitat preference off the coast of the Bahamas. Adults appear to be grouped into 'harems' with a single adult male and several females occupying more productive habitats over continental shelf waters of canyon walls, whereas subadults appear to stay in separate groups in less productive waters (Jefferson *et al.* 2008).

Blainville's beaked whales prey on mesopelagic and deep-water lantern fishes and other fish species and some squid, with recorded dives to 1400 m depth and more than 54 minutes duration (Bannister *et al.* 1996, MacLeod *et al.* 2003, Baird *et al.* 2006, Tyack *et al.* 2006, Jefferson *et al.* 2008). Foraging dives are thought to include both deep dives (greater than 800 m depth) and mid-water dives (100–600 m), and mid-water dives appear to be more common during daylight hours (Baird *et al.* 2008a). These beaked whales also spend long periods at shallow depths of less than 50 m, which may compensate for the physiological demands of their long and deep dives (Jefferson *et al.* 2008). Bioenergetic models developed to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales indicate that beaked whales require energy-dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher quality habitats could negatively affect their populations (New *et al.* 2013).

Heavy scarring on older males probably results from fighting using the pair of large, flattened tusk-like teeth as weapons during agonistic encounters between competing males, and scarring on females indicates vigorous sexual encounters during mating (Warneke 2008b, Dalebout *et al.* 2008). Very little is known about sexual reproduction in Blainville's beaked whales, but the birth of a calf was observed in the northern Bahamas region (N. Hauser *pers. comm.* in Woinarski *et al.* 2014). Age at sexual maturity is about eight to nine years (Warneke 2008b, Claridge 2013), but their gestation period, calving interval, maximum longevity and generation length are unknown.

Risks and threatening processes

Blainville's beaked whales have been recorded as bycatch from Japanese tuna fishing off WA and the Seychelles, and in the North Pacific Ocean by Taiwanese fishers. Some are taken in directed fisheries for cetaceans in the Philippines and elsewhere (MacLeod *et al.* 2006, Taylor *et al.* 2008d, Pitman 2009, Reeves *et al.* 2013). Use of military active sonar has been implicated in mass strandings of Blainville's beaked whales (Jepson *et al.* 2003, 2005, Fernandez *et al.* 2005, Yang *et al.* 2008, D'Amico *et al.* 2009, Moretti *et al.* 2014) and loud sounds from seismic surveys and other anthropogenic activities are also considered likely to cause disturbance and stress (Cox *et al.* 2006, MacLeod and D'Amico 2006). Stomach contents of a Blainville's beaked whale stranded in southern Brazil included a large quantity of ingested plastic debris that may have led to starvation and death (Secchi and Zarzur 1999). Potential threats to these beaked whales include prey depletion from expanding commercial fisheries, particularly for pelagic squid, and bioaccumulation of persistent toxic pollutants (Bannister *et al.* 1996, Woinarski *et al.* 2014).

Conservation and listing status

Blainville's beaked whale is listed as a cetacean species under the EPBC Act, but is not listed in any States or the Northern Territory within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and similarly in the previous Australian conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, Blainville's beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al.* 2008d) and is listed in Appendix II of CITES.

Ginkgo-toothed beaked whale *Mesoplodon ginkgodens* (Level 2 PSA Residual Risk – High)

Distribution and range

The global distribution of ginkgo-toothed beaked whales is uncertain. Individuals identified as ginkgo-toothed beaked whales have been recorded from about 23 widely-scattered stranding records in the temperate and tropical regions of the Pacific and Indian Oceans, mostly from Japan, with other strandings from Sri Lanka east to New Zealand and the Galapagos Islands and from coastal regions in North America (MacLeod *et al.* 2006, Taylor *et al.* 2008e, Thompson *et* *al*. 2013). However, more recent genetic and morphological analyses have indicated that at least seven specimens from Sri Lanka, Maldives, Seychelles, Kiribati and Hawai'i may represent a distinct species or subspecies, and therefore *M. ginkgodens* may only occur in the Pacific Ocean (Dalebout *et al*. 2007, 2012, Baker *et al*. 2013).

Within Australian waters there is one stranding record of a ginkgo-toothed beaked whale from western Victoria and three strandings from southern NSW, which may have included a mother and calf pair (Bannister *et al*. 1996, Ross 2006, 2008a). Genetic analyses have recently confirmed that the individual that stranded in western Victoria is *M. ginkgodens* (Dalebout *et al*. 2012). The Australian range of this species overlaps partly with the SPF area from coastal Victoria, off NSW and Queensland.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of ginkgo-toothed beaked whales and the Australian and global population trends are unknown (Bannister *et al*. 1996, Ross 2006, Taylor *et al*. 2008e, Woinarski *et al*. 2014). These beaked whales are thought to be uncommon (Taylor *et al*. 2008e) and this species has not been reliably identified at sea (Jefferson *et al*. 2008).

Biology and feeding ecology

Ginkgo-toothed beaked whales grow to 5.3 m long with females slightly larger on average and maximum weight is about 1.5 t (Bannister *et al*. 1996, Jefferson *et al*. 2008, Ross 2008a). Almost nothing is known about the biology and ecology of these beaked whales and their habitat is unknown, however beaked whales typically occur in deep offshore waters greater than 2000 m depth or over continental slopes or underwater canyons (MacLeod and D'Amico 2006, Jefferson *et al*. 2008, Pitman 2009). The diet of ginkgo-toothed beaked whales is not known but they are assumed to be deep divers that prey on mesopelagic and deep-water benthopelagic squid and some fish species occurring between 200 to 2000 m depths, similar to other beaked whale species (MacLeod *et al*. 2003, Jefferson *et al*. 2008). New *et al*. (2013) developed bioenergetic models to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales. The models indicate that beaked whales require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al*. 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher quality habitats could negatively affect their populations (New *et al*. 2013).

Very little is known about the life history of ginkgo-toothed beaked whales. Based on limited data sexual maturity was estimated to occur at about 4.5 m length (Bannister *et al*. 1996), but the age at sexual maturity, gestation, calving interval, longevity and generation length for ginkgo-toothed beaked whales are unknown.

Risks and threatening processes

Some ginkgo-toothed beaked whales have been taken by Japanese and Taiwanese whalers, and some have been caught in deep-water drift gillnets (Taylor *et al*. 2008e). Ginkgo-toothed beaked whales are vulnerable to anthropogenic noise and acoustic disturbance, and use of military active sonar has been implicated in mass strandings of these beaked whales (Wang and Yang 2006, Yang *et al*. 2008). Potential threats include prey depletion from expanding fisheries, particularly for pelagic squid, ingestion of plastic debris and bioaccumulation of persistent toxic pollutants (Bannister *et al*. 1996, Woinarski *et al*. 2014).

Conservation and listing status

The ginkgo-toothed beaked whale is listed as a cetacean species under the EPBC Act, but is not listed in states within its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al*. 2014), and similarly in the previous Australian conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, the ginkgo-toothed beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al*. 2008e) and is listed in Appendix II of CITES.

Gray's beaked whale *Mesoplodon grayi* (Level 2 PSA Residual Risk – High)

Gray's beaked whales occur primarily in cool temperate to higher latitude regions of the Southern Hemisphere with most records from 30°S to 45°S (MacLeod *et al*. 2006, Ross 2008b, Van Waerebeek *et al*. 2010, Otley *et al*. 2012). These beaked whales have a circumpolar distribution around Antarctica, with many sightings in the austral summer from Antarctic waters and near the Antarctic continent to 65–67°S, with one extra-limital Northern Hemisphere stranding record from the Dutch coast in the North Sea (Bannister *et al*. 1996, Dalebout *et al*. 2004, MacLeod *et al*. 2006, Van Waerebeek *et al*. 2010, Scheidat *et al*. 2011). Sightings at sea indicate that these beaked whales are relatively common southwest of the Chatham Islands in the South Pacific Ocean, with strandings occurring mainly from New Zealand and southern Australia, South Africa, Argentina, Chile and Peru (Dalebout *et al*. 2004, Taylor *et al*. 2008f, Thompson *et al*. 2013, Groom *et al*. 2014).

In Australian waters there is one documented live-sighting of a Gray's beaked whale off the coast of WA (Gales *et al.* 2002). This species is the most commonly recorded beaked whale species in WA waters with 48 individuals recorded in 33 stranding events (Groom *et al.* 2014). Gray's beaked whale has also been recorded from strandings in NSW, Victoria, Tasmania, SA and from subantarctic Heard Island and McDonald Islands (McManus *et al.* 1984, Kemper and Ling 1991, Bannister *et al.* 1996, Kemper *et al.* 2005, Ross 2006). Gray's beaked whales have also been sighted southwest of Tasmania, to the south of WA and in subantarctic waters south of Australia (Van Waerebeek *et al.* 2010). Their Australian range overlaps extensively with the SPF area from NSW across to southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of Gray's beaked whales and the Australian and global population trends are unknown (Bannister *et al.* 1996, Ross 2006, Taylor *et al.* 2008f, Woinarski *et al.* 2014). This species is the second most commonly stranded ziphiid in Australian waters and also commonly strands in New Zealand, and sightings indicate that they are relatively common off Tasmania and southern WA (Bannister *et al.* 1996, Van Waerebeek *et al.* 2010, Thompson *et al.* 2013, Groom *et al.* 2014). Gray's beaked whales may be relatively common and widespread in the Southern Ocean (Pitman 2009, Van Waerebeek *et al.* 2010).

Biology and feeding ecology

Gray's beaked whales grow to maximum sizes of about 5.3 m for females and 5.6 m for males and can weigh at least 1100 kg (Jefferson *et al.* 2008). These beaked whales occur mainly in deep-water habitats beyond the edge of the continental shelf, although some sightings are reported from shallow water often associated with individuals that are ill or coming in to strand (Gales *et al.* 2002, Dalebout *et al.* 2004, MacLeod and D'Amico 2006, Taylor *et al.* 2008f). Gray's beaked whales occur near the Antarctic continent during the austral summer with some sightings among sea ice (MacLeod *et al.* 2006, Jefferson *et al.* 2008, Van Waerebeek *et al.* 2010, Scheidat *et al.* 2011). Around southern Australia and New Zealand most strandings occur in summer and autumn, and records of females and calves may indicate some seasonal movements of females to lower latitude inshore habitats for calving and mating (Bannister *et al.* 1996, Dalebout *et al.* 2004, Ross 2008b, Thompson *et al.* 2013). In New Zealand waters, records of pregnant females and females in groups with dependent calves indicate that the calving season occurs during summer (Thompson *et al.* 2013). Sightings and strandings of Gray's beaked whales are usually of individuals or pairs, although mass strandings of up to 25–28 animals have been recorded at the Chatham Islands (Bannister *et al.* 1996, Gales *et al.* 2002, Dalebout *et al.* 2004, Van Waerebeek *et al.* 2010).

The diet of Gray's beaked whales is not well known but they are assumed to be deep divers that prey on mesopelagic and deep-water benthopelagic fish and squid occurring between 200 to 2000 m depths, although only fish remains have been confirmed from stomach contents (Bannister *et al.* 1996, MacLeod *et al.* 2003, Pitman 2009). Bioenergetic models developed to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales indicate that beaked whales require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher quality habitats could negatively affect their populations (New *et al.* 2013).

Little is known about the life history of Gray's beaked whales. Older males have heavy tooth-rake scarring that probably results from aggressive interactions between males using their single pair of tusk-like teeth (Ross 2008b, Dalebout *et al.* 2008). The age at sexual maturity, gestation, calving interval, maximum longevity and generation length for Gray's beaked whales are unknown.

Risks and threatening processes

Gillnet and longline fisheries operate throughout the range of Gray's beaked whales, hence some incidental bycatch is considered likely to occur (Taylor *et al.* 2008f). A female with propeller scars was observed in New Zealand waters indicating that a vessel strike had occurred (Dalebout *et al.* 2004). Potential threats include loud anthropogenic noise and acoustic disturbance such as military active sonar and seismic surveys that are known to cause disturbance and stress to other beaked whales (Cox *et al.* 2006), ingestion of plastic debris and bioaccumulation of persistent toxic pollutants, and prey depletion from expanding fisheries (Bannister *et al.* 1996, Woinarski *et al.* 2014). The potential effects of climate and oceanographic variability and change including ocean warming are uncertain but are predicted to be unfavourable for the species' range (MacLeod 2009).

Conservation and listing status

Gray's beaked whale is listed as a cetacean species under the EPBC Act, Rare in South Australia, but is not listed in other states within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and as 'No category assigned but possibly secure' in the previous Australian conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, Gray's beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al.* 2008f) and is listed in Appendix II of CITES.

Hector's beaked whale *Mesoplodon hectori* (Level 2 PSA Residual Risk – High)

Distribution and range

Hector's beaked whales occur in cool temperate regions of the Southern Hemisphere from about 35°S to 55°S (Ross 2006), with most records from strandings in New Zealand, southern Australia, South Africa, southern South America, Brazil, the Falkland Islands and South Georgia (MacLeod *et al.* 2006, Ross 2008c, Van Waerebeek *et al.* 2010, Otley *et al.* 2012, Thompson *et al.* 2013).

Within Australian waters, Hector's beaked whales have been recorded from a small number of stranded individuals from Tasmania, SA and WA (Bannister *et al.* 1996, Kemper *et al.* 2005, Ross 2006, Van Waerebeek *et al.* 2010, Groom *et al.* 2014). One Hector's beaked whale with the species identity confirmed by DNA analysis of a skin sample was observed alive near Perth (32°S) in WA (Gales *et al.* 2002). This observation was significant as it was the first record of this species from the eastern Indian Ocean region (Gales *et al.* 2002). The range of Hector's beaked whale overlaps extensively with the SPF area across southern Australia.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of Hector's beaked whales and the Australian and global population trends are unknown (Bannister *et al.* 1996, Ross 2006, Taylor *et al.* 2008g, Woinarski *et al.* 2014). These beaked whales are thought to be quite rare, with only about 30 records globally (Baker 1999, Pitman 2009, Groom *et al.* 2014). Based on stranding records, Hector's beaked whales may be relatively more abundant around New Zealand (Thompson *et al.* 2013).

Biology and feeding ecology

Hector's beaked whales grow to lengths up to about 4.4 m for females and 4.3 m for males with a maximum weight of about 800 kg (Ross 2006, 2008c). Almost nothing is known about the biology and ecology of these beaked whales and their habitat is unknown, however beaked whales typically occur in deep offshore waters greater than 2000 m depth or over continental slopes (MacLeod and D'Amico 2006, Jefferson *et al.* 2008, Pitman 2009). The small approximately 3 m long male identified near Perth (WA) appeared to be in good condition and swam about 50 m from shore and this individual breached occasionally (Gales *et al.* 2002). Little information is available on the diet of Hector's beaked whales but they are known to prey on squid (Jefferson *et al.* 2008), and are assumed to be deep divers that prey on mesopelagic and deep-water benthopelagic species, similar to other beaked whale species (Bannister *et al.* 1996, MacLeod *et al.* 2003, Pitman 2009). New *et al.* (2013) developed bioenergetic models to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales. The models indicate that beaked whales require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher quality habitats could negatively affect their populations (New *et al.* 2013).

A female and calf pair were recorded from northern Tasmania during early April (Van Waerebeek *et al.* 2010), but very little is known about reproduction in these beaked whales. Adult males are scarred probably as a result of intraspecific fighting with a pair of small tusk-like teeth that erupt in males (Ross 2008c). Sexual maturity occurs at about 4.0 m length (Ross 2006), but the age at sexual maturity, gestation, calving interval, longevity and generation length for these beaked whales are unknown.

Risks and threatening processes

Little information is available to assess threats for this species, but Taylor *et al.* (2008g) considered that some fisheries bycatch was likely to occur throughout their range, and noted that even low levels of bycatch may not be sustainable. Like other beaked whales, Hector's beaked whales are considered likely to be vulnerable to anthropogenic noise and acoustic disturbance from naval active sonar and seismic surveys that are known to cause stress and in some cases are associated with strandings of other beaked whales (Cox *et al.* 2006). Climate change and oceanographic variability are predicted to be unfavourable for the range of this species (MacLeod 2009). Other potential threats for Hector's beaked whales include prey depletion from expanding fisheries, particularly for pelagic squid, ingestion of plastic debris and bioaccumulation of persistent toxic pollutants (Bannister *et al.* 1996, Woinarski *et al.* 2014).

Conservation and listing status

Hector's beaked whale is listed as a cetacean species under the EPBC Act, Rare in SA, but is not listed in other states within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and similarly in the previous Australian conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, Hector's beaked whale was assessed as Data Deficient for the IUCN

Red List in 2008 (Taylor *et al.* 2008g) and is listed in Appendix II of CITES.

Strap-toothed beaked whale *Mesoplodon layardii* (Level 2 PSA Residual Risk – High)

Distribution and range

Strap-toothed beaked whales have a circumpolar distribution in cold temperate waters in the Southern Hemisphere, with most records between 32°S to 60°S, with the southernmost record at 63°S (MacLeod *et al.* 2006, Jefferson *et al.* 2008, Van Waerebeek *et al.* 2010, Scheidat *et al.* 2011). Stranding records include Australia, New Zealand, the Kerguelen Islands, Heard Island, Argentina, the Falkland Islands, Uruguay and Brazil (MacLeod *et al.* 2006).

There have been more than 70 stranding records from Australian waters, making the strap-toothed beaked whales the most commonly stranded beaked whale species in the Australian region (Bannister *et al.* 1996, MacLeod *et al.* 2006, Ross 2008d, Groom *et al.* 2014). Australian stranding records include the most northern record for this species at 20°S in Queensland, with other strandings from NSW, Victoria, Tasmania, SA and WA, and two records from subantarctic Macquarie Island and one from Heard Island (Dixon 1980, Kemper and Ling 1991, Bannister *et al.* 1996, Baker and van Helden 1999, Kemper *et al.* 2005, Ross 2006, 2008, Van Waerebeek *et al.* 2010, Groom *et al.* 2014). Additional records of strap-toothed beaked whales occur in the Southern Ocean south of Australia (Van Waerebeek *et al.* 2010). Their Australian range overlaps completely with the SPF area from Queensland across to southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of strap-toothed beaked whales and the Australian and global population trends are unknown (Ross 2006, Taylor *et al.* 2008h, Woinarski *et al.* 2014). This species may not be rare compared with other *Mesoplodon* species (Taylor *et al.* 2008h), and they may be more common seasonally off southern Australia than other beaked whales based on their relatively high frequency of strandings (Bannister *et al.* 1996, Ross 2006, Groom *et al.* 2014).

Biology and feeding ecology

Strap-toothed beaked whales are one of the largest mesoplodont species with adult males growing to about 6.1 m long and females up to 6.2 m long, and they are estimated to weigh more than 1300 kg (Jefferson *et al.* 2008). These beaked whales are not well understood but are thought to occur mostly in cold temperate oceanic waters beyond the edge of the continental shelf, and feed seasonally in deep water areas with higher productivity over continental slope and submarine canyon habitats (MacLeod and D'Amico 2006, Ross 2008d, Pitman 2009). Increased strandings from January to April in Australian waters may indicate seasonal movements to lower latitude habitats in summer (Bannister *et al.* 1996, Ross 2008d).

Analyses of stomach contents indicate that strap-toothed beaked whales feed primarily on deep sea pelagic squid species with some fish and crustacean remains also recorded (Bannister *et al.* 1996, MacLeod *et al.* 2003, Pitman 2009). They are thought to be deep divers that prey on mesopelagic and deep-water species occurring between 200 to 2000 m depths, like other mesoplodont species (MacLeod *et al.* 2003, Pitman 2009). Bioenergetic models developed to investigate linkages between feeding energetics and the requirements for survival and reproduction for beaked whales indicate that they typically require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher quality habitats could negatively affect their populations (New *et al.* 2013).

Strap-toothed beaked whales have been recorded in small groups of up to four animals (Bannister *et al.* 1996, Jefferson *et al.* 2008). Adult males develop a pair of highly distinctive and unusual 30 cm long, flattened tusk-like teeth that grow over the rostrum and prevent the jaw from opening widely (Dalebout *et al.* 2008). These teeth may be used in agonistic encounters among males, with older males becoming heavily scarred (Dalebout *et al.* 2008, Jefferson *et al.* 2008). Calves are recorded from summer months through to early autumn in Australian and New Zealand waters, and gestation is estimated to be about nine-12 months (Bannister *et al.* 1996, Thompson *et al.* 2013). The age at sexual maturity, calving interval, maximum longevity and generation length are unknown.

Risks and threatening processes

Taylor *et al.* (2008h) noted that gillnet and longline fisheries occur throughout the range of strap-toothed beaked whales, and considered that some incidental bycatch was likely to occur. These beaked whales are considered likely to be vulnerable to anthropogenic noise and acoustic disturbance from naval active sonar and seismic surveys, which are known to cause disturbance and stress in other beaked whales (Cox *et al.* 2006). Climate variability and change and ocean warming are predicted to be unfavourable for the range of this species (MacLeod 2009). Other potential threats for strap-toothed beaked whales include prey depletion from expanding fisheries, particularly for pelagic squid, ingestion of plastic debris and bioaccumulation of persistent toxic pollutants (Bannister *et al.* 1996, Woinarski *et al.* 2014).

Conservation and listing status

The strap-toothed beaked whale is listed as a cetacean species under the EPBC Act, but is not listed in any states within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and as 'No category assigned but possibly secure' in the previous Australian conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, the strap-toothed beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al.* 2008h) and is listed in Appendix II of CITES.

True's beaked whale *Mesoplodon mirus* (Level 2 PSA Residual Risk – High)

Distribution and range

True's beaked whales appear to have an unusual disjunct, anti-tropical distribution with isolated populations in the Northern Hemisphere in the North Atlantic Ocean, and in the Southern Hemisphere (MacLeod *et al.* 2006, Jefferson *et al.* 2008, Taylor *et al.* 2008i). These disjunct populations have some differences in colouration and cranial characteristics (Jefferson *et al.* 2008), and a deep mitochondrial DNA divergence that is similar to the differences between some other *Mesoplodon* species, but further research is needed to determine whether these divergent populations represent distinct species or subspecies (MacLeod *et al.* 2006, Dalebout *et al.* 2007). In the Southern Hemisphere, stranding records are from temperate regions of the southern Indian Ocean from South Africa, from southern Australia, New Zealand and in southern Brazil, with sightings off Madagascar (MacLeod *et al.* 2006, Constantine *et al.* 2014).

Within Australian waters, True's beaked whales have been recorded from some stranded individuals from Tasmania, Victoria and WA (Bannister *et al.* 1996, Ross 2006, 2008e, Groom *et al.* 2014), with live sightings off southern NSW noted in Ross (2008e). Their Australian range overlaps extensively with the SPF area from southern NSW across to southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of True's beaked whales and the Australian and global population trends are unknown (Bannister *et al.* 1996, Ross 2006, Taylor *et al.* 2008i, Woinarski *et al.* 2014). Observations of True's beaked whales are extremely rare (Ross 2008e). Taylor *et al.* (2008i) noted that this species might not be rare in the North Atlantic Ocean.

Biology and feeding ecology

True's beaked whales grow to about 4.9–5.3 m long and weigh up to 1.4 t (Ross 2006, 2008e). Little information is available on the biology and ecology of True's beaked whales and their habitat is largely unknown, however beaked whales typically occur in deep offshore waters greater than 2000 m depth or over continental slopes and this species has been sighted over deep water greater than 1000 m depth near a steep drop-off (Tove 1995, MacLeod and D'Amico 2006, Jefferson *et al.* 2008, Pitman 2009). Stranded True's beaked whales have had *Loligo* spp. and other squid beaks and fish remains in their stomachs and they are thought to prey on mesopelagic and deep-water benthopelagic squid and some fish species occurring between 200 to 2000 m depths, similar to other beaked whale species (Bannister *et al.* 1996, MacLeod *et al.* 2003, Jefferson *et al.* 2008, Constantine *et al.* 2014). New *et al.* (2013) developed bioenergetic models to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales. The models indicate that beaked whales require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output, and even small but consistent non-lethal disturbances resulting in displacement from higher-quality habitats could negatively affect their populations (New *et al.* 2013).

True's beaked whales have been observed in small groups of up to three individuals (e 2008, Jefferson *et al.* 2008). Little is known about reproduction in these beaked whales, but stranding records from WA included two mother and calf pairs and two individual calves, which Groom *et al.* (2014) considered might indicate that breeding occurs in waters off the WA coast. Weaning is thought to occur at about one year of age (Ross 1984), but age at sexual maturity, gestation, calving interval, longevity and generation length are unknown.

Risks and threatening processes

Very little information is available on threats to this species, however Taylor *et al.* (2008i) considered that fisheries bycatch from gillnets in deep water was probably the most significant threat. True's beaked whales are likely to be vulnerable to anthropogenic noise and acoustic disturbance from naval active sonar and seismic surveys that are known to cause stress and in some cases are associated with strandings of other deep-diving beaked whales (Cox *et al.* 2006, Taylor *et al.* 2008i). Some stranded individuals had swallowed plastic debris that may have led to their death (Taylor *et al.* 2008i, Constantine *et al.* 2014). Climate change and oceanographic variability are predicted to be unfavourable for the range of this species (MacLeod 2009). Other potential threats include prey depletion from expanding fisheries, particularly for pelagic squid, and bioaccumulation of persistent toxic pollutants (Bannister *et al.* 1996, Woinarski *et al.* 2014).

Conservation and listing status

True's beaked whale is listed as a cetacean species under the EPBC Act, but is not listed in states within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and similarly in the previous Australian conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, True's beaked whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al.* 2008i) and is listed in Appendix II of CITES.

Cuvier's beaked whale *Ziphius cavirostris* (Level 2 PSA Residual Risk – High)

Distribution and range

Cuvier's beaked whale are the most widely distributed species of beaked whale with an extensive distribution in all oceans and most seas including the Mediterranean Sea, extending from tropical to temperate regions and some polar regions in both hemispheres (MacLeod *et al.* 2006, Heyning and Mead 2009, Van Waerebeek *et al.* 2010). Their distribution in Australian waters is poorly known but they have been recorded from all states and the Northern Territory (Bannister *et al.* 1996, Warneke 2008c, Groom *et al.* 2014). Cuvier's beaked whales have also been recorded from Macquarie Island (Ross 2006) and Christmas Island (Brewer *et al.* 2009), and with some sightings from eastern Australia (MacLeod *et al.* 2006). Their Australian range overlaps completely with the SPF area from Queensland across to southern WA.

Population size and trends

There are no reliable estimates of the Australian regional abundance or the total global abundance of Cuvier's beaked whales, and the Australian and global population trends are unknown (Ross 2006, Taylor *et al.* 2008j, Woinarski *et al.* 2014). However, worldwide abundance was suggested to be well over 100,000 individuals with about 80,000 in the eastern tropical Pacific, and about 15,000 in waters around Hawai'i (Taylor *et al.* 2008j). Dalebout *et al.* (2005) estimated the global population to be larger with about 456,000 to 916,000 breeding adults, based on levels of genetic variation. Warneke (2008c) noted that their abundance in Australian waters was unknown but they may be abundant, and acoustic surveys in the Coral Sea indicate that beaked whales (most likely including Cuvier's beaked whales) may be much more abundant than indicated by their infrequent sightings and strandings records (Parnum *et al.* 2011).

Biology and feeding ecology

Cuvier's beaked whales grow to an average size of about 6.1 m with the longest reliably measured individual recorded to be 6.9 m long, and maximum weight is nearly 3000 kg (Jefferson *et al.* 2008, Heyning and Mead 2009). These beaked whales are pelagic and primarily occur in offshore waters greater than 200–1000 m deep near the continental slope and submarine canyon habitats, around oceanic islands and in some enclosed seas (Jefferson *et al.* 2008, Taylor *et al.* 2008j). Dalebout *et al.* (2005) analysed global genetic structure of Cuvier's beaked whales and found a high degree of isolation and low maternal gene flow among oceanic populations and also in some regional populations, particularly in the Mediterranean Sea where the population was highly differentiated from the North Sea.

Cuvier's beaked whales are extraordinary divers with recent dive records including dives to 2992 m depth and a duration of 137 minutes, which are both new mammalian dive records (Schorr *et al.* 2014). These beaked whales have a stereotypic pattern of deep and shallow dives, with deep dives having a mean depth of 1400 m and duration of 67 minutes, and many of the deep dives exceed their aerobic dive limit by a factor of two or more (Schorr *et al.* 2014). Stomach contents from relatively few individuals have been analysed but they appear to feed primarily on mesopelagic and deep-sea squid and fish, and occasionally take crustaceans (MacLeod *et al.* 2003, Taylor *et al.* 2008j, Heyning and Mead 2009). They appear to feed both in the water column and near the bottom (Jefferson *et al.* 2008). Bioenergetic models developed to investigate linkages between feeding energetics and the requirements for survival and reproduction for Ziphiidae beaked whales indicate that these whales require energy dense prey and relatively high quality habitat to meet their requirements for successful reproduction (New *et al.* 2013). Poorer resource availability would be likely to lead to an extension of the inter-calving interval and reduced reproductive output. New *et al.* (2013) concluded that even small but consistent non-lethal disturbances resulting in displacement from higher-quality habitats could negatively affect beaked whale populations.

Cuvier's beaked whales strand relatively frequently, with most strandings from Australian waters occurring from January to July, which suggests that these beaked whales make some seasonal movements to the edge of the continental shelf (Bannister *et al.* 1996, Warneke 2008c). These whales are mostly observed in small groups of two to seven individuals or alone, with some larger groups containing up to 25 individuals occasionally recorded (Warneke 2008c, Jefferson *et al.* 2008). Adult males are thought to use their single pair of conical teeth as weapons in agonistic encounters, resulting in heavy scarring in older males (Warneke 2008c, Heyning and Mead 2009). Relatively little is known about the reproductive biology of Cuvier's beaked whales. Age at sexual maturity is about 11 years for both sexes, with maximum longevity of at least 28 years for females and 47 years for males (Warneke 2008c). Generation length may be about 25 years for this species (Woinarski *et al.* 2014).

Risks and threatening processes

Cuvier's beaked whales have been taken as bycatch in some cetacean fisheries, including opportunistic catches in the Japanese beaked whale fishery (Taylor *et al.* 2008j). Bycatch of these beaked whales has been reported in some drift gillnet fisheries, the Italian swordfish fishery and in some other fisheries, and assessments of regional stranding data indicate that the most common human-related cause of mortality for these beaked whales was entanglement and incidental captures, followed by shooting or spearing (Taylor *et al.* 2008j, Weir and Pearce 2013). This species was listed as a cetacean interaction in the Western and Central Pacific Fisheries Commission (WCPFC) tropical purse seine fishery during 2007–2009, with one individual encountered and zero mortalities in 2010 (WCPFC-SC8-2012). Cuvier's beaked whales appear to be exceptionally sensitive to anthropogenic noise disturbance, acoustic trauma and diving-related pathologies, particularly associated with the use of military mid-frequency active sonar which has been implicated in mass strandings of this species and some other deep-diving whales (Frantzis 1998, Jepson *et al.* 2003, Fernandez *et al.* 2005, Cox *et al.* 2006, MacLeod and D'Amico 2006, D'Amico *et al.* 2009). Other potential threats include prey depletion from expanding commercial fisheries, and bioaccumulation of persistent toxic pollutants (Bannister *et al.* 1996, Ross 2006, Woinarski *et al.* 2014).

Conservation and listing status

Cuvier's beaked whale is listed as a cetacean species under the EPBC Act, Rare in SA, Data Deficient in the Northern Territory, but is not listed in other states in its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Least Concern in Australian waters but its conservation is poorly resolved (Woinarski *et al.* 2014). In the previous Australian conservation status assessments in Australian waters this species was assessed as 'No category assigned but possibly secure' (Bannister *et al.* 1996, Ross 2006). Globally, Cuvier's beaked whale was assessed as Least Concern for the IUCN Red List in 2008 (Taylor *et al.* 2008j) and is listed in Appendix II of CITES. A proposal to list the Mediterranean subpopulation of Cuvier's beaked whale on Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals was endorsed at the eleventh Conference of the Parties in Ecuador in November 2014.

Pygmy killer whale *Feresa attenuata* (Level 2 PSA Residual Risk – High)

Distribution and range

The pygmy killer whale has an extensive circumglobal distribution in tropical to subtropical regions in the Pacific, Indian and Atlantic oceans (Jefferson *et al.* 2008, Donahue and Perryman 2009). Most records of pygmy killer whales occur between 35°S and 40°N, with a few higher latitude sightings and stranding events that are considered to be mostly extra-limital records that may be associated with unusual warm water conditions (Taylor *et al.* 2008k, Donahue and Perryman 2009, Owen and Donnelly 2014, Ender *et al.* 2014). In Australian waters, pygmy killer whales have been sighted near the edge of the continental shelf off Wollongong in NSW and off Eden near 37°S and in the area to the northeast of Australia, with stranding records from northern NSW and WA (Bryden 1976, Bannister *et al.* 1996, Ross 2006, Owen and Donnelly 2014). One beach cast individual was reported from Denial Bay in SA (Kemper 2008b). Its southern Australian range overlaps partly with the SPF area off NSW and southern Queensland and southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of pygmy killer whales and the Australian and global population trends are unknown (Ross 2006, Taylor *et al.* 2008k, Woinarski *et al.* 2014). These whales are considered to be uncommon or rare throughout their range and are one of the least known small delphinid species (Ross 2006, McSweeney *et al.* 2009, Donahue and Perryman 2009). Sightings are more frequent in the eastern tropical Pacific, Hawai'i and Japan (McSweeney *et al.* 2009). Wade and Gerrodette (1993) estimated the abundance of pygmy killer whales in the eastern tropical Pacific region to be about 38,900 (CV = 0.31) and noted that this was the second lowest abundance of the delphinid species documented in that region. A small population of island-associated pygmy killer whales occurs off Hawai'i (Taylor *et al.* 2008k).

Biology and feeding ecology

Pygmy killer whales grow to about 2.6 m long and can weigh up to 225 kg (Jefferson *et al.* 2008). They typically occur in deep offshore warm-water oceanic habitats and have been observed near the edge of the continental shelf (Taylor *et al.* 2008k, Owen and Donnelly 2014). They are rarely observed in nearshore waters except around some oceanic islands such as Hawai'i where sightings occur from about 3 to 16 km offshore in habitat depths ranging from 113 m to greater than 2800 m (McSweeney *et al.* 2009). Long-term resighting records off Hawai'i over a 21-year period indicate year-round use of the area by a small population with high site-fidelity and stable long-term associations in mixed-sex groups (McSweeney *et al.* 2009). Group size usually ranges from a few to about 50 individuals although larger groups containing several hundred whales have been observed (Ross 2006, Jefferson *et al.* 2008, Donahue and Perryman 2009, Owen and Donnelly 2014).

Little is known about the diet and other aspects of the biology of pygmy killer whales. They have been reported to feed on cephalopods, fish and some other cetaceans, and stomach contents of individuals that were caught as bycatch in fisheries or stranded contained remnants of small fish and squid (Zerbini and Santos 1997, Donahue and Perryman 2009). These small whales have been reported to attack and occasionally eat other small cetaceans including spinner and common dolphins involved with tuna fishery interactions in the eastern tropical Pacific and in the South Atlantic Ocean (Ross 2008f, Taylor *et al*. 2008k). Females are sexually mature at about 2.3 m length (Ross 2008f), but the breeding season, gestation period, calving interval, longevity and generation length for pygmy killer whales are not known.

Risks and threatening processes

The relatively low abundance and apparent small subpopulation sizes of pygmy killer whales make them particularly susceptible to human impacts and small takes (Taylor *et al*. 2008k). Ross (2006) considered that this species is likely to be taken in illegal and incidental catches in northern Australian waters. Two pygmy killer whales were reported killed as bycatch in WCPFC tropical purse seine fishery, in 2009 (WCPFC SC8 2012). Directed catch in harpoon and driftnet fisheries and incidental bycatch in fisheries operations in Indonesia, the Philippines, Sri Lanka, Taiwan, Japan, Ghana and the Caribbean region are reported (Reeves *et al*. 2003, 2013, Taylor *et al*. 2008k, Donahue and Perryman 2009, Weir and Pierce 2013). Ender *et al*. (2014) noted that interactions with fisheries and entanglement in marine debris are emerging threats for this species in Indonesian waters.

Recent records of mass strandings, mostly from Taiwan, have been associated with increased anthropogenic noise and acoustic disturbances particularly involving loud sounds from seismic surveys and use of military active sonar (Brownell *et al*. 2009). Other threats include pollution and climate change and oceanographic variability, with prey depletion due to fisheries noted as a potential threat (Taylor *et al*. 2008k, Woinarski *et al*. 2014).

Conservation and listing status

The pygmy killer whale is listed as a cetacean species under the EPBC Act, but the species is not listed in any states in its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al*. 2014), and similarly in previous Australian conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, the pygmy killer whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al*. 2008k) and is listed in Appendix II of CITES.

False killer whale *Pseudorca crassidens* (Level 2 PSA Residual Risk – High)

Distribution and range

The false killer whale has an extensive circumglobal distribution in tropical to warm temperate regions between latitudes 45°N and 45°S with some individuals moving to higher latitude cold temperate habitats occasionally (Ross 2006, Warneke 2008d, Taylor *et al*. 2008l). Their distribution in Australian waters is poorly known but they have been recorded from numerous strandings from all states and the Northern Territory and have been sighted in many locations in tropical and temperate seas (Bannister *et al*. 1996, Chatto and Warneke 2000, Kemper *et al*. 2005, Ross 2006). This species has also been reported from Scott Reef off north-west WA and the Cocos (Keeling) Islands (Brewer *et al*. 2009). Their Australian range overlaps completely with the SPF area from Queensland across to southern WA.

Population size and trends

There are no estimates of the Australian regional abundance or global abundance of false killer whales and the Australian and global population trends are unknown (Taylor *et al*. 2008l, Woinarski *et al*. 2014). Although this species is widely distributed and there have been numerous strandings, they are considered to be naturally uncommon throughout their range (Baird 2009). Between 1970 and 1996 mass strandings occurred on average every two-and-a-half years and involved about 20–250 individuals hence the population size in Australian waters was suggested to be greater than 10,000 individuals (Bannister *et al*. 1996, Woinarski *et al*. 2014). Wade and Gerrodette (1993) estimated the abundance of false killer whales in the eastern tropical Pacific region to be about 39,800 (CV = 0.64), with other regional estimates including about 16,000 (CV = 0.26) in coastal waters of Japan and China (Taylor *et al*. 2008l), 1552 (CV = 0.66) for the Hawaiian pelagic stock and 552 (CV = 1.09) for the Northwestern Hawaiian Islands (Bradford *et al*. 2014).

Biology and feeding ecology

False killer whales grow to about 5 m long for females and up to 6 m long for males, which can weigh up to 2000 kg (Jefferson *et al*. 2008, Baird 2009). False killer whales from Japan are about 10–20 per cent larger than those in South Africa (Ferreira *et al*. 2014). They generally occur in deep oceanic habitats but will approach closer to shore and use shallow-water areas around oceanic islands and sometimes over the continental shelf (Jefferson *et al*. 2008, Baird 2009). These whales are regularly sighted in the semi-enclosed Port Essington harbour in the Northern Territory

(Palmer *et al.* 2010). Seasonal movements are known in some areas and may be associated with movements of warm currents and prey availability (Warneke 2008d). Strandings in southern Australia mostly occur from May to September and may indicate some seasonal movement inshore or dispersal along the continental shelf (Bannister *et al.* 1996).

