Conservation Management Plan for the Southern Right Whale

A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999*
2011–2021

Acknowledgements

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EXECUTIVE SUMMARY

Introduction

Southern right whales (*Eubalaena australis*) are currently listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) because they have undergone a severe reduction in numbers as a result of commercial whaling. An initial recovery plan for southern right whales was developed for the period 2005 to 2010. A review of that plan found that despite progress on many recovery actions and evidence of some population increase in south-west Australian waters, southern right whale habitat occupancy is still constrained in comparison to historical occupancy, and current abundance is still well below estimated historic abundance. The review recommended an updated recovery plan for the southern right whale be developed to reflect new knowledge and prioritise research needed to monitor population recovery and better predict the impacts of threats such as climate change. This plan conforms to the International Whaling Commission's (IWC) 'Conservation Management Plan' format, while meeting the requirements of a recovery plan under the EPBC Act.

Recovery Objective

The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.

Interim Recovery Objectives (2011–2021)

Recognising that the long-term recovery objective is unlikely to be achieved during the life of this plan, the following interim recovery objectives have been set for the period covered by the plan. The first three interim objectives assist in assessing the conservation status of the south-eastern and south-western populations against the EPBC Act listing criteria, and the remaining two relate to legal and management protection, and to minimising recognised threats.

1. Demonstrate that the number of southern right whales occurring off south-west Australia (nominally south-west Australian population) is increasing at or near the maximum biological rate.
2. Demonstrate that the number of southern right whales occurring off south-east Australia (nominally south-east Australian population) is showing signs of increase.
3. The nature and degree of difference between the south-eastern and south-western Australian populations of southern right whales is clearly understood.
4. Current levels of legal and management protection for southern right whales are maintained or improved and an appropriate adaptive management regime is in place.
5. Anthropogenic threats are demonstrably minimised.

Biology

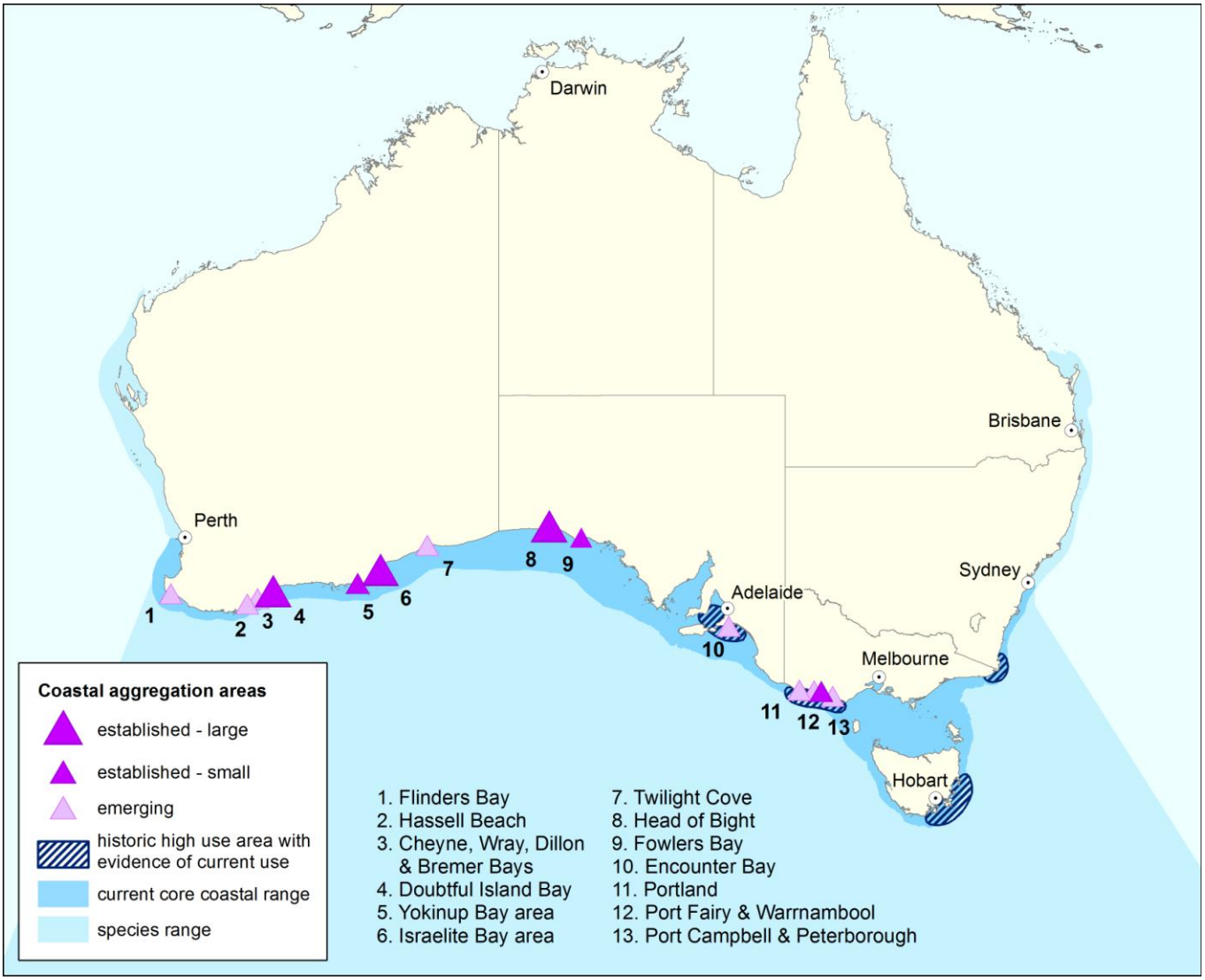
Southern right whales are medium to large black (or less commonly grey-brown) baleen whales. They can be recognised by the lack of a dorsal fin, rotund body shape, and whitish callosities (patches of keratinised skin colonised by cyamids - small crustaceans) on the head. Southern right whales reach a maximum length of approximately 17.5 metres and a weight of around 80 tonnes with mature females slightly larger than males.