These whales are highly social and typically occur in groups of 10–100 individuals but can aggregate to form large herds containing about 100 up to 1000 whales that appear to be temporary associations of smaller groups that aggregate to feed on locally abundant prey (Ross 2006, Warneke 2008d, Baird 2009). Long-term associations of some individuals have been documented over 15 years in Hawaiian waters, and strong social bonds are evident among identified individuals, which may influence their propensity for mass stranding (Baird 2009). They are one of the species most commonly involved with mass-stranding events with the largest stranding event recorded involving 835 individuals (Jefferson *et al.* 2008, Baird 2009). False killer whales prey mainly on large pelagic fish, including tunas and sailfish, and squid, but also feed on smaller dolphins released from tuna purse seine fisheries in the eastern tropical Pacific, and have been recorded to prey upon a humpback whale calf *Megaptera novaeangliae* and attack sperm whales *Physeter macrocephalus* (Baird *et al.* 2008b, Baird 2009). Age at sexual maturity is thought to be about eight–10 years for females and 10–18 years for males from Japan, gestation is about 15.5 months and calving interval is about 6.9 years in Japan and increases with age (Warneke 2008d, Baird 2009, Ferreira *et al.* 2014). Maximum age is estimated to be about 57 years for males and 62 years for females (Baird 2009), and generation length may be about 35 years (Woinarski *et al.* 2014).

Risks and threatening processes

Large numbers of false killer whales have been taken in drive fisheries in Japan and Taiwan, and they are hunted opportunistically in Japan, Taiwan, Indonesia and the West Indies (Taylor *et al.* 2008l). Their depredation of fish from commercial longlines and sport fishing has resulted in considerable bycatch and deliberate culling in some regions (Hamer *et al.* 2012). The rate of bycatch mortality or serious injury from longline interactions in Hawaiian waters exceeds their Potential Biological Removal limit and is biased towards females which is likely to have an increased impact on population growth (Baird *et al.* 2014), and considerable declines in abundance of false killer whales have been reported around Hawai'i since the 1980s (Reeves *et al.* 2009). Bycatch mortality of false killer whales was reported in the offshore gillnet fishery in northern Australia in the 1980s (Harwood and Hembree 1987), and bycatch occurs in purse seine nets in the eastern tropical Pacific, and in trawl, gill and other nets in Chinese coastal fisheries (Taylor *et al.* 2008l, Reeves *et al.* 2013). False killer whales are known to ingest discarded plastic, and high levels of cadmium and other toxins have been recorded in stranded animals (Kemper *et al.* 1994, Baird 2009). Potential threats include prey depletion from commercial fisheries, and false killer whales are considered likely to be vulnerable to anthropogenic noise and acoustic disturbance, particularly from military active sonar and seismic surveys (Cox *et al.* 2006, Woinarski *et al.* 2014).

Conservation and listing status

The false killer whale is listed as a cetacean species under the EPBC Act, Rare in South Australia, Least Concern in the Northern Territory, but is not listed in other states within its Australian range (Woinarski *et al.* 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and as 'No category assigned but possibly secure' in the previous conservation status assessments in Australian waters (Bannister *et al.* 1996, Ross 2006). Globally, the false killer whale was assessed as Data Deficient for the IUCN Red List in 2008 (Taylor *et al.* 2008l) and is listed in Appendix II of CITES.

Australian humpback dolphin *Sousa sahulensis* (formerly Indo-Pacific humpback dolphin *Sousa chinensis*) (Level 2 PSA Residual Risk – High)

Distribution and range

The Australian humpback dolphin is a recently described new species resulting from a comprehensive taxonomic revision of the humpback dolphin genus *Sousa* based on evidence from skeletal and external morphology, phylogenetic analyses and colouration (Jefferson and Rosenbaum 2014). The Australian humpback dolphin species was previously included within the Indo-Pacific humpback dolphin species *Sousa chinensis*, but their distribution ranges are now recognised to be separated by a wide distribution gap coinciding with Wallace's Line (Jefferson and Rosenbaum 2014). The Australian humpback dolphin occurs in Australian waters ranging from subtropical regions in southern Queensland and northern NSW (31°27'S) across northern Australia and along the coast of WA south to Shark Bay (25°S), as well as in waters of the Sahul Shelf off northern Australia extending to southern New Guinea (Chatto and Warneke 2000, Parra *et al.* 2004, Ross 2006, Parra and Ross 2009, Cagnazzi *et al.* 2011, Allen *et al.* 2012, Jefferson and Rosenbaum 2014, Palmer *et al.* 2014a). Their Australian range overlaps slightly with the SPF area in northern NSW and southern Queensland.

Population size and trends

The population size and trends of Australian humpback dolphins in Australian and New Guinea waters are not reliably known, however Woinarski *et al*. (2014) considered that the Australian population may be about 10,000 mature individuals (plausible range 5000 to 20,000). Population trends have been assessed at only a few Australian sites and only over relatively short periods, and most of these sites include areas with intensive coastal and port development pressures, hence subpopulation declines reported from two of these sites may not be representative of other subpopulations across northern Australia (Woinarski *et al*. 2014).

Abundance estimates are available for four subpopulations along the east coast of Queensland. In Moreton Bay, southeastern Queensland abundance estimates were 163 (95 per cent confidence interval (CI) = 108–251) for 1984–1986, and 119 (95 per cent CI = 81–166) for 1985–1987, with an overall density estimated to be about one dolphin per 10 square kilometres (km^2) in the bay (Corkeron *et al*. 1997). Further north, abundance in the Great Sandy Strait region was estimated to be about 150 Australian humpback dolphins (95 per cent CI = 132–165), and association patterns and resighting data indicated that the subpopulation consists of two largely geographically distinct communities with the southern community consisting of about 75 individuals (95 per cent CI = 66–83) and the northern community about 76 individuals (95 per cent CI = 71–86) (Cagnazzi *et al*. 2011). Extensive surveys along the central Queensland coast during 2006–2011 identified three subpopulations of humpback dolphins occurring in Port Curtis, Keppel Bay and in the northern region of the study area, with some movement of individuals evident between the three areas (Cagnazzi 2011). Abundance estimates from the industrialised Port Curtis declined from 84 dolphins in 2007 to 76 dolphins in 2010, and declined significantly to about 45 dolphins after 2010 following a large flood and substantial port expansion and development (D. Cagnazzi pers. comm. in Woinarski *et al*. 2014). Abundance in Keppel Bay declined from about 114 to about 104 dolphins after the flood. This subpopulation had significantly higher juvenile survival compared with the Port Curtis subpopulation. Abundance in the northern region was estimated to be about 64 dolphins (Cagnazzi 2011). These data indicate that the combination of flood impacts and habitat disturbance from large-scale port development can significantly reduce the abundance of Australian humpback dolphin subpopulations that use tropical coastal habitats (D. Cagnazzi pers. comm. in Woinarski *et al*. 2014). Abundance in Cleveland Bay, in north-east Queensland was estimated at 59 (95 per cent CI = 44–78) dolphins, but most individuals were not permanent residents, but used the area regularly and temporarily emigrating then re-immigrating into the bay (Parra *et al*. 2006a). This species also occurs further north along the northern Queensland coast but abundance estimates are not available for that region.

In Northern Territory waters, minimum subpopulation sizes were estimated to vary from 133 to 145 individuals in Darwin Harbour, and total abundance estimates in Port Essington were highly variable among sampling periods, ranging from 48 to 207 humpback dolphins (Palmer *et al*. 2014a, 2014b). Bejder *et al*. (2012) estimated that the total abundance of humpback dolphins in WA waters was likely to be less than 5000 individuals. Brown *et al*. (2012) photo-identified 54 humpback dolphins around North West Cape and suggested that this area may represent an important habitat, and Allen *et al*. (2012) documented high encounter rates with humpback dolphins in the Dampier Archipelago and off Port Hedland.

Corkeron *et al*. (1997) speculated that humpback dolphins may be in decline in Australian waters, but noted that the conservation status of subpopulations was largely unknown throughout their Australian range.

Biology and feeding ecology

Australian humpback dolphins grow to about 2.7 m long (Jefferson and Rosenbaum 2014), and typically occur in protected coastal habitats mostly in shallow waters less than 15 m deep near estuarine river mouths, tidal channels and mangroves, and in some inshore reef habitats (Parra *et al*. 2002, 2006b, Parra 2006, Allen *et al*. 2012, Palmer *et al*. 2014a). Aerial surveys along the Great Barrier Reef (GBR) demonstrated that most humpback dolphins occurred within 10 km of the coast, but in the northern GBR they have been recorded further offshore in sheltered waters (Corkeron *et al*. 1997). In Northern Territory waters, all 138 records of humpback dolphins from a collated database were within 10 km of the coast and within 20 km of river mouths, and nearly 25 per cent of records were in tidal rivers with some individuals sighted in tidal sections of rivers up to 50 km upstream from the river mouth (Palmer *et al*. 2014a). In northwestern Australia, humpback dolphins also occur around islands and near steep coastal cliffs away from their typical shallow coastal habitat (Allen *et al*. 2012).

Australian humpback dolphins are often sympatric with Australian snubfin dolphins *Orcaella heinsohni*, but they can occur further away from estuaries and river mouths and in slightly deeper waters than snubfin dolphins in northeastern Australian regions (Parra 2006, Parra *et al*. 2006b). Australian humpback dolphins and snubfin dolphins interact frequently; occasional interbreeding and hybridisation has been recorded (Jefferson and Rosenbaum 2014). Humpback dolphins also frequently occur with Indo-Pacific bottlenose dolphins *Tursiops aduncus* in Western Australian waters (Allen *et al*. 2012, Brown *et al*. 2012). Australian humpback dolphins appear to have a fission-fusion society characterised by mostly short-term interactions between individuals apart from mothers and calves, and they usually occur in small groups ranging in size from one–12 dolphins with a mean group size of about 3.5 dolphins, although larger groups have been recorded foraging behind fishing trawlers (Parra *et al*. 2002, 2006b, 2011, Cagnazzi 2011). These humpback dolphins appear to be opportunistic and generalist feeders that prey on a wide variety of coastal, estuarine and some reef-associated fish species, and some cephalopods and crustaceans (Ross 1984, Hale 1997, Parra and Ross 2009, Parra *et al*. 2011). Stomach contents from six humpback dolphins killed in shark nets or stranded along the Queensland coast between 1970 and 2008 were dominated by teleost fish, particularly grunt fish *Pomadasys* sp., cardinal fish *Apogon* sp., and smelt-whiting *Sillago* sp., with low numbers of cephalopods and bivalves present in one stomach (Parra and Jedensjo 2014).

No detailed studies have been completed on the life history of Australian humpback dolphins, but the available information suggests that it may be similar to its congener *S. chinensis* (Jefferson and Rosenbaum 2014). Studies of *S. chinensis* indicate that sexual maturity occurs at about nine–14 years for females and 13–16 years for males, gestation is about 10–12 months, and the interbirth interval is about 3–5 years (Taylor *et al*. 2007, Porter 2008, Parra and Ross 2009). A captive individual held at the SeaWorld theme park in southern Queensland was estimated to be at least 48 years of age (Jefferson and Rosenbaum 2014), and generation length is estimated to be 20.4 years for *S. chinensis* (Taylor *et al*. 2007).

Risks and threatening processes

Australian humpback dolphins have small subpopulation sizes that appear to be relatively isolated and genetically differentiated, they have a relatively slow reproductive rate, and they rely on coastal habitats that are increasingly being altered by human activities, which makes them highly vulnerable to local population decline or extirpation (Parra *et al*. 2006a, 2011, Cagnazzi 2011, Allen *et al*. 2012). In Australian waters, humpback dolphins are subject to entanglement and bycatch mortality in shark nets deployed for protection of bathers and in various types of fishing nets including gillnets, which could lead to local depletion of subpopulations (Paterson 1990, Hale 1997, Gribble *et al*. 1998, Parra *et al*. 2004, Cagnazzi *et al*. 2011). Increasing coastal development and port expansion with associated increases in catchment run-off and reduced water quality, increased vessel movements and anthropogenic noise disturbance are all likely to cause disturbance, stress and disrupt behaviour, and will degrade important coastal habitats for humpback dolphins in Australian waters (Bannister *et al*. 1996, Woinarski *et al*. 2014). Elevated levels of organochlorine compounds and polycyclic aromatic hydrocarbons have been detected from biopsy samples of Australian humpback dolphins in the central and southern GBR region (Cagnazzi *et al*. 2013) that could impair the function of their immune, endocrine and nervous systems, health status or reproduction (Evans 2003). Toxoplasmosis infection was recorded in this species from Townsville, north Queensland following flood events and possibly contaminated run-off from urban coastal areas (Bowater *et al*. 2003). Prey depletion from commercial fisheries is a potential threat for humpback dolphin subpopulations and may be exacerbated by other forms of habitat degradation (Bannister *et al*. 1996, Woinarski *et al*. 2014). Predicted increases in severe cyclones and flood events associated with climate variability and change could affect key coastal habitats for these dolphins (Woinarski *et al*. 2014).

Conservation and listing status

The recently described *Sousa sahulensis* humpback dolphin species in Australian waters is not currently listed under the EPBC Act, however, the humpback dolphin is listed under its former name *Sousa chinensis* as a cetacean species and as a listed migratory species under the EPBC Act, Near Threatened in Queensland, Data Deficient in the Northern Territory, Priority 4 in WA, but the species is not listed in NSW (Woinarski *et al*. 2014). The humpback dolphin was recently assessed as Near Threatened in Australian waters by Woinarski *et al*. (2014), who noted that its conservation status was difficult to categorise due to uncertainty about population size and trends, and that a categorisation of Data Deficient may also be appropriate. The humpback dolphin was previously assessed as 'Insufficiently known' in Australian waters (Bannister *et al*. 1996, Ross 2006). Due to the recent recognition and separation of this species from *S. chinensis*, there is no global assessment of *Sousa sahulensis* for the IUCN Red List. The congener *S. chinensis* was assessed as Near Threatened in 2008 (Reeves *et al*. 2008) and is listed in Appendix I of CITES.

Rough-toothed dolphin *Steno bredanensis* (Level 2 PSA Residual Risk – High)

Distribution and range

Rough-toothed dolphins occur in tropical to warm temperate regions of the Pacific, Indian and Atlantic Oceans and in many semi-enclosed seas, with a latitudinal range mostly between 40°N and 35°S (Jefferson *et al*. 2008, West *et al*. 2011). Their distribution in Australian waters is poorly known, with records from southern NSW, Queensland, Northern Territory and Barrow Island off WA (Bannister *et al*. 1996, Ross 2006). Their Australian range overlaps partly with the eastern SPF area from southern NSW to Queensland.

Population size and trends

There is no robust estimate of the Australian regional population size of rough-toothed dolphins and the Australian and global population trends are unknown (Hammond *et al*. 2008, Woinarski *et al*. 2014). Ross (2008g) considered that this species was common in Australian waters, and globally it is considered to be abundant with no reported population declines (Hammond *et al*. 2008). The population size and status of rough-toothed dolphins is poorly known throughout most of their range (West *et al*. 2011). Wade and Gerrodette (1993) estimated the abundance of rough-toothed dolphins in the eastern tropical Pacific region to be about 145,900 (CV = 0.32), with other regional estimates including about 2223 (CV = 0.41) in the northern Gulf of Mexico, and 8709 (CV = 0.45) for the United States Exclusive Economic Zone (EEZ) around the Hawaiian Islands (Barlow 2006, West *et al*. 2011).

Biology and feeding ecology

Rough-toothed dolphins are slightly sexually dimorphic with females growing to about 2.7 m long and males growing to about 2.8 m long, with an average body weight of 130 kg and a maximum recorded weight of 155 kg (West *et al*. 2011). These dolphins are generally found in deep oceanic waters beyond the continental shelf and are commonly sighted in deep water habitats greater than 500-2000 m depth closer to the coasts of steep volcanic islands, but they also occur in shallow coastal waters in some regions (Ross 2008g, West *et al*. 2011).

These dolphins can be solitary or occur in groups of 10–20 individuals, but can aggregate to form larger groups containing up to 160 dolphins (West *et al*. 2011). They appear to have a fission-fusion type of social organisation, and form dynamic subgroups of two to eight individuals, with strong social bonds between mothers and calves or juvenile dolphins (West *et al*. 2011). Rough-toothed dolphins also form mixed schools with bottlenose dolphins and other cetacean species, and are thought to be capable of deep dives with dive times up to 15 minutes (Jefferson *et al*. 2008, West *et al*. 2011). Solitary and mass stranding events have been recorded in many regions (West *et al*. 2011). The diet of rough-toothed dolphins inferred from stomach contents includes a range of fish and squid, octopus, molluscs and sometimes algae, and these dolphins appear to form small cooperative hunting groups to catch large and fast swimming dolphinfish *Coryphaena hippurus* (Ross 2008g, West *et al*. 2011). Their common name derives from the numerous fine vertical ridges on their teeth, which is unique among extant dolphin species and may be an adaptation for grasping and holding large and slippery prey (Ross 2008g, West *et al*. 2011). Age at sexual maturity is reported to be about six–14 years of age and longevity is at least 32–36 years (Taylor *et al*. 2007, Jefferson *et al*. 2008, West *et al*. 2011) hence generation length may be about 18–23 years (Woinarski *et al*. 2014).

Risks and threatening processes

Rough-toothed dolphins are taken in drive fisheries in Japan, Solomon Islands and Papua New Guinea, and are also targeted in other fisheries in Sri Lanka, West Africa and the Caribbean (West *et al*. 2011). This species is sometimes reported as bycatch in purse seine fisheries in the eastern tropical Pacific, and small numbers are taken as bycatch in gillnet, driftnet and pelagic longline fisheries in Sri Lanka, Brazil, Taiwan, Japan, central North Pacific and probably elsewhere in warm-temperate and tropical habitats (Hammond *et al*. 2008, West *et al*. 2011). Illegal catches in fisheries within the Australian EEZ were considered to be likely (Ross 2006). Rough-toothed dolphins are reported to take bait from fisheries in Hawai'i (West *et al*. 2011). Rough-toothed dolphins are known to ingest discarded plastic bags resulting in compromised health and strandings, and elevated levels of persistent organic pollutants have been recorded in some stranded and immature individuals (West *et al*. 2011). Prey depletion from commercial fisheries is considered to be a potential threat (Bannister *et al*. 1996, Woinarski *et al*. 2014).

Conservation and listing status

The rough-toothed dolphin is listed as a cetacean species under the EPBC Act, Data Deficient in the Northern Territory, but is not listed in other states within its Australian range (Woinarski *et al*. 2014). This species was recently assessed as Data Deficient in Australian waters (Woinarski *et al*. 2014), and similarly in the previous conservation status assessments in Australian waters (Bannister *et al*. 1996, Ross 2006). Globally, the rough-toothed dolphin was assessed as Least Concern for the IUCN Red List in 2008 (Hammond *et al*. 2008) and is listed in Appendix II of CITES.

Common minke whale: *Balaenoptera acutorostrata* (Level 2 PSA Residual Risk – High)

Distribution and range

The common minke whale species has a cosmopolitan distribution extending from about 69°S to 80°N and occurs in all major ocean basins but is not recorded from the northern Indian Ocean region (Rice 1998, Reilly *et al*. 2008, Perrin and Brownell 2009, Acevedo *et al*. 2011). The dwarf minke whale *Balaenoptera acutorostrata* unnamed subspecies *sensu* Best (1985) is the subspecies of common minke whale *Balaenoptera acutorostrata* that occurs in Australian waters and is restricted to the Southern Hemisphere, with two other subspecies recognised in the Northern Hemisphere (Arnold *et* *al*. 1987, Rice 1998, Perrin and Brownell 2009). Arnold *et al*. (2005) concluded that the dwarf minke whale should continue to be recognised as an undescribed subspecies of *B. acutorostrata* but they noted that it might warrant recognition as a separate species. The distribution of the dwarf minke whale is not well known but the subspecies has been recorded in Australia, New Zealand, New Caledonia, South America, South Africa and from the Southern Ocean in the subantarctic and occasionally from higher latitude regions including close to the ice edge at about 65°S (Best 1985, Arnold *et al*. 1987, Zerbini *et al*. 1996, Perrin and Brownell 2009, Acevedo *et al*. 2011).

Their distribution in Australian waters is not well known, but they have been recorded north to 11°S in the northern GBR region and in deeper waters of the Coral Sea, and north to about 14°S along Western Australia (Arnold *et al*. 1987, 2005, Arnold 1997, Birtles *et al*. 2002, Bannister 2008, Birtles and Arnold 2008). Aggregations of these whales occur in the northern GBR during the austral winter, with sightings off Australia mostly from March–April to October (Arnold *et al*. 1987, Birtles and Arnold 2008, Curnock *et al*. 2013). One stranded dwarf minke whale was recorded from SA (Kemper *et al*. 2005). These whales occur in subantarctic waters south of Australia mostly between 55°S and 62°S from December to March, and are occasionally recorded further south to about 65°S (Kasamatsu *et al*. 1993, Bannister *et al*. 1996, Bannister 2008, Pastene *et al*. 2010). Their Australian range overlaps completely with the SPF area from Queensland across to southern WA.

Population size and trends

The population size and trends of dwarf minke whales in Australian waters are unknown (Bannister 2008). Estimates of the numbers of these whales interacting with tourist vessels in the northern GBR were 449 (standard error ± 68) in 2006 and 342 (standard error ± 62) in 2007 (Arnold *et al*. 2005, Sobtzick 2011, A. Birtles and M. Curnock *pers. comm.* in Woinarski *et al*. 2014). It is not possible to estimate abundance of these whales in the Southern Hemisphere, because sighting data do not reliably distinguish dwarf minke whales from the more abundant and partially sympatric Antarctic minke whale *B. bonaerensis* (Reilly *et al*. 2008).

Biology and feeding ecology

Dwarf minke whales grow to about 7.8 m long and can weigh up to 5–6 t (Birtles and Arnold 2008). These whales occur both in deeper offshore oceanic waters and in shallower continental shelf habitats, and in the northern GBR they are regularly observed on or near coral reefs near the shelf edge in waters less than 50 m deep, sometimes over the shelf and offshore in the Coral Sea (Arnold *et al*. 1987, 2005, Birtles and Arnold 2008). Photo-identification data indicate that many individual whales return to the same reef areas in the northern GBR over at least several years, which may indicate that there are local subpopulations in some regions (Birtles *et al*. 2002, Arnold *et al*. 2005, Birtles and Arnold 2008, Sobtzick 2011). There is evidence of seasonal migration of some dwarf minke whales from Antarctic waters to lower latitudes in the western South Pacific Ocean, and the timing of sightings south of Australia and then further north along the Australian coast suggests that these whales may also migrate seasonally in the Australian region (Bannister 2008, Pastene *et al*. 2010). These whales are usually first sighted alone or in pairs, but they are inquisitive and aggregations of more than a dozen whales have been reported near boats and swimmers (Birtles *et al*. 2002, Birtles and Arnold 2008, Mangott *et al*. 2011, Curnock *et al*. 2013).

These whales are thought to feed mainly on fish including myctophid lantern fish but may also lunge feed on euphausiid swarms, and feed on small euphausiid species at lower latitudes (Bannister 2008). Dwarf minke whale calves have been recorded in the northern GBR, with stranding records of some neonates from southern Queensland to Victoria (Birtles and Arnold 2008). The life history characteristics of dwarf minke whales are largely unknown hence information is mostly based on Northern Hemisphere common minke whales. Age at first reproduction is estimated to be about eight years, gestation is about 10 months, and the mean calving interval is estimated to be about one year (Best 1985, Taylor *et al*. 2007 Perrin and Brownell 2009). Generation length is estimated to be 22.1 years (Taylor *et al*. 2007).

Risks and threatening processes

In contrast to most other baleen whale species, dwarf minke whales were not specifically targeted by commercial whaling, and relatively few of these whales were killed in commercial whaling or 'special permit' whaling by Japan in the Southern Hemisphere compared with Antarctic minke whales (Bannister 2008, Reilly *et al*. 2008, Clapham and Baker 2009). Common minke whales have been recorded as bycatch in fisheries gear (Reilly *et al*. 2008, Reeves *et al*. 2013) including in purse seine nets in the western Indian Ocean (Anderson 2014). A relatively high frequency of entanglement scarring has been observed for dwarf minke whales from the GBR region (A. Birtles *pers. comm.* in Woinarski *et al*. 2014). One dwarf minke whale was recorded to have drowned in a shark net off Cairns (Paterson 1990). Other threats to dwarf minke whales include climate and oceanographic variability and change; increasing anthropogenic noise and acoustic disturbance; exposure to persistent toxic pollutants; increasing port expansion and associated vessel movements and risk of vessel strike; disturbance and stress caused by whale-watching and swimming with dwarf minke whales; and potential for prey depletion caused by commercial fisheries (Woinarski *et al*. 2014).

Conservation and listing status

The dwarf minke whale subspecies is not listed under the EPBC Act, however at the species level the common minke whale is listed as a cetacean species and as a migratory species under the EPBC Act and listed as Rare in SA but is not listed in other states within its Australian range (Woinarski *et al.* 2014). The dwarf minke whale subspecies was recently assessed as Data Deficient in Australian waters (Woinarski *et al.* 2014), and similarly in the previous conservation status assessment (Bannister *et al.* 1996). Globally, the common minke whale was assessed as Least Concern for the IUCN Red List in 2008 (Reilly *et al.* 2008), and this species is listed in Appendix I of CITES.

Summary: cetacean species at risk from direct interactions with mid-water trawl and purse seine gear in the SPF

Mid-water trawl

- *The 15 odontocete species described in the first panel report have different distribution ranges that vary in their extent of overlap with the SPF area.*
  - *The species at highest risk of interactions with mid-water trawls in the SPF are bottlenose dolphins and short-beaked common dolphins* Delphinus delphis *whose diet includes small pelagic fish and these dolphins are known to interact extensively with trawl fisheries in Australia and internationally; some common bottlenose dolphins* Tursiops truncatus *and possibly short-beaked common dolphins were previously recorded as bycatch in mid-water trawls in the SPF.*
  - *Although the hourglass dolphin* Lagenorhynchus obscurus *remained at high risk for the mid-water trawl sector of the SPF after the residual risk assessment, its oceanic distribution range may only overlap marginally with the SPF area, the species has not been recorded interacting with trawl fisheries, is not obviously threatened, and is assessed as Least Concern in Australian waters and globally. Therefore, the panel did not consider the hourglass dolphin to be a particularly high-risk species for direct interactions associated with the SPF mid-water trawl sector.*
- *The six baleen whale species described in the first panel report have different distribution ranges and these overlap extensively or completely with the SPF area. Five of these species are listed as threatened species and are therefore matters of national environmental significance requiring a high level of protection under the EPBC Act. Southern right whales* Eubalaena australis *and blue whales* Balaenoptera musculus *are listed as Endangered, while fin whale* B. physalus, *sei whale* B. borealis *and humpback whales* Megaptera novaeangliae *are listed as Vulnerable.*
  - *These six whale species exhibit different biological and ecological characteristics, and their abundance and the extent to which populations are recovering following significant depletion from whaling, varies.*
  - *Their diet and life history traits, and the nature and extent of potential interactions with fisheries' operations also differ between species. Bryde's whales* Balaenoptera edeni *feed mainly on small pelagic schooling fishes, while fin, sei and humpback whales feed mainly on crustaceans but also feed on small pelagic fish species to varying degrees.*
  - *Humpback whale abundance is increasing rapidly and the south-west subpopulation of southern right whales is also increasing, hence there is increased risk of vessel strike and other interactions such as entanglement in fishing gear for these species within the SPF area.*
  - *Vessel strike has also been recorded for the other whale species, particularly for fin whales.*
  - *Entanglement or bycatch in various types of fishing gear has been reported for all six whale species.*
  - *Occasional incidental bycatch in trawl nets and other fishing gear has been reported for humpback, fin and Bryde's whales, and fin whales have been reported feeding behind a trawl codend.*
- *Therefore these whale species have a wide range of known and potential interactions with mid-water trawl and other fisheries.*

Purse seine

- *The 14 odontocete species and the common minke whale described above have different distribution ranges that vary in their extent of overlap with the SPF area. All cetacean species are protected under the EPBC Act and the Australian humpback dolphin and the common minke whale are also listed as migratory species and are therefore matters of national environmental significance requiring a high level of protection under the EPBC Act.*
- *These species exhibit a wide range of biological and ecological characteristics including abundance, diet and life-history traits, and the nature and extent of their interactions recorded with purse seine and other fisheries varies, hence the risks of interactions with purse seine operations in the SPF need to be assessed separately for each species.*

- *Of the 15 cetacean species described above, the pygmy killer whale, false killer whale, rough-toothed dolphin and the common minke whale have been reported to interact with purse seine operations overseas resulting in some incidental bycatch, which suggests that these species may be at increased risk of interactions with purse seine fishing operations in the SPF.*
- *In Australian waters, the short-beaked common dolphin is the species most often reported in interactions with purse seine operations in the SASF resulting in bycatch mortality, and bottlenose dolphins were previously reported as bycatch in the WA purse seine fishery for pilchards. These species were assessed in the first declaration report.*

5.3.2 Nature and extent of interactions

As noted in the first declaration report, entanglement, injury and fisheries bycatch mortality is the major recognised threat to many smaller cetacean species in Australian waters and internationally, particularly from purse seine, gillnet and trawl fishing, as well as from discarded fisheries gear (reviewed in Shaughnessy *et al.* 2003, Zollett and Rosenberg 2005, Read *et al.* 2006, Zollett 2009, Reeves *et al.* 2013, Anderson 2014). The risk of bycatch is influenced by factors such as whether the cetaceans feed on prey species that are also targeted by fisheries, the extent to which cetaceans feed in areas that are used by fisheries, the types of prey species and fisheries activities involved, and the intersection of fishing zones with migratory pathways or habitats regularly used by some cetacean species (Couperus 1997). Although cetacean bycatch rates have been substantially reduced in some fisheries in recent decades, there is potential for increased frequency and intensity of interactions leading to increased bycatch mortality in future as human populations and fisheries' operations increase (Hall *et al.* 2000, Read *et al.* 2006).

Nature and extent of trawl fishery interactions: global

A summary of the panel's assessment of the nature and extent of trawl fishery interactions with cetaceans is provided below. This summary is drawn from the panel's first declaration report.

- The nature and likelihood of interactions between cetaceans and mid-water trawl fisheries varies substantially among species. Bottlenose dolphins and short-beaked common dolphins are likely to be at higher risk based on reported interactions with trawls and bycatch in Australia and internationally.
- Direct interactions with fishing operations include net feeding, foraging behind trawlers, and feeding on discards and fish escaping from nets. Vessel collisions resulting in injury or death of whales and some other cetaceans are thought to be relatively common in Australian waters but are not well documented. Most severe or fatal injuries to whales are caused by collisions from vessels greater than 80 m in length.
- Fisheries bycatch mortality is the major threat to many smaller cetacean species in Australian waters and internationally. Cetacean bycatch occurs in most areas where trawling occurs and they are more often caught in mid-water trawls than in bottom trawls. The risk of bycatch increases where prey species are also targeted by fisheries and where fishing grounds overlap with important habitats used by cetaceans for aggregating, feeding, breeding and as migratory routes.
- Analyses of common dolphin bycatch in New Zealand mid-water trawl fisheries showed that bycatch occurred in vessels longer than 90 m, and bycatch was highest in trawls where the headline depth was between 10–40 m, and during longer tows of two to six hours in duration. Light conditions and fishing location also significantly influenced common dolphin bycatch rates. Sharp vessel turns and changes in speed may increase the risk of bycatch.
- Cetaceans that frequently interact with trawlers and other fisheries can become habituated, leading to altered social interactions and increased risk of bycatch.
- Acoustic disturbance can be important for cetaceans because they have a very highly developed acoustic sense and sounds are vitally important for their ecology and survival.

Nature and extent of trawl fishery interactions: Australia and the SPF

The first panel report summarised interactions between trawl fisheries and cetaceans in Australia as follows:

- The SPF area encompasses the known distribution range of most cetacean species occurring in Australian waters; this area is known to be important to many cetacean species and interactions with mid-water trawl and other fisheries have occurred for many species.
- A total of 25 dolphin mortalities were reported in mid-water trawls in the SPF during 2004 and 2005, comprising some common bottlenose dolphins and possibly short-beaked common dolphins. The absence of reported interactions with cetaceans in this fishery in more recent years coincides with low levels of fishing and observer effort. Therefore, it is difficult to estimate the overall extent of direct interactions with cetaceans by mid-water trawl gear in the SPF.

Nature and extent of purse seine fishery interactions with cetaceans

Purse seine fishing has been the major cause of dolphin bycatch internationally. For example, during the 1960s an estimated 200,000–500,000 dolphins were killed annually in the eastern tropical Pacific Ocean when purse seines were set on groups of spotted dolphins *Stenella attenuata*, eastern spinner dolphins *Stenella longirostris orientalis* and short-beaked common dolphins that were associated with yellowfin tuna *Thunnus albacares* (e.g. Perrin 1969, Wade 1995, Gerrodette and Forcada 2005, Wade *et al*. 2007, Gerrodette *et al*. 2012). This purse seine fishery began in the late 1950s (Hall 1998), and during the period from 1960 to 1972 it is estimated that more than 4 million dolphins were killed in the eastern tropical Pacific Ocean (Wade 1995). This extreme bycatch mortality became known as the 'tuna-dolphin issue' and resulted in significant declines in at least three dolphin stocks—northeast offshore spotted dolphins *S. attenuata attenuata*, coastal spotted dolphins *S. attenuata graffmani*, and eastern spinner dolphins, and these stocks were designated as 'depleted' under the US Marine Mammal Protection Act of 1972 (Wade 1995, Wade *et al*. 2007, Gerrodette *et al*. 2012). Abundances of eastern spinner dolphins were reduced to an estimated one-third of pre-fishery levels while abundances of north-east offshore spotted dolphins were reduced to an estimated one-fifth of pre-fishery levels (Wade *et al*. 2007). Subsequently, there has been a reported 98 per cent reduction in dolphin bycatch mortality in the eastern tropical Pacific Ocean following fisheries management interventions (e.g. Hall 1998, Inter-American Tropical Tuna Commission (IATTC) 2013), which included techniques for releasing dolphins alive after a set (International Seafood Sustainability Foundation (ISSF) 2014). However, as noted below, these dolphin populations have not recovered at the rates expected following reduction in high bycatch levels (Gerrodette and Forcada 2005).

As a result of the high bycatch issue in the Eastern Pacific Ocean tuna fishery (Hall 1998), the US National Marine Fisheries Service (NMFS) started an observer program to estimate mortality on larger vessels in the fishery (Hall and Roman 2013). In 1976, the member nations of the IATTC implemented a tuna-dolphin program and signed onto the Agreement on the International Dolphin Conservation Program (AIDCP) to reduce dolphin mortality. A critically important component of the program was that every vessel had an annual dolphin mortality limit that, if exceeded, would require the vessel to stop fishing on dolphins. Since 1993, the IATTC has had 100 per cent coverage of the trips by seiners larger than 363 t capacity resulting in a very large database of observations on purse seine sets (Hall and Roman 2013).

Despite the currently low levels of dolphin mortality in the eastern Pacific tuna fishery, these depleted populations have not recovered (Gerrodette and Forcada 2005). The fishery has had population-level effects beyond the reported direct bycatch mortality, possibly due to reduced reproductive success brought about by stress from constant chasing and encirclement by purse seiners, or under-reporting of bycatch, ecosystem changes and other species' effects on dolphin population dynamics (Gerrodette and Forcada 2005, Wade *et al.* 2007, Cramer *et al*. 2008). However, more recent studies indicate that some dolphin stocks may be beginning to recover while others are not (Gerrodette *et al*. 2008).

From 1994 to 2004, 27,644 purse seine sets were observed in the Western and Central Pacific Ocean (WCPO) (Molony 2005). A total of 687 marine mammals from 137 sets were reported as captured of which only 49 were identified to species (Molony 2005): 24 short-beaked common dolphins, 18 bottlenose dolphins, four spinner dolphins, two short-finned pilot whales and one pygmy killer whale. Molony (2005 cited in NMFS 2006) estimated that about 900 marine mammals were captured across the whole fishery of which 50 were killed. Most mammals were incidentally captured from 'associated' sets: 11 sets were on live whales and, in fact, the largest number of marine mammal interactions occurred due to deliberate sets on whales (486 sets or 1.76 per cent of all sets) (Molony 2005). Within the WCPO, sei whales were the baleen whale species that was most commonly encircled by purse seines targeting tuna schools feeding on pelagic baitfish though they escaped virtually unharmed (Bailey *et al*. 1996 in NMFS 2006). However fishery interactions with delphinids are much more common than with baleen whales (NMFS 2006). Overall, the WCPO purse seine fishery is thought to have little impact on the sustainability of marine mammal stocks in the WCPO (Molony 2005). Setting on cetaceans has been banned by the European Commission (European Commission 2007) so cetacean bycatch and mortality should be much reduced in the future (Anderson 2014).

Sets made on whale-associated tuna schools in the western Indian Ocean could result in injury and mortality (Romanov 2002, Molony 2005). While the major potential cetacean interactions in the western and central Indian Ocean are with free school sets, fishermen regularly used sightings of Bryde's whales to find tuna schools. During 1981–1999 nearly 10 per cent of all sets were reported to have been made in association with whales, probably Bryde's whale (Anderson 2014). When encircled, the whales often remain in the net until pursing is complete and escape most commonly by diving under the purse line or by ramming through the net (Romanov 2002). Estimates of whale mortality are likely to be underestimated mainly due to unreliability of some observer data and under-reporting (Anderson 2014) and many encircled whales died later from injuries received during escapement and entanglement (IOTC 2012). The true scale of total baleen whale mortality in the western Indian Ocean purse seine area is unknown but may have been of the order of 10s annually (Anderson 2014). Setting on cetaceans has recently been banned by the Indian Ocean Tuna Commission (IOTC 2013) so cetacean bycatch and mortality should be reduced in the future (Anderson 2014).

Other international purse seine fisheries that were identified as reporting incidental capture and mortality of cetaceans were in Alaska where in 1994 a humpback whale was caught in a salmon purse seine net (Allen and Angliss 2014), and in 2008, when a humpback whale was entangled in herring purse seine but was released alive (Allen *et al*. 2014). In New Zealand, the purse seine jack mackerel fishery is known to occasionally catch common dolphins (Richard Wells, Deepwater Group Ltd, New Zealand, pers. comm., 12 October 2014 cited in Finley *et al*. 2015a).

Nature and extent of purse seine fishery interactions with cetaceans: Australia and the SPF

South Australian Sardine Fishery

The short-beaked common dolphin has been the cetacean species subject to the most significant bycatch in the SASF (Finley *et al*. 2015a). An observer program undertaken by Hamer *et al*. (2008) to assess the accuracy of logbook data and measure rates of interaction with short-beaked common dolphins recorded rates of encirclement and mortality of dolphins much higher than those reported in logbooks. During the initial observer program period from November 2004 to June 2005, an estimated 1728 encirclements and 377 mortalities were estimated to have occurred across the entire fleet (Hamer *et al*. 2008). Analysis of data collected through logbook records and the independent scientific observer program indicates that some interactions with dolphins have led to injury and mortality (South Australian Sardine Industry Association (SASIA) 2009). A Code of Practice (SASF CoP) was introduced in 2005 that aimed to mitigate operational interactions with dolphins, and a second observer program from November 2005 until June 2006 revealed significant reductions in the observed rates of dolphin encirclement and mortality (Hamer *et al*. 2008).

PIRSA (2014) report that between 2007–08 and 2012–13, the SASF had interactions with 282 short-beaked common dolphins, of which 257 were caught, four entangled and 21 had some other form of interaction. Around 99 per cent of these animals were released alive. In that period the majority of cetacean interactions occurred in Spencer Gulf and the highest annual number of interactions was in 2011–12, when 273 interactions with cetaceans were reported (Tsolos and Boyle 2014).

Small Pelagic Fishery

The known distribution ranges of 44 cetacean species in Australian waters overlap to some extent with the SPF area, hence there is potential for interactions to occur between these cetaceans and purse seine and mid-water trawl operations in the SPF. The panel recognised that the nature and extent of interactions between cetaceans and the SPF is likely to vary among species and also in relation to purse seine and mid-water trawl operations.

The most comprehensive compilation of data on interactions with protected species in the mid-water trawl and purse seine sectors of the SPF is contained in Tuck *et al*. (2013). They reported that between 2001 and 2011 there were no interactions with dolphins reported by fishers or observers in the purse seine sector of the SPF. Between 2006–07 and 2011–12 the rate of observer coverage in the purse seine fleet varied from 2 per cent to 12 per cent (see Table 2.2). AFMA notes that there were no reported purse seine gear interactions with any TEPS since the first SPF Bycatch and Discarding Workplan commenced in 2009, with very low levels of reported interactions before then (AFMA 2014b). No interactions with cetaceans were reported in logbooks in the mid-water trawl and purse seine sectors of the SPF in the period 2012–2014 (to the end of the third quarter) (AFMA 2014e).

Information available on the purse seine JMF, the forerunner to the SPF, provides no evidence of interactions with cetaceans (Harris and Ward 1999).

Other Australian purse seine fisheries

The main Australian purse seine fisheries operating in the area of the SPF are the SBTF, the Western Australian SCPSMF and the purse seine sector of the NSW Ocean Haul fishery.

There have been no logbook or observer reports of purse seine interactions with cetaceans in the purse seine component of the SBTF (AFMA 2013). While this fishery is regarded as highly selective, resulting in minimal interactions with non-target species, the absence of verified independent observer data on the level of TEPS interactions is noted as an issue (Baker and Finley 2013 cited in Finley *et al*. 2015a).

One short-beaked common dolphin calf was entangled and drowned in King George Sound in the SCMPSF during the observer period, 1 March to 15 April 2007 (Western Australian Department of Fisheries 2008). In the past, bottlenose dolphins, *Tursiops* sp., have been taken in the purse seine fishery for pilchards (Shaughnessy *et al*. 2003).

Three assessments of the NSW Ocean Haul Fishery by the Department of the Environment (in 2003, 2008 and 2013) did not identify any concerns about the interactions of the fishery with any protected species. The 2013 submission to the Department of the Environment (NSW Department of Primary Industries 2013) noted that there were no observer data available and did not report any interactions with cetaceans.

In addition to the three fisheries above, the panel noted that a developmental purse seine fishery for Australian sardines, operating just north of the north-east boundary of the SPF, had significant interactions with dolphins. Between August 1997 and November 1998, 72 dolphins were encircled by fishing operations and nine of these died. All dolphin encirclements and deaths were recorded by the on-board observer and reported to the management authority. As a result, all Queensland waters were closed, and remain closed, to purse seine nets (State of Queensland 2000).

Summary: nature and extent of direct interactions between cetaceans and purse seine fisheries

- *The present rate of interaction of cetaceans in international purse seine fisheries appears to be relatively low although it has previously been much higher.*
- *Higher rates of marine mammal interaction will occur if nets are set on dolphin groups or whales, a practice that is now prohibited in many fisheries*
  - *extremely high and unsustainable levels of dolphin bycatch mortality occurred in the Eastern Pacific Ocean tuna fisheries when purse seines were deliberately set on groups of dolphins, prior to fisheries management interventions that have significantly reduced dolphin bycatch mortality.*
- *Delphinids are likely to suffer stress from frequent encirclement and capture in purse seines while large cetaceans are more able to escape and may have lower mortality, but mortality after escape or release is likely to be underestimated.*
- *There have been no reported interactions with cetaceans in the purse seine sector of the SPF to date and no evidence of interactions in the earlier JMF.*
- *Similarly there have been no reported interactions with cetaceans in the SBTF purse seine fishery.*
- *Reported interactions with cetaceans by purse seine fisheries for Australian sardine in NSW and WA have been very low/nil whereas purse seine fisheries for Australian sardines in Queensland and South Australia had significant interactions with dolphins.*
- *The panel notes that observers were responsible for identifying and reporting the cetacean interaction issues in the Queensland and South Australian fisheries and the panel did not discount under-reporting of interactions in logbooks as an issue in Australian purse seine fisheries.*
- *The panel noted that setting on dolphins does not occur in Australian fisheries. Further, the panel has assumed that the FPA will not target Australian sardines. As a result, the panel concluded that the interaction rates in the Eastern Pacific Ocean tuna fisheries and in Australian sardine fisheries may not be indicative of the likely level of interactions with dolphins by FPA purse seine operation.*

5.3.3 Management of cetacean interactions

Management of cetacean interactions in trawl fisheries

A summary of the panel's assessment of the nature and extent of trawl fishery interactions with cetaceans is provided below. This summary is drawn from the panel's first declaration report.

- Management and mitigation measures that have some potential for reducing direct interactions with and associated bycatch of some species of cetaceans include excluder devices and other gear modifications, acoustic deterrent pingers, modified fishing practices, temporal and spatial closures, bycatch triggers and move-on rules.
- Excluder designs tested to date have not been consistently effective in reducing cetacean bycatch in trawls, and at present there is no solution to filter or deter cetaceans from entering the net opening.
- Excluder devices have reduced bycatch mortality of some marine megafauna in some trawl fisheries in Australian waters and internationally, but these need to be carefully designed and optimised for each fishery and for different species of cetaceans.
  - Underwater cameras have shown very high rates of interaction between dolphins and trawl operations in some fisheries, and further research and monitoring is needed to understand the behaviour of cetaceans in trawl nets. Common dolphins and bottlenose dolphins may behave differently when constrained within nets and may require different excluder designs and location of escape holes, which complicates the development and optimisation of excluder devices in the SPF area where both species occur.
- Acoustic pingers have been effective in reducing bycatch of some cetaceans in some gillnet fisheries, but their effectiveness in reducing cetacean bycatch in relatively noise-saturated pelagic trawl fisheries is unclear, with mixed results reported in different studies in Australia and overseas.

- Some studies have reported significant reductions in bycatch mortality of common dolphins, but pingers appear unlikely to deter common bottlenose dolphins from interacting with trawl nets or effectively mitigate bycatch for this species.

- Codes of practice to reduce the risk of interactions include suspension of fishing and relocation to another area following bycatch events, but the success of the 'move on' tactic for cetaceans is uncertain.
- Spatial and temporal fishing closures can reduce interactions and bycatch mortality of cetaceans where the risks of interactions and bycatch are relatively high and consistent and where closures encompass sufficient parts of the range. However, effective planning of closures requires detailed knowledge of spatial and temporal use of habitats, which is lacking for most cetacean species in the SPF area.
- Data on population size and trends, genetic structure, and mortality from fisheries' bycatch and other anthropogenic threats are lacking for most cetacean species in the SPF area. This precludes the development of population demographic models needed to determine sustainable biological removal limits for these species and bycatch trigger limits for cetaceans in the SPF mid-water trawl fishery.
- Independent observer programs are very important for assessing fisheries management options because they provide more reliable data on cetacean interactions and bycatch mortality, enabling adaptive management to reduce the risks of interactions.

Management of cetacean interactions in purse seine fisheries

International

Since its inception in 2009, the ISSF, a global partnership of scientists, the tuna industry and the World Wide Fund for Nature, has made efforts to better understand what the main issues of concern are in the tuna purse seine fisheries of the world (Eastern Pacific, Western Pacific, Atlantic and Indian Oceans), by using scientific information primarily from scientific observer programs to quantify relative impacts, as well as:

- conducting at-sea research to investigate potential mitigation measures
- conducting workshops with purse seine skippers to share with them mitigation techniques and to seek their input about other potential mitigation measures
- advocating for regional fisheries management organisations (RFMOs) to adopt mandatory data collection and mitigation measures (Restrepo *et al.* 2014).

Mitigation and monitoring measures have been adopted by the relevant RFMOs in relation to marine mammals specifically (ISSF 2014, Justel-Rubio and Restrepo 2015):

- IATTC
  - The AIDCP establishes total per-stock and annual limits on incidental dolphin mortality (DMLs), with a structured protocol for allocating and keeping track of DMLs (using observers). A vessel must stop setting on dolphin associations for the rest of the year once its DML has been reached.
  - 100 per cent observer coverage on all large purse seiners (more than 363 t in carrying capacity) and lower coverage on smaller vessels is required.
- IOTC
  - Resolution 13/04 prohibits deliberate purse seine sets around cetaceans and requires reporting of interactions.
  - Resolution 10/04 established a regional observer program that requires at least 5 per cent coverage for vessels more than 24 m in length, and for smaller vessels operating in the high seas.
- WCPFC
  - Conservation and Management Measure 2011-03 prohibits deliberate purse seine sets around cetaceans and requires reporting of interactions.
  - 100 per cent coverage on purse seine vessels that fish on the high seas or between two or more EEZs is required.

In 2011, the ISSF initiated a research program to develop and test technical options to reduce bycatch resulting from industrial tuna fisheries.

Mitigation measures to reduce the bycatch of marine mammals in tuna purse seine fisheries

Gabriel *et al*. (2005) described various methods to reduce the bycatch that was initially a serious consequence of setting on dolphins. Dolphins are capable of leaping over the purse lines but they tended not to, and instead they tried to escape through the net wall, which led to drowning of hundreds of thousands of animals. Enlarging mesh size to allow dolphins to escape was not a solution because the tuna and dolphins were often a similar size (Gabriel *et al*. 2005). Playing back the alarm call of the dolphins, or using other acoustic signals (e.g. killer whale sounds) have not been successful (Gabriel *et al*. 2005). The first method that was successful was the 'back-down process' developed by industry and several modifications were made subsequently.

- The 'back-down' process used for dolphin sets (developed by Captain Anton Maizetich in 1959–1960)
  - When two-thirds of the purse seine net is hauled, the vessel is put into reverse in a wide arc, elongating the net into a long channel instead of a circle. The dolphins tend to congregate at the end away from the vessel whereas the tuna generally range back and forth in the channel between the dolphins and the vessel. When the tuna are near the vessel, the vessel is reversed rapidly causing the cork line farthest from the vessel to submerge for several metres and allowing dolphins to escape. This may have to be done several times until all dolphins have escaped (Gabriel *et al*. 2005). Dolphins exit the net while the vessel pulls the net under the dolphin group (Hall and Roman 2013).
- Use of Medina panels (developed by Captain Harold Medina 1971)
  - To prevent dolphins becoming entangled in the mesh by their jaws or pectoral fins, panels of the netting in the 'back-down' area are replaced with small-meshed netting, a Medina panel (Francis 1992, Gabriel *et al*. 2005). Additional strips of finer mesh sections of net about 33 feet deep are placed adjacent to the back-down area and below the corkline (Francis *et al*. 1992). This apron forms a ramp that makes it easier for the dolphins to swim over the cork line without becoming entangled (Gabriel *et al*. 2005). This modification resulted in significant reductions in mortality (Coe *et al*. 1984).
- Other methods to aid release of dolphins from the net were reported on by Francis *et al*. (1992) as follows.
  - *Use of the skiff to prevent collapse of the seine*. To keep the net from collapsing while dolphins remain inside, the net skiff is used to pull the seiner to starboard, away from the seine.
  - *Use of speedboats to prevent net collapse*. The speedboats, whose principal purpose was to prevent the dolphins from getting away from the seiner, are equipped with towing bridles and can be used to tow on the corkline if the net threatens to collapse.
  - *Use of rafts and swimmers to effect release*. A crewman in an inflatable raft is deployed within the net to herd the dolphins toward the release area near the apex of the back-down channel to prevent them from swimming back toward the seiner and to help in the manual rescue of trapped or entangled animals.
  - *Optimised set orientation and back-down manoeuvring*. Guidelines to aid in determining the best orientation of the set with respect to wind conditions and proper rudder, bow thruster, and skiff controls were developed to minimise the chance of the net billowing, a situation called 'canopying'.
  - *Use of pear-shaped snap rings which helps to reduce the time before back-down begins*. Instead of a simple steel ring, the design is pear-shaped and has a spring-loaded gate portion that can be opened for inserting or removing the purse line. In conventional purse seining, once the rings are up, the rings must be transferred from being supported by the purse line to being supported by the cantilevered ring stripper. With the snap rings this process is unnecessary and sacking up (the process of reducing the water in the net and raising the fish to the surface) can begin immediately after the rings are up. This innovation can save up to 15 minutes, reducing the time that the dolphins are exposed to canopies or net collapse (Francis *et al*. 1992).

Australia

There are two Australian examples where dolphin interactions in purse seine fisheries have become a management issue. As noted in Section 5.3.2, in Queensland the management response was to prohibit the use of the purse seine fishing method. In the SASF, the issue has been addressed through an industry code of practice (SASF CoP) (SASIA 2009). The key mitigation elements of the SASF CoP, as they apply to dolphins are:

- skippers are encouraged to communicate the presence of dolphins in 'real time' to allow other skippers to avoid aggregations of dolphins
- to minimise shots by offering other skippers the opportunity to take excess fish
- to assess the presence of dolphins prior to setting the net and suspend the set until the area is free of dolphins

- to assess the presence of dolphins in the net as soon as the net is pursed
- if dolphins are present in the pursed net, enact the release of the dolphin/s as the priority
  - let the front of the net go to create a safe escape route for dolphins
  - 'drop rings', haul additional net and/or utilise thrusters/skiffs to ensure that dolphins are released successfully
  - if the encircled dolphin is in range of the fishing vessel or skiff, use the TEPS cradle to guide the dolphin through an opening in the net or over the corkline
- Ward *et al.* (2013) noted in their assessment of the effectiveness of the SASF CoP that:
  - In 2012–13, observers monitored 9.8 per cent of net-sets in the SASF and reported that 26 short-beaked common dolphins were encircled (32.1 dolphins per hundred net-sets) in 10 encirclement events and one mortality occurred (1.2 dolphins per hundred net-sets).
  - In the same period, logbook data recorded 226 encircled dolphins in 99 encirclement events and four mortalities from four of those events.
  - The rates of encirclement and mortality recorded by observers were 1.2 and 3.1 times higher, respectively, than those recorded in logbooks when an observer was not on board.
  - The discrepancy between interaction rates recorded in logbooks in the absence of an observer and those reported by observers has reduced since the industry-initiated program to monitor dolphin interactions in real-time in 2011.
  - The SASF CoP has reduced rates of encirclement and mortality.

SPF – mid-water trawl

Part 13 accreditation of the SPF under the EPBC Act requires that:

- Prior to fishing, mid-water trawl vessels must have in place effective mitigation approaches and devices to the satisfaction of AFMA to minimise interactions with dolphins, seals and seabirds.
- AFMA requires that at least one observer be deployed on each new mid-water trawl vessel for the first 10 fishing trips with additional observer coverage or other monitoring implemented as appropriate, following scientific assessment of the SPF.

AFMA enforces this by requiring the development and implementation of an approved VMP that sets out operational and management approaches to minimise and mitigate interactions with marine mammals and seabirds. Each VMP is developed by AFMA in consultation with industry and the Department of the Environment, and all SPF mid-water trawl operators are required to comply with and enforce them onboard. With respect to onboard observer coverage, AFMA has an observer coverage target of 20 per cent of shots and, in accordance with the Part 13 accreditation above, observer coverage of the first 10 trips is required for new boats entering the fishery or existing boats moving into significantly new areas.

The panel noted that under an FPA there might be overlap in fishing and associated interactions with dolphins, including bycatch mortality between the SPF and the gillnet sector of the GHAT fishery, and considered that management arrangements would need to take account of this issue. The panel noted that the gillnet sector of the GHAT fishery currently has a Dolphin Strategy (AFMA 2014f) that includes individual vessel based bycatch limits and 100 per cent observer coverage through electronic monitoring in the 'Dolphin Observation Zone' and an exclusion from fishing in the area for six months if the individual bycatch limit of that vessel is met or exceeded.

SPF - purse seine

AFMA's observer coverage target for purse seine in the SPF is 10 per cent of shots or the first five trips for new boats entering the fishery or existing boats moving into significantly new areas (AFMA 2014b). In contrast to mid-water trawl, use of the purse seine fishing method in the SPF does not require a VMP nor are cetacean excluder devices mandated. Instead, the SPF CoP (Anon. 2008a) includes voluntary operating practices to minimise impacts on the environment, particularly to TEPS. With respect to cetaceans Clauses 3.3 and 3.4 are most relevant:

"3.3 Fishers will make every reasonable endeavour to return any captured individual of a Threatened, Endangered, or Protected Species (TEPS) alive:

- having priority of consideration for the safety of the vessel crew members engaged in the release of the animal; and
- in a manner that, where appropriate, utilises techniques outlined in the "Protected Species Handling Manual" produced by Ocean Watch Australia Ltd.

3.4 Recognising the wide range of vessel sizes, gear configurations, style, and operational practices of the purse seine fleet, each such vessel shall employ one or more of the following TEPS Mitigation Practices

3.4.1 Where a TEPS is captured by the fishing operation, when any such TEPS cannot be released by the application of 3.3 and the TEPS exhibits unreasonable distress, the vessel Master shall terminate the shot and release one end of the net to enable release of the contents of the net by towing the net open whilst maintaining tension on the net wall to minimise entanglement opportunities until such time that TEPS have exited the net.

3.4.2 Where a TEPS is observed within the deployed purse seine net the TEPS Mitigation action relevant to the circumstances is undertaken consistent with the premise that early detection and action is the key to successful mitigation of TEPS interactions."

The panel found that the Protected Species Handling Manual (Anon. 2008b) referred to in the SPF CoP outlined procedures for handling dolphins and whales, in relation to disentangling them from fishing gear and releasing the animal. However, the advice on whales relates largely to release of these species from entanglements with head-gear on traps rather than purse seine gear.

5.3.4 Nature and extent of direct interactions of the FPA with cetaceans

The panel's consideration of the impact of the presence of the processing vessel, fishing methods, fishing effort and transhipment under the FPA fishing scenario on the likely nature and extent of cetacean interactions is provided below.

The processing vessel

As noted in Chapter 4, the presence of the processing vessel may increase the risk of vessel strike compared to typical SPF fleet operations. Vessel strike is a threat to some cetacean species and particularly for threatened large whale species with depleted populations (e.g. Laist *et al*. 2001, Kemper *et al*. 2008, Silber *et al*. 2009). Vessel strikes are thought to be relatively common in Australian waters including the SPF area but these are not well documented. The incidence of vessel strikes is likely to increase in future as some whale populations continue to increase following severe depletion from whaling. The risk of vessel strike from large fishing vessels in the SPF area is uncertain, but international data indicate that most severe or lethal vessel strikes are caused by vessels that are 80 m or longer and which travel at speeds greater than 14–15 km per hour (Laist *et al*. 2001, Vanderlaan and Taggart 2007). The panel considered that the processing vessel would likely meet these criteria.

The risk of vessel strike with cetaceans under the FPA is likely to be highest when the processing vessel is travelling to and from port to unload. The panel considered (see Chapter 4) that there was unlikely to be any significant difference between the number of transit trips made by the processing vessel under the FPA and that of the vessel in DCFA1. The risk associated with vessel strike is therefore not considered to be any higher under the FPA than under DCFA1. However, those risks are likely to be higher than under typical SPF fleet operations since vessel strikes by the processing vessel are, due to its size and speed, more of a risk to cetaceans than the smaller, slower wet boats of the typical SPF fleet.

Fishing method

As detailed above and in Section 5.3.2, most cetacean interactions (particularly bycatch mortality) in the SPF have occurred in the mid-water trawl sector of the fishery. Given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels than the typical SPF fleet, this would likely result in an increase in the number of interactions and greater levels of cetacean bycatch mortality under the FPA compared to those of the SPF to date.

Fishing effort

As discussed in Section 4.4.2 the panel considered that compared to the typical and, particularly the recent SPF fleet, the ability to tranship fish under the FPA would result in increased effort and catch in both the purse seine and mid-water trawl sectors. The panel could not, however, quantify this increase nor could it determine whether fishing effort and catch would be more or less concentrated (see Section 4.4.3). However, factors that could influence the number and/or the rate of interactions with cetaceans under the FPA include the configuration of the fleet in terms of fishing method (see above), any change in the spatial and temporal pattern of fishing, and the process of transhipment (see below).

Spatial and temporal pattern of fishing

Whether the rate of interaction changes will largely be determined by whether the FPA fleet fishes in areas or at times of the year that have not been fished previously. SPF fleet operations to date have not operated extensively in areas of the highest cetacean species richness (see Figure 5.6). The FPA will allow the catching fleet to fish the SPF more broadly, although the extent of any expansion will be constrained by the need to return to port regularly to refuel. As discussed in

Chapter 4, the panel could not predict with any confidence the spatial and temporal distribution of fishing effort under the FPA. However, if the FPA catching fleet ventured into areas of higher cetacean species richness, the nature and extent of interactions, including bycatch mortality, of cetaceans could vary from that of the SPF fleet to date. While there remains some uncertainty about the potential rate of direct interactions with cetaceans under the FPA, the panel considered that the rate of interactions was likely to remain low if previous experience in the SPF was a reliable guide to the likely rate of interactions and given the fuel carrying capacity of the wet boat fleet.

Transhipment

Catches of purse seine vessels fishing under the FPA are at the surface, and therefore more readily available to cetaceans, while the catch is transhipped/pumped to the processing vessel. The panel assumed that discarding from purse seine vessels would be allowed under the FPA. This has been the case in the SPF to date and in the earlier JMF where transhipment occurred. Since interactions with cetaceans in the purse seine sector of the SPF and the JMF have been low, the panel considered that any accidental loss of fish during transfer from purse seine vessels to the processing vessel under the FPA would pose no additional risk to cetaceans.

The panel concluded that the transhipment of fish to the processing vessel via pumping was unlikely to pose a discernibly greater risk to cetaceans than fishing operations under the DCFA1, in the typical SPF fleet or in the earlier JMF where fish were routinely 'transhipped' from fishing vessels.

Panel assessment: likely nature and extent of direct interactions by the FPA with cetaceans

- *The extent of interactions of the FPA with cetaceans will depend on the number of transit trips made by the processing vessel, the actual fleet configuration, the fishing practices adopted, the level of fishing effort, the spatial and temporal pattern of fishing and the cetacean mitigation measures used.*
- *While there remains some uncertainty about the possible loss of fish during transhipment from purse seine vessels and the potential for such loss to increase cetacean interactions, there is no evidence to suggest that the practice of transhipment would pose a specific risk to cetaceans.*
- *The extent of cetacean interactions with the FPA would likely be higher than the DCFA1 and typical SPF fleet.*
- *Most mid-water trawl interactions with dolphins in the SPF have occurred in the south-east area of the SPF.*
- *All reported interactions between cetaceans and mid-water trawl and purse seine in the area of the SPF have involved dolphins.*
- *If the presence of the processing vessel allows fishing to extend into areas not previously fished and of higher cetacean species richness, this could result in differences in the rate of interactions and the species involved.*
- *Compared to the typical SPF fleet:*
  - *there would be more effort under the FPA and this would likely result in a greater number of interactions*
  - *the FPA scenario would likely result in an increase in cetacean bycatch mortality given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels*
  - *if the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect a change in both the rate of interactions and the cetacean species involved.*
- *Compared to DCFA1:*
  - *The number of interactions with cetaceans under the FPA may be less, similar or more depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.*
  - *The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). As a result, there may be less potential for a change in the species composition of cetacean interactions than under the DCFA1. The FPA would be more likely to focus its fishing in areas nearer the coast where short-beaked dolphins happen to be more abundant and interactions with this species may therefore be higher than under DCFA1.*
  - *Both the DCFA1 and FPA fleets will concentrate their fishing in the waters of the shelf and upper slope, where the target species are distributed. As a result, it is unlikely that either fleet would fish extensively in areas of the highest cetacean species richness (see Figure 5.6).*

5.3.5 Assessment of the effectiveness of the proposed measures to mitigate impacts

Mid-water trawl

No specific measures had been proposed for the FPA but it is assumed that the routine management arrangements for the SPF (AFMA 2014e) would be applied to all purse seine and mid-water trawl vessels in the FPA catching fleet. VMPs would be required for mid-water trawl vessels, however, the SPF Bycatch and Discarding Workplan for the SPF does not specify what these VMPs would require for cetacean mitigation purposes (AFMA 2014b).

Under the DCFA1 scenario there was a requirement for 100 per cent observer coverage on the mid-water trawl fishing vessel. Under the FPA scenario the observer coverage targets for mid-water trawl would be 20 per cent of shots or the first 10 trips for new boats entering the fishery, or existing boats moving into significantly new areas. The panel notes that the reduced level of observer coverage would significantly reduce the capacity to independently verify cetacean interactions. Further, the panel notes that 'new boats' and 'new areas' are not defined by AFMA and considers that this would need to be addressed to provide confidence that fishing activities of FPA mid-water trawl vessels in new fishing areas were monitored adequately to detect any change in the rate of interactions with cetaceans.

Purse seine

AFMA does not require VMPs for purse seine vessels nor does the SPF CoP address the issue of discards of biological material. The panel assumed that purse seine vessels operating under the FPA would be permitted to discard fish. As noted above, the panel found that the protected species handling manual referred to in the SPF CoP provides advice on releasing dolphins but little relevant advice on whales.

The target observer coverage for purse seine in the SPF is 10 per cent of shots or the first five trips for new boats entering the fishery or existing boats moving into significantly new areas (AFMA 2014b). As noted above the panel believes that 'new boats' and 'new areas' should be defined by AFMA to provide confidence that FPA purse seine vessels fishing in new fishing areas were monitored adequately to detect interactions and any change in the rate of interactions with cetaceans.

Panel assessment: effectiveness of proposed measures

- *The requirement to have a VMP for marine mammals, including cetaceans, on mid-water trawl vessels, is the only specific management measure to avoid, reduce or mitigate the impact of FPA mid-water trawl vessels on cetaceans.*
- *The current management arrangements do not specify any requirements of such VMPs in relation to cetaceans. The panel could not therefore assess the effectiveness of VMPs for cetaceans.*
- *There are no specific management measures in place to avoid, reduce or mitigate the impact of the FPA purse seine vessels on cetaceans.*
- *The application of observer requirements for mid-water trawl and purse seine vessels are loosely defined and, as a result, provide little confidence that they would adequately monitor fishing in new areas under the FPA.*

5.3.6 Actions to avoid, reduce and mitigate adverse environmental impacts

Panel assessment and advice: effectiveness of proposed measures and actions to avoid, reduce and mitigate impacts of direct interactions by the FPA with cetaceans

Mid-water trawl

The following advice draws heavily on the panel's assessment of the impact of mid-water trawl on cetaceans in its first declaration report.

- *Use an excluder device for cetaceans only after its operation has been optimised for the vessel, fishery and different dolphin species, including both bottlenose and short-beaked common dolphins, under a scientific permit with the required level of performance developed in consultation with experts, noting that excluder designs tested to date have not been consistently effective in reducing cetacean bycatch in trawls, and at present there is no solution to filter or deter cetaceans from entering the net opening.*
- *Use underwater video to monitor dolphin behaviour within the net and around the excluder device to determine the efficacy of the excluder device and levels of cryptic mortality.*
- *Ensure 100 per cent observer coverage of mid-water trawl fishing operations and, if trigger limits are used in conjunction with move-on rules or requirements to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.*

- *Management actions applied to dolphin interactions in the SPF should be consistent with the current spatial management zones and actions to mitigate dolphin bycatch in the gillnet sector of the GHAT fishery off SA.*

Purse seine

- *Incorporate the elements of the SASF CoP that relate to mitigation of interactions with dolphins (see Section 5.3.3) into the SPF CoP.*
- *Validate the logbook reporting of interactions with dolphins in purse seine operations in the SPF through independent observer coverage.*

All fishing operations

- *Introduce a bycatch rate trigger limit for dolphin species for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas on a precautionary rather than an evidentiary basis.*
- *In response to a single dolphin mortality, require the vessel to move to an area where interactions with cetaceans are less likely, based on available data on estimated at-sea density distributions.*
- *Assess the efficacy of acoustic deterrent pingers (during rigorous controlled trials under scientific permit with the required level of performance developed in consultation with experts), and temporal and spatial closures, that have been shown elsewhere to have potential to reduce the risk of interactions for some cetacean species, including dolphins.*
- *Prohibit the discard of any biological waste (excluding the release of any protected fauna) from all fishing and processing vessels.*
- *In addition to the above actions to mitigate impacts on dolphins, ensure that monitoring and agreed management responses are in place to allow a timely management response if other cetacean species interact with the FPA.*
- *The risk of vessel strike by the processing vessel could be reduced by:*
  - *reducing the co-occurrence of whales and vessels where possible, in particular by identification and avoidance of key feeding grounds or aggregation areas*
  - *use of reduced vessel speed zones to reduce the likelihood of fatal vessel strikes in identified high-risk areas*
  - *using marine mammal observers to alert vessel crew to the presence of cetaceans in the vicinity or path of vessels.*

5.3.7 Research and monitoring to reduce uncertainties

The previous sections have highlighted the considerable uncertainties associated with assessing the likely nature and extent of direct interactions of cetaceans with the FPA and the efficacy of the proposed management measures to mitigate interactions with cetaceans and the FPA. The panel's first declaration report examined in detail some potential areas of research that could reduce the uncertainties associated with the impacts of DCFA1 on cetaceans (see Expert Panel on a Declared Commercial Fishing Activity 2014, Section 5.3.6). The panel considered that these remain relevant to the FPA.

Panel advice: research and monitoring to reduce uncertainties

Research that addresses the following questions could help to reduce uncertainties about the potential for adverse environmental impacts of the FPA on protected cetacean species.

- *What regions in the SPF area are important habitats used by cetaceans that have increased risk of interactions with the FPA?*
- *What levels of mortality arising from interactions with the FPA could be sustained by cetacean populations in the SPF area?*
- *What modifications to the proposed fishing gear and operations of the FPA are needed to improve management and reduce the potential for interactions including bycatch of cetaceans?*
- *At a minimum, maintain the current management arrangements which specify targets of observer coverage for existing vessels of 10 per cent of purse seine coverage and full coverage for either five or 10 trips respectively for new vessels entering the fishery or moving into new areas (AFMA 2014d) and clearly define the terms 'new areas' and 'new vessels'.*
- *Develop a dedicated observer program for purse seine vessels to validate logbook reporting of interactions with protected cetacean species.*

5.4 Seabirds

5.4.1 Species assessed

There are 89 protected species of birds that occur within the SPF area (see Appendix 3). The ecological risk assessments (ERA) for the SPF purse seine and mid-water trawl sectors (Daley *et al.* 2007a, Daley *et al.* 2007b respectively) identified 78 bird species as possibly interacting with the fisheries. Of the 78 species, 53 were albatrosses and petrels which are species usually most impacted by direct interactions with fisheries, particularly by longline fisheries (Baker *et al.* 2002, Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011a). Two species of albatross are now considered synonymous thereby reducing the current ERA lists to 76 valid species. The remainder of the dataset comprised penguins, cormorants, gannets, boobies, tropicbirds, skuas, gulls and terns, all of which are considered at low risk of mortality from trawling.

Of the valid 76 bird species, the ERA for the SPF mid-water trawl sector (Daley *et al.* 2007b) assessed only three as high risk: shy albatross *Thalassarche cauta*, Chatham albatross *T. eremita* and black-browed albatross *T. melanophris*. Subsequent residual risk assessments reduced their risks to medium (AFMA 2010b) based on expert information with regard to the high level of observer coverage (54 per cent) during the assessment period (2003–2009) during which no interactions were recorded. Therefore, all bird species assessed were at medium (43) or low (33) risk from mid-water trawl operations in the SPF.

The ERA for the SPF purse seine sector (Daley *et al* 2007a) assessed all 76 species at high risk initially. All risks were reduced to medium (70) or low (6) risk in the subsequent residual risk assessment by AFMA using an over-ride based on expert advice that reduced the selectivity of the gear i.e. purse seine nets being open at the surface allow birds to escape (AFMA 2010a).

Overall, no seabirds assessed in the SPF ERA processes were identified as high risk. However, there are a further 13 species that were not identified by the ERA process but these species were mostly terrestrially-based or probably extra-limital and therefore highly unlikely to be encountered. The only oversight in the ERA process was the Australian fairy tern *Sternula nereis nereis* which is listed as Vulnerable under the EPBC Act. This bird lives and breeds in coastal locations throughout the SPF (Blakers *et al.* 1984) and feeds on anchovies, sardines and blue sprat *Spratelloides robustus* (Taylor and Roe 2004) and probably overlaps with the Commonwealth fishery on its inshore boundary.

A panel-commissioned review of literature on global purse seine fisheries (Finley *et al.* 2015a) found that seabird bycatch was not considered to be a problem. The only purse seine fishery reporting significant seabird bycatch was the Western Australian SCPSMF for Australian sardine which caught flesh-footed shearwaters *Ardenna carneipes* (see Section 5.4.2).

5.4.2 Nature and extent of interactions in the SPF and other Australian purse seine fisheries

SPF

The purse seine and mid-water trawl fisheries operate in areas of medium-high seabird richness (Figure 5.7) particularly off the Tasmanian east coast in the Eastern Zone, and in areas where many CPF seabird species occur (Figure 5.8). The species richness of all seabirds and CPF birds in the Great Australian Bight (GAB) tends to be less than elsewhere. Despite the very high abundances of some of the CPF species such as short-tailed shearwaters *Ardenna tenuirostris* estimated in the millions, the level of interaction with the fisheries has been low historically (see first declaration report).

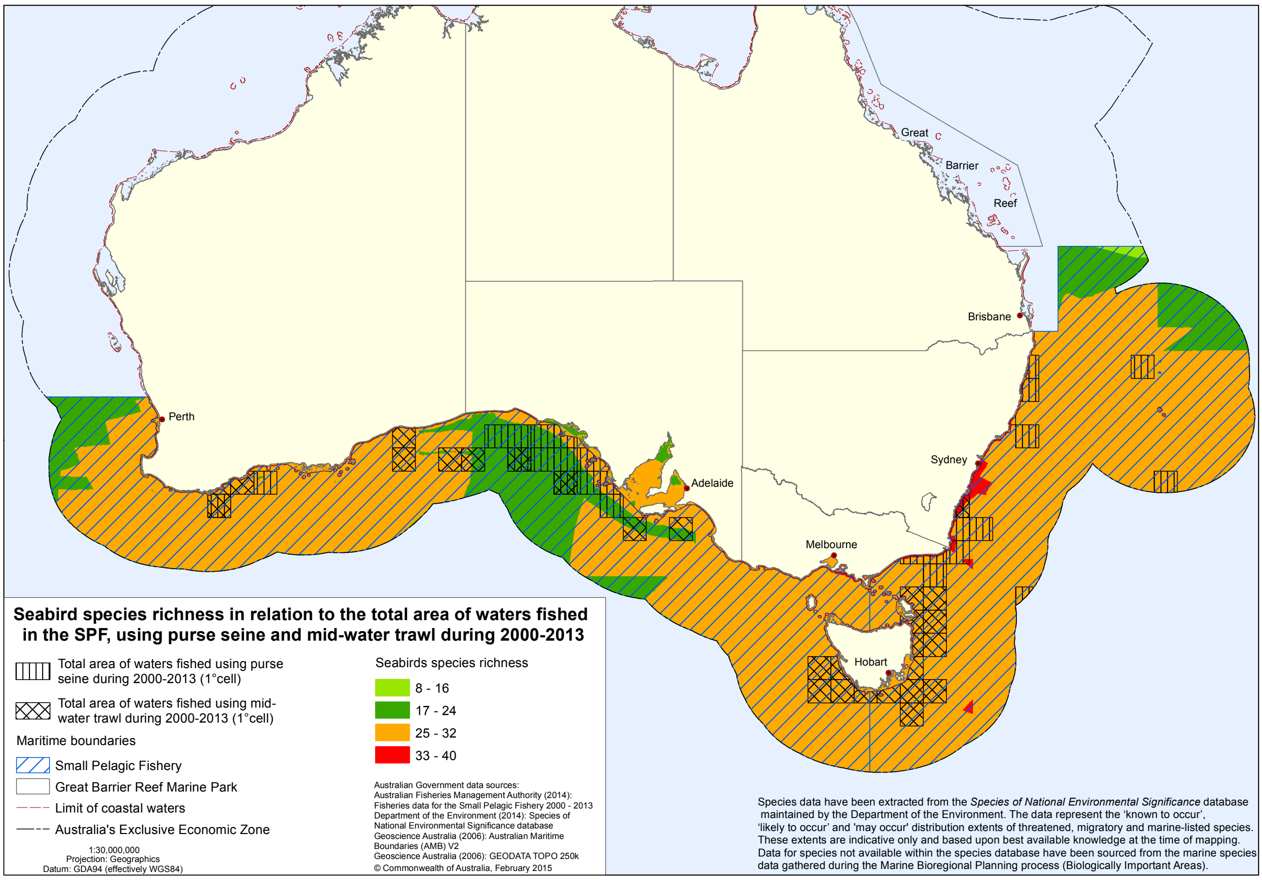

Figure 5.7 Seabird species richness (number of species) in relation to the total area of waters fished in the SPF using purse seine and mid-water trawl during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

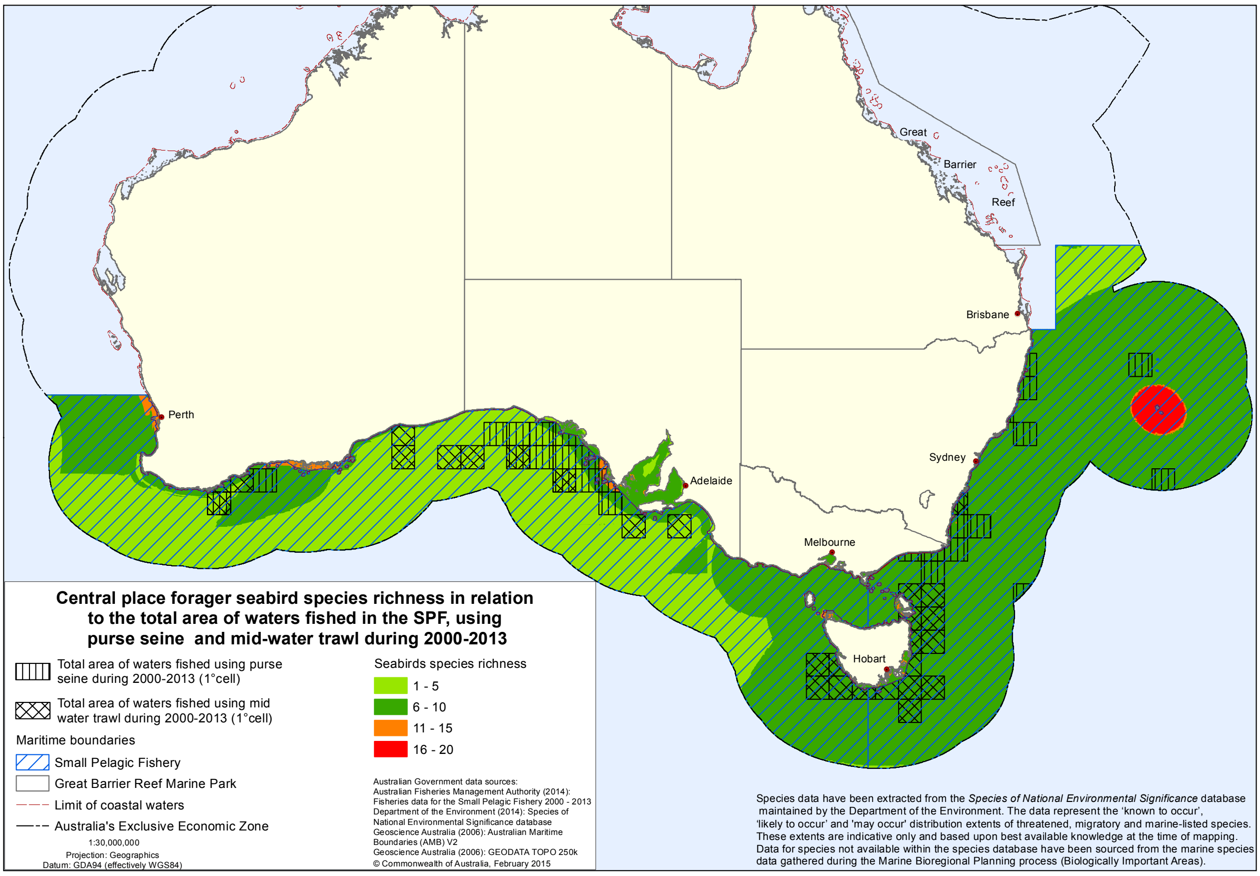

Figure 5.8 CPF seabird species richness (number of species) in relation to the total area of waters fished in the SPF using purse seine and mid-water trawl during 2000–2013. Source: Map produced by ERIN using unpublished AFMA data.