Nineteenth century whaling drastically reduced southern right whale numbers. An estimated 55 000 to 70 000 whales were present in the southern hemisphere in the late 1700s. By the 1920s there may have been fewer than 300 individuals remaining throughout the southern hemisphere. Detailed individual-based information collected from populations of southern right whales in Australia, New Zealand, Argentina and Southern Africa suggest the global population now exceeds 12 000 whales. Population trend data are also available for Australia, Argentina and Southern

Africa that indicate these populations are currently increasing at approximately seven per cent each year[92]. The population is thought to have begun to recover following protection in 1935, but illegal Soviet whaling in the 1960s is estimated to have removed over half the remaining population and delayed recovery. Subsequent protection measures have seen the population increase to the point where the most recent estimate for the total Australian population is approximately 3500 individuals. However, it is important to note that the increase has not been consistent across the population range and some population segments remain at greater risk than others.

Southern right whales occur only in the southern hemisphere. They have a circumpolar distribution between latitudes of 16°S and 65°S. The Australian southern right whale population differs from other populations on mtDNA haplotype frequencies, although nuclear genes show little differentiation between Australian and New Zealand populations. In Australian coastal waters, southern right whales occur along the southern coastline including Tasmania, generally as far north as Sydney (33°53'S, 151°13'E) on the east coast and Perth (31°55'S, 115°50'E) on the west coast. There are occasional occurrences further north, with the extremities of their range recorded as Hervey Bay (25°00'S, 152°50'E) and Exmouth (22°23'S, 114°07'E). In coastal areas, southern right whales generally occur within two kilometres off shore and tend to be distinctly clumped in aggregation areas.

Figure 1: Coastal aggregation areas for southern right whales



Southern right whales in south-western Australia appear to be increasing at the maximum biological rate but there is limited evidence of increase in south-eastern Australian waters. Until recently, southern right whales in Australia were considered to be one population. Preliminary data suggest that south-eastern and south-western Australian right whales may represent distinct matrilineal genetic stocks. This idea is supported by their differential recovery rates. The two Australian southern right whale populations differ from other populations on mtDNA haplotype frequencies, although nuclear genes show little differentiation between Australian and New Zealand populations.

Calving takes place very close to the coast in Australia, usually in waters less than 10 metres deep. Nursery grounds are occupied from May to October. Female-calf pairs generally stay within the calving ground for 2–3 months. On average, southern right whales have a single calf every three years. Gestation lasts 12 months, lactation at least 7–8 months with weaning complete within 12 months. Female southern right whales show calving site fidelity, generally returning to the same location to give birth and nurse offspring.

Other population classes stay in the calving grounds for shorter and variable periods. There is substantial movement along the coast indicating that connectivity of coastal habitat is important. The general absence from coastal areas of reproductively mature females in virtually all years between calving indicates that not all whales migrate to the coast each year. The winter distribution of these whales is unknown but may include offshore habitat where mating occurs.

Southern right whales from Australian populations probably forage between about 40°S and 65°S, generally south of Australia. In the region of the Sub-Tropical Front (41–44°S) they mainly consume copepods, while at higher latitudes (south of 50°S) krill is the main prey item. Right whales feed by surface skimming or shallow dives, trapping plankton on fine baleen fibres. The migratory paths between calving and feeding areas are not well understood.

Southern right whales have few natural predators. Calves, juveniles or weakened adults may be killed by sharks, which are common in some Australian calving grounds, or killer whales. Adult southern right whales rarely strand, but small numbers of calves are regularly found dead or stranded near calving grounds.

Threats

The known and potential threats to southern right whales are described below. The known threats of entanglement and vessel disturbance are more likely to affect individuals, while the potential threats are more likely to have a population level effect.

Known threats affecting southern right whales in Australian waters are:

A. Entanglement - Entanglement can harm or kill individual whales, and can reduce the fitness of an individual by restricting mobility and impairing breathing, swimming or feeding ability. Entanglement causes physical damage, e.g. nets and lines cutting through the skin and blubber thus exposing the animal to infection and amputation or death. Entanglements in Australian waters primarily come from commercial fishery equipment and marine debris.

B. Vessel Disturbance - Vessel disturbance can occur in the form of collisions or by disrupting the behaviour of animals. Southern right whales appear to be the primary whale species involved in vessel collisions in the southern hemisphere[100]. They accounted for 50 per cent of whale mortalities resulting from vessel collisions in a rapid assessment of data on vessel collisions with cetaceans in the southern hemisphere[100]. Vessel collision can lead to mortality or significant injury. Chronic disturbance leading to increased energetic costs or disruption of critical social behaviours as individual animals try to avoid vessels may result from activities such as boat-based whale watching, particularly from recreational boats.

Threats potentially affecting the Australian population of southern right whales are:

C. Whaling - The impacts of commercial hunting on southern right whales have been well documented. While currently banned under the IWC moratorium on commercial whaling and due to classification by the IWC of all southern right whale populations as Protected Stocks, the potential for other countries to recommence commercial whaling exists and pressure may well increase as the population recovers.

D. Climate Variability and Change - There is evidence that climate variability affects reproductive output in southern right whales. Much is unknown about the impact of climate change on the food webs on which southern right whales rely.

However, research to date suggests detrimental impacts on reproductive output from warming events are possible. Changes to climate and oceanographic processes may also lead to decreased productivity and different patterns of prey distribution and availability.

E. Noise Interference - Loud noises or long exposure may lead to avoidance of important habitat areas, interruption to communication and, in some situations, physical damage, including permanent or temporary hearing loss. Potential forms of harmful noise interference in Australian waters include seismic surveys, other industrial activities such as drilling, pile driving, blasting and dredging, defence activities, vessel noise, and aircraft operating at low altitude.

F. Habitat Modification - Habitat modification through the development of infrastructure such as ports, marinas, aquaculture facilities, and ocean/marine energy production facilities could lead to the physical displacement of southern right whales from their preferred habitats or disruption to normal behaviour. Animals may also encounter chemical pollution in the form of sewage and industrial discharges, run off from onshore activities, and accidental spills. In their feeding grounds they are most at risk from bioaccumulation of human-made chemicals such as organochlorines.

G. Overharvesting of Prey - Depletion of prey through over-harvesting may be a potential future threat. Changes to climate and oceanographic processes may also lead to decreased productivity and different patterns of prey distribution and availability.

Actions

Actions have been developed to assess population recovery and assist recovery by addressing key threats to Australian southern right whales. The most important known and potential threats to southern right whales are identified through the risk analysis in Section 5. Recovery actions to address these more important threats are discussed in Section 6. Recovery actions have not been developed to address threats rated as 'low' or 'moderate'. Detail of these actions and performance measures are outlined in Section 6 of this Conservation Management Plan. A summary of the actions is provided here. The Conservation Management Plan is based around the need to aid and monitor the recovery of the south-western and the south-eastern populations.