The most comprehensive compilation of data on interactions with protected species in the mid-water trawl and purse seine sectors of the SPF is contained in Tuck *et al.* (2013). They reported that, between 2001 and 2011, there were 38 recorded seabird interactions: 37 in the mid-water trawl sector and one in the purse seine sector. No interactions with seabirds were reported in logbooks in the mid-water trawl and purse seine sectors of the SPF in the period 2012–2014 (to the end of the third quarter) (AFMA 2014e).

The mid-water trawl sector interactions were discussed in the panel's first declaration report (p.159). In summary, there was one fairy prion *Pachyptila turtur* released unharmed and 36 shearwater interactions (24 flesh-footed shearwaters, eight short-tailed shearwaters and four unidentified shearwater species) of which 22 were fatal. The panel concluded that the rate of seabird interactions with mid-water trawl operations under the FPA was likely to be similar to the past rate of interactions of SPF mid-water trawl operations. The panel concluded that the rate of interactions in the SPF to date was likely to have been low due partly to a low level of discharge of biological material in the form of discards in the fishery, and this is assumed to remain the case in the FPA scenario.

Prior to 2000, there is no evidence indicating that seabirds interacted significantly or at all with the purse seine JMF off Tasmania at its peak in the 1980s (Harris and Ward 1999). From then, effort declined in the JMF, and particularly in the subsequent SPF. In the purse seine sector since 2001, only two interactions with seabirds were recorded and neither caused mortality: an unidentified species of storm petrel (AFMA 2009a) and a yellow-nosed albatross *Thalassarche chlororhynchos* were both released unharmed in 2005–06 (AFMA 2009a, Tuck *et al.* 2013). AFMA (2014b) states that the risk of bycatch of TEPS when using purse seine gear is low and that there have been no reported purse seine gear interactions with TEPS since the first SPF Bycatch and Discarding Workplan commenced in 2009, and very low levels of reported interactions before this.

An investigation into cumulative catch of non-target species in Commonwealth fisheries, using black-browed *Thalassarche melanophris* and shy albatross *T. cauta cauta* as two of several case studies, found that due to low levels of observer coverage, extrapolation of observed catch rates to overall rates was highly uncertain (Phillips *et al.* 2010). They stated that a "more informative cumulative assessment, which could better direct how bycatch policy and legislation should be applied more strategically in the interests of governments, fishers and the general community, may not be possible until observer coverage across fisheries is increased or logbook reporting of wildlife bycatch becomes more reliable" (Phillips *et al*. 2010). Under-reporting was also clearly an issue in the SCPSMF (see section below on state managed fisheries). The panel concluded that under-reporting is an issue of concern however the real level of seabird interaction in the SPF is still likely to be relatively low.

Impacts on seabirds resulting from acoustic disturbance or behavioural changes brought about by habituation to fishing operations are not considered as interactions according to AFMA observers and were not reviewed by Tuck *et al*. (2013). The panel found no evidence suggesting that acoustic disturbance from fishing vessels either mid-water trawl or purse seine was likely to be a source of direct interactions with seabirds. While 'habituation' to fishing operations for jack mackerel was suggested in some AFMA observer reports (McKinley unpublished (a) and (b)) whether this alters long-term seabird behaviour is unknown. The observers noted that the proximity of other fishing operations, e.g. longlining and other non-SPF trawling operations, were more likely to contribute to habituation. The SPF CoP (Anon. 2008a) acknowledges habituation of seals but does not mention seabirds specifically.

Southern Bluefin Tuna Fishery

A panel-commissioned review of the international literature on purse seine fisheries (Finley *et al*. 2015a) did not find that birds were at high risk of direct capture from purse seine fisheries. Of the Commonwealth purse seine fisheries, the SBTF is the main fishery operating within the broad area of the SPF. While the targets of these fisheries, bluefin tuna and skipjack, are much larger and distinct from the SPF target species, the fisheries operate off southern Australia within the SPF jurisdiction and potentially interact with the same range of TEPS as the SPF purse seine fishery. Prior to the establishment of an observer program in the purse seine component of the SBTF in 2002–03, there was little information on TEPS interactions (AFMA 2005). This concern was addressed with the development of strategies and actions under a Bycatch Action Plan, which included development of a Code of Practice and AFMA logbook and data management actions. Between 2003 and 2011, six interactions with seabirds were recorded by observers which resulted in four fatalities: two short-tailed shearwaters, one unidentified species of storm petrel and one 'unidentified shearwater' (AFMA 2013, DSEWPaC 2013). According to the AFMA quarterly logbook reports (AFMA 2014e), there have been no interactions reported in the period 2006 to 2014. In 2007, the ERA for the SBTF identified 73 seabirds, none of which were assessed at high risk (Hobday *et al*. 2007). Both residual risk assessment and ecological risk management reports were completed in 2009 finding no TEPS were at high risk in the SBTF (AFMA 2009b, AFMA 2009c).

State managed fisheries

In the state-managed purse seine fisheries for sardine, interactions with seabirds vary. State purse seine fisheries operating in the area of the SPF include the NSW Ocean Haul sector, the SASF and the Western Australian SCPSMF.

Three assessments of the NSW Ocean Haul Fishery by the Department of the Environment (in 2003, 2008 and 2013) did not identify any concerns about the interactions of the fishery with any protected species. The 2013 submission to the Department of the Environment (NSW Department of Primary Industries, 2013) noted that there were no observer data available and that there had been one report of an interaction with a large seabird in September 2012. It is unclear whether this interaction involved purse seine gear.

In the SASF for the period 2007–08 to 2012–13, there has been one interaction (entanglement) involving two shearwaters (unidentified species) resulting in death (Tsolos and Boyle 2014). However in the SCPSMF, which operates within 3 nautical miles (nm) offshore, there was a high rate of interaction with flesh-footed shearwaters in one particular zone (Zone 1: King Sound, Albany). It was estimated that prior to 2006–07 when the bycatch mitigation project began, annual shearwater mortality was likely to have been around 900–1000 birds (Dunlop 2007 cited in Western Australian Department of Fisheries 2008, Appendix 6). The hot-spot of interactions around the Albany zone during February and March coincides with breeding activities and a critical time when birds provision their chicks and are limited in their foraging range. They are reported to feed on small fish, cephalopods and crustaceans and offal from fishing boats (Milledge 1977 in Blakers *et al*. 1984), and sardines would be an appropriate prey. The shearwaters were attracted to the 'bait ball' (of sardines) when visible, and during hauling, to enmeshed 'stickers' (Western Australian Department of Fisheries 2008, Appendix 5). Interactions with this species were also found to increase during daylight hours.

In 2006, a Western Australian Department of Fisheries working group examined the issue of seabird interactions in the fishery and developed strategies for the mitigation of seabird bycatch which are reviewed and adjusted annually. In the 2006–07 and 2007–08 seasons, the fishery monitored shearwater bycatch during the peak interaction period between 1 March to 15 April and 1 March to 30 April respectively. The agreed management measures included the submission of bycatch report forms and implementation of an observer program during which two observers recorded the outcomes of fishing operations during the monitoring/mitigation period (Western Australian Department of Fisheries 2008). All fishers in Zone 1 agreed to reduce bycatch to 0.84 birds per trip aiming to reduce this value annually and continue to support a code of practice (WA CoP) developed in 2008.

Between the 2006–07 and 2007–08 seasons, entanglement and mortality rates decreased (Table 5.3) despite a 31 per cent increase in fishing effort in 2007-08. Total bird mortality was estimated at 200, down from around 1000 (Western Australian Department of Fisheries 2008).

Table 5.3 Flesh-footed shearwater interactions for 2006–07 and 2007–08, SCPSMF

SEASON	NO. OF OBSERVED TRIPS	NUMBER ENTANGLED	ENTANGLEMENT RATE (% BIRDS/TRIP)	NUMBER OF MORTALITIES	MORTALITY RATE (% BIRDS/TRIP)	% MORTALITIES PER ENTANGLEMENT
2006–07	48	512	10.66	54	1.12	10.5
2007–08	64	395	6.17	54	0.84	13.6

Source: Western Australian Department of Fisheries (2008).

The 2007–08 observer data (Table 5.3) were compared with fisher records for the same period to estimate entanglement and mortality rates and the difference between the two data sets. Rates of shearwater entanglement were 1.54 per trip for fisher data and 6.17 per trip for observer data; mortality rates were 0.29 per trip for fishers and 0.84 per trip for observers resulting in an under-reporting factor of 2.9 (Western Australian Department of Fisheries 2008, Appendix 6). The observer program ended in 2009 (Finley *et al.* 2015a) however monitoring of shearwaters is ongoing (see below).

A bycatch reduction program has been in place for the past seven years. The following mitigation measures (Mr S. Walters, Western Australian Department of Fisheries *in litt.* 25 February 2015; Ms Felicity Horn, Western Australian Fishing Industry Council (WAFIC) *in litt* 5 March 2015) recently agreed upon by industry, Oceanwatch (South Coast Natural Resource Management (NRM) Officer), WAFIC, the Western Australian Department of Fisheries and the Western Australian Department of Parks and Wildlife will be implemented in the fishery for the special mitigation period (15 March to 30 April):

- A dawn closure from 5am to 9am between 15 March and 31 March and from 5:30 am to 9:00 am from 1 April to 30 April.
- Fishers to consult each other prior to fishing on high risk days where the level of risk of shearwater interaction may be higher, noting it is likely 3-4 vessels will operate during this time. Industry to inform the Western Australian Department of Fisheries of days they don't go fishing so these can be reported.
- Fishers act in accordance with the WA CoP and Manual for Setting Protocol, Wildlife Interaction and Species Identification.
- Three crew members are to be on board during daylight hours to implement the tow-off procedure or two members if the vessel is fitted with bow thrusters with suitable power for the task.

In addition to the above measures, a trial of a weighted line through the net to remove the fold in the net will recommence in 2015.

The "Manual for Setting Protocol, Wildlife Interactions and Species Identification" (Anon. 2008b) mentioned in the mitigations measures and in the WA CoP was developed specifically for purse seine fisheries by Ocean Watch and SeaNet in collaboration with the operators of the SCPSMF and the Western Australian Fishing Industry Council. This manual provides a guide to identification of seabirds and protocols for the handling and release of net-entangled birds and the reporting of banded birds.

Ongoing monitoring of shearwater interactions in the SCPSMF for 2015 (Mr S. Walters, Western Australian Department of Fisheries *in litt.* 25 February 2015) includes:

- Bycatch record sheets containing records of protected species interactions be completed for all fishing trips.
- Dead shearwaters are collected along Middleton and Goode Beach at a monetary cost to fishers and processors. The shearwaters are then tagged and kept in cold storage for collection from the Department of Parks and Wildlife for an autopsy.
- The South Coast NRM officer (OceanWatch) is to provide a report at the completion of the special mitigation period regarding the outcomes of the mitigation measures implemented and trialed during the special mitigation period.

Following the 2015 special mitigation period, WAFIC will be preparing a report and generally reviewing the success of the program over the past seven years (Ms Felicity Horn, WAFIC pers. comm. 10 March 2015).

Recently, the Western Australian Department of Fisheries implemented an Ecosystem Based Fisheries Management framework under which an assessment of risks to regional ecological assets , i.e. captured fish species, protected species, benthic habitats and external impacts, was made (Fletcher and Santoro 2014). As a protected species, the shearwater bycatch was assessed as moderate (= acceptable) due to implementation of the WA CoP. This fishery underwent Marine Stewardship Council pre-assessment in 2014 (Molony *et al.* 2014).

There still remains a need to demonstrate that a mortality rate of around 200 would not impact on the local meta-population in King George Sound (Western Australian Department of Fisheries 2008, Appendix 6). Recent population estimates indicate that the global population could be as much as 40 per cent smaller than previously thought; the total WA population was estimated at between 18,300–35,900 pairs while the Breaksea Island (King George Sound) population was estimated at 1862 ±1226 pairs (Lavers 2015). A sustainable bycatch limit is yet to be determined.

Other fisheries

While the SCPSMF has had a significant problem with flesh-footed shearwater interactions, it should be noted that more are killed in tuna longlining operations. Baiting of hooks is an important feature that distinguishes this method from mid-water trawl and purse seine methods which do not involve baiting and which are therefore generally less attractive to birds. A study of the Eastern Tuna and Billfish Fishery (ETBF) around Lord Howe Island, a breeding colony for flesh-footed shearwaters, estimated between 1794–4486 birds per year were killed during the period 1998–2002, a rate of mortality considered unsustainable (Baker and Wise 2005). This heightened interaction with the longline fishery was attributed to the birds' habit of diving for scraps and following baited hooks (Marchant and Higgins 1990). The fishery has since successfully mitigated the bycatch of shearwaters (Mr Barry Baker, Latitude 42, pers. comm. 24 February 2015). However, recent studies of the ETBF fishery and the interactions with flesh-footed shearwaters found that the most likely reason for falling bycatch rates in that fishery was more to do with movement of the fishery away from the birds rather than changes in technique (Reid *et al*. 2012). This suggests that area closures are potentially the only method of mitigation for species for which standard mitigation practices fail.

Of concern is the recent evidence showing that unreported cryptic mortality associated with warp-strike could seriously cause underestimation of bycatch mortality in trawl fisheries (Parker *et al*. 2013). As in the longline fishery, the high incidence of seabird interaction with these fisheries was caused by discharge of waste whilst fishing. Previously, the panel found widespread agreement of a strong link between discharge of biological material from trawl vessels and seabird interactions (Expert Panel on a Declared Commercial Fishing Activity 2014). Prohibition of discarding of offal or any material during fishing operations is considered the single-most effective mitigation strategy (Mr Barry Baker, Latitude 42, pers. comm. 24 February 2015) and minimisation of offal discharge is a condition of VMPs for mid-water trawlers in the SPF (see Section 5.4.3).

Species

Based on the information available, the species most commonly involved in interactions with mid-water trawl and purse seine gear in the area of the SPF is the flesh-footed shearwater. Flesh-footed shearwaters are listed under the Japan and Australia Migratory Bird Agreement[12] which provides for "the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships" (Department of the Environment 2015). The Action Plan for Australian Birds 2010 (Garnett *et al*. 2011) recommended raising the flesh-footed shearwater listing from Least Concern to Near Threatened on the basis that populations may be approaching a 30 per cent decline in three generations, loss of breeding habitat, pollution and bycatch in longline fisheries. This species is found throughout the SPF and, as noted above, interactions have been recorded in the mid-water trawl sector and in the purse seine sector of the SCPSMF.

Summary: nature and extent of direct interactions with seabirds

- *The reported rate of interactions with seabirds in the SPF has been low, particularly in the purse seine sector, despite most operations having been in areas of high seabird species richness. The panel concluded that the low rate of interactions in the purse seine sector reflected the fact that birds can generally interact with fish in the purse seine net without capture. The low rate of interactions in the mid-water trawl sector was due to a low level of discharge of biological material in the fishery. However, the panel did not dismiss the issue of under-reporting of seabird interactions.*
- *Based on the information available, the species most commonly involved in interactions with mid-water trawl and purse seine gear in the SPF area are shearwaters, most commonly the flesh-footed shearwater.*
- *Proximity to seabird breeding sites is probably a major factor in the rate of interactions. For example, the flesh-footed shearwater interaction and mortality rate in the SCPSMF was orders of magnitude higher than either fishing method in the SPF and this appears to be explained by the fact that the SCPSMF operates within close proximity to shore and breeding sites. The panel noted that this fishery targets Australian sardine which is a targeted prey of the flesh-footed shearwater in the SCPSMF and is assumed by the panel not to be targeted by the FPA.*

12 Details of the Agreement can be found at http://www.environment.gov.au/biodiversity/migratory-species/migratory-birds.

5.4.3 Management of seabird interactions in the SPF

There are no specific seabird-mitigation measures in place for mid-water trawl vessels in the SPF. However, Part 13 accreditation of the SPF under the EPBC Act requires that mid-water trawl boats must have in place effective mitigation approaches and devices to minimise interactions with seabirds. AFMA enforces this by requiring the development and implementation of an approved seabird VMP. These plans are developed by AFMA in consultation with the Department of the Environment and industry, and all SPF mid-water trawl operators are required to comply with and enforce them onboard. The SPF Bycatch and Discarding Workplan states that VMPs "must contain measures to minimise and avoid where possible, the discharge of biological material whilst fishing gear is in the water and to use physical mitigation devices in a particular manner to avoid interactions with seabirds." (AFMA 2014b).

The SPF CoP (Anon 2008a) covers issues such as minimising impact on TEPS. While some of the SPF CoP reflects legislative requirements, it also includes voluntary operating practices routinely undertaken. With respect to seabirds, Clause 3.3 is most relevant:

"Fishers will make every reasonable endeavour to return any captured individual of a Threatened, Endangered, or Protected Species (TEPS) alive:

- having priority of consideration for the safety of the vessel crew members engaged in the release of the animal; and
- in a manner that, where appropriate, utilises techniques outlined in the "Protected Species Handling Manual" produced by Ocean Watch Australia Ltd."

The panel found that the "Protected Species Handling Manual" referred to in the SPF CoP outlined procedures for handling seabirds and reducing interactions in longlining operations which are irrelevant to purse seine or mid-water fishing operations in the SPF. The panel concluded that this manual is largely irrelevant and therefore inadequate in dealing with seabirds interacting with either fishing gear in the SPF.

The panel considered that the WA CoP "Manual for Setting Protocol, Wildlife Interactions and Species Identification" (Anon 2008b) specifically for a purse seine fishery was more appropriate to the SPF purse seine sector than the manual referred to in the SPF CoP. The SCPSMF manual also provides a guide to identification of seabirds, noting that AFMA does provide a protected-species guide (AFMA 2006), and protocols for the handling and release of net-entangled birds and the reporting of banded birds.

5.4.4 Nature and extent of direct interactions of the FPA with seabirds

Fishing effort

As discussed in Section 4.4.2 the panel considered that compared to the typical and, particularly the recent SPF fleet, the ability to tranship fish under the FPA would result in increased effort and catch in both the purse seine and mid-water trawl sectors. The panel could not, however, quantify this increase nor could it determine whether fishing effort and catch would be more or less concentrated (see Section 4.4.3). However, factors that could influence the number and/or the rate of interactions with protected species under the FPA include the configuration of the fleet in terms of fishing method, any change in the spatial and temporal pattern of fishing and the process of transhipment.

Fishing method

As noted in Section 5.4.2, most seabird interactions in the SPF have occurred in the mid-water trawl sector of the fishery. The FPA fleet configuration includes more mid-water trawl and less purse seine vessels than the typical SPF fleet. This may mean that the number of interactions with seabirds may rise under the FPA compared to those of the SPF to date. However the rate of interactions (interactions per shot) with mid-water trawl gear would not necessarily change and the VMPs should act to maintain low interaction rates.

Spatial and temporal pattern of fishing

Whether the rate of interaction changes will largely be determined by whether the FPA fleet fishes in areas or at times of the year that have not been fished previously. As discussed in Chapter 4, the panel could not predict with any confidence the spatial and temporal distribution of fishing effort under the FPA.

The introduction of a processing vessel would extend the range of the catching fleet and thus there is scope for a change in the spatial and temporal pattern of fishing. If this occurred, there may be a change in the number of interactions, the species encountered and the risk profiles of these species from that of the past. The panel believes that the FPA will enable the catching fleet to fish more broadly in the SPF than in the past, however it is not possible to predict with any certainty the spatial and temporal pattern of fishing under the FPA. As a result there is some uncertainty about the potential rate of direct interactions with seabirds under the FPA. The panel agreed, however, that the rate of interactions was likely to remain low.

Transhipment

Catches of purse seine vessels fishing under the FPA are at the surface, and therefore more readily available to seabirds, while the catch is transhipped/pumped to the processing vessel. However, the panel noted that such pumping had occurred previously in the JMF and SPF without any significant seabird interactions and that any seabirds attracted to feed on fish in the purse seine net would be able to escape given that the net is open at the surface.

The panel assumed that discarding from purse seine vessels would be allowed under the FPA. This has been the case in the SPF to date and in the earlier JMF where transhipment occurred. Since interactions with seabirds in the purse seine sector of the SPF and the JMF have been low, the panel considered that any accidental loss of fish during transfer from purse seine vessels to the processing vessel under the FPA would pose no additional risk to the seabirds.

Observers on mid-water trawl operations in the SPF stated that birds can be abundant and numbers increase when hauling. Smaller seabirds were observed feeding on fish falling from the front of the net when hauling or during pumping operations but were not interacting physically (Kranz unpublished, AFMA unpublished data). Observer reports from the 2002–03 pair trawl trials in the SPF stated that up to 100 kg of fish could be lost during these operations (McKinley unpublished (a) and (b)). Observer reports from small pelagic operations in the GAB indicated much greater seabird attraction particularly to flesh-footed shearwaters when offal was discharged just prior to hauling or during hauling (Gerner unpublished (a) and (b)). Larger seabirds such as albatrosses tended to sit further astern still feeding on discharged offal. This raises the possibility that any accidental loss of fish during transhipment might attract seabirds to the fishing operations and increase the risk of interaction. However, as noted in Chapter 4, the panel assumed that the VMPs for mid-water trawl vessels would prohibit the discarding of any biological material while gear (including the pump) was in the water, thus avoiding any increased risk of interaction and fatality with seabirds.

The panel concluded that the transhipment of fish to the processing vessel via pumping was unlikely to pose a greater risk to seabirds than pumping operations to transfer fish from the net to the catching vessel in the DCFA1 or in the typical SPF fleet, or than the transhipment of fish in the earlier JMF.

Panel assessment: likely nature and extent of direct interactions of the FPA with seabirds

- *The extent of interactions of the FPA with seabirds will depend on the actual fleet configuration, the fishing practices adopted, the level of fishing effort, the spatial and temporal pattern of fishing and the seabird mitigation measures used.*
- *While there remains some uncertainty about the possible loss of fish during transhipment and the potential for such loss to increase seabird interactions, there is no evidence to suggest that the practice of transhipment poses a specific risk to seabirds.*
- *The rate of interactions between the SPF fleet and seabirds has been low, despite most operations having been in areas of high seabird species richness.*
- *While the number of seabird interactions may be higher in the purse seine component of the wet boat fleet than in the mid-water trawl component, seabird mortalities are more likely to arise from interactions with mid-water trawl operations.*
- *Overall, the panel expects that the rate of interactions with seabirds would remain low under the FPA. Since it is not possible to predict with any certainty where or when the FPA fleet might fish or the intensity of that fishing, it is not possible to provide any firm conclusions on the likely rate of interactions between the fleet and seabirds.*
- *Compared to the typical SPF fleet:*
  - *there would be more effort under the FPA and this would likely result in a greater number of interactions*
  - *an FPA scenario would likely result in an increase in seabird bycatch mortality given that the FPA fleet configuration includes more mid-water trawl vessels*
  - *if the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect a change in both the rate of interactions and the seabird species involved*
- *Compared to DCFA1:*
  - *The number of interactions with seabirds under the FPA may be less, similar or more depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.*

- *The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). This may mean that they are more likely to fish closer inshore than DCFA1 and potentially have more interactions with protected CPF species of seabirds.*

5.4.5 Assessment of the effectiveness of the proposed measures to mitigate impacts

No specific measures had been proposed for the FPA but it is assumed that the routine management arrangements for the SPF (AFMA 2014e) would be applied to all purse seine and mid-water trawl vessels in the FPA catching fleet. VMPs would be required for mid-water trawl vessels and the panel assumed that, as with DCFA1, these would prohibit the discharge of offal and biological material (including whole fish) while gear is in the water.

AFMA does not require VMPs for purse seine vessels nor does the SPF CoP address the issue of discards of biological material. The panel assumed that purse seine vessels operating under the FPA would be permitted to discard fish. As noted above, the panel found that the protected species-handling manual referred to in the SPF CoP does not apply to purse seine interactions with seabirds.

5.4.6 Actions to avoid, reduce and mitigate adverse environmental impacts

While the risk of seabird interactions is considered to be very low in the SPF, the panel considered that certain actions could be taken in alignment with internationally recognised standards that would further ensure minimal risk of interactions. The following advice reiterates the advice for mid-water trawl vessels in the first declaration report and includes additional advice for purse seine. Based on experience in other fisheries, it is likely that seabird interactions in the SPF may be under-reported. This can only be addressed by validation of logbook data through increased observer coverage.

Panel advice: actions to avoid, reduce and mitigate adverse environmental impacts on seabirds

The panel considered that the following actions could be taken to manage the risk of adverse environmental impacts arising from direct interactions of the FPA's purse seine and mid-water trawl catching fleet with seabirds.

Mid-water trawl

- *Any requirements in the VMPs for mid-water trawl vessels regarding discharge of biological material, the removal of stickers and warp maintenance should be consistent with or equivalent to the advice of the Agreement on the Conservation of Albatrosses and Petrels (ACAP 2013 a, b and c).*
- *The ACAP advice regarding net binding, bird-scaring lines and the use of a snatch block should be adopted noting that the use of bird-scaring lines and net binding are part of the seabird VMP for Australia's winter blue grenadier fishery.*
- *If bird bafflers and warp deflectors are to be used, develop and optimise the design under scientific permit and in consultation with experts, noting that seabird captures in the Southern and Eastern Scalefish and Shark Fishery have been reduced by 75 per cent using 'pinkies'.*
- *Ensure that any seabird VMP meets the requirements of the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011–2016 (DSEWPaC 2011b).*
- *Direct deck lighting inboard and keep to the minimum level necessary for the safety of the crew.*

Purse seine

- *Update the SPF CoP by replacing the 'Protected Species Handling Manual' with, at a minimum, the bird handling protocol developed for the SCPSMF, and ideally, develop a protocol for handling protected species specifically for the SPF and all relevant gear types.*

All fishing operations

- *Develop advice on the correct interpretation of 'interactions' with seabirds in consultation with the Department of the Environment to ensure that it is consistent with the intent of the memorandum of understanding between the Department and AFMA and ensure that FPA operators and crew are familiar with this advice*
- *Validate logbook reports on interactions with seabirds through increased and spatially representative observer coverage.*
- *If unacceptable levels of interactions with protected seabird species occur, suspend fishing immediately and adopt one of the following options:*

- *time and area closures, noting that these will rely on knowledge of spatial and temporal uses of bird habitats that overlap with the fishery*
- *trigger limits and move-on rules*
- *review of transhipment procedures if the interactions occur during transhipment.*

5.4.7 Research and monitoring to reduce uncertainties

Given the uncertainties identified above in relation to the potential for changes in the spatial and temporal pattern of fishing under the FPA to alter the nature and extent of past interactions with seabirds in both sectors of the SPF, it is imperative that a high level of observer coverage apply to the FPA particularly if it includes mid-water trawlers.

The panel heard of the potential risk posed by uninitiated crews (Mr R. Wells, Resourcewise pers. comm. 28 April 2014) and the importance of education of the crew in ensuring that mitigation measures were properly implemented (e.g. Mr F. Drenkhahn and Mr S. Boag *in litt*. 28 October 2013 in Finley *et al*. 2015b[13]).

Panel advice: research and monitoring to reduce uncertainties

The following research and monitoring could reduce uncertainties about the potential for adverse environmental impacts arising from direct interactions between the FPA and protected seabird species:

- *Maintain the current management arrangements which specify targets of observer coverage for existing vessels of 10 per cent of purse seine coverage and 20 per cent of mid-water trawl coverage and full coverage for either five or 10 trips respectively for new vessels entering the fishery or moving into new areas (AFMA 2014d), and clearly define the terms 'new areas' and 'new vessels'.*
- *Identify ecologically sensitive seabird species, areas and times where spatial management strategies may be appropriate to mitigate direct interactions if required.*
- *Use electronic monitoring via video camera/s to assist in quantifying warp strikes.*
- *If warp strike is occurring, consider installing corpse catchers on warps to assist in understanding whether there is a level of cryptic mortality from warp strike that has been undetected.*
- *Develop a dedicated observer program for all SPF fishing operations to validate logbook reporting of interactions with protected seabird species. In the mid-water trawl sector this should focus on observing and validating warp interactions and trawl entanglements.*
- *Collect, analyse and publish observer data on all seabird interactions, including on the levels and causes of seabird bycatch. Ensure crews are properly trained in the use of the required seabird mitigation and on reporting requirements.*

13 Cited in Expert Panel on a Declared Commercial Fishing Activity (2014) as Elgin Associates unpublished (a).

6 Assessment of the fish processing activity - localised depletion

6.1 Introduction

The panel defined localised depletion as a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing. This definition is consistent with that adopted in the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014). Under that strict interpretation, the panel concluded that it is inevitable that any fishing by the declared commercial fishing activities (DCFAs) in either the first or second declaration, or that has occurred in past or present fisheries (Jack Mackerel Fishery (JMF) or Small Pelagic Fishery (SPF)), will cause, or has caused, localised depletion. It was clearly noted that localised depletion should not be confused with range contraction or overall stock depletion. As in the panel's assessment of the DCFA in the first declaration (DCFA1), the central issue for the panel's assessment of the fish processing activity (FPA) was whether the fishing activity could be concentrated enough, both spatially and temporally, to cause a localised depletion of the target species sufficient to cause adverse environmental impacts to the Commonwealth marine environment.

The panel's assessment of DCFA1 considered factors that would influence the extent and impact of localised depletion such as the scale and persistence of the depletion and the vulnerability of the SPF species to localised depletion (see Section 6.4 in the first declaration report). Pertinent to the assessment of the FPA is the conclusion that "Whether the localised depletion occurs as a result of one or many boats is irrelevant according to international and Australian fisheries managers and scientific experts interviewed by the panel. Vessels of a smaller capacity tend to concentrate effort around their home ports because their limited fish handling and storage facilities, and fuel and provisioning capacity, restrict their range. A fleet of many smaller vessels has the potential to create localised depletion if the fishing intensity is spatially and temporally dense" (Expert Panel on a Declared Commercial Fishing Activity 2014).

The panel's assessment of DCFA1 focused on the assessment of the impacts of localised depletion by a single large-scale, mid-water trawl freezer vessel. In contrast, the catching fleet under the FPA fishing scenario comprises three vessels using purse seine and two vessels using mid-water trawl. All of these vessels are wet boats (i.e. cannot freeze catch).

The panel considered that there were potentially five elements of the FPA that might modify the impacts of localised depletion compared to those under the first declaration, i.e. DCFA1. These were:

- that the processing vessel did not fish
- the reduced storage capacity of the processing vessel
- an additional and possibly enhanced fish finding ability provided by the processing vessel to the catching fleet
- that the catching fleet comprised five wet boats, three of which used purse seine and two that used mid-water trawl, rather than a single freezer trawler using mid-water trawl
- the ability to tranship catch via a pump from the catching fleet to the processing vessel.

These differences are considered below in relation to the potential impacts on target species and on predators, particularly central place forager (CPF) species of localised depletion arising from the FPA. In addition, the panel has made a relative, qualitative assessment of potential impacts between the DCFAs, i.e. DCFA1, the mid-water trawl activity (MTA) and the FPA, and the past and present SPF fleet. The panel acknowledges that many assumptions were made in the development of the scenarios of the FPA, none of which might truly reflect the nature of the activity had it proceeded.

6.2 Assessment of the impact of localised depletion arising from the FPA on target species

6.2.1 Summary of potential impact of localised depletion arising from DCFA1 on target SPF species

The nature of the potential adverse environmental impacts that might arise from localised depletion on target species in the SPF under DCFA1 was discussed in detail in Chapter 6 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014) and will not be repeated here. However, many of the findings and outcomes are relevant to this assessment of the FPA and are summarised below.

With regard to DCFA1's capacity to catch fish, the panel concluded that the ability of a mid-water trawl vessel to stay on a school of fish and therefore take a greater proportion of that school so as to increase the extent of localised depletion was dictated more by the behaviour of the school than by the particular characteristics of the mid-water trawl vessel and was not significantly affected by the freezing and processing capacity of the vessel specified in DCFA1.

With regard to small pelagic species' vulnerability to fishing, the panel found that SPF target species had characteristics that made them both vulnerable to fishing (detection and size of schooling behaviour and association with environmental features) and resilient to fishing (swimming proficiency, reproductive capacity and unpredictability of schooling behaviour). These latter qualities are able to reduce the temporal and spatial extent of any depletion that occurs from fishing or natural causes and therefore on the extent of adverse environmental impacts either on the target species themselves or on dependent predator species.

With regard to current and past harvest rates of small pelagic species in southern Australia, the panel was unable to find evidence of discernible adverse impacts on the target species. The available genetic evidence for jack mackerel *Trachurus declivis* did not suggest that past, apparently high, levels of fishing had significantly affected reproductive capacity. There have been no significant changes in the age or size composition of redbait *Emmelichthys nitidus* in recent years that might indicate a potential impact on reproductive capacity. There were too few data available for the Australian sardine *Sardinops sagax* in the Eastern Zone, or blue mackerel *Scomber australasicus* to determine significant changes on age, size structure or reproductive capacity to date but the low levels of effort and catch suggest that there is little likelihood that this has occurred. There is no evidence to suggest that localised depletion has caused any impacts on genetic diversity. Furthermore, the panel considered that any localised depletion of SPF target species that might arise from the DCFA1 was unlikely to affect the overall status of stocks of those species in the SPF, assuming that the total allowable catches (TACs) are set in accordance with the current Harvest Strategy Policy (HSP) (Department of Agriculture, Fisheries and Forestry (DAFF) 2007) and with the best possible stock estimates.

6.2.2 Potential impacts of localised depletion arising from the FPA on target SPF species

Target species

As noted above, SPF target species possess characteristics that make them resilient to fishing and to the risk of adverse environmental impacts arising from localised depletion. This resilience will apply whether the fishing operation takes the form of the DCFA1, the MTA, the FPA or the typical SPF fleet operation.

The nature of the potential adverse impacts on target species in the SPF under the FPA was considered to be essentially the same as for DCFA1 discussed in detail in the first declaration report (Section 6.5 of Expert Panel on a Declared Commercial Fishing Activity 2014) and summarised above.

The direct effect of removal of the target species was a reduction in stock size such that changes occur in size and age structure at lower levels of exploitation, through to reduction in reproductive capacity and loss of genetic diversity at higher levels of exploitation. As discussed above, such impacts have not been detected in the SPF target stocks even at the relatively high exploitation rates in the JMF when jack mackerel catches in the 1980s were up to four-times greater than the current Eastern Zone TAC (Section 6.8.3 of first declaration report) and from 10-times higher than the catches in the post-2000 SPF fishery (see Figure 3.4 in Ward *et al.* 2014). The panel concluded in the first declaration report that "The impact of localised deletion of a target species on its stock status will depend in part on whether the stock as a whole is being managed sustainably. A stock that is in an overfished state, or for which catch/effort limits are not set sustainably, is clearly more susceptible to the impact of localised depletion events than well-managed stocks" (Expert Panel on a Declared Commercial Fishing Activity 2014).

Given the conservative exploitation rates in the SPF and that concerns about the basis for spawning stock biomass estimates are being addressed, the panel considered that any localised depletion of SPF target species that might arise from the FPA was unlikely to affect the overall status of stocks of those species in the SPF. The panel also acknowledged that recent TACs have not been caught in the SPF thus adverse environmental effects were unlikely to be occurring now.

The recent review of the harvest strategy settings for the SPF (Smith *et al*. 2015), completed since the first declaration report, found that target reference points of B_{50} and B_{20}[14] were consistent with current HSP default settings (see DAFF 2007). Combined with evidence from other studies, the authors considered that these suggested levels were "safe from an ecosystem perspective and provide reasonable levels of yield relative to MSY [maximum sustainable yield]" (Smith *et al*. 2015). Perhaps more importantly, Smith *et al*. (2015), taking into account the broad range of life histories and ecology of the SPF species (see Chapter 4 and Section 6.4.2 in the first declaration report), also suggested that exploitation rates should be species-specific or possibly even stock-specific. They concluded that currently some of the Tier 1 harvest rates in the SPF Harvest Strategy (AFMA 2008) appear too high for some species. The panel notes that none of the SPF stocks are currently managed at Tier 1. Smith *et al*. (2015) also made further suggestions regarding more appropriate harvest rates for the other Tier levels.

The suggestion by Smith *et al*. (2015) that species harvest rates might need to be stock-specific is dependent on knowledge of stock boundaries, however, their interpretation of stock was based on the east-west split of the SPF. In the first declaration report the panel noted that movement and structure of the SPF stocks are rather poorly known and genetic evidence suggesting sub-structuring within the jack mackerel and Australian sardine stocks (Ovenden 2015[15]) could be investigated further to establish risks of localised depletion at sub-population level. Finer sub-structuring of stocks, for example into genetically distinct spawner groups as in sardines, may have further implications for determining appropriate harvest rates. However, the evidence for jack mackerel, in particular, is inconclusive and while sub-structuring may occur it may have little impact on determination of the TAC or harvest rate, depending on how the separation is produced and maintained.

As discussed in Section 4.4.2, the panel considered that compared to the typical, particularly recent, SPF fleet, the ability to tranship fish under the FPA would result in increased effort and catch in both the purse seine and mid-water trawl sectors. The panel could not, however, quantify this increase nor could it determine whether fishing effort and catch would be more or less concentrated (see Section 4.4.3). However, according to the panel's definition of localised depletion, increased catch would necessarily result in increased localised depletion. Whether the localised depletion arising from the ability to tranship under the FPA is large enough and maintained for long enough to cause adverse effects to the target species is the central issue for the assessment.

The processing vessel

Since the processing vessel in the FPA does not fish, it has no direct impact on localised depletion. The direct impact will be incurred through the catching fleet. The storage capacity (and fuel capacity) of the processing vessel will influence how long it can remain at sea before returning to port to unload and/or refuel. However, the panel considered that this would have less bearing on the potential impact of localised depletion arising from the FPA than the constraints around the fuel-carrying capacity of the catching fleet, which will influence how often the catching fleet needs to return to port to refuel.

The catching fleet

The panel considered that the FPA catching fleet had the potential to cause localised depletion, as defined by the panel. The FPA scenario involves one less purse seine vessel and one more mid-water trawl vessel than has been the case 'on average' in the SPF. Since it is recognised that purse seine fishing has more capacity to take a whole school of fish by encircling the school compared with mid-water trawl which trawls through the school, the reduced purse seine capacity of the FPA, compared to the typical SPF fleet, might reduce the potential for localised depletion. This is reinforced by the examples of localised depletion of small pelagic species identified in the first declaration report (see Box 6.1) all of which involved purse seine fishing. For the same reason, compared to DCFA1, which relied entirely on mid-water trawl gear, the inclusion of purse seine gear in the FPA may increase the potential for localised depletion.

14 B_{50} and B_{20} represent 50 per cent and 20 per cent of unfished biomass respectively.
15 Cited in Expert Panel on a Declared Commercial Fishing Activity (2014) as Ovenden unpublished.

Box 6.1 Examples of localised depletion effects in fisheries for small pelagic species

Several examples of serial depletion, or possible depletion, in other fisheries for small pelagic species outside Australia were reviewed by the panel in the first declaration report. These were a purse seine fishery targeting four species of mackerels in the Java Sea (Cardinale *et al*. 2011); a purse seine fishery on anchovy *Engraulis ringens* in the Humboldt Current off Peru (Bertrand *et al*. 2012); and a purse seine fishery for Atlantic menhaden *Brevoortia tyrannus* in Chesapeake Bay (Haddon 2009). While these fisheries were not transhipping, they illustrate the effect that a fleet of small vessels that are constrained to relatively small ranges from a home port can have on local target stocks. Of these three, the first had obvious depletion effects on the stocks, and the anchovy fishery was shown to have had adverse impacts on Peruvian boobies *Sula variegate,* but no clear evidence for adverse impacts on either target or dependent species was proven for the menhaden fishery case. In all three cases the fleet size was large (500 reducing to 200 in the Java Sea, and the TAC was large (100,000 tonnes (t) for menhaden).

The panel considered that the assistance in finding fish provided to the catching fleet by the processing vessel would increase the fishing efficiency of the catching fleet. However, as noted in Chapter 4, the panel did not consider that this assistance was likely to be a significant determinant of the extent of localised depletion under the FPA.

Transhipment

A panel commissioned literature review (Hamer 2015) found no evidence of localised depletion attributable to transhipment. The review examined experience in two Australian fisheries where transhipment is allowed: the South Australian Sardine Fishery (SASF) and the Northern Prawn Fishery (NPF).

Management arrangements in the SASF do not provide for transhipping specifically, however "pumping from the net of another vessel is informally encouraged and is likely to occur when one vessel catches more than it can carry" (Hamer 2015). This was seen as a 'prudent' measure to prevent removal of fish, whether landed or dumped, exceeding the total allowable commercial catch (TACC). There is some evidence suggesting that localised depletion may have occurred in the SASF in the mid-2000s and may have had some adverse effects: shifts in the age structure of the sardine stock in the Spencer Gulf; a decline in catch-per-unit-effort; and low egg counts from daily egg production surveys (Rogers and Ward 2005 and Ward *et al*. 2006 cited in Hamer 2015, Shanks 2006). Various explanations were proposed to explain these events (Shanks 2006, and see Expert Panel on a Declared Commercial Fishing Activity 2014), however the practice of transhipment was not implicated directly. TACCs were reduced substantially from 2006 and subsequent assessments have found that the stock appears to be relatively stable (Ward *et al*. 2012). A recent risk assessment attributed only a medium risk of fishery impacts on the spawning biomass of the sardine stock (Primary Industries and Regions, South Australia (PIRSA) 2013). In 2012, Senator the Hon. Joseph Ludwig, then Commonwealth Minister for Fisheries, stated that "Scientific studies have also determined that at catch levels of around 30,000 t per annum the South Australian sardine fishery is not impacting on the healthy functioning of the local ecosystem. This strongly suggests that at the much lower catch levels in the SPF over a much larger area, the risk of ecosystem impacts from localised depletion are low." (Ludwig, 2012)

The NPF targets sedentary crustaceans with demersal nets and is therefore not strictly comparable to the SPF; however this fishery does employ transhipment. The NPF uses motherships that transport frozen product back to port and provision the fishing vessels, allowing them to stay within the area for up to 80–90 per cent of available fishing time, longer than would be possible without the support of the motherships. In the late 1990s up to 130 vessels were actively fishing and by the end of the fishing season catch-per-unit-effort declined due to over-fishing (Timcke *et al*. 1999). Analyses of vessel monitoring data and catch records by Deng *et al*. (2005) supported the hypothesis that the rate of depletion of the two species of tiger prawn (*Penaeus semisulcatus* and *P. esculentus*) was more rapid in highly aggregated fishing areas than in randomly fished areas and that the effect of this type of behaviour could be "quite marked and should be investigated". How much transhipment contributed to the over-fishing of the 1990s is unknown, however, many other factors such as natural variability of stocks, improved fish-finding technology, and the size of the fleet probably had greater measurable impact than the transhipment capability. The effort in the fishery has since fallen to less than half (currently 52 vessels, AFMA 2014g) thus relieving pressure and allowing stocks to rebuild, and transhipment is still permitted.

Summary: Assessment of the potential impact of localised depletion arising from the FPA on target SPF species

- *Localised depletion, as defined by the panel, will occur under the FPA but is unlikely to have adverse environmental impacts on the SPF target species.*
- *Given that no impacts on target species were discernible during periods of the fishery when catches were relatively high, i.e. higher than current TACs, the panel concluded that the FPA is unlikely to cause localised depletion to such an extent as to cause adverse environmental impacts on the target species.*
- *The relative impacts of localised depletion on the target stocks caused by the FPA, DCFA1 and the typical SPF fleet will be influenced by the fishing method used, the concentration and intensity of fishing effort and the quantum of catch.*
- *The storage capacity of the processing vessel is not relevant to the assessment of the potential for the FPA to cause localised depletion resulting in adverse environmental impacts.*
- *The ability to tranship at sea would potentially allow for the catching fleet to increase its effort and hence the extent of localised depletion compared to operations in the past but this would be constrained by the need for the catching fleet to regularly return to port to refuel.*
- *The panel concluded that compared to the typical SPF fleet, the FPA is likely to:*
  - *increase the quantum of catch because of the improved efficiency of fishing offered by the presence of the processing vessel*
  - *increase the distribution of effort by allowing wet boats greater range and therefore reduce the intensity of fishing in a given area*
  - *reduce the proportion of catch taken by purse seine with potentially less impacts on individual schools of fish.*
- *The panel concluded that compared to DCFA1 (and the MTA) that the FPA is likely to:*
  - *result in similar levels of catch*
  - *reduce the distribution of effort since wet boats are more constrained by the need to return to port to refuel, and therefore increase the intensity of fishing in a given area*
  - *increase the proportion of catch taken by purse seine with potentially more impacts on individual schools of fish.*
- *The panel could not predict how these factors would balance out. However, as in its assessment of DCFA1 and the MTA, the panel considered that any localised depletion of SPF target species that might arise from the FPA was unlikely to affect the overall status of stocks of those species in the SPF, assuming that the TACs are set in accordance with the current SPF Harvest Strategy (AFMA 2008) and with the best possible stock estimates. The panel notes that current and ongoing research is designed to ensure that this is the case. The panel remains of the view that further research into stock structure would be needed to improve certainty about the appropriate spatial scale at which to manage effort and catch of SPF stocks.*
- *The panel noted that the catching fleet of the FPA may be configured quite differently to the one assessed here. For example, the proposed configuration of the fishing fleet by the proponent of the proposal to bring a processing vessel into the SPF was one purse seine and one mid-water trawler (Mr G. Geen, Director, Seafish Tasmania in litt. cited in Hamer 2015). This configuration would likely present a significantly smaller risk than the FPA scenario assessed here.*

6.3 Assessment of the impact of localised depletion arising from the FPA on protected predator species

6.3.1 Summary of potential impact of localised depletion arising from the DCFA1 on protected predator species

The issue of ecological allocation of resources to dependent predators and the 'trade-offs' that might be necessary to support growing demand for food supplies was examined in the first declaration report (see Section 6.6 in Expert Panel on a Declared Commercial Fishing Activity 2014). The critical issue was to determine the level of removal of the prey species that, when added to the requirements of the overall ecosystem and taking into account natural variability, would not cause unacceptable adverse impacts to the ecosystem or components. Ecological modelling of the southern Australia region was discussed in Chapter 4 of the first declaration report: an important finding was that current exploitation rates under the SPF Harvest Strategy (AFMA 2008) appear to provide an adequate 'ecological allocation' to CPFs and other dependent predators, and that no adverse impacts were likely at the current level of allowable harvest. As noted in Section 6.2.2, the recent review of the Harvest Strategy (Smith *et al*. 2015) supported the current HSP default setting of B_{50} and B_{20} (DAFF 2007) as the target and limit reference points as safe from an ecosystem perspective while allowing reasonable yields. The panel did not address the issue of TAC setting directly as several research projects were in place to improve both stock estimates and harvest strategy policy.

However, as noted in the first declaration report, the available ecological models gave results at a spatial scale that is less finely resolved than is required to identify adverse impacts on particular species of CPFs such as fur seals, sea lions and birds. To avoid those impacts the ecological allocation needs to be within reach of the CPFs, both spatially and temporally. The ability of predators to switch prey in times of reduced prey availability can mitigate the effects of depletion. This ability is inherent in predators of small pelagic species so they can cope with the fluctuations of abundance of their prey that are caused by environmental variability, and which may be indistinguishable from the fluctuations caused by fishing. However, some predators, while being able to switch prey when necessary may be switching to sub-optimal diets that in the long term reduce breeding success or longevity.

The nature of the potential adverse environmental impacts on predators and CPFs that might arise from localised depletion in the SPF under DCFA1 was discussed in detail in Chapter 6 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014) and will not be repeated here. However many of the findings and outcomes are relevant to this assessment of the FPA and are summarised below.

From dietary data for predators of small pelagic fish collated from studies and sources, including a commissioned technical review by Patterson *et al*. (2015)[16], the panel found that southern bluefin tuna *Thunnus maccoyii* (SBT) had a high reliance on SPF species in Australian waters especially as juveniles. The panel concluded that SBT being migratory, highly mobile and opportunistic, had greater ability to forage on other prey even as juveniles than many species such as the CPFs. The panel considered that the risk of adverse impacts from localised depletion on SBT arising from concentrated fishing effort by DCFA1, under sustainable catch limits, was unlikely.

The panel concluded that the nature and extent of impact would depend on the spatial and temporal scale of the depletion. Concentrated fishing activity at locations and times when CPFs are most susceptible to the impacts of prey depletion may reduce foraging efficiency resulting in longer foraging trips and/or reduced rates of provisioning to offspring. Persistent depletion can result in reduced offspring growth rates, fledging/weaning mass and reduced survival, and reduced adult breeding success. Longer-term impacts can affect major demographic factors such as survival, recruitment and reproductive rates that drive population age structure, growth rates and, ultimately, population size.

The panel also noted that the distinction between fishing-induced prey depletion at the broader stock level or at the local level is irrelevant to a CPF. However, localised depletion, and any associated adverse environmental impacts, may be shorter in duration (days to months) and less persistent than those caused by broader stock depletions.

CPF species have been shown to be highly responsive to changes in prey availability within their key foraging areas but the panel found very few studies that linked reduced foraging and reproductive performance to the impacts of fishing, and even fewer to localised depletion. Five international case studies demonstrate active management, at some level, of the potential impacts of localised depletion caused by fishing on CPF species. These case studies focus on:

- Peruvian anchovy *Engraulis ringens* and Peruvian boobies *Sula variegata*
- North Sea sandeels *Ammodytes marinus* and seabirds
- Benguela anchovy *Engraulis encrasicolus*/sardine *Sardinops sagax* and African penguins *Spheniscus demersus*
- Atka mackerel *Pleurogrammus monopterygius* and Steller sea lions *Eumetopias jubatus* (Alaska)
- Antarctic krill *Euphausia superba* (Commission for the Conservation of Antarctic Marine Living Resources fisheries).

In only one case study (Peruvian boobies) was there compelling evidence for localised depletion. In three case studies (North Sea, Benguela, Alaska) impacts on CPFs were identified (declines in population size and reproductive success). Despite uncertainty of the cause of those impacts, spatial closures have been introduced as a precautionary measure to mitigate potential adverse impacts of localised depletion. In one case study (the Antarctic krill fishery), spatial closures to protect CPFs from indirect fishing impacts are only in development.

16 Cited in Expert Panel on a Declared Commercial Fishing Activity (2014) as Patterson *et al. unpublished.*

Within Australia there are even fewer studies linking reduced foraging and reproductive performance of CPFs to the impacts of fishing on their prey species. The studies on little penguin *Eudyptula minor*, Australasian gannet *Morus serrator* and crested tern *Thalasseus bergii* following the 1995 and 1998 sardine mortality events in southern Australia provided some insight on the potential impacts on CPFs when a major prey species suddenly becomes unavailable. An estimated 70 per cent of the sardine biomass in that area died over short periods in each year. Impacts on the birds included dietary shifts, reduced provisioning rates and reduced chick, juvenile and adult survival (Dann *et al*. 2000, Bunce *et al*. 2005, McLeay *et al*. 2009). In South Australia (SA), Goldsworthy *et al*. (2011) attempted to identify a suite of reproductive and foraging performance indicators in four CPFs to act as ecological performance indicators (EPIs) for the SASF. However, the short time series (of three to four years) for most species precluded a meaningful conclusion.

The panel concluded that there was a potential for localised depletion of target species by DCFA1 to adversely impact their predators in the SPF. The most susceptible to impact were the CPF species, especially those with restricted foraging ranges while raising offspring and where species targeted by the SPF constitute a significant portion of their diet. The CPFs that forage within the SPF and for which SPF target species contribute more than 10 per cent of their diet include Australian fur seal *Arctocephalus pusillus doriferus*, New Zealand fur seal *A. forsteri*, Australasian gannet, short-tailed shearwater *Ardenna tenuirostris*, little penguin, crested tern and shy albatross *Thalassarche cauta cauta*.
The key areas of importance to these species are in south-eastern Australia, especially Bass Strait, Tasmania and SA. There remains some uncertainty about other CPF species that might be susceptible to localised depletion since diet information is poor or unavailable. The panel also noted that there is very limited monitoring of CPF populations and the chance of detecting any indirect fishery-related impacts within the SPF area is extremely low.

6.3.2 Potential for adverse environmental impacts from localised depletion arising from the FPA on protected predators and CPF species

As discussed in Section 6.2.2, the impact of the characteristics of the processing and storage capacity of the processing vessel itself of the FPA has no direct relevance to CPFs. However, an increase in effort under the FPA, compared to the SPF fleet to date, will increase the level of localised depletion which might increase the risk of adverse environmental impacts, particularly if the effort is concentrated spatially and temporally. Whether the depletion is large and persistent enough to cause adverse effects to the predators is the central issue.

Smith *et al*. (2015) found that the HSP settings for target and limit reference points are appropriate for small pelagic species and were "safe from an ecosystem perspective". This implies that TACs set in accordance with the HSP are adequate to account for the dietary requirements of predators of small pelagic species. Modelling exploitation of small pelagic species, either singly or in combination, and even at very high levels of exploitation that far exceeded the HSP rules, resulted in minimal impact of the broader ecosystem except for a minor decrease in shark biomass (Smith *et al*. 2015). This ability of predators to switch prey in the absence of any particular prey mitigated negative impacts of the loss of that prey.

Smith *et al*. (2015) also found that exploitation rates should be species-specific or even stock specific, taking into account the broad range of life histories and ecology of the SPF species. While these findings are applicable to the broader stock, the question remains as to what level of localised depletion i.e. concentration of removal, could produce adverse environmental effects on dependent predators.

SBT

The panel collated dietary data for predators of small pelagic fish from studies and sources including a commissioned technical review by Patterson *et al*. (2015). Most of the species that ate a high proportion of small pelagic species were CPFs, dolphins, SBT and sharks. The importance of the prey varied according to region, length and timing of study and life history stage (see Tables 4.1 and 4.2 in Expert Panel on a Declared Commercial Fishing Activity 2014). The panel also warned that the data in some instances were up to several decades old and becoming less reliable. Of the non-CPFs, SBT was the most dependent on small pelagic species. Young *et al*. (1997) collected SBT specimens from the east and south coasts of Tasmania between 1992 and 1994 from inshore around the Hyppolyte Rocks and offshore in oceanic waters. Inshore fish (40–130 centimetres (cm)) ate around 45 per cent jack mackerel and 30 per cent redbait while offshore fish (74–192 cm) ate around 24 per cent and 1 per cent respectively (Young *et al*. 1997). Juvenile squid *Notodarus gouldi*, krill *Nyctiphanes australis* and Australian sardines were also important in inshore diets. Adult fish fed further offshore, sometimes in the fronts and eddies of the East Australian Current and on a greater diversity of prey including macrozooplankton particularly the copepod *Phronima sedentaria* and larger pelagic fishes such as Rays bream *Brama brama*.

Young *et al*. (1997) concluded that the inshore waters were important for immature SBT on their annual migration through Tasmanian waters coinciding with autumn blooms of phytoplankton. These blooms provide food for krill which in turn provide food for jack mackerel and redbait. As krill abundance declines towards winter, jack mackerel and redbait move on in search of prey and become more difficult to find. SBT then move offshore in search of prey and the inshore tuna fishery declines (Young *et al.* 1997). The complexity and variability of this east Tasmanian ecosystem were discussed in detail in the first declaration report with particular reference to the 'ups and downs' of the fishery for jack mackerel over the past decades. Natural variability of oceanographic conditions that are fundamental in 'driving' the ecosystem will cause variability in phytoplankton and higher trophic levels in the food web. Large changes in the fishery for jack mackerel caused by changed availability and catchability of the fish have been observed since the 1950s. Obviously, SBT at the next trophic level would also experience changes in availability of this prey.

Another factor to consider in relation to SBT prey is that the SBT (largely immature) were taking jack mackerel less than 125 millimetres (mm) (length measured along the longest axis) (Young *et al.* 1997), about half the size taken by the JMF (250–370 mm fork length). Similar size selectivity was found for Australasian gannets off southern Tasmania and little penguins (see first declaration report). However the panel noted that there has to be sufficient mature stock to maintain recruitment of juveniles for the dependent predators and for the stock itself (Expert Panel on a Declared Commercial Fishing Activity 2014). With regard to the FPA, the panel concluded that SBT was migratory, highly mobile and opportunistic and had greater ability, even as juveniles, than species such as the CPFs, to forage on other prey. The panel considered that the risk of adverse impacts on SBT from localised depletion of SPF target stocks was low and unlikely to be detectable, particularly given the large environmental variability experienced in this region.

CPF species

There is very limited information currently available that enables the panel to assess the potential for adverse impacts on CPF species from localised depletion in the SPF. The CPF species most susceptible to localised depletion of SPF target species were identified in the first declaration report by taking into account both their dietary reliance on SPF target species (more than 10 per cent) and their reliance on near-colony prey resources while raising offspring (Expert Panel on a Declared Commercial Fishing Activity 2014). They are the Australian fur seal, New Zealand fur seal, Australasian gannet, short-tailed shearwater, little penguin, crested tern and shy albatross. The key areas of importance to these species include south-eastern Australia, especially Bass Strait, Tasmania and South Australia, although information is variable. There are few studies that have examined the potential impact of localised depletion on these species. Further, the dietary data available for CPFs in the SPF are by no means comprehensive and therefore this list of susceptible CPF species is unlikely to be comprehensive.

As discussed in the previous section, the panel considers that the studies reviewed in the DCFA1 assessment that identified links between prey abundance and population performance of CPFs are relevant to assessment of the FPA. These studies provided some insight about the likely nature of adverse impacts from localised depletion. The responses of little penguins, Australasian gannets and crested terns to the Australian sardine mortality events of 1995 and 1998 serve to illustrate the severity of a depletion needed to not only affect populations but to be detectable, if only for a few years. They also show that a level of persistence of the depletion event is needed in order to have ongoing adverse effects beyond what might be expected through natural variability, which was not the case in these events.

Similarly, the study linking reproductive and foraging success parameters for CPF seals and seabirds to annual changes in Australian sardine catch and biomass (Goldsworthy *et al.* 2011) provided further insights into potential impacts in the event of declines in sardine abundances in the GAB. Negative correlations were found between sardine annual catch and the morphology and growth of New Zealand fur seal pups, the breeding success of little penguins, the morphology of crested terns and the growth of shearwaters. However, because of the very short time series and unclear trophic and spatial overlap between the fishery and some of the predators, the authors expressed the need for caution when interpreting the results and noted that longer time series were needed to enable more robust analyses.

Spatial and temporal pattern of fishing

As discussed above, it is not possible to accurately predict where and to what extent localised depletion will occur or how long that depletion might persist under a FPA. As the panel concluded in Section 4.2.2, the introduction of a processing vessel enables catching vessels to stay at sea for longer periods. This could enable the catching fleet to fish areas of the fishery that have not been previously accessible due to their distance from ports, and provides an economic incentive to increase fishing effort. However, while the fleet would be less constrained spatially, the panel cannot predict whether the fleet would increase their range or concentrate effort in areas traditionally fished compared to the SPF to date, or both.

The panel believes that an expansion of range might increase the exposure of more CPF colonies to fishing activity by the FPA but to a far lesser extent than the DCFA1 or MTA. Conversely, the FPA has an increased ability to avoid those areas or move out of them if a problem occurs then does the typical SPF fleet, but to a far lesser extent than the DCFA1 or MTA.

In the first declaration report the panel concluded that: "Because central-place foraging predators (seabirds and pinnipeds) raise offspring on land, the availability of key prey resources near their breeding colonies at key times (e.g. incubation and chick rearing in seabirds, lactation in pinnipeds) is critical to their reproductive success and the longer-term sustainability and maintenance of breeding populations. This dependency on near-colony prey resources at certain locations and times increases the vulnerability of these species to localised depletion of prey in their key foraging areas" (Expert Panel on a Declared Commercial Fishing Activity 2014). Therefore, if the FPA fleet concentrated more effort in fishing grounds closer to home ports, as has been the case in the SPF to date, the risk of adverse impacts arising from increased levels of localised depletion would only occur if these grounds are in CPF foraging areas and the effort occurs at critical times.

The first declaration report identified the distribution of known breeding colonies of six of the key CPF species excluding crested tern (Figure 6.1). These were predominantly located in the south east region of the SPF and most are adjacent to areas that have been historically fished by the SPF. A panel-commissioned review by Patterson *et al.* (2015) for the first declaration report identified timing of breeding and offspring growth for the most susceptible CPFs (Figure 6.2). However, the extent of the CPF-specific foraging areas adjacent to their colonies is an important factor in determining overlap with the fishery. Goldsworthy *et al.* (2011) estimated the spatial distribution of foraging and consumption effort off South Australia for five key CPF species in the area of the SASF. These models highlighted areas of importance to these species in the SASF (Figure 6.3), however they were not designed for management of localised depletion and do not take into account the critical times. They also do not address the CPFs that are dependent on SPF species other than Australian sardine.

The panel concluded that it is not possible to predict the spatial and temporal pattern of fishing of the FPA but that there is the potential for increased localised depletion and an increased risk of adverse environmental impacts on CPFs compared to the SPF operations to date.

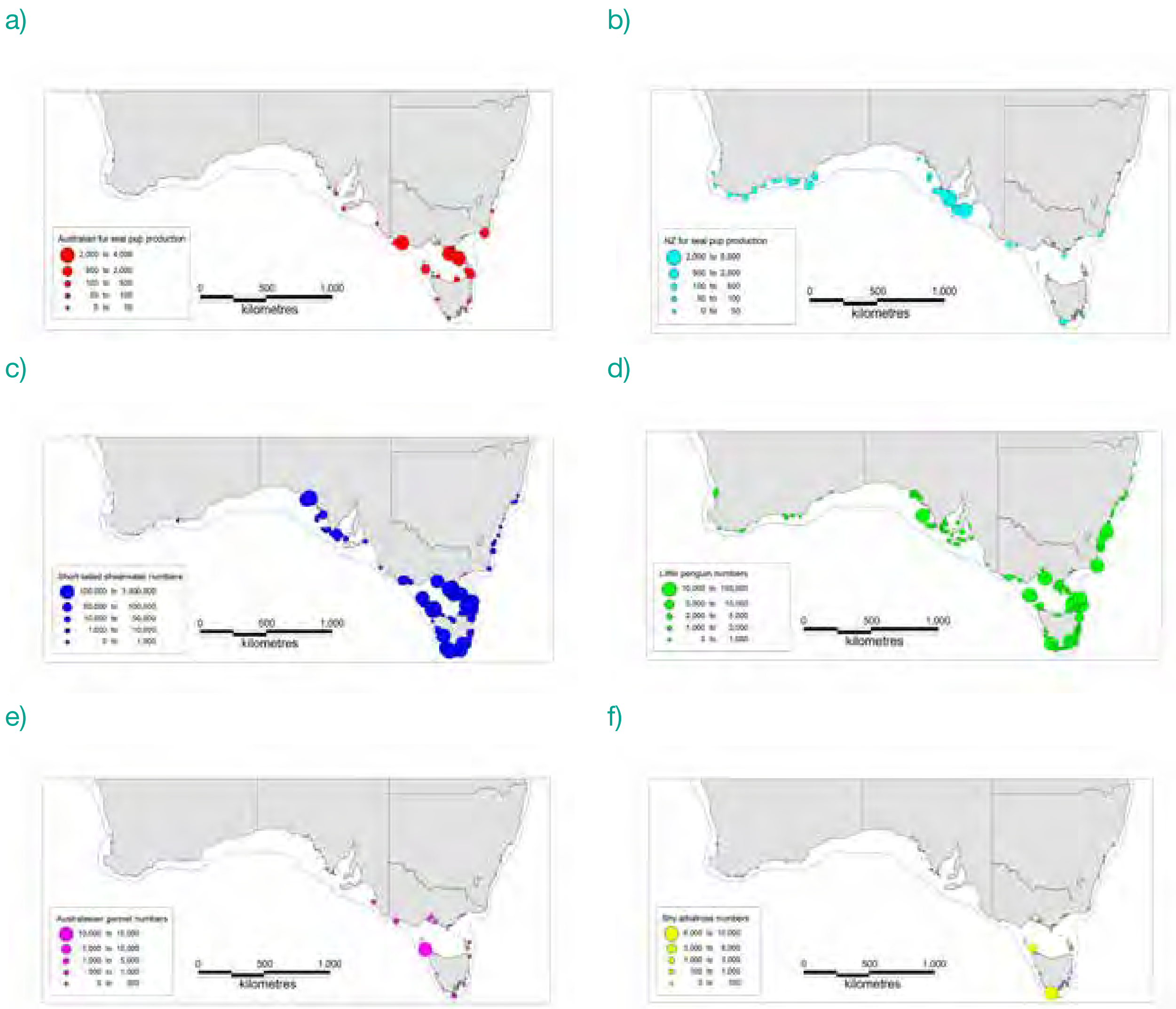

Figure 6.1 Distribution of breeding colonies of six key CPF species that occur in the SPF: a) Australian fur seals, b) New Zealand fur seals, c) short-tailed shearwater, d) little penguin, e) Australasian gannet, and f) shy albatross. Symbols are scaled to the size of the populations. The 200 metre bathymetry isobath is indicated. **Source:** S. Goldsworthy, South Australian Research and Development Institute (SARDI) unpublished.

SPECIES	FORAGING MODE	J	A	S	O	N	D	J	F	M	A	M	J
Australian fur seal	benthic												
New Zealand fur seal	pelagic												
Short-tailed shearwater	plunge dive												
Little penguin Vic./Tas./NSW	pelagic												
Little penguin SA/WA	pelagic												
Australian gannet	plunge dive												
Crested tern	plunge dive												
Shy albatross	surface feeder												

Figure 6.2 Approximate timing, by month, of breeding and offspring growth for key CPF species in the SPF area (light green). The periods of greatest vulnerability to CPFs (incubation, chick feeding, early lactation) when offspring are young are indicated in dark green. General foraging mode is also indicated. **Source:** adapted from Patterson *et al.* (2015) and S. Goldsworthy, SARDI, unpublished data.

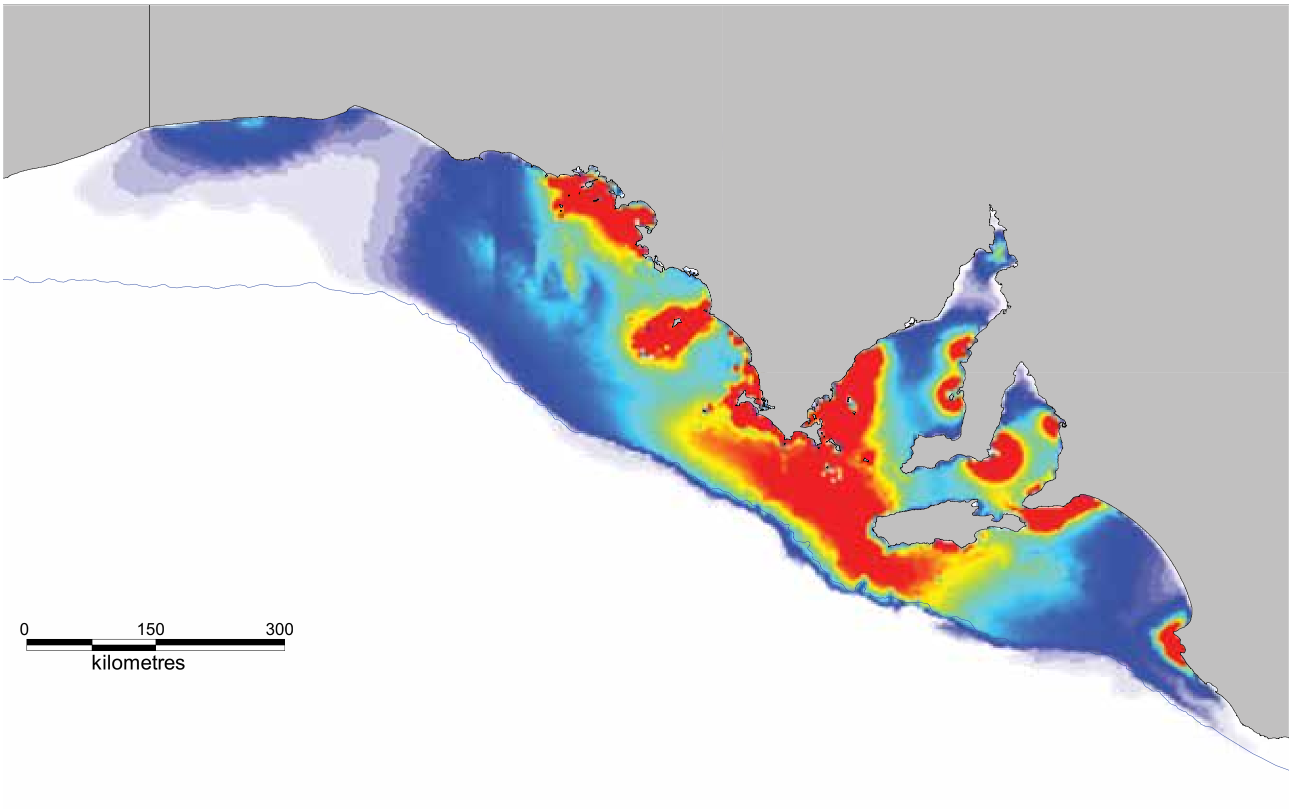

Figure 6.3 Combined model of the spatial distribution of foraging effort for five CPFs over shelf waters off South Australia, drawn as heat plots (New Zealand fur seal, Australian sea lion, short-tailed shearwater, little penguin and crested tern). **Source:** S. Goldsworthy, SARDI unpublished; redrawn from data from Goldsworthy *et al.* (2011).

Summary: Potential for adverse environmental impacts from localised depletion arising from the FPA on predators and CPF species

- *CPFs that forage within the SPF and for which SPF target species comprise more than 10 per cent of the diet include Australian fur seal, New Zealand fur seal, Australasian gannet, short-tailed shearwater, little penguin, crested tern and shy albatross.*
- *There remains some uncertainty about other CPF species that might be susceptible to localised depletion since diet information is poor or unavailable.*
- *Key areas of importance to these species include south-eastern Australia, especially Bass Strait, Tasmania and South Australia.*
- *The relative impacts of localised depletion caused by the FPA, DCFA1 and the typical SPF fleet on CPFs will be influenced by the quantum of catch and the intensity and the distribution of effort.*
- *The panel concluded that compared to the typical SPF, the FPA is likely to:*
  - *increase the quantum of catch because of the improved efficiency of fishing offered by the presence of the processing vessel*
  - *allow wet boats to remain at sea for longer and therefore may*
    - *broaden the distribution of effort and reduce the intensity of fishing in a given area*
    - *increase the fishing effort in a given area*
    - *if fishing is concentrated in critical foraging areas of the CPFs, slightly increase the potential for localised depletion and the risk of adverse impacts on CPFs*
    - *if fishing is more broadly distributed, slightly decrease the potential for localised depletion and the risk of adverse impacts on CPFs.*
- *The panel concluded that compared to the DCFA1 and MTA, the FPA is likely to:*
  - *result in similar or higher levels of catch*
  - *reduce the distribution of effort since wet boats are much more constrained by the need to return to port to refuel, and therefore increase the intensity of fishing in a given area*
  - *if fishing is concentrated in critical foraging areas, increase the potential for localised depletion and potentially the risk of adverse impacts on CPFs.*
- *The panel could not predict how these factors would balance out. However, overall, the panel concluded that there was slightly more potential for the FPA fishing fleet to have adverse impacts on protected CPF species than the typical SPF fleet but slightly less potential than under DCFA1 or the MTA.*

6.3.3 Management of the impacts of localised depletion on CPFs

There are three mechanisms that contribute to SPF management of localised depletion. These are:

- management settings including precautionary reference points
- zoning of stocks, TACs and individual transferable quotas
- prescribed responses to localised depletion.

The reference settings prescribed by the SPF Harvest Strategy claim to be precautionary, a view supported by Smith *et al.* (2015). According to their model results the recommended harvest levels were found to have minimal impact throughout the ecosystem and therefore allow adequate provision for dependent predators.

Zoning (Eastern and Western Zones) of stocks and TACs is an attempt to allocate catch and effort across the fishery. However, there is evidence to suggest that further sub-structuring of stocks of jack mackerel and Australian sardine might exist. There is no further information regarding this sub-structuring or if this is important to the issue of ecological allocation to dependent CPFs.

The SPF Harvest Strategy (AFMA 2008) does specifically acknowledge the risk of adverse impacts from localised depletion on CPFs (Box 6.2).

Box 6.2 Accounting for ecological impacts

"On the basis of all available information including independent observations of the fishery, the potential ecological effects of the SPF will also be considered by SPFRAG [Small Pelagic Fishery Resource Assessment Group] when setting RBCs [recommended biological catches] using the following decision rules.

1. If evidence of significant interactions with threatened, endangered or protected species exists, SPFRAG must recommend one or more of the following:

- that a program be established to mitigate interactions; and/or
- an appropriate reduction in the RBC; and/or
- that the stock/s be reduced to a lower level Tier (ie with a smaller catch).

2. If, as a result of fishing, there is evidence of localised depletion or a concerning trend/change in age/size structure, SPFRAG must recommend one or more of the following:

- an appropriate reduction in the RBC; and/or
- appropriate spatial or other management measures.

3. If, as a result of fishing in the SPF, there is evidence of changes in ecosystem function (eg. reduced breeding success of seabirds), SPFRAG must recommend one or more of the following:

- an appropriate reduction in the RBC; and/or
- appropriate spatial or other management measures; and/or
- that a program be established to:
  - assess the potential impacts of the fishery on the ecosystem;
  - investigate potential ecological performance indicators for the fishery; and
  - report management performance against those indicators."

(AFMA 2008)

There were no additional measures proposed to be applied to the FPA in order to monitor or to address any increased risk of localised depletion on CPF species.

Panel assessment: proposed measures to manage the risks to CPF species arising from localised depletion caused by the FPA

- *The overall level of exploitation permitted in the SPF is consistent with the best available advice on management of small pelagic species.*
- *The overall level of exploitation proposed in the SPF Harvest Strategy has been found to be adequate from an ecosystem perspective; however, species-specific and possibly stock-specific exploitation rates may need to be adjusted.*
- *The precautionary SPF Harvest Strategy settings are unlikely to make a significant contribution to avoiding adverse environmental impacts of localised depletion on CPF species. While separate TACs are allocated to Eastern and Western Zones, there is no finer spatial allocation of catch or effort.*
- *The provisions of the SPF Harvest Strategy outline responses to localised depletion once it has been detected.*
- *There are no measures in place in the SPF that would detect the spatial and temporal extent of localised depletion or adverse environmental effects that arise from it.*
- *There are no spatial and temporal closures in place, or proposed, that address potential trophic impacts to CPF species in the SPF.*

6.3.4 Actions that could be taken to manage localised depletion in the SPF

The mitigation measures for reducing the risk of adverse environmental impacts of localised depletion caused by the FPA on CPFs are the same as those proposed by the panel for the DCFA1. These are:

- spatial allocation of TAC
- move-on rules
- spatial closures.

Spatial allocation of TAC

The use of spatially allocated TACs would require the SPF fishery to be managed in smaller spatial management units within which the consumption needs of predators of SPF species (including CPFs) would be assessed and taken into account. Area-specific TACs would be set for each management unit. However, unless the management units are relatively small in scale, spatial allocation may not prevent most of the allocated catch within a management unit being taken in a small geographic space over a short time period, as a result this may be a less effective management tool to mitigate the potential impacts of localised depletion on CPFs.

Move-on rules

Move-on rules could be applied to critical foraging zones of CPFs and/or at critical times (for example, during breeding season, chick or pup-rearing periods) to manage the potential adverse impacts from localised depletion by the FPA on CPFs. These rules are a form of spatial closure that is enforced after a certain level of catch has been taken within a sensitive CPF area and at sensitive times.

The panel notes that the Small Pelagic Fishery Resource Assessment Group (SPFRAG) is focusing effort on the use of move-on rules (SPFRAG 2014) and is discussing two options: moving a set distance or moving on to another grid, both of which would require close monitoring of catches. It is the panel's view that there is less information available to inform the setting of a meaningful level of catch over space and time as required by a move-on rule than is the case for broader, spatial/temporal closures.

Spatial closures

Spatial closures are used to prevent any fishery catch taking place in critical foraging areas, typically adjacent to CPF species' breeding colonies. Closures may be temporary to protect CPFs at critical time periods, such as during the breeding season, or permanent where animals may reside at colonies or haul-outs year round, and where offspring may be provisioned over longer time periods (e.g. seals with long lactation periods). Typically, the extent of the spatial closure(s) would be determined by an understanding of where the key foraging areas are, or on limitations in the foraging ranges or spatial at sea distribution, and would potentially vary among species and populations in their scale, timing and duration.

The panel notes that SPFRAG (2014) continues to view the use of spatial/temporal closures as part of the toolbox for managing localised depletion.

Panel advice: actions that could be taken to manage the risks to CPF species arising from localised depletion caused by the FPA

- *There are three main precautionary management approaches that could be implemented to mitigate the potential adverse impacts of localised depletion caused by fishing on CPFs: spatial allocation of catch, move-on rules and spatial closures.*
- *Spatial closures are the most common form of precautionary management used to mitigate the potential adverse impacts of localised depletion on CPFs; however, the effectiveness of spatial closures for this purpose has not been clearly demonstrated. Their effectiveness depends heavily on the ability to determine the scale of spatial closures that would be appropriately precautionary for particular species at particular locations and at particular times.*
- *The panel considered that the risks to CPF protected species from localised depletion caused by the FPA should be managed by taking a proactive approach separating the fishing activity from the key foraging areas and times used by CPF species rather than through move-on rules. This does not discount the potential value of move-on rules in the context of direct interactions with protected species.*
- *While determining the appropriate scale of the required closures in particular times and areas will remain a challenge, there are reasonable datasets available in at least some areas of the SPF that could inform these decisions. It may be necessary to extrapolate from this information in order to define appropriate spatial closures elsewhere in the SPF.*
- *It is likely that these spatial closures will need to be modified adaptively to reflect additional information as it becomes available, either through fishing or targeted research.*

- *Global studies on CPFs demonstrate that they are responsive to changes in the availability of prey within their foraging range, but they do not distinguish between changes caused by localised and overall stock depletion. Careful consideration of how management of the entire stock, and especially the reduction in available biomass through fishing, impacts on CPFs at a local scale and at critical times, is required.*

6.3.5 Research and monitoring to reduce uncertainty associated with the risk of localised depletion

In the first declaration report the panel found no conclusive evidence of historical localised depletion that caused adverse environmental impacts in the SPF, and that remains the case under the FPA. The high level of dependence by some predators, particularly CPF species, highlights the need to manage for the risk of such impacts. It also points to the potential to use populations of these species to monitor the health of the SPF resources.

Many of the uncertainties that have been identified in relation to the panel's ability to assess the extent of localised depletion likely under an FPA cannot be addressed through monitoring and research. Some uncertainties reflect the dynamic nature of the marine environment and consequently, responses of small pelagic species. Some reflect the dynamics of fishing operations and economics. Thus many of the uncertainties will remain and management must, therefore, be precautionary and adaptive.

Target species

The panel considered that it is reasonable to expect that a significant increase in catch of SPF target species is likely to occur under a fleet configuration that is more economically efficient, can produce higher-priced product for human consumption and has a greater capacity to stay at sea and to fish the area of the SPF more broadly. The configuration of the FPA fleet assumed by the panel in its assessment, would allow more catch to be taken within the constraints of the TACs. In order to minimise the risk that fishing is concentrated on sub-populations of redbait, blue mackerel and jack mackerel, further investigation into the population structure of these species would be appropriate.

The projects identified by Ovenden (2015) in the first declaration report are still considered by the panel fundamental to understanding stock structure in the SPF species and to enabling better and more appropriate spatial management of all stocks. More robust spatial management of the stocks should reduce the likelihood and risks associated with localised depletion of those species. The projects identified ranged between a very cost-effective re-analysis of existing jack mackerel and sardine data, if available, using the latest statistical methods, to more targeted studies, at increasing costs, on all SPF species, including blue mackerel, yellowtail scad and redbait for which there is very poor information. Some of the latter studies could easily be added into the fishery–independent surveys currently being conducted or planned in the SPF. Ovenden (2015) also advocated that a combination of genetics and single–generation markers such as otolith chemistry, parasite abundance, tagging and tracking, is needed to define stocks and better understand "crinkles in connectivity between populations" but the panel noted that the SPF has limited resources to support such a range of research programs. The panel supports further well-designed and targeted research in this area to clarify the extent of sub-structuring within the Eastern and Western Zones specifically, and the SPF more broadly.

The panel considered that ongoing monitoring of the length frequency of catch taken by the FPA fleet and the SPF fleet more generally would be important for monitoring overall stock health and detecting any localised effects on target stocks. The catch of the FPA catching fleet would be frozen onboard the processing vessel therefore management measures would need to ensure that arrangements were made for observers to collect this information prior to freezing.

Panel advice: research and monitoring to reduce uncertainty associated with the risk of localised depletion

Research and monitoring in the following areas could reduce uncertainties associated with stock structure and hence with the adverse impacts of localised depletion arising from the FPA on target species and CPFs:

- *Well-designed and targeted research to clarify the extent of sub-structuring of SPF target species within the Eastern and Western Zones specifically, and the SPF more broadly.*
- *Dietary studies to determine which key CPFs or other commercially or ecologically important predators are most reliant on SPF species.*
- *Studies to better understand the critical foraging areas, habitats and times for key CPFs.*
- *Examination of the biological response of CPFs to changes in prey availability.*
- *Ongoing monitoring of the length frequency of catch taken by the whole fleet including the FPA catching vessels at a statistically appropriate sampling intensity.*
- *Development and implementation of potential ecological performance indicators for the fishery.*

CPF species

The panel determined in the first declaration report that there are widespread and large uncertainties in the population status and abundance of CPFs, the spatial distribution of foraging effort, and diet for most species and that remains the case under the FPA. To address these uncertainties and inform the understanding of the potential impacts from reductions in prey availability caused by any form of SPF depletion on the availability of prey to CPF within their key foraging areas, the panel reaffirms the following four research and monitoring needs:

1. Dietary studies to determine which key CPFs or other commercially or ecologically important predators are most reliant on SPF species.

In general, information on the importance of SPF species and other commercially targeted species in the diets of CPF predators is patchy, leading to large uncertainties due to the lack of representativeness in locations and years and for some species the basic information is absent. As a consequence there may be other species for which there are limited data that may well be susceptible to impacts associated with the SPF.

2. Studies to better understand the critical foraging areas, habitats and times for key CPF species.

There are major gaps in information on the distribution of key foraging areas for CPF species throughout the SPF area. Critical gaps include comprehensive and representative data on the foraging distributions and ranges at critical life-history stages for seabirds (during the incubation and chick rearing to fledging) and for seals (the key foraging areas of adult females throughout lactation). In managing for the potential adverse impacts of localised or stock depletion on dependent CPFs, such information is necessary to determine the scale of spatial closures that would be appropriately precautionary for particular species at particular locations and at particular times. This does not preclude the introduction of interim precautionary closures based on available information.

3. Biological response of key CPFs to changes in prey availability.

There are a number of global studies that provide an important foundation to our understanding of how CPF species respond to variation in prey availability over short and long time scales (see Boyd *et al.* 2006 and chapters therein). Unfortunately, there are few such studies in Australia that can be drawn upon to provide any insight into the likely nature and consequence of indirect fishing impacts on protected CPF species. Long-term monitoring of key CPF species' populations in the SPF area could provide important information on assessing the indirect effects of fishing. Such studies could monitor foraging efficiency, provisioning rates and offspring growth rates and fledging/weaning mass, survival and adult breeding success. Monitoring of annual production and/or population size would also provide very relevant time series and key performance indicators of CPF health, and would indirectly measure the degree to which potential indirect effects of fishing are being managed/mitigated.

4. Establishment of EPIs.

The panel noted the provision in the SPF Harvest Strategy for the establishment of a program to assess the potential impacts of the fishery on the ecosystem, investigate potential EPIs for the fishery and report management performance against those indicators if there is evidence of changes in ecosystem function (e.g. reduced breeding success of seabirds). The panel considered that there would be merit in establishing such a program in a proactive way, i.e. to detect such events, rather than only as a response mechanism.

7 Assessment of the Declared Commercial Fishing Activities

7.1 Introduction

The panel's Terms of Reference required it to assess and advise on two declared commercial fishing activities particularly the potential for the activities to result in adverse environmental impacts. The assessment related to:

- the likely nature and extent of direct interactions of the mid-water trawl activity (MTA) and the fish processing activity (FPA) with species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act), particularly seals, dolphins and seabirds
- the potential for any localised depletion of Small Pelagic Fishery (SPF) target species, arising from the MTA and the FPA to result in adverse impacts to the Commonwealth marine environment, including the target species' predators protected under the EPBC Act.

Based on its assessment of those issues, and consideration of the proposed management of the MTA and the FPA, the panel has provided advice on actions that could be taken to avoid, reduce and mitigate adverse environmental impacts of the DCFA and on scientific research and monitoring that could reduce uncertainties about those impacts.

A summary of the panel's assessment, guidance on interpretation of the outcomes of the assessment and the panel's advice, and concluding comments, are provided below.

7.2 The mid-water trawl activity

7.2.1 Assessment and advice on direct interactions with protected species

The MTA differs from the declared commercial fishing activity (DCFA1) under the first declaration (*Final (Small Pelagic Fishery) Declaration 2012*) only in that its minimum storage capacity is reduced by 400 tonnes (t). The panel found that the uncertainties around the pattern of fishing likely to be undertaken by DCFA1 applied equally to the MTA. The panel considered that its assessment was not sufficiently sensitive to detect any differential impacts on the nature and extent of direct interactions with protected species arising from a 400 t reduction in storage capacity. The panel's assessment and advice on the DCFA1's direct interactions with protected species therefore applies to the MTA. A full summary of that advice can be found in Section 7.2 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014). Some key points are summarised below.

- The MTA is a mid-water freezer trawler with a minimum storage capacity of 1600 t, operating in the SPF.
- The MTA would be able to stay at sea for longer periods and to fish more extensively in the SPF area than previous mid-water trawlers in the SPF. It would be likely to focus its fishing effort on the shelf and slope areas of the SPF where the target species are predominantly distributed but would likely fish these areas more extensively than previous fishing operations in the SPF.
- If the MTA operated in areas or at times of the year that have not been fished previously by mid-water trawl vessels, it is reasonable to expect that rates of interaction with protected species, the species involved and the risk profile of those species may differ from those of the past. However, it is not possible to predict with certainty the species involved, the spatial/temporal pattern of fishing or the intensity of fishing by the MTA because the fishing plan will be dictated by the prevailing environmental and economic conditions.
- While it is inevitable that the MTA would interact with protected species of pinnipeds, cetaceans and seabirds, there remains considerable uncertainty about the likely extent of these interactions and the level of direct interactions resulting in injury or mortality of protected species that could occur without causing an adverse environmental impact.
- Most fisheries, including the SPF, are managed in similarly uncertain environments.
- There are actions that could be taken to avoid, reduce and mitigate the risks of adverse environmental impacts occurring, and research and monitoring could be undertaken to reduce the uncertainties (see Section 3.2).

7.2.2 Assessment and advice on localised depletion

In relation to localised depletion, the panel considered that the reduced storage capacity of the MTA may reduce the extent of localised depletion and the risks associated with adverse impacts arising from such depletion. Conversely, the reduced capacity to stay at sea may provide an incentive to stay in a localised area for more extended periods compared to the more wide-ranging activity possible under DCFA1. Given the uncertainties associated with the fishing pattern of the MTA, the panel considered that it was unlikely that it could detect any meaningful distinction between the likely impact of localised depletion caused by the MTA and that caused by the DCFA1. The panel's assessment and advice on the impacts of localised depletion under DCFA1 therefore applies to the MTA. A full summary of that advice can be found in Section 7.3 of the first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014). Some key points are summarised below.

- The panel defined localised depletion as a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing.
- Localised depletion is an inevitable consequence of any fishing activity including the MTA.
- The panel found no conclusive evidence of historical localised depletion that caused adverse environmental impacts in the SPF, noting that there were no monitoring programs in place specifically designed to detect localised depletion.
- Exploitation rates in the SPF are considered to be conservative against international benchmarks for small pelagic fisheries and concerns about the basis for spawning stock biomass estimates and the SPF Harvest Strategy Policy are being addressed. It is unlikely that any localised depletion of SPF target species arising from the MTA would affect the overall status of those species.
- The MTA has the potential to have adverse impacts on central place forager (CPF) species through localised depletion. Whether that potential is realised depends on where, when and how intensively the MTA fishes. However, it is not possible to predict with certainty the species composition, the spatial/temporal pattern of fishing or the intensity of fishing by the MTA because the fishing plan will be dictated by the prevailing environmental and economic conditions.
- There remains uncertainty about the nature and extent of adverse impacts on CPFs from localised depletion arising from the MTA.
- There are actions that could be taken to avoid, reduce and mitigate the risks of adverse environmental impacts occurring, and research and monitoring could be undertaken to reduce these uncertainties (see Section 3.3).

7.3 The fish processing activity

The FPA operates in the SPF using a vessel with minimum storage capacity of 1600 t that receives or processes SPF quota species from a fishing fleet. The panel assumed that the fishing fleet comprised wet boats, three of which used purse seine and two that used mid-water trawl. To underpin its assessment of the FPA, the panel considered the likely operation of the FPA and the factors that would affect its interactions with protected species and, through localised depletion, its impact on those species and the broader marine environment. The key findings are summarised below.

- The panel assumed that the processing vessel did not resupply, refuel or re-crew the catching fleet.
- Under the FPA, transhipment will occur through pumping fish from the nets or the holds of the catching fleet to the processing vessel. The panel did not find any evidence to suggest that the process of transhipment would pose any specific threat to protected species.
- Interactions between the processing vessel and protected species would be largely restricted to vessel strike with cetaceans while the vessel was transiting between the fishing grounds and ports to unload/refuel. The potential for vessel strike is not considered to be any higher under the FPA than under DCFA1. However, it may be higher than under SPF fleet operations to date.
- Fish-finding capability provided to the catching fleet by the processing vessel was unlikely to be a significant determinant of interactions with protected species or of the extent of localised depletion under the FPA.
- The processing vessel would have no direct impact on localised depletion and any direct impact would be incurred through the catching fleet.
- Compared to the typical and particularly the recent SPF fleet, the FPA scenario would most likely result in increased effort in both the purse seine and mid-water trawl sectors. However, the panel could not quantify this increase.

- Any change in the spatial and temporal distribution of effort, compared to typical SPF fleet operations, may have implications for interactions with and/or indirect impacts on protected species. The panel could not predict whether the FPA would result in a broader distribution of effort or greater effort in areas fished previously by the SPF fleet. This will depend on the availability of fish, the fuel-carrying capacity of the catching fleet and skippers' knowledge of the fishing grounds, all of which may vary over time.
- Existing management arrangements in the SPF require vessel management plans (VMPs) for all mid-water trawl vessels but not for purse seine vessels. The panel has assumed that the purse seine component of the FPA catching fleet and the processing vessel would not be required to have a VMP.

7.3.1 Assessment and advice on direct interactions with protected species

Pinnipeds

All of the breeding distribution of the Australian and New Zealand fur seal *Arctocephalus pusillus doriferus* and *A. forsteri* in Australia, and most of the breeding distribution of the Australian sea lion *Neophoca cinerea*, occurs within the area of, or adjacent to, the SPF. Seals are common marine predators in southern Australia and are attracted to any fishing activity that occurs within their foraging range. The greater the level, frequency or predictability of fishing activity, the greater the number of seals that are likely to be attracted to, and interact with, fishing operations. If fishing is persistent over time and fishing activities provide opportunities for seals to gain nutritional benefits, then part of their populations can become habituated to fishery interactions.

Fur seals readily interact with trawl fisheries throughout the area of the SPF, and these interactions can include net feeding, entering the trawl net, and habituation to fishing activities. With these interactions, some level of bycatch mortality is inevitable and in areas of high seal abundance and/or high fishing activity, likely to be common, even with best-practice management. Mid-water trawls in the SPF with seal excluder devices (SEDs) that were monitored by underwater video, during 2006 and 2007, recorded a high incidence of net entry by fur seals during trawls and very high bycatch mortality.

Pinnipeds also readily interact with purse seine fisheries that overlap with their foraging range. Most interactions involve net feeding, with seals taking advantage of the pursed fish which provide an abundant and easy food source that can be gained with little energetic cost compared to normal foraging. The vast majority of interactions are non-lethal, as seals can readily move in and out of the net over the float line and are not usually impeded in accessing the surface to breathe.

It is not possible to predict with any certainty the location, timing or intensity of fishing of the FPA fleet and as a result it is not possible to provide any firm conclusions on the likely rate of interactions between the FPA fleet and pinnipeds. However, the panel recognises that the extent of interactions with fishing activities will largely be determined by the extent to which they are concentrated in key pinniped foraging areas. Historically most trawl fisheries' interactions with pinnipeds have been with Australian fur seals in southeastern Australia. There would be uncertainty about the extent of interactions with pinnipeds if the FPA catching fleet and particularly the mid-water trawl vessels fished off South Australia and Western Australia. In these regions, New Zealand fur seal and Australian sea lion are most common. Neither species has been exposed to the level of bycatch mortality from trawl fisheries experienced by Australian fur seals, so there is uncertainty about the differential impacts of bycatch on their populations. This is especially significant for the threatened Australian sea lion.

Overall, the panel considered that the extent of interactions with the FPA would likely be higher than the DCFA1 and typical SPF fleet, noting that purse seine is likely to have extremely low levels of pinniped mortality.

Compared to the typical SPF fleet, the panel considered that:

- There would be more effort under the FPA and this would likely result in a greater number of interactions.
- The FPA scenario would likely result in an increase in pinniped bycatch mortality given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels.
- If the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect that the rate of interactions with pinnipeds might change and potentially involve interactions with all three pinnipeds rather than just fur seals.

Compared to DCFA1, the panel considered that:

- The number of interactions with pinnipeds under the FPA may be less, similar or more, depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel, then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.
- The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). This may mean that they are more likely to fish closer inshore than DCFA1 and potentially have more interactions with protected CPF species such as fur seals and sea lions.

Actions to avoid, reduce and mitigate adverse environmental impacts on pinnipeds

Mid-water trawl

- VMPs for mid-water trawl vessels should stipulate the use of an upward-opening SED, with hood, with the requirement for underwater monitoring of SED efficacy and cryptic mortality to assess and improve performance.
- VMPs should set daily and per-shot trigger limits on fur seals and provision for move-on rules with a requirement to move to an area where interactions with seals are less likely.
- Introduce a bycatch rate trigger limit for fur seals for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas.
- Ensure 100 per cent observer coverage of all mid-water trawl fishing operations and, if daily or per shot trigger limits are used in conjunction with move-on rules or with a requirement to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.
- Require 'stickers' to be removed from trawl nets before shooting.
- Implement spatial closures for mid-water trawl that mitigate bycatch interactions with fur seals, especially in regions adjacent to breeding colonies where there is high transit and foraging activity by central place foraging lactating adult females.
- Implement Australian sea lion closures off south Australia, as specified in Condition 1 (e) for the DCFA1 (see Section 3.1) amended to include waters out to 183 metres depth, consistent with the outer extent of the gillnet component of the Gillnet, Hook and Trap (GHAT) Fishery.
- If such closures off South Australia are not implemented, bycatch trigger limits and management arrangements for Australian sea lion in the mid-water trawl sector of the SPF should be introduced consistent with those in the Australian sea lion Management Zones in the GHAT Fishery.
- Implement mid-water trawl closures and bycatch trigger limits for Australian sea lion colonies occurring within the SPF off Western Australia.

Purse seine

- Review the protected species handling manual referred to in the SPF Purse Seine Code of Practice to ensure it provides information on how to safely remove live seals from purse seine nets that have been pursed or 'dried-out', and for removing them from the vessel deck.

Research and monitoring to reduce uncertainties

- What are the individual and cumulative fishery-related bycatch impacts on pinniped populations?
- What levels of fishery-related mortality can pinniped populations sustain?
- Where are the regions of critical foraging habitat for pinniped populations where the management of direct interactions with the FPA may be most needed?
- Are there additional modifications to fishing gear and behaviour that can reduce the potential for direct interactions by the FPA with pinnipeds?

Cetaceans

Nearly all cetaceans recorded in Australian waters have ranges that overlap to some extent with the SPF area. The risk of interactions increases where prey species are also targeted by fisheries and where fishing grounds overlap with important habitats used by cetaceans for aggregating, feeding, breeding and as migratory routes. The nature and likelihood of interactions between cetaceans and mid-water trawl and purse seine fisheries varies widely among these species. Bottlenose dolphins *Tursiops* spp. and short-beaked common dolphins *Delphinus delphis* are likely to be at higher risk of interaction based on reported interactions with these gear types and bycatch mortality in Australia and internationally. The evidence suggests that in Australian waters most interactions with these species in purse seine nets result in dolphins escaping or being released alive whereas higher mortality rates are incurred as a result of interactions with mid-water trawl gear. Interaction rates with dolphins in international purse seine tuna fisheries that set on dolphins, and in other Australian purse seine fisheries that target Australian sardines *Sardinops sagax* may not be indicative of likely rates of interactions in the FPA.

Direct interactions with fishing operations include net feeding and feeding on discards, and fish escaping from nets. Vessel collisions resulting in injury or death of whales and some other cetaceans are thought to be relatively common in Australian waters but are not well documented. Most severe or fatal injuries to whales from vessel strike are caused by collisions from vessels greater than 80 m, and higher speed increases the risk of serious injury or death. The processing vessel of the FPA may therefore have a higher risk of vessel strike than vessels typically used in the SPF but not significantly different from that of the DCFA1.

It is highly likely that there will be some direct interactions between the FPA and cetaceans. The FPA would enable fishing to occur more extensively in the SPF area, which would increase the range of cetacean species likely to be encountered. The nature and extent of direct interactions by the FPA with cetaceans is uncertain but some cetacean mortality is likely. The panel concluded that species such as bottlenose dolphins and short-beaked common dolphins, that are known to prey on small pelagic fish, and interact extensively with trawl fisheries and purse seine fisheries, are at increased risk of being taken as bycatch by the FPA, whereas some larger whale species may be at slightly higher risk from vessel strike.

The lack of information on the distribution and abundance, population trend, genetic structure, and location and timing of use of important habitats for most cetacean species, greatly increases the uncertainties about the likelihood of direct interactions occurring and whether such interactions would result in significant environmental impacts for these protected species.

Compared to the typical SPF fleet, the panel considered that:

- There would be more effort under the FPA and this would likely result in a greater number of interactions.
- The FPA scenario would likely result in an increase in cetacean bycatch mortality given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels.
- If the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect a change in both the rate of interactions and the cetacean species involved.

Compared to DCFA1, the panel considered that:

- The number of interactions with cetaceans under the FPA may be less, similar or more, depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.
- The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly). As a result, there may be less potential for a change in the species composition of cetacean interactions than under the DCFA1. The FPA would be more likely to focus its fishing in areas nearer the coast where short-beaked dolphins happen to be more abundant and interactions with this species may therefore be higher than under DCFA1.
- Both the DCFA1 and FPA fleets would concentrate their fishing in the waters of the shelf and upper slope, where the target species are distributed. As a result, it is unlikely that either fleet would fish extensively in areas of the highest cetacean species richness further offshore.

Actions to avoid, reduce and mitigate adverse environmental impacts on cetaceans

Mid-water trawl

The following advice is drawn from the panel's assessment of the impact of mid-water trawl on cetaceans in its first declaration report.

- Use an excluder device for cetaceans only after its operation has been optimised for the vessel, fishery and different dolphin species, including both bottlenose and short-beaked common dolphins, under a scientific permit with the required level of performance developed in consultation with experts, noting that excluder designs tested to date have not been consistently effective in reducing cetacean bycatch in trawls, and at present there is no solution to filter or deter cetaceans from entering the net opening.
- Use underwater video to monitor dolphin behaviour within the net and around the excluder device to determine the efficacy of the excluder device and levels of cryptic mortality.
- Management actions applied to dolphin interactions in the SPF should be consistent with the current spatial management zones and actions to mitigate dolphin bycatch in the gillnet sector of the GHAT Fishery off South Australia.

Purse seine

- Incorporate the elements of the South Australian Sardine Fishery Code of Practice that relate to mitigation of interactions with dolphins into the SPF Purse Seine Code of Practice.
- Validate the logbook reporting of interactions with dolphins in purse seine operations in the SPF.

All fishing operations

- Introduce a bycatch rate trigger limit for dolphin species for the fishery or fishing areas, or a total mortality trigger for a fishing season and/or fishing areas on a precautionary rather than an evidentiary basis.
- In response to a single dolphin mortality, require the vessel to move to an area where interactions with cetaceans are less likely, based on available data on estimated at-sea density distributions.
- Assess the efficacy of acoustic deterrent pingers (during rigorous controlled trials under scientific permit with the required level of performance developed in consultation with experts), and temporal and spatial closures, that have been shown elsewhere to have potential to reduce the risk of interactions for some cetacean species, including dolphins.
- Prohibit the discard of any biological waste (excluding the release of any protected fauna) from all fishing and processing vessels.
- Ensure 100 per cent observer coverage of mid-water trawl fishing operations and, if trigger limits are used in conjunction with move-on rules or requirements to review mitigation measures, provide sufficient observer capacity to ensure that underwater video footage is monitored at the end of each shot to maximise response times to mortalities.
- In addition to the above actions to mitigate impacts on dolphins, ensure that monitoring and agreed management responses are in place to allow a timely management response if other cetacean species interact with the FPA.
- The risk of vessel strike by the processing vessel could be reduced by:
  - reducing the co-occurrence of whales and vessels where possible, in particular by identification and avoidance of key feeding grounds or aggregation areas
  - use of reduced vessel speed zones to reduce the likelihood of fatal vessel strikes in identified high-risk areas
  - using marine mammal observers to alert vessel crew to the presence of cetaceans in the vicinity or path of vessels.

Research and monitoring to reduce uncertainties

- What regions in the SPF area are important habitats used by cetaceans that have increased risk of interactions with the FPA?
- What levels of mortality arising from interactions with the FPA could be sustained by cetacean populations in the SPF area?
- What modifications to the proposed fishing gear and operations of the FPA are needed to improve management and reduce the potential for interactions including bycatch of cetaceans?
- At a minimum, maintain the current management arrangements which specify targets of observer coverage for existing vessels of 10 per cent of purse seine coverage and full coverage for either five or 10 trips respectively for new vessels entering the fishery or moving into new areas, and clearly define the terms 'new areas' and 'new vessels'.

- Develop a dedicated observer program for purse seine vessels to validate logbook reporting of interactions with protected cetacean species.

Seabirds

The reported rate of interactions with seabirds in the SPF has been low, particularly in the purse seine sector, despite most operations having been in areas of high seabird species richness. This is most likely because of the ability of birds to interact with fish in the open purse seine net without capture and the low level of discharge of biological material in the mid-water trawl sector. However, the panel did not dismiss the issue of under-reporting of seabird interactions.

Based on the information available, the species most commonly involved in interactions with mid-water trawl and purse seine gear in the SPF area are shearwaters, predominantly the flesh-footed shearwater. Proximity of fishing operations to seabird breeding sites and the time of day that fishing occurs may be major determinants of the rate of interactions.

The panel considered that the extent of interactions of the FPA with seabirds will depend on the actual fleet configuration, the fishing practices adopted, the level of fishing effort, the spatial and temporal pattern of fishing and the seabird mitigation measures used. While there remains some uncertainty about the possible loss of fish during transhipment and the potential for such loss to increase seabird interactions, there is no evidence to suggest that the practice of transhipment poses a specific risk to seabirds.

It is not possible to predict with any certainty the location, timing or intensity of fishing of the FPA fleet. As a result, it is not possible to provide any firm conclusions on the likely rate of interactions between the fleet and seabirds. However, the panel expected that the rate of interactions with seabirds would remain low under the FPA.

Compared to the typical SPF fleet, the panel considered that:

- There would be more effort under the FPA and this would likely result in a greater number of interactions.
- The FPA scenario would likely result in an increase in seabird bycatch mortality given that the FPA fleet configuration includes more mid-water trawl and less purse seine vessels.
- If the presence of the processing vessel allows fishing to extend into areas not previously fished or more intensive fishing of some areas, it is reasonable to expect a change in both the rate of interactions and the seabird species involved.
- The panel concluded that there was unlikely to be any discernible differential impact of the FPA on the interaction rate with seabirds and that the rate was likely to be low. Since the processing vessel does not fish, there would be no additional risk posed through entanglement with fishing gear. Risk of collision with the processing vessel is also not considered to be different to that with any other vessel, and is likely to be low since there would be no attractant such as discarded biological material.

Compared to DCFA1, the panel considered that:

- The number of interactions with seabirds under the FPA may be less, similar or more depending on the comparative levels of effort and catch under each scenario. For example, if the mid-water trawl wet boat catching fleet of the FPA needs to expend more fishing effort to take the same amount of catch as the DCFA1 fishing vessel, then the number of interactions could be higher. The panel could not predict with any certainty the relative levels of effort in the catching fleets under DCFA1 and the FPA.
- The FPA fleet would be more constrained in terms of the additional area of the fishery that can be fished (wet boats will remain constrained by the need to refuel and return to port regularly) and this may mean that they are more likely to fish closer inshore than DCFA1 and potentially have more interactions with protected CPF species of seabirds.

The panel considered that there are actions that could be taken to avoid, reduce and mitigate potential impacts of the FPA on seabirds and and monitoring that could be undertaken to reduce the uncertainties.

Actions to avoid, reduce and mitigate adverse environmental impacts on seabirds

Mid-water trawl

- Any requirements in the VMPs for mid-water trawl vessels regarding discharge of biological material, the removal of stickers and warp maintenance should be consistent with or equivalent to the advice of the Agreement on the Conservation of Albatrosses and Petrels (ACAP).
- The ACAP advice regarding net binding, bird scaring lines and the use of a snatch block should be adopted noting that the use of bird scaring lines and net binding are part of the seabird VMP for Australia's winter blue grenadier *Macruronus novaezelandiae* fishery.

- If bird bafflers and warp deflectors are to be used, develop and optimise the design under scientific permit and in consultation with experts, noting that seabird captures in the Southern and Eastern Scalefish and Shark Fishery have been reduced by 75 per cent using 'pinkies'.
- Ensure that any seabird VMP meets the requirements of the *National recovery plan for threatened albatrosses and giant petrels 2011-2016*.
- Direct deck lighting inboard and keep to the minimum level necessary for the safety of the crew.

Purse seine

- Update the SPF Purse Seine Code of Practice by replacing the 'Protected Species Handling Manual' with, at a minimum, the bird handling protocol developed for the Western Australian South Coast Purse Seine Managed Fishery, and ideally, develop a protocol for handling protected species specifically for the SPF and all relevant gear types.

All fishing operations

- Develop advice on the correct interpretation of 'interactions' with seabirds in consultation with the Department of the Environment to ensure that it is consistent with the intent of the memorandum of understanding between the Department and the Australian Fisheries Management Authority and ensure that FPA operators and crew are familiar with this advice.
- Validate logbook reports on interactions with seabirds through increased and spatially representative observer coverage.
- If unacceptable levels of interactions with protected seabird species occur, suspend fishing immediately and adopt one of the following options:
  - time and area closures, noting that these will rely on knowledge of spatial and temporal uses of bird habitats that overlap with the fishery
  - trigger limits and move-on rules
  - review of transhipment procedures if the interactions occur during transhipment.

Research and monitoring to reduce uncertainties

- Maintain the current management arrangements which specify targets of observer coverage for existing vessels of 10 per cent of purse seine coverage and 20 per cent of mid-water trawl coverage and full coverage for either five or 10 trips respectively for new vessels entering the fishery or moving into new areas and clearly define the terms 'new areas' and 'new vessels'.
- Identify ecologically sensitive seabird species, areas and times where spatial management strategies may be appropriate to mitigate direct interactions if required.
- Use electronic monitoring via video camera(s) to assist in quantifying warp strikes.
- If warp strike is occurring, consider installing corpse catchers on warps to assist in understanding whether there is a level of cryptic mortality from warp strike that has been undetected.
- Develop a dedicated observer program for all SPF fishing operations to validate logbook reporting of interactions with protected seabird species. In the mid-water trawl sector this should focus on observing and validating warp interactions and trawl entanglements.

7.3.2 Assessment and advice on localised depletion

As in its assessment of DCFA1, the panel interpreted localised depletion as a spatial and temporal reduction in the abundance of a targeted fish species that results from fishing. Localised depletion, as distinct from range contraction or overall stock depletion, is therefore an inevitable consequence of fishing under the FPA. The central issue for the panel's assessment was whether the fishing activity of the FPA could be concentrated enough, both spatially and temporally, to cause a localised depletion of the target species sufficient to cause adverse environmental impacts to the Commonwealth marine environment.

The panel assessed the potential impact of localised depletion arising from the FPA on the target species and on protected species of CPFs. A summary of those assessments is presented below.

SPF target species

In relation to the specific characteristics of the FPA, the panel found that:

- Localised depletion, as defined by the panel, will occur under the FPA.
- Given that no impacts on target species were discernible during periods of the fishery when catches have been high, the panel concluded that the FPA is unlikely to cause localised depletion to such an extent as to cause adverse environmental impacts on the target species.
- The storage capacity of the processing vessel is not relevant to the assessment of the potential for the FPA to cause localised depletion that has adverse environmental impacts.
- The ability to tranship at sea would potentially allow for the catching fleet to increase its effort and hence increase the extent of localised depletion compared to operations in the past but this would be constrained by the need for the catching fleet to regularly return to port to refuel.
- The relative impacts of localised depletion on the target stocks caused by the FPA, DCFA1 and the typical SPF fleet will be influenced by the fishing method used, the concentration and intensity of fishing effort and the quantum of catch.

The panel concluded that:

- compared to the typical SPF fleet, the FPA is likely to
  - increase the quantum of catch because of the improved efficiency of fishing offered by the presence of the processing vessel
  - increase the distribution of effort by allowing wet boats greater range and therefore reduce the intensity of fishing in a given area
  - reduce the proportion of catch taken by purse seine with potentially less impacts on individual schools of fish.
- compared to DCFA1 (and the MTA), the FPA is likely to
  - result in a similar quantum of catch
  - reduce the distribution of effort since wet boats are more constrained by the need to return to port to refuel, and therefore increase the intensity of fishing in a given area
  - increase the proportion of catch taken by purse seine with potentially more impacts on individual schools of fish.

The panel could not predict how these competing factors would balance out. However, as in its assessment of DCFA1 and the MTA, the panel considered that any localised depletion of SPF target species that might arise from the FPA was unlikely to affect the overall status of stocks of those species in the SPF, assuming that the total allowable catches (TACs) are set in accordance with the current SPF Harvest Strategy and with the best possible stock estimates. The panel noted that current and ongoing research is designed to ensure that this is the case. However, the panel remains of the view that further research into stock structure would be needed to improve certainty about the appropriate spatial scale at which to manage effort and catch of SPF stocks.

Research and monitoring to reduce uncertainties

Uncertainties associated with stock structure and hence with the adverse impacts of localised depletion arising from the FPA on target species could be reduced by research and monitoring in the following areas:

- clarification of the extent of sub-structuring of SPF target species within the Eastern and Western Zones specifically, and the SPF more broadly
- ongoing monitoring of the length frequency of catch taken by the whole fleet, including the FPA, at a statistically appropriate sampling intensity.

Central place foragers

Concentrated fishing activity at locations and times when CPFs are most susceptible to the impacts of prey depletion may result in longer foraging trips and/or reduced rates of provisioning to offspring. Persistent depletion can result in reduced offspring growth rates, fledging/weaning mass and reduced survival, and reduced adult breeding success. Longer-term impacts can affect major demographic factors such as survival, recruitment and reproductive rates that drive population age structure, growth rates and, ultimately, population size.

Although CPF species have been shown to be highly responsive to changes in prey availability within their key foraging areas, very few studies have linked reduced foraging and reproductive performance to the impacts of fishing, and even fewer to localised depletion. Only the case study on Peruvian boobies *Sula variegata* found compelling evidence for localised depletion (see Box 6.1). In three other case studies in the North Sea, Benguela and Alaska where declines in population size and reproductive success in CPF predators have been identified (see Section 6.3), spatial closures have been introduced as a precautionary measure to mitigate potential adverse impacts of localised depletion even though the causes of the declines are uncertain.

There is very limited information currently available that enables the panel to assess the potential for adverse impacts on CPF species from localised depletion in the SPF. The CPF species most susceptible to localised depletion of SPF target species, taking into account both their dietary reliance on SPF target species (more than 10 per cent) and their reliance on near-colony prey resources while raising offspring, are the Australian fur seal, New Zealand fur seal, Australasian gannet *Morus serrator*, short-tailed shearwater *Ardenna tenuirostris*, little penguin *Eudyptula minor*, crested tern *Thalasseus bergii* and shy albatross *Thalassarche cauta cauta*. The key areas of importance to these species include south-eastern Australia, especially Bass Strait, Tasmania and South Australia. Few studies have examined the potential impact of localised depletion on these species. This list of susceptible CPF species is unlikely to be comprehensive since there are significant gaps in the dietary data available for CPFs in the SPF.

The panel noted that the overall level of exploitation permitted in the SPF is consistent with the best available advice on management of small pelagic species and that this has been found to be adequate from an ecosystem perspective. However, the panel considered that the SPF Harvest Strategy settings are unlikely to make a significant contribution to avoiding adverse environmental impacts of localised depletion on CPF species, since while separate TACs are allocated to the Eastern and Western Zones, there is no finer spatial allocation of catch or effort. Further, the panel noted that while the SPF Harvest Strategy outlines responses to localised depletion once it has been detected, there are no measures in place in the SPF that would detect the spatial and temporal extent of localised depletion or adverse environmental effects that arise from it and there are no spatial and temporal closures in place, or proposed, that address potential trophic impacts to CPF species in the SPF.

The panel concluded that the FPA has the potential to have adverse impacts on CPF species through localised depletion and that the nature and extent of those impacts would depend on the spatial and temporal scale of the depletion. Since it is not possible to predict the location, time or intensity of fishing or the quantum of catch in any area under the FPA, there remain uncertainties about the impact of the FPA on protected CPF species.

The panel concluded that, compared to the typical SPF fleet, the FPA is likely to:

- increase the quantum of catch because of the improved efficiency of fishing offered by the presence of the processing vessel
- allow wet boats to remain at sea for longer and therefore
  - broaden the distribution of effort and reduce the intensity of fishing in a given area, or
  - increase the fishing effort in a given area
  - slightly increase the potential for localised depletion and the risk of adverse impacts on CPFs if fishing is concentrated in critical foraging areas of the CPFs
  - slightly decrease the potential for localised depletion and the risk of adverse impacts on CPFs if fishing is more broadly distributed.

The panel concluded that, compared to DCFA1 and MTA, the FPA is likely to:

- result in similar or higher levels of catch
- reduce the distribution of effort since wet boats are much more constrained by the need to return to port to refuel, and therefore increase the intensity of fishing in a given area.

The panel could not predict how these factors would balance out. However, overall, the panel concluded that there was slightly more potential for the FPA fishing fleet to have adverse impacts on protected CPF species than the typical SPF fleet but slightly less potential than under DCFA1 or the MTA.

Actions to avoid, reduce and mitigate adverse environmental impacts

Spatial closures are the most common form of precautionary management used to mitigate the potential adverse impacts of localised depletion on CPF predators; however, the effectiveness of spatial closures for this purpose has not been clearly demonstrated. Their value depends heavily on the ability to determine the size of spatial closures that would be appropriate for particular species at particular locations and at particular times.

The panel concluded that the risks to the key CPF species identified above from localised depletion caused by the FPA could be addressed proactively by separating the fishing activity from their key foraging areas. Determining the appropriate temporal or spatial scale of the closures will be challenging but reasonable datasets exist for at least some CPF species in some areas of the SPF. It may be necessary to extrapolate from this information in order to define appropriate spatial closures elsewhere in the SPF. Closures would need to be modified adaptively to reflect new information from fishing or targeted research.

Research and monitoring to reduce uncertainties

- Dietary studies to determine which key CPFs or other commercially or ecologically important predators are most reliant on SPF species.
- Studies to better understand the critical foraging areas, habitats and times for key CPFs.
- Examination of the biological response of CPFs to changes in prey availability.
- Development and implementation of potential ecological performance indicators for the fishery.

7.4 Interpretation and context

The panel's guidance on interpretation and context of its assessment provided in the panel's first declaration report remains relevant to this assessment. This guidance can be found in full in Section 7.4 of the panel's first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014). The key points relevant to the assessment of the MTA and the FPA are as follows.

- The SPF target species are not as influential in the southern Australian ecosystem compared to small pelagic species in other more productive upwelling systems around the world that support much larger biomasses of similar species.
- After consideration of the available information, including the results of a recent management strategy evaluation of the SPF Harvest Strategy, and with regard to international advice on appropriate management settings for small pelagic species, the panel assumed that the total allowable catches for SPF target species are sustainable and enforceable.
- The panel's assessment is based on specific MTA and FPA fishing scenarios (see Boxes 2.1 and 2.2) and a number of assumptions (see Chapter 4). Any significant changes to those scenarios and assumptions would necessarily affect the panel's assessment and advice. In particular, further consideration of the impact of the FPA on the spatial and temporal pattern of fishing and the implications for adverse environmental impacts would be required if:
  - the FPA included the re-supply, refuelling and re-crewing of the catching fleet by a processing vessel
  - the configuration of the FPA catching fleet differed significantly, in terms of the number of vessels and/or the fishing methods used, from the fleet configuration scenario used in this report.
- The optimal combination of individual actions identified by the panel to avoid, reduce and mitigate adverse environmental impacts of the MTA and the FPA would need to be determined in relation to the specific characteristics of the proposed vessel gear and fishing plan.
- The panel's advice on research and monitoring that could be implemented to reduce uncertainties about the environmental impacts of the MTA and the FPA should be considered in the context of the trade-offs between precaution and the time and cost involved in acquiring new information.
- The potential environmental impacts of the MTA and the FPA need to be considered in the context of the cumulative impacts of all fisheries operating in the area of the SPF.

7.5 Concluding comments

The panel has been able to identify with some confidence the likely nature of the interactions of the MTA and the FPA with protected species in the SPF. The form of direct interactions, and the species most likely to be affected by both direct interactions and localised depletion have been identified and the panel has provided specific advice on measures that could be taken to avoid, reduce and mitigate these impacts. However, even if these measures were adopted, the panel considers that direct interactions with protected species and localised depletion, as defined by the panel, will occur under the MTA and the FPA. The panel's assessment has confirmed that there are considerable uncertainties relating to the extent of the impacts that would arise from these activities and the level of impact that would create adverse environmental outcomes.

The panel reiterates the points made in the first declaration report:

- The uncertainties relating to the MTA and the FPA are not dissimilar to those in many other fisheries in Australia and elsewhere.
- A precautionary and adaptive, risk-based approach to management of the potential impacts of the MTA and FPA would be required.
- The panel's assessment of the MTA and the FPA should be considered in the context of the role that SPF target species play in the southern Australian ecosystem, the management regime that controls the catch of those species, and of the cumulative impacts of fishing in the area of the SPF on protected species.

Appendix 1 Terms of Reference for the Expert Panel on a Declared Commercial Fishing Activity

Background

On 26 April 2013, the then Minister for Sustainability, Environment, Water, Population and Communities made the *Final (Small Pelagic Fishery) Declaration (No. 2) 2013* (the second Final Declaration) which came into force on 27 April 2013.

This declaration provides that the following commercial fishing activities are declared commercial fishing activities for the purposes of Part 15B of the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (the EPBC Act):

a. Mid-water trawl activity

This is a commercial fishing activity that:

i. is in the Small Pelagic Fishery; and
ii. uses the mid-water trawl method; and
iii. uses a vessel which has a storage capacity for fish or fish products of 1600 tonnes or greater.

b. Fish processing activity

This is a commercial fishing activity that:

i. is in the Small Pelagic Fishery; and
ii. uses a vessel which has storage capacity for fish or fish products of 1600 tonnes or greater; and
iii. consists of receiving or processing fish or fish products that are quota species that have been taken in the Small Pelagic Fishery.

The declared commercial fishing activities are prohibited for up to two years while an expert panel conducts an assessment and reports to the Minister on the activities.

The expert panel is established under section 390SH of the EPBC Act, as are the terms of reference for its assessment.

Terms of Reference

The expert panel will assess the declared commercial fishing activities, particularly the potential for the activities to result in adverse environmental impacts.

The expert panel will assess and advise on:

1. the likely nature and extent of direct interactions of the declared commercial fishing activities with species protected under the EPBC Act, particularly seals, dolphins and seabirds;
2. the potential for any localised depletion of target species (arising from the declared commercial fishing activities) to result in adverse impacts to the Commonwealth marine environment, including the target species' predators protected under the EPBC Act;
3. actions that could be taken by operators of the declared commercial fishing activities or relevant regulatory authorities to avoid, reduce and mitigate adverse environmental impacts of the activities;
4. monitoring or scientific research that would reduce any uncertainties about the potential for adverse environmental impacts resulting from the declared commercial fishing activities;
5. any other matters about the environmental impacts of the declared commercial fishing activities that the expert panel considers relevant to its assessment; and
6. other related matters that may be referred to it by the Minister.

Date for report

The expert panel must report to the Minister by 27 March 2015.

Manner of carrying out assessment

In carrying out its assessment, the expert panel will:

a. examine existing scientific literature, other relevant information and any ongoing research or monitoring projects relevant to the impacts of the declared commercial fishing activities;

b. consult with and seek submissions from experts in relevant scientific disciplines where the expert panel believes this is necessary to clarify areas of uncertainty about the environmental impacts of the declared commercial fishing activities;

c. consider the fisheries management arrangements under which the declared commercial fishing activities are proposed to operate and the extent to which those management arrangements address the relevant environmental impacts and uncertainties;

d. take account of the requirements of the EPBC Act as they relate to the operation and accreditation of Commonwealth fisheries;

e. commission, through the Department of the Environment, new reviews, research projects, modelling or analyses which the expert panel believes are necessary to fill critical knowledge gaps and where the results of those projects and analyses will allow the expert panel to fulfil its terms of reference;

f. consult with relevant experts and stakeholders, including in the operations of the declared commercial fishing activities, on the nature and effectiveness of measures available to reduce direct interactions with EPBC Act protected species and the potential ecological effects of any localised depletion resulting from the declared commercial fishing activities; and

g. identify further necessary and practicable monitoring or research projects that would reduce critical uncertainties for decision making relevant to any future operations of the declared commercial fishing activities.

Appendix 2 Advice provided to the panel

The panel is very grateful to the many people that provided insights and inputs to inform the panel's assessment. Those people and the nature of their input to the panel's work are identified below. The panel also relied upon advice received during the development of its first declaration report (Expert Panel on a Declared Commercial Fishing Activity 2014, see Appendix 2).

Table A2.1 People who provided advice to the panel

NAME AND POSITION	EXPERTISE	NATURE OF CONSULTATION
Mr Crispian Ashby, Program Manager, Fisheries Research and Development Corporation	Fisheries research	Provision of research reports
Mr John Burgess, Executive Officer/Director, Australian National Sportfishing Association Ltd	Recreational fishing	Submission
Dr James Findlay, Chief Executive Officer, Australian Fisheries Management Authority (AFMA) Dr Nick Rayns, Executive Manager, Fisheries Management, AFMA Mr Steve Shanks, Manager, Scallop, Norfolk Island, Coral Sea and Small Pelagic Fisheries, AFMA	Fisheries management	Written responses to requests for information and questions Meeting
Mr Gerry Geen, Director, Seafish Tasmania Pty Ltd	Commercial fishing operations: mid-water trawl	Submission to Interim Declaration Written response to questions
Ms Rebecca Hubbard, Coordinator, Stop the Trawler Alliance	Conservation	Submission
Mr AK (Sandy) Morison, Fisheries Consultant, Morison Aquatic Sciences	Fisheries Science	Submission
Mr Grant Pullen, Manager, Wild Fisheries Management Branch, Tasmanian Department of Primary Industries, Parks, Water and Environment	Fisheries management	Phone meeting

Appendix 3 EPBC Act protected species in the SPF area

Protected species

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
MARINE MAMMALS						
Pinnipeds						
Arctocephalus forsteri	New Zealand fur seal	Marine	Medium	Medium	Medium	Medium
Arctocephalus gazella	Antarctic fur seal	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Arctocephalus pusillus	Australian fur seal, cape fur seal	Marine	High	High	High	High
Arctocephalus tropicalis	Subantarctic fur seal	Vulnerable Marine	Medium	Medium	Medium	Medium
Hydrurga leptonyx	Leopard seal	Marine	High	Medium	High	High
Leptonychotes weddelli	Weddell Seal	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Lobodon carcinophagus	Crabeater seal	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Mirounga leonina	Southern elephant seal	Vulnerable Marine	High	Medium	High	High
Neophoca cinerea	Australian sea lion	Vulnerable Marine	Medium	Medium	High	Medium
Ommatophoca rossii	Ross seal	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Cetaceans: Baleen whales						
Balaenoptera acutorostrata	Common minke whale	Cetacean Migratory	Medium	Medium	High	High
Balaenoptera bonaerensis	Antarctic minke whale	Cetacean Migratory	Medium	Medium	Medium	Medium
Balaenoptera borealis	Sei whale	Vulnerable Cetacean Migratory	Medium	Medium	Medium	Medium
Balaenoptera edeni	Bryde's whale	Cetacean Migratory	Medium	Medium	Medium	Medium
Balaenoptera musculus	Blue whale	Endangered Cetacean Migratory	Medium	Medium	Medium	Medium

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Balaenoptera omurai	Omura's whale	Not listed (all cetaceans protected in the Australian Whale Sanctuary)	Not assessed	Not assessed	Not assessed	Not assessed
Balaenoptera physalus	Fin whale	Vulnerable Cetacean Migratory	Medium	Medium	Medium	Medium
Caperea marginata	Pygmy right whale	Cetacean Migratory	Medium	Medium	Medium	Medium
Eubalaena australis	Southern right whale	Endangered Cetacean Migratory	Medium	Medium	Medium	Medium
Megaptera novaeangliae	Humpback whale	Vulnerable Cetacean Migratory	Medium	Medium	High	High
Cetaceans: Toothed cetaceans						
Berardius arnuxii	Arnoux's beaked whale	Cetacean	Medium	Medium	Medium	Medium
Delphinus delphis	Common dolphin, short-beaked common dolphin	Cetacean	Medium	Medium	Medium	Medium
Feresa attenuata	Pygmy killer whale	Cetacean	High	Medium	High	High
Globicephala macrorhynchus	Short-finned pilot whale	Cetacean	High	Medium	High	High
Globicephala melas	Long-finned pilot whale	Cetacean	High	Medium	High	High
Grampus griseus	Risso's dolphin, grampus	Cetacean	High	High	High	High
Hyperoodon planifrons	Southern bottlenose whale	Cetacean	High	Medium	High	High
Kogia breviceps	Pygmy sperm whale	Cetacean	Medium	Medium	Medium	Medium
Kogia sima	Dwarf sperm whale	Cetacean	Medium	Medium	High	High
Lagenodelphis hosei	Fraser's dolphin, Sarawak dolphin	Cetacean Migratory	High	High	High	High
Lagenorhynchus cruciger	Hourglass dolphin	Cetacean	High	High	High	High
Lagenorhynchus obscurus	Dusky dolphin	Cetacean Migratory	Low	Low	High	Medium
Lissodelphis peronii	Southern right whale dolphin	Cetacean	High	High	High	High
Mesoplodon bowdoini	Andrews' beaked whale	Cetacean	High	Medium	High	High
Mesoplodon densirostris	Blainville's beaked whale, dense-beaked whale	Cetacean	High	Medium	High	High
Mesoplodon ginkgodens	Ginkgo-toothed beaked whale	Cetacean	High	Medium	High	High
Mesoplodon grayi	Gray's beaked whale	Cetacean	High	Medium	High	High

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Mesoplodon hectori	Hector's beaked whale	Cetacean	High	Medium	High	High
Mesoplodon layardii	Strap-toothed beaked whale	Cetacean	High	Medium	High	High
Mesoplodon mirus	True's beaked whale	Cetacean	High	Medium	High	High
Orcinus orca	Killer whale, orca	Cetacean Migratory	Medium	Medium	High	High
Peponocephala electra	Melon-headed whale	Cetacean	Medium	Medium	Medium	Medium
Phocoena dioptrica	Spectacled porpoise	Cetacean	Not assessed	Not assessed	Not assessed	Not assessed
Physeter macrocephalus	Sperm whale	Cetacean Migratory	Medium	Medium	Medium	Medium
Pseudorca crassidens	False killer whale	Cetacean	High	Medium	High	High
Sousa sahulensis (formerly *Sousa chinensis*)	Australian humpback dolphin (formerly Indo-Pacific humpback dolphin)	Cetacean Migratory	Medium	Medium	High	High
Stenella attenuata	Spotted dolphin, pantropical spotted dolphin	Cetacean Migratory	Medium	Medium	Medium	Medium
Stenella coeruleoalba	Striped dolphin	Cetacean	High	High	High	High
Stenella longirostris	Long-snouted spinner dolphin	Cetacean Migratory	Medium	Medium	Medium	Medium
Steno bredanensis	Rough-toothed dolphin	Cetacean	Medium	Medium	High	High
Tasmacetus shepherdi	Shepherd's beaked whale	Cetacean	Medium	Medium	Medium	Medium
Tursiops aduncus	Indo-Pacific bottlenose dolphin	Cetacean Migratory	High	High	High	High
Tursiops truncatus	Common bottlenose dolphin	Cetacean	High	High	High	High
Ziphius cavirostris	Cuvier's beaked whale	Cetacean	High	Medium	High	High
Dugong						
Dugong dugon	Dugong	Marine Migratory	Medium	Medium	Medium	Medium
Seabirds (central place forager species bolded)						
Anous minutus	Black noddy	Marine	Low	Low	High	Medium
Anous stolidus	Common noddy	Marine	Low	Low	High	Medium
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable Marine	Low	Low	High	Medium
Apus pacificus	Fork-tailed swift	Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Ardea alba (listed Marine as *Ardea alba* and listed Migratory as *Egretta alba*)	Great egret, white egret	Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Ardenna carneipes (listed marine as *Puffinus carneipes*)	Flesh-footed shearwater, fleshy-footed shearwater	Marine	Medium	Medium	High	Medium
Ardenna tenuirostris (listed Marine as *Puffinus tenuirostris*)	Short-tailed shearwater	Marine Migratory	Medium	Medium	High	Medium
Botaurus poiciloptilus	Australasian bittern	Endangered	Not assessed	Not assessed	Not assessed	Not assessed
Calonectris leucomelas (listed Migratory as *Puffinus leucomelas*)	Streaked shearwater	Marine Migratory	Medium	Medium	High	Medium
Catharacta skua	Great skua	Marine	Medium	Medium	High	Medium
Daption capense	Cape petrel	Marine	Medium	Medium	High	Medium
Diomedea epomophora epomophora (listed Marine and Migratory as *D. epomophora* (sensu stricto))	Southern royal albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Diomedea exulans amsterdamensis	Amsterdam albatross	Endangered Marine Migratory	Medium	Medium	High	Medium
Diomedea exulans antipodensis	Antipodean albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Diomedea exulans exulans (listed Marine and Migratory as *D. dabbenena*)	Tristan albatross	Endangered Marine Migratory	Medium	Medium	High	Medium
Diomedea exulans (sensu lato)	Wandering albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Diomedea exulans gibsoni (listed Marine and Migratory as *D. gibsoni*)	Gibson's albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Diomedea sanfordi	Northern royal albatross	Endangered Marine Migratory	Medium	Medium	High	Medium
Eudyptula minor	Little penguin	Marine	Low	Low	High	Medium
Fregetta grallaria grallaria	White-bellied storm-petrel (Tasman Sea, Australasian)	Marine	Medium	Medium	High	Medium
Fregetta tropica	Black-bellied storm-petrel	Marine	Medium	Medium	High	Medium

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Fulmarus glacialoides	Southern fulmar	Marine	Medium	Medium	High	Medium
Garrodia nereis	Grey-backed storm petrel	Marine	Medium	Medium	High	Medium
Haliaeetus leucogaster	White-bellied sea eagle	Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Halobaena caerulea	Blue petrel	Vulnerable Marine	Medium	Medium	High	Medium
Larus dominicanus	Kelp gull	Marine	Low	Low	High	Medium
Larus novaehollandiae	Silver gull	Marine	Low	Low	High	Medium
Larus pacificus	Pacific gull	Marine	Low	Low	High	Medium
Lugensa brevirostris	Kerguelen petrel	Marine	Medium	Medium	High	Medium
Macronectes giganteus	Southern giant-petrel	Endangered Marine Migratory	Low	Low	High	Medium
Macronectes halli	Northern giant-petrel	Vulnerable Marine Migratory	Low	Low	High	Medium
Morus capensis	Cape gannet	Marine	Low	Low	High	Medium
Morus serrator	Australasian gannet	Marine	Low	Low	High	Medium
Neophema chrysogaster	Orange-bellied parrot	Critically endangered Marine	Not assessed	Not assessed	Not assessed	Not assessed
Oceanites oceanicus	Wilson's storm petrel	Marine	Low	Low	High	Low
Pachyptila desolata	Antarctic prion	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Pachyptila belcheri	Slender-billed prion	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Pachyptila salvini	Salvin's prion	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Pachyptila turtur	Fairy prion	Marine	Medium	Medium	High	Medium
Pachyptila vittata	Broad-billed prion	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Pandion haliaetus	Osprey	Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Pelagodroma marina	White-faced storm-petrel	Marine	Low	Low	High	Low
Pelecanoides urinatrix	Common diving-petrel	Marine	Low	Low	High	Low
Phaethon rubricauda	Red-tailed tropicbird	Marine	Low	Low	High	Medium
Phalacrocorax fuscescens	Black-faced cormorant	Marine	Medium	Medium	High	Medium
Phoebetria fusca	Sooty albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Phoebetria palpebrata	Light-mantled sooty albatross	Marine Migratory	Medium	Medium	High	Medium
Procellaria aequinoctialis	White-chinned petrel	Marine Migratory	Medium	Medium	High	Medium
Procellaria cinerea	Grey petrel	Marine Migratory	Low	Low	High	Medium
Procellaria parkinsoni	Black petrel	Marine Migratory	Medium	Medium	High	Medium
Procellaria westlandica	Westland petrel	Marine Migratory	Medium	Medium	High	Medium
Procelsterna cerulea	Grey ternlet	Marine	Low	Low	High	Medium
Pseudobulweria rostrata	Tahiti petrel	Marine	Low	Low	High	Medium
Pterodroma cervicalis	White-necked petrel	Marine	Medium	Medium	High	Medium
Pterodroma lessoni	White-headed petrel	Marine	Low	Low	High	Medium
Pterodroma leucoptera leucoptera	Gould's petrel	Endangered Marine	Medium	Medium	High	Medium
Pterodroma macroptera	Great-winged petrel	Marine	Medium	Medium	High	Medium
Pterodroma mollis	Soft-plumaged petrel	Vulnerable Marine	Medium	Medium	High	Medium
Pterodroma neglecta neglecta	Kermadec petrel (western)	Vulnerable Marine	Low	Low	High	Medium
Pterodroma nigripennis	Black-winged petrel	Marine	Medium	Medium	High	Medium
Pterodroma solandri	Providence petrel	Marine	Medium	Medium	High	Medium
Puffinus assimilis	Little shearwater	Marine	Medium	Medium	High	Medium
Puffinus bulleri	Buller's shearwater	Marine	Medium	Medium	High	Medium
Puffinus gavia	Fluttering shearwater	Marine	Low	Low	High	Medium
Puffinus griseus	Sooty shearwater	Marine	Low	Low	High	Medium
Puffinus huttoni	Hutton's shearwater	Marine	Low	Low	High	Medium
Puffinus pacificus	Wedge-tailed shearwater	Marine	Medium	Medium	High	Medium
Stercorarius antarcticus	Brown skua	Not listed	Not assessed	Not assessed	Not assessed	Not assessed
Sterna albifrons	Little tern	Marine	Low	Low	High	Low
Sterna anaethetus	Bridled tern	Marine	Low	Low	High	Low
Sterna caspia	Caspian tern	Marine	Low	Low	High	Medium
Sterna dougallii	Roseate tern	Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Sterna fuscata	Sooty tern	Marine	Low	Low	High	Medium
Sterna hirundo	Common tern	Marine	Low	Low	High	Medium

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Sterna paradisaea	Arctic tern	Marine	Low	Low	High	Medium
Sterna striata	White-fronted tern	Marine	Low	Low	High	Low
Sterna sumatrana	Black-naped tern	Marine	Low	Low	High	Medium
Sternula nereis nereis	Australian fairy tern	Vulnerable	Not assessed	Not assessed	Not assessed	Not assessed
Sula dactylatra	Masked booby	Marine	Low	Low	High	Medium
Thalassarche bulleri platei	Buller's albatross, Pacific albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Thalassarche cauta cauta (listed Marine and Migratory as *T. cauta* (sensu stricto))	Shy albatross, Tasmanian shy albatross	Vulnerable Marine Migratory	High	Medium	High	Medium
Thalassarche chlororhynchos bassi/T. carteri	Indian yellow-nosed albatross, Atlantic yellow-nosed albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Thalassarche chrysostoma	Grey-headed albatross	Endangered Marine Migratory	Medium	Medium	High	Medium
Thalassarche eremita	Chatham albatross	Endangered Marine Migratory	High	Medium	High	Medium
Thalassarche melanophris	Black-browed albatross	Vulnerable Marine Migratory	High	Medium	High	Medium
Thalassarche melanophris impavida (listed Marine and Migratory as *T. impavida*)	Campbell albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Thalassarche salvini	Salvin's albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Thalassarche steadi	White-capped albatross	Vulnerable Marine Migratory	Medium	Medium	High	Medium
Thalasseus bergii (listed Marine as *Sterna bergii*)	Crested tern	Marine	Low	Low	High	Medium
MARINE REPTILES						
Turtles						

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Caretta caretta	Loggerhead turtle	Endangered Marine Migratory	Medium	Medium	Medium	Medium
Chelonia mydas	Green turtle	Vulnerable Marine Migratory	Medium	Medium	Medium	Medium
Dermochelys coriacea	Leatherback turtle	Endangered Marine Migratory	Medium	Medium	Medium	Medium
Eretmochelys imbricata	Hawksbill turtle	Vulnerable Marine Migratory	Medium	Medium	Medium	Medium
Lepidochelys olivacea	Olive Ridley turtle, Pacific Ridley turtle	Endangered Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Natator depressus	Flatback turtle	Vulnerable Marine Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Seasnakes						
Acalytophis peroni	Horned seasnake	Marine	Medium	Medium	Medium	Medium
Aipysurus laevis	Olive seasnake	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Aipysurus pooleorum	Shark Bay seasnake	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Astrotia stokesii	Stokes' seasnake	Marine	Medium	Medium	Medium	Medium
Disteira kingii	Spectacled seasnake	Marine	Medium	Medium	Medium	Medium
Disteira major	Olive-headed seasnake	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Hydrophis elegans	Elegant seasnake	Marine	Low	Low	Low	Low
Hydrophis ornatus/ Chitulia ornata	Spotted seasnake, ornate reef seasnake	Marine	Medium	Medium	Medium	Medium
Pelamis platurus	Yellow-bellied seasnake	Marine	Medium	Medium	Medium	Medium
SHARKS AND RAYS						
Carcharias taurus (east coast population)	Grey nurse shark	Critically endangered	Medium	Medium	Medium	Low*
Carcharias taurus (west coast population)	Grey nurse shark (west coast population)	Vulnerable	Medium	Medium	Not assessed	Low*
Carcharodon carcharias	Great white shark	Vulnerable Migratory	Medium	Medium	High	Low*
Centrophorus harrissoni	Harrisson's dogfish, endeavour dogfish, dumb gulper shark, Harrisson's deepsea dogfish	Conservation dependent	Not assessed; not listed at the time of ERA	Not assessed	Not assessed, not listed at the time of ERA	Not assessed

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Centrophorus zeehaani	Southern dogfish, endeavour dogfish, little gulper shark	Conservation dependent	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time ERA	Not assessed
Cetorhinus maximus	Basking shark	Migratory	Not assessed	Not assessed	Not assessed	Not assessed
Galeorhinus galeus	School shark, eastern school shark, snapper shark, tope, soupfin shark	Conservation dependent	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time of ERA	Not assessed
Isurus oxyrinchus	Shortfin mako, mako shark	Migratory	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time ERA	Not assessed
Isurus paucus	Longfin mako	Migratory	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time ERA	Not assessed
Lamna nasus	Porbeagle, mackerel shark	Vulnerable Migratory	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time ERA	Not assessed
Manta birostris	Giant manta ray	Migratory	Not assessed: not listed the time of ERA	Not assessed	Not assessed, not listed at time of ERA	Not assessed
Pristis zijsron	Green sawfish, dindagubba, narrowsnout sawfish	Vulnerable	Not assessed, not listed at the time of ERA	Not assessed	Not assessed, not listed at the time of ERA	Not assessed
Rhincodon typus	Whale shark	Vulnerable Migratory	Medium	Medium	Medium	Low*
TELEOST FISH						
Syngnathids						
Acentronura australe	Southern pygmy pipehorse	Marine	Low	Low	Low	Low
Acentronura tentaculata	Shortpouch pygmy pipehorse	Marine	Low	Low	Low	Low
Campichthys galei	Gale's pipefish	Marine	Low	Low	Low	Low
Campichthys tryoni	Tryon's pipefish	Marine	Low	Low	Low	Low
Choeroichthys suillus	Pig-snouted pipefish	Marine	Low	Low	Low	Low
Corythoichthys amplexus	Fijian banded pipefish, brown-banded pipefish	Marine	Low	Low	Low	Low
Corythoichthys ocellatus	Orange-spotted pipefish, ocellated pipefish	Marine	Low	Low	Low	Low

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Cosmocampus howensis	Lord Howe pipefish	Marine	Low	Low	Low	Low
Festucalex cinctus	Girdled pipefish	Marine	Low	Low	Low	Low
Filicampus tigris	Tiger pipefish	Marine	Low	Low	Low	Low
Halicampus boothae	Booth's pipefish	Marine	Low	Low	Low	Low
Halicampus brocki	Brock's pipefish	Marine	Low	Low	Low	Low
Halicampus grayi	Mud pipefish, Gray's pipefish	Marine	Low	Low	Low	Low
Heraldia nocturna	Upside-down pipefish, eastern upside-down pipefish	Marine	Low	Low	Low	Low
Hippichthys cyanospilos	Blue-speckled pipefish, blue-spotted pipefish	Marine	Low	Low	Low	Low
Hippichthys heptagonus	Madura pipefish, reticulated freshwater pipefish	Marine	Low	Low	Low	Low
Hippichthys penicillus	Beady pipefish, steep-nosed pipefish	Marine	low	Low	Low	Low
Hippocampus abdominalis	Big-belly seahorse, eastern potbelly seahorse, New Zealand potbelly seahorse	Marine	Low	Low	Low	Low
Hippocampus angustus	Western spiny seahorse, narrow-bellied seahorse	Marine	Low	Low	Low	Low
Hippocampus breviceps	Short-head seahorse, short-snouted seahorse	Marine	Low	Low	Low	Low
Hippocampus kelloggi	Kellogg's seahorse, great seahorse	Marine	Low	Low	Low	Low
Hippocampus kuda	Spotted seahorse, yellows seahorse	Marine	Low	Low	Low	Low
Hippocampus minotaur	Bullneck seahorse	Marine	Low	Low	Low	Low
Hippocampus planifrons	Flat-face seahorse	Marine	Low	Low	Low	Low
Hippocampus subelongatus	West Australian seahorse	Marine	Low	Low	Low	Low
Hippocampus whitei	White's seahorse, crowned seahorse, Sydney seahorse	Marine	Low	Low	Low	Low
Histiogamphelus briggsii	Crested pipefish, Briggs' crested pipefish, Briggs' pipefish	Marine	Low	Low	Low	Low
Histiogamphelus cristatus	Rhino pipefish, Macleay's crested pipefish, ring-back pipefish	Marine	Low	Low	Low	Low
Hypselognathus horridus	Shaggy pipefish, prickly pipefish	Marine	Low	Low	Low	Low
Hypselognathus rostratus	Knifesnout pipefish, Knife-snouted pipefish	Marine	Low	Low	Low	Low

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Kaupus costatus	Deepbody pipefish, deep-bodied pipefish	Marine	Low	Low	Low	Low
Kimblaeus bassensis	Trawl pipefish, Bass Strait pipefish	Marine	Low	Low	Low	Low
Leptoichthys fistularius	Brushtail pipefish	Marine	Low	Low	Low	Low
Lissocampus caudalis	Australian smooth pipefish, smooth pipefish	Marine	Low	Low	Low	Low
Lissocampus fatiloquus	Prophet's pipefish	Marine	Low	Low	Low	Low
Lissocampus runa	Javelin pipefish	Marine	Low	Low	Low	Low
Maroubra perserrata	Sawtooth pipefish	Marine	Low	Low	Low	Low
Micrognathus andersonii	Anderson's pipefish, shortnose pipefish	Marine	Low	Low	Low	Low
Micrognathus brevirostris[17]	Thorntail pipefish, thorn-tailed pipefish	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Microphis manadensis	Manado pipefish, Manado River pipefish	Marine	Low	Low	Low	Low
Mitotichthys meraculus	Western crested pipefish	Marine	Low	Low	Low	Low
Mitotichthys mollisoni	Mollison's pipefish	Marine	Low	Low	Low	Low
Mitotichthys semistriatus	Halfbanded pipefish	Marine	Low	Low	Low	Low
Mitotichthys tuckeri	Tucker's pipefish	Marine	Low	Low	Low	Low
Nannocampus subosseus	Bonyhead pipefish, bony-headed pipefish	Marine	Low	Low	Low	Low
Notiocampus ruber	Red pipefish	Marine	Low	Low	Low	Low
Phycodurus eques	Leafy seadragon	Marine	Low	Low	Low	Low
Phyllopteryx taeniolatus	Common seadragon, weedy seadragon	Marine	Low	Low	Low	Low
Pugnaso curtirostris	Pugnose pipefish, Pug-nosed pipefish	Marine	Low	Low	Low	Low
Solegnathus dunckeri	Duncker's pipehorse	Marine	Low	Low	Low	Low
Solegnathus hardwickii[18]	Pallid pipehorse, Hardwick's pipehorse	Marine	Not assessed	Not assessed	Not assessed	Not assessed
Solegnathus lettiensis	Gunther's pipehorse, Indonesian pipefish	Marine	Low	Low	Low	Low
Solegnathus robustus	Robust pipehorse, Robust spiny pipehorse	Marine	Low	Low	Low	Low
Solegnathus spinosissimus	Spiny pipehorse, Australian spiny pipehorse	Marine	Low	Low	Low	Low
Solenostomus cyanopterus/paegnius	Robust ghostpipefish, blue-finned ghost pipefish,	Marine	Low	Low	Medium	Low

17 The panel noted that this species is not valid in Australia. Now *M. pygmaeus.* (Codes for Australian Aquatic Biota (CAAB) Taxon code 37 282087).
18 The panel noted that this species is not valid in Australia. Current valid species likely to be *Solegnathus* sp. 1. (CAAB Taxon code 37 282099).

GROUP/SCIENTIFIC NAME	COMMON NAME(S)	EPBC ACT LISTING STATUS	LEVEL 2 PSA RISK (MID-WATER TRAWL) (DALEY *ET AL.* 2007B)	LEVEL 2 PSA RESIDUAL RISK (MID-WATER TRAWL) (AFMA 2010B)	LEVEL 2 PSA RISK (PURSE SEINE) (DALEY *ET AL.* 2007A)	LEVEL 2 PSA RESIDUAL RISK (PURSE SEINE) (AFMA 2010A)
Solenostomus paradoxus	Ornate ghostpipefish, harlequin ghost pipefish, ornate Ghost pipefish	Marine	Low	Low	Low	Low
Stigmatopora argus	Spotted pipefish, gulf pipefish	Marine	Low	Low	Low	Low
Stigmatopora nigra	Widebody pipefish, wide-bodied pipefish, black pipefish	Marine	Low	Low	Low	Low
Stipecampus cristatus	Ringback pipefish, Ring-backed pipefish	Marine	Low	Low	Low	Low
Syngnathoides biaculeatus	Double-end pipehorse, double-ended pipehorse, alligator pipefish	Marine	Low	Low	Medium	Low
Trachyrhamphus bicoarctatus	Bentstick pipefish, Bend stick pipefish, Short-tailed pipefish	Marine	Low	Low	Low	Low
Urocampus carinirostris	Hairy pipefish	Marine	Low	Low	Low	Low
Vanacampus margaritifer	Mother-of-pearl pipefish	Marine	Low	Low	Low	Low
Vanacampus phillipi	Port Phillip pipefish	Marine	Low	Low	Low	Low
Vanacampus poecilolaemus	Longsnout pipefish, Australian long-snout pipefish, long-snouted pipefish	Marine	Low	Low	Low	Low
Vanacampus vercoi	Verco's pipefish	Marine	Low	Low	Low	Low
Other teleost fish						
Hoplostethus atlanticus	Orange roughy	Conservation dependent	Not assessed, not listed at the time of ERA	Not assessed	Not assessed	Not assessed
Rexea solandri	Gemfish	Conservation dependent	Not assessed, not listed at the time of ERA	Not assessed	Not assessed	Not assessed
Thunnus maccoyii	Southern bluefin tuna	Conservation dependent	Not assessed, not listed at the time of ERA	Not assessed	Not assessed	Not assessed

*Level 3 SAFE assessment

Rationale for not assessing direct interactions of the Fish Processing Activity with species groups

Dugong *Dugong dugon*

The panel did not assess the possible impact of direct interactions on dugong specifically, due to the very marginal overlap of the species' distribution with the area of the Small Pelagic Fishery (SPF) and noting that no interactions with dugong in the mid-water trawl or purse seine sector of the SPF had been recorded in the period 2002–2013 (Tuck *et al*. 2013, AFMA 2014e). Finley *et al*. (2015a) considered that while purse seine interactions with dugong in the SPF were possible they were unlikely given the species distribution and behaviour. The distribution of dugong in relation to trawl and purse seine effort in the SPF (2000–2013) is mapped in Figures A3.1 and A3.2 respectively.

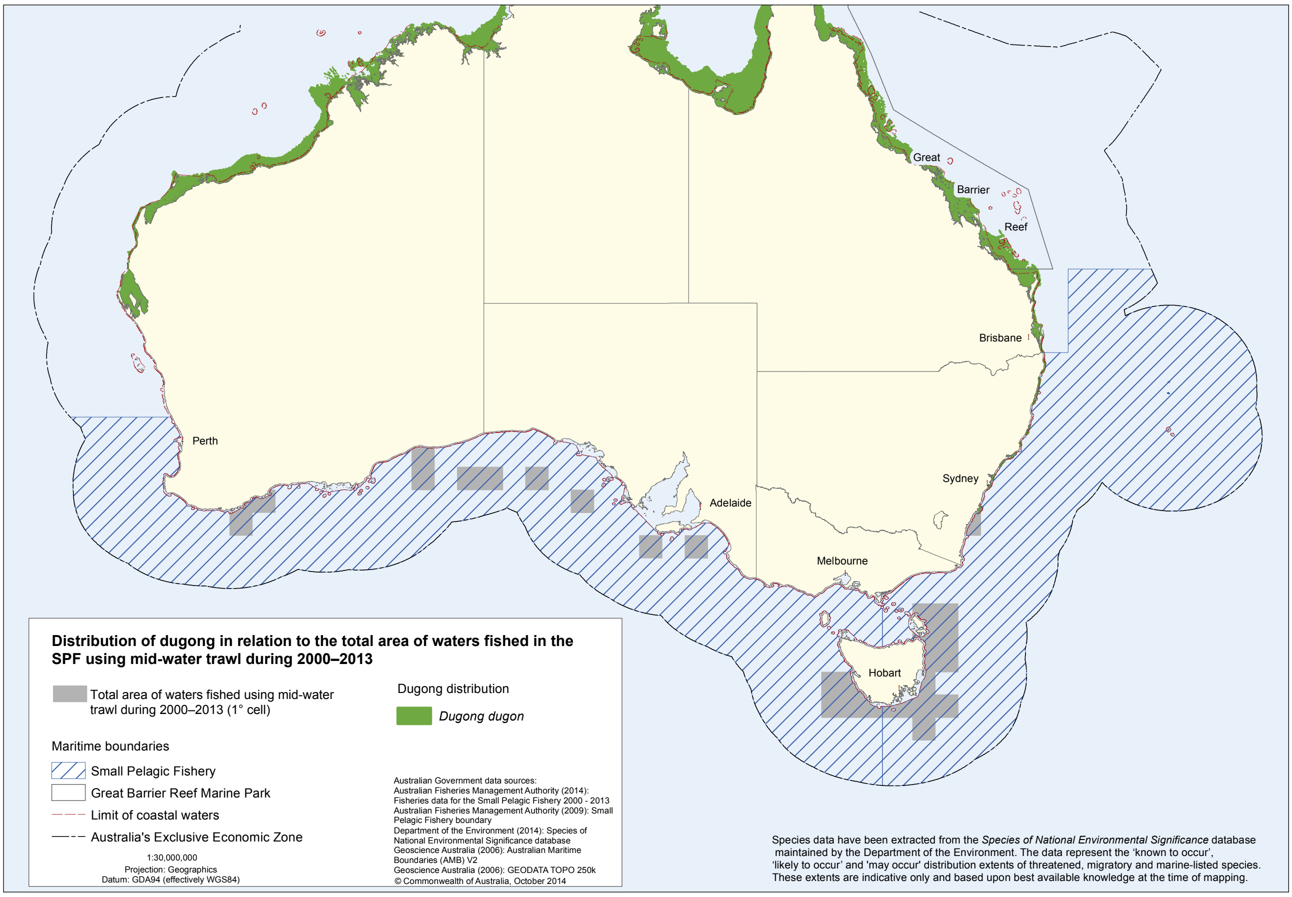

Figure A3.1 Distribution of dugong in relation to the total area of waters fished in the SPF using mid-water trawl during 2000–2013. **Source:** Map produced by the Environmental Resources Information Network (ERIN), Department of the Environment using unpublished AFMA data.

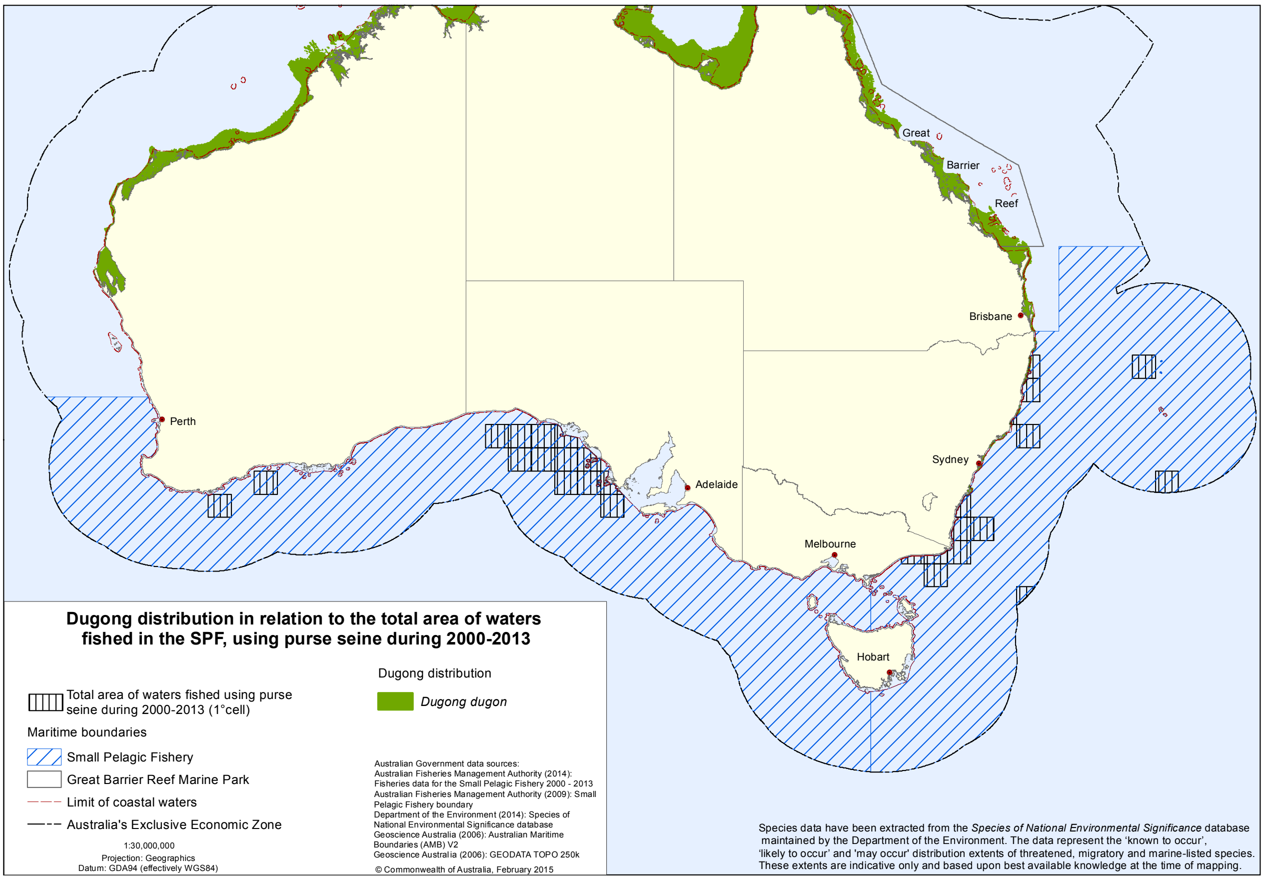

Figure A3.2 Distribution of dugong in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

Turtles

Finley *et al.* (2015b)[19] found that the likelihood of interaction of mid-water trawl gear with turtles in the SPF was low to moderate. The panel noted that no interactions with turtles in the mid-water trawl sector of the SPF had been recorded in the period 2002–2013 (Tuck *et al.* 2013, AFMA 2014e). As a result, the panel did not assess the possible impact of direct interactions of mid-water trawl gear with turtles specifically.

Finley *et al.* (2015a) found that interactions between loggerhead turtles *Caretta caretta*, green turtles *Chelonia mydas* and leatherback turtles *Dermochelys coriacea* and purse seine gear were moderately likely. However, no interactions with turtles in the purse seine sector of the SPF had been recorded in the period 2002-2013 (Tuck *et al.* 2013, AFMA 2014e). As a result, the panel did not assess the possible impact of direct interactions of purse seine gear with turtles specifically.

The distribution of protected species of turtles in relation to mid-water trawl and purse seine effort in the SPF (2000–2013) is mapped in Figures A3.3 and A3.4 respectively.

19 Cited in Expert Panel on a Declared Commercial Fishing Activity (2014) as Elgin Associates unpublished (a).

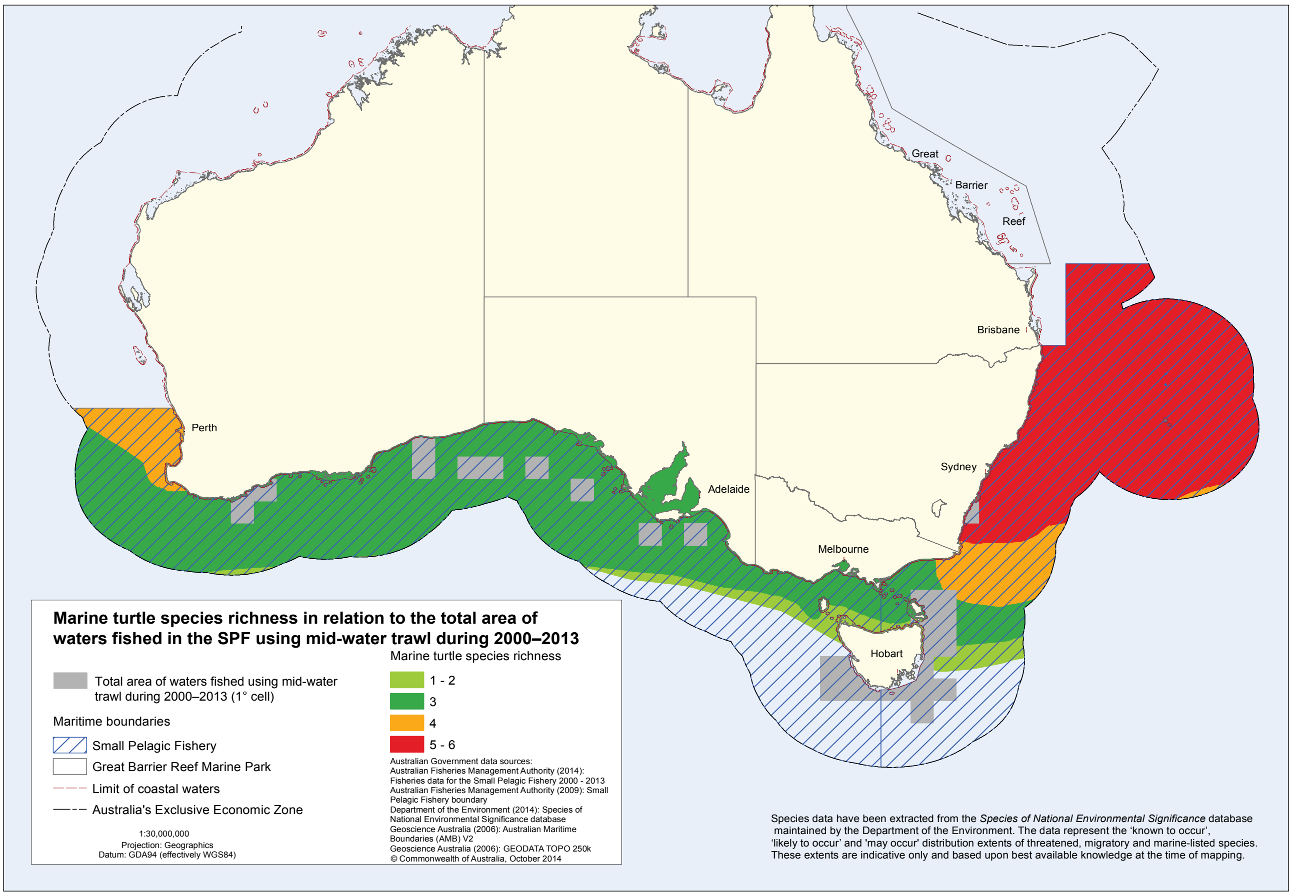

Figure A3.3 Marine turtle species richness in relation to the total area of waters fished in the SPF using mid-water trawl during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

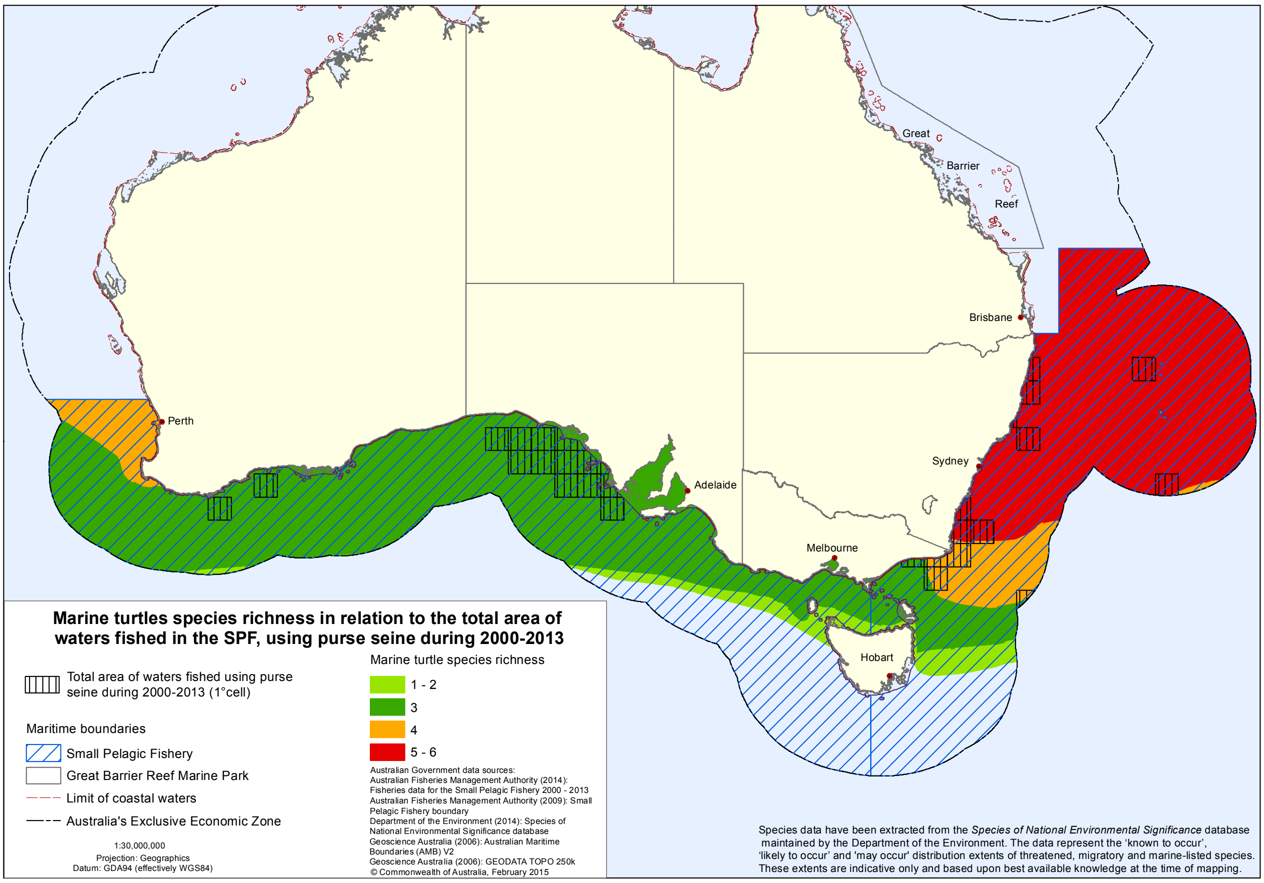

Figure A3.4 Marine turtle species richness in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

Seasnakes

The panel did not assess the possible impact of direct interactions on protected species of seasnakes specifically, due to the generally low overlap of the species' distribution with the area of the SPF and noting that no interactions with seasnakes in the mid-water trawl or purse seine sectors of the SPF were recorded in the period 2002–2013 (Tuck *et al.* 2013, AFMA 2014e). Finley *et al.* (2015a) found that interactions with seasnakes by purse seine gear in the SPF were unlikely.

The distribution of protected species of seasnakes in relation to mid-water trawl and purse seine effort in the SPF (2000–2013) is mapped in Figures A3.5 and A3.6 respectively.

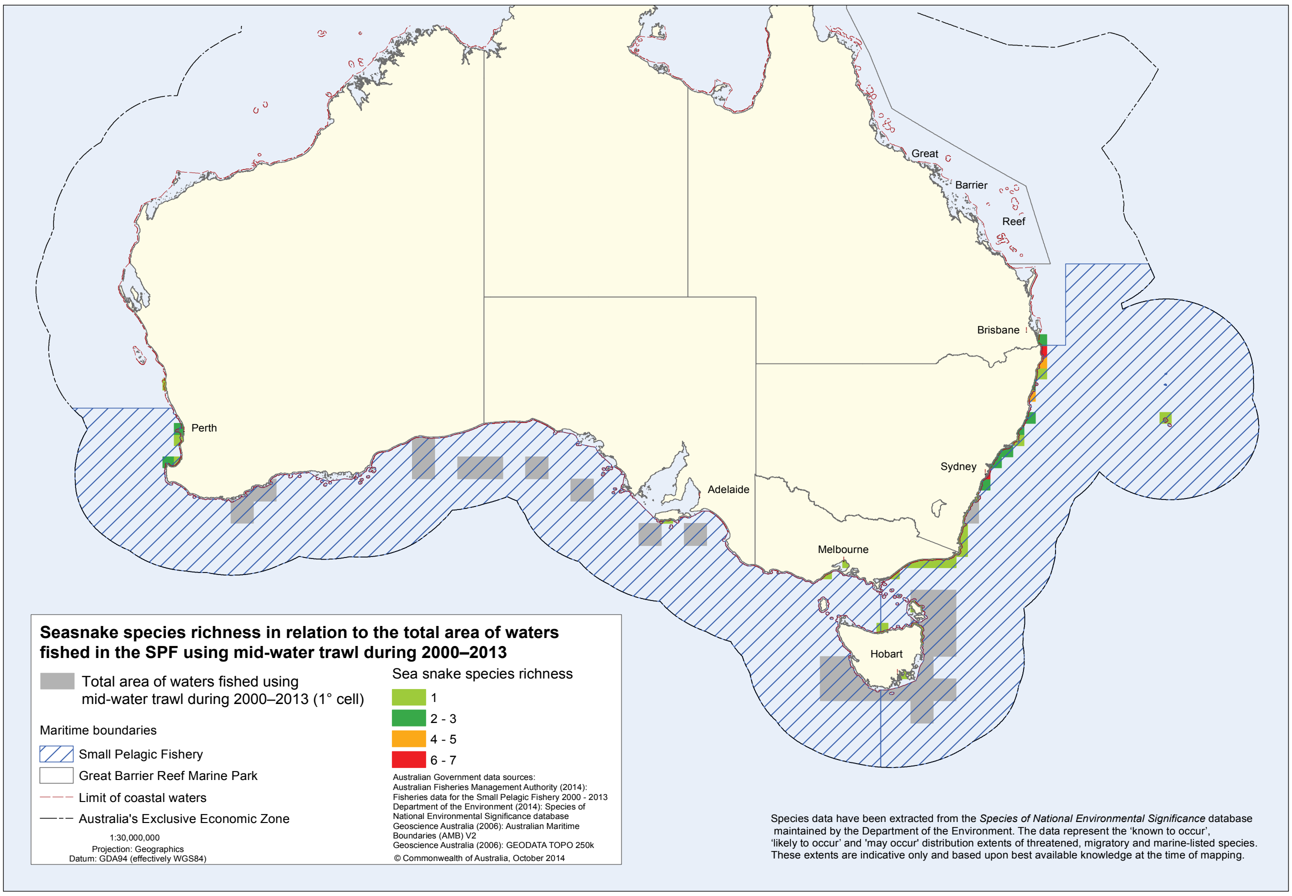

Figure A3.5 Seasnake species richness in relation to the total area of waters fished in the SPF using mid-water trawl during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

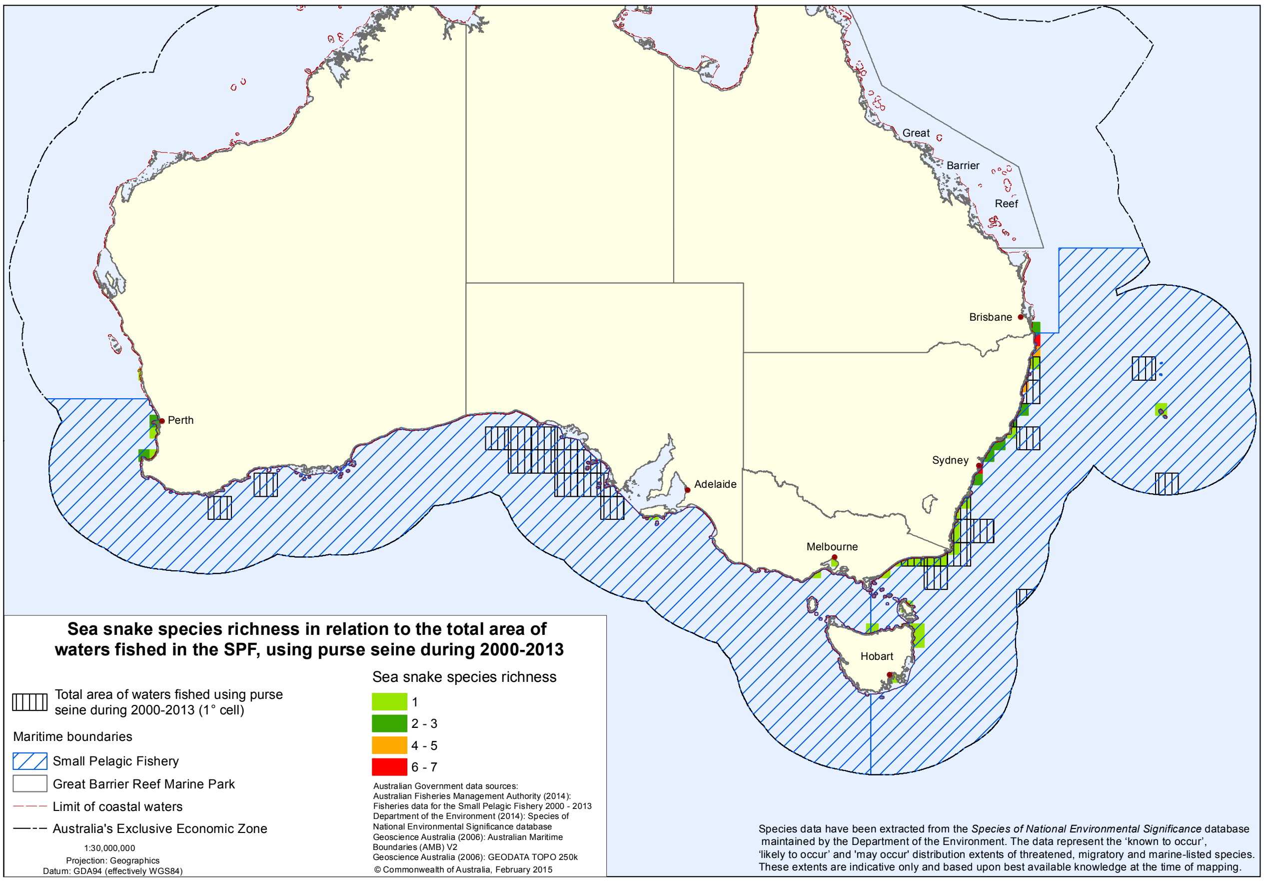

Figure A3.6 Seasnake species richness in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

Sharks and rays

Of the 13 protected species (including separate east and west stocks of grey nurse shark *Carcharias taurus*) of sharks and rays occurring in the area of the SPF, only four (grey nurse shark east and west stocks, great white shark *Carcharias carcharodon* and whale shark *Rhincodon typus*), were assessed in the SPF mid-water trawl ecological risk assessment (ERA) (Daley *et al.* 2007b). Each of these was assessed at medium risk by both the ERA and subsequent residual risk assessment. The ERA did not assess basking shark *Cetorhinus maximus* and the remaining species were not protected species at the time the ERA was conducted.

The panel noted that there are only two records of protected shark species being captured in the SPF mid-water trawl sector in the period 2000 to 2011 (Tuck *et al.* 2013). In each case a single individual of great white shark and of shortfin mako shark *Isurus oxyrinchus* was captured. Further, of the other protected shark species occurring in the SPF, the panel considered that Harrisson's dogfish *Centrophorous harrissoni*, southern dogfish *C. zeehaani* and school shark *Galeorhinus galeus* are generally likely to be out of the depth range of mid-water trawl gear. Finley *et al.* (2015b) found that it was unlikely that the mid-water trawl sector of the SPF would interact with grey nurse shark or longfin mako *Isurus paucus*. While Finley *et al.* (2015b) found that it was possible that interactions could occur with porbeagle *Lamna nasus* and basking shark, no interactions with these species were recorded in the mid-water trawl sector of the SPF in the period 2002–2013 (Tuck *et al.* 2013, AFMA 2014e). Similarly, there are no records of interactions with the giant manta ray *Manta birostris* and extremely low records of catch of any skates or rays in the mid-water trawl sector of the SPF (Tuck *et al.* 2013).

Finley *et al.* (2015a) found that of the protected species of sharks and rays in the SPF the giant manta ray was 'likely' to interact with purse seine vessels and interactions with basking shark, great white shark and shortfin mako shark were possible. However the panel notes that no interactions with protected species of sharks and rays have been reported in the purse seine sector of the SPF (Tuck *et al.* 2013, AFMA 2014e).

As a result, the panel has not assessed the possible impact of direct interactions with protected species of sharks and rays specifically. The distribution of these species in relation to mid-water trawl and purse seine effort in the SPF (2000–2013) is mapped in Figures A3.7 and A3.8 respectively.

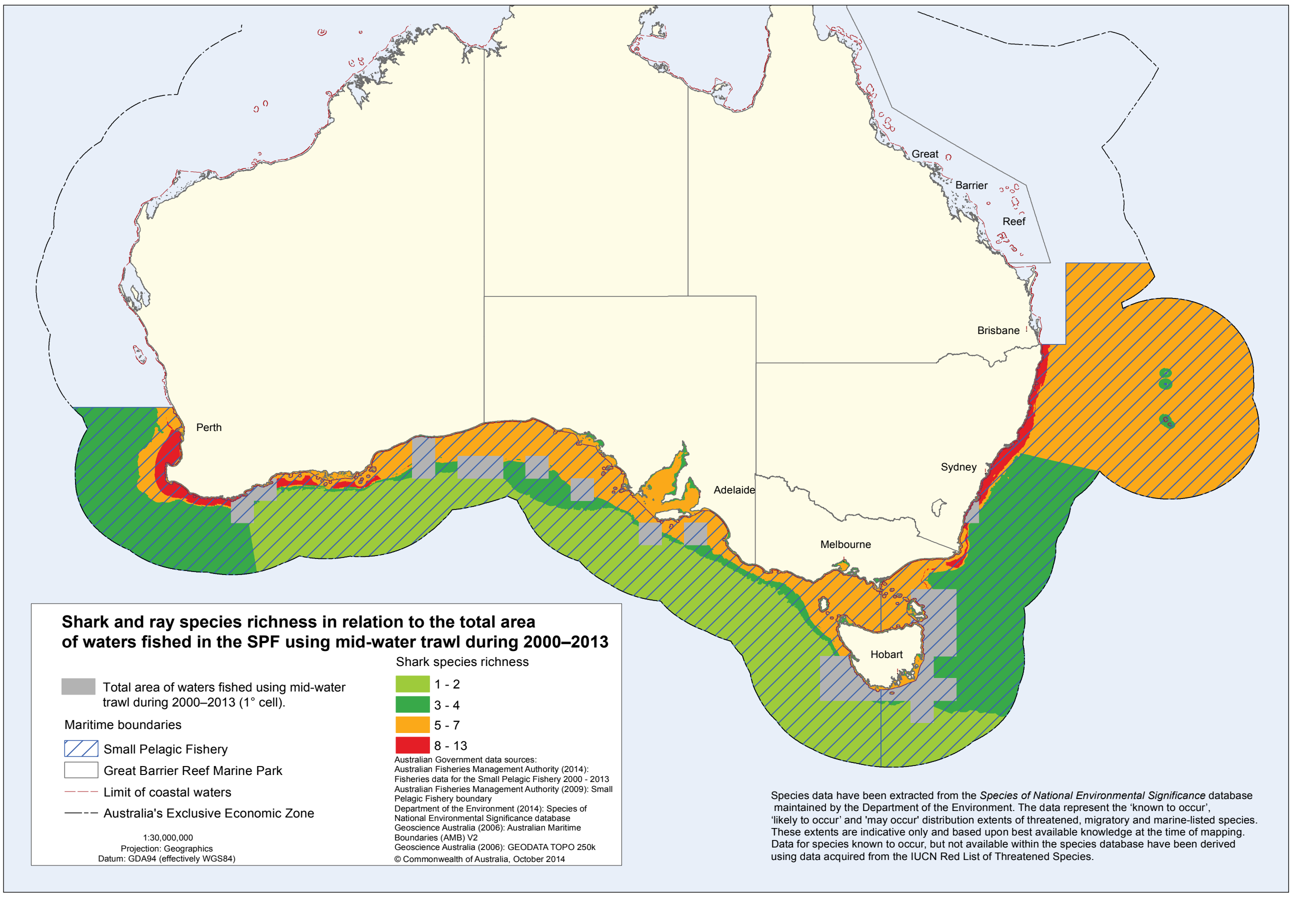

Figure A3.7 Shark and ray species richness in relation to the total area of waters fished in the SPF using mid-water trawl during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

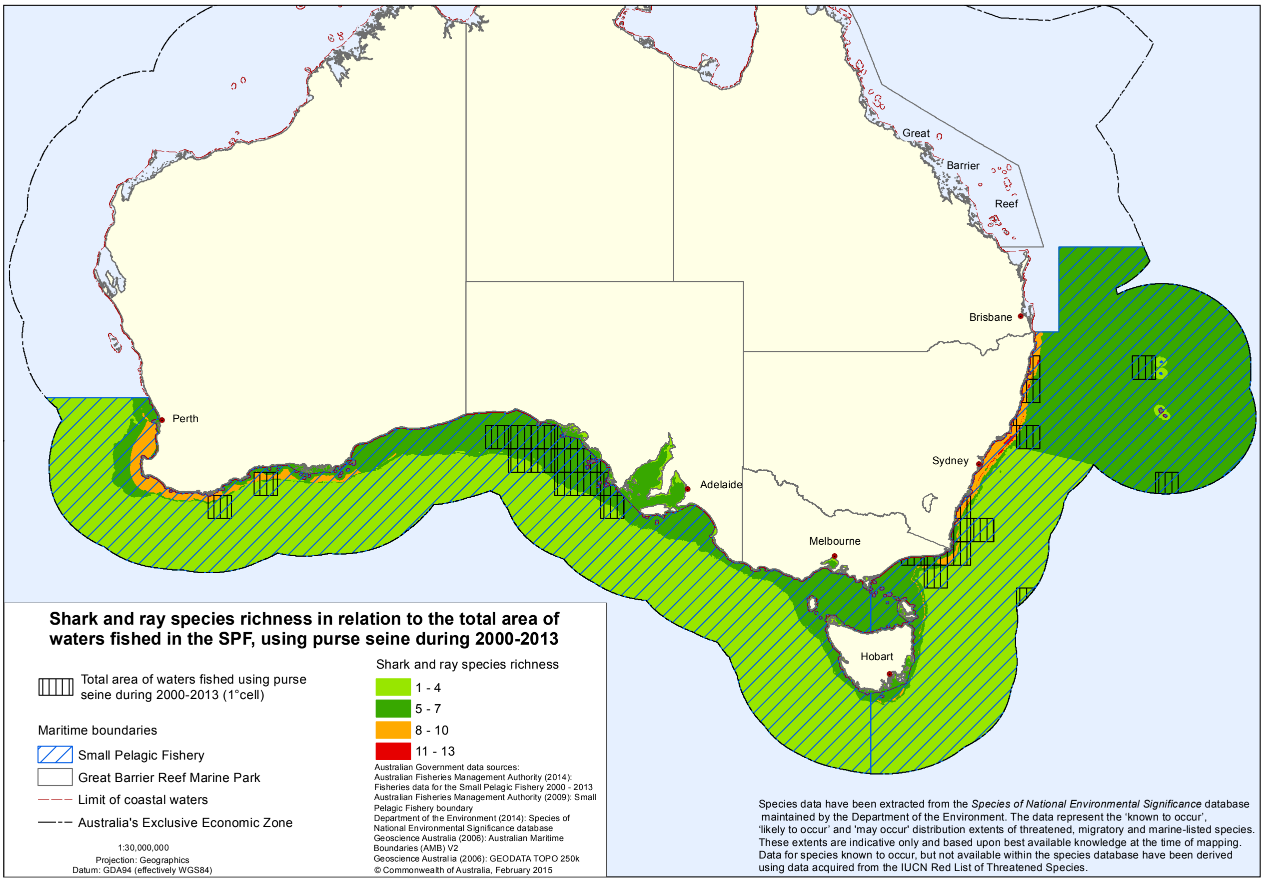

Figure A3.8 Shark and ray species richness in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

Teleosts

Sixty-six species of syngnathids occur within the area of the SPF. Sixty-four of these were rated as low-risk in the mid-water trawl sector ERA (Daley *et al.* 2007b). This rating largely reflects a low susceptibility of these species to the fishing gear/method. The remaining two species were not assessed in the ERA but the panel considered that these two species had limited overlap with the area of the SPF and that it was reasonable to assume these species were unlikely to be more susceptible to the fishing gear/method than the other 64 syngnathid species assessed in the ERA. The purse seine sector ERA (Daley *et al.* 2007a) found all species to be at low risk except for *Syngnathoides biaculeatus*, which was assessed as medium risk. Finley *et al.* (2015a) found that it was unlikely that the purse seine gear would interact with this species.

The panel noted that there were no reported interactions between syngnathids and mid-water trawl or purse seine gear in the period 2002–13 (Tuck *et al.* 2013, AFMA 2014e). The distribution of protected species of syngnathid in relation to mid-water trawl and purse seine effort in the SPF (2000–2013) is mapped in Figures A3.9 and A3.10 respectively.

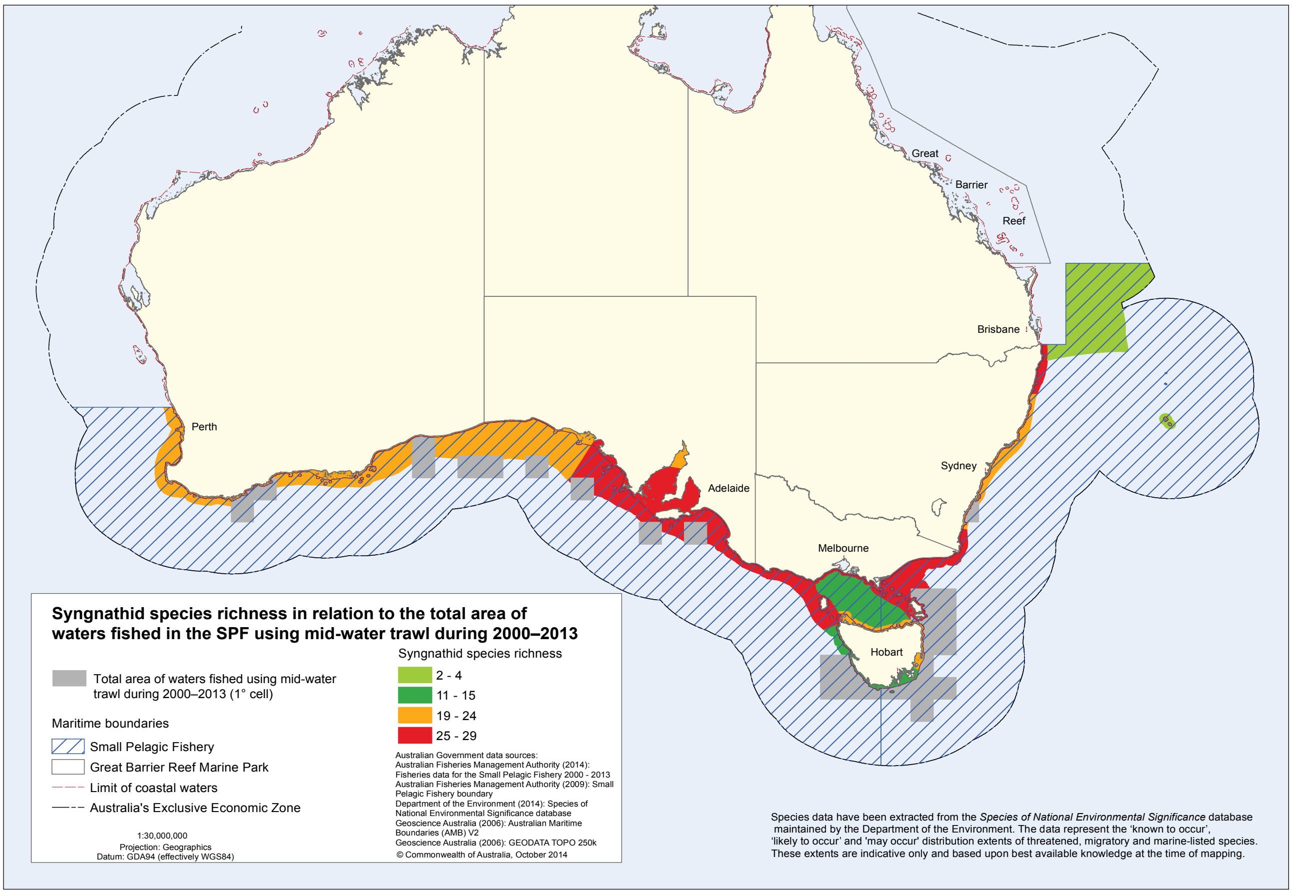

Figure A3.9 Syngnathid species richness in relation to the total area of waters fished in the SPF using mid-water trawl during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

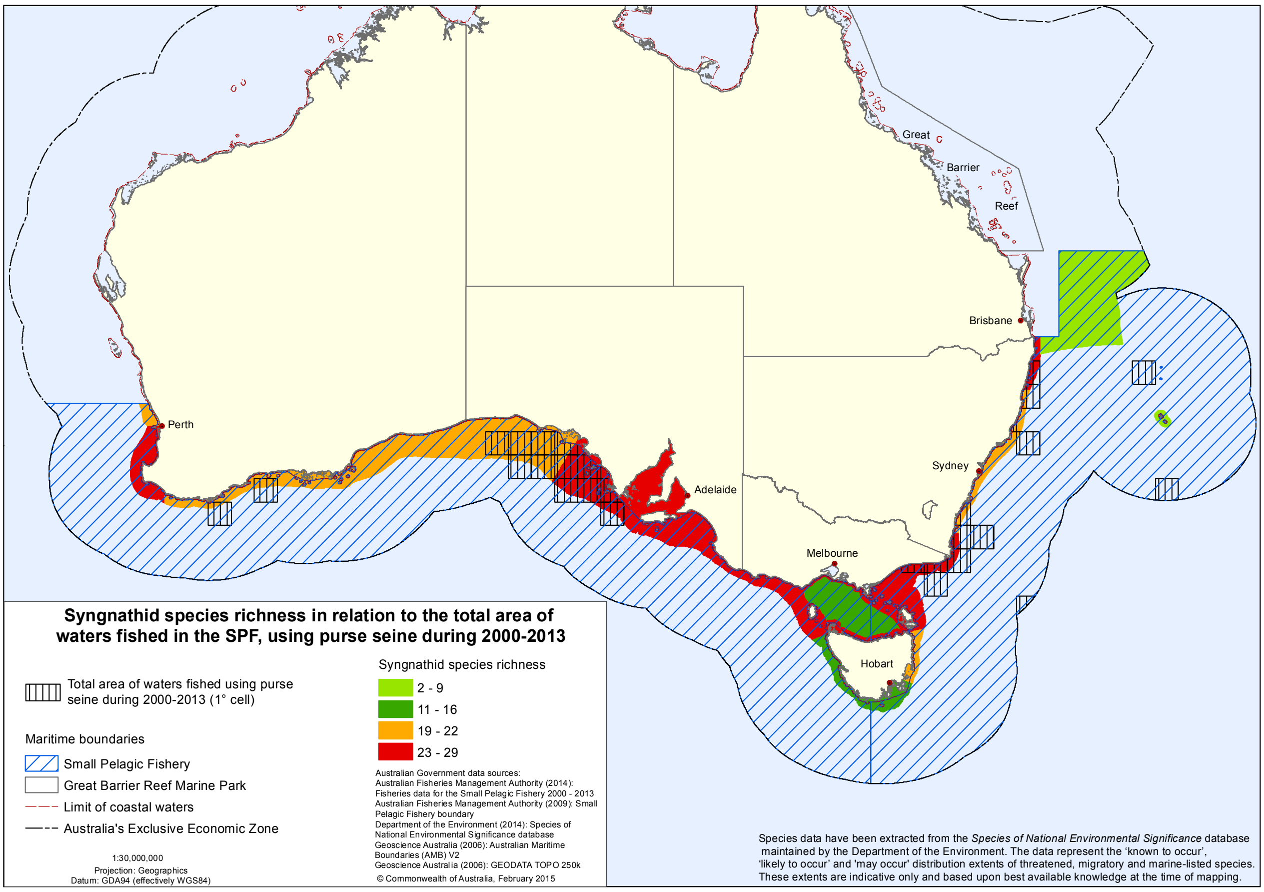

Figure A3.10 Syngnathid species richness in relation to the total area of waters fished in the SPF using purse seine during 2000–2013. **Source:** Map produced by ERIN using unpublished AFMA data.

In addition, there are three protected species of teleost fishes occurring in the area of the SPF (gemfish *Rexea solandri,* orange roughy *Hoplostethus atlanticus* and southern bluefin tuna *Thunnus maccoyii*). The panel considered that orange roughy is likely to be out of the normal depth range of mid-water trawl and purse seine gear. Very small quantities of gemfish and no southern bluefin tuna or orange roughy were recorded in the SPF mid-water trawl sector in the period 2002–2011 (Tuck *et al.* 2013). Neither of these species was reported in the purse seine catch over the same period. As a result, the panel has not assessed the possible impact of direct interactions with these protected species of teleosts specifically.

Shortened forms

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACAP	Agreement on the Conservation of Albatrosses and Petrels
AFMA	Australian Fisheries Management Authority
AIDCP	Agreement on the International Dolphin Conservation Program
CI	Confidence interval
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Cwlth	Commonwealth of Australia
cm	centimetre
CoP	Code of Practice
CPF	Central place forager
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTS	Commonwealth Trawl Sector
CV	Coefficient of variation
DAFF	Department of Agriculture, Fisheries and Forestry (Commonwealth) (former)
DCFA	Declared Commercial Fishing Activity
DCFA1	Declared Commercial Fishing Activity of the first declaration
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth) (former)
DML	Dolphin mortality limit
EEZ	Exclusive Economic Zone
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPI	Ecological Performance Indicator
ERA	Ecological risk assessment
ERAEF	Ecological risk assessment for the effects of fishing
ERIN	Environmental Resources Information Network
ETBF	Eastern Tuna and Billfish Fishery
FPA	Fish processing activity
FRDC	Fisheries Research and Development Corporation
GAB	Great Australian Bight
GBR	Great Barrier Reef
GHAT	Gillnet, Hook and Trap (Fishery)
IATTC	Inter-American Tropical Tuna Commission
IOTC	Indian Ocean Tuna Commission
ISSF	International Seafood Sustainability Foundation
ITQ	Individual transferable quota
IUCN	International Union for Conservation of Nature and Natural Resources
JMF	Jack Mackerel Fishery
kg	kilogram

km	kilometre
km^2	square kilometre
m	metre
mm	millimetre
MTA	Mid-water trawl activity
NMFS	National Marine Fisheries Service (USA)
nm	nautical mile
NPF	Northern Prawn Fishery
NRM	Natural Resource Management
NSW	New South Wales
PIRSA	Primary Industries and Regions, South Australia
PSA	Productivity-susceptibility analysis
RBC	Recommended biological catch
RFMO	Regional fisheries management organisation
SA	South Australia
SARDI	South Australian Research and Development Institute
SASF	South Australian Sardine Fishery
SASIA	South Australian Sardine Industry Association
SBT	Southern bluefin tuna
SBTF	Southern Bluefin Tuna Fishery
SCPSMF	South Coast Purse Seine Managed Fishery (Western Australia)
SCAR EGS	Scientific Committee for Antarctic Research Expert Group on Seals
SED	Seal excluder device
SESSF	Southern and Eastern Scalefish and Shark Fishery
SFR	Statutory Fishing Right
SPF	Small Pelagic Fishery
SPFRAG	Small Pelagic Fishery Resource Assessment Group
SST	Sea surface temperature
t	tonne
TAC	Total allowable catch
TACC	Total allowable commercial catch
TEPS	Threatened, endangered and protected species
US	United States of America
VMP	Vessel management plan
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WCPO	Western and Central Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission

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