Table 1: Summary of actions to assess population recovery and address key threats to Australian southern right whales.

A: Assessing and Addressing Threats
A.1: Maintain and improve existing legal and management protection
A.2: Assessing and addressing anthropogenic noise (shipping, industrial and seismic)
A.3: Reducing commercial fishing entanglements
A.4: Impacts of climate variability and change
A.5: Addressing vessel collisions
A.6: Addressing infrastructure and coastal development impacts
B: Measuring Recovery
B.1: Measuring and monitoring population recovery
B.2: Investigating the two-population model
B.3: Understanding offshore distribution and migration
B.4: Characterising behaviour and movements

1. INTRODUCTION

Southern right whales (*Eubalaena australis*) are currently listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An initial recovery plan for southern right whales was developed for the period 2005 to 2010. This new plan reviews and builds on the previous plan and has been presented in a new format that conforms with the International Whaling Commission's 'Conservation Management Plan' format, while meeting the requirements of a recovery plan under the EPBC Act.

Nineteenth century whaling drastically reduced southern right whale numbers. An estimated 55 000 to 70 000 southern right whales were present in the southern hemisphere in the late 1700s. By the 1920s there may have been fewer than 300 individuals remaining. Subsequent protection measures have seen numbers increase to the point where the most recent estimate for the Australian population is 3500 individuals[11]. However, it is important to note that the increase has not been consistent across the species range and some populations remain at greater risk than others.

Southern right whales in Australia were until recently considered to be one population. It is now proposed that south-east Australian right whales are most likely a separate population from those in the south-west[35]. Southern right whales in south-western Australia appear to be increasing at the maximum biological rate but there is little evidence of increase in south-eastern Australian waters. The 2011–2021 Conservation Management Plan is therefore based around the need to aid and monitor the recovery of two possibly separate populations.

This Conservation Management Plan outlines the current status of, and threats to, the southern right whale in Australian waters and prioritises recovery actions for the 2011–2021 period. This plan should be considered in the context of a number of significant developments in Australian cetacean conservation over the life of the initial 2005–2010 Recovery Plan including:

- Scientific advances in our knowledge of Australian southern right whales. Results from research and monitoring reports and publications produced during the 2005–2010 Recovery Plan period have been used to update this recovery plan, and are listed in the bibliography of this document.
- Australian Government participation in the IWC particularly in relation to the development of the Conservation Management Plan framework as a new way of protecting cetaceans under the auspices of the IWC.
- Establishment of the Australian Marine Mammal Centre (AMMC) – an organization involved in the research and management of marine mammals around Australia and internationally.
- Establishment of the Southern Ocean Research Partnership - an Australian Government- led initiative through the IWC that will develop regional non-lethal cetacean research partnerships.
- Production of management documents for areas of impact and concern for whales in Commonwealth waters and provision of guidance to state regulatory agencies and industry, e.g. EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (2008) (Seismic Guidelines)[4] and the Australian National Guidelines for Whale and Dolphin Watching (2005)[6] (whale watching guidelines).
- Continuing discussions with the energy industry, marine scientists and state government agencies on whether existing assessments and conditions appropriately manage the impacts associated with infrastructure development and seismic surveys.
- Best practice training and preparedness efforts by state government staff involved in disentanglement operations and coordinated response to reports of injuries, stranding and mortality.
- Improved mechanisms for commercial fishers to reduce the likelihood of interaction and report bycatch or other

interactions with whales, dolphins and other protected species, e.g. through voluntary codes of practice.

- Civil maritime surveillance and response services reporting environmental incidents such as marine pollution, and contributing to marine species protection through reporting sightings of marine mammals.
- Recognition of southern right whale Biologically Important Areas in the marine bioregional planning process designed to identify regional conservation priorities.
- Ongoing support for research programs that improve understanding of southern right whale recovery and interactions with humans.

1.1 Review of the 2005–2010 Recovery Plan

The Southern Right Whale 2005–2010 Recovery Plan was reviewed in 2010: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/cetaceans-assessment.html. The review recommended an update of the recovery plan for the southern right whale as, despite evidence of good recovery rates for the south-western population, the recovery rate of the south-eastern population of southern right whales remains low. Performance measures used to review the 2005–2010 Recovery Plan included:

- a comparison of the recovery rate of southern right whales against the optimum biological rate of approximately seven per cent
- expansion into suitable habitat
- domestic and international protection regimes.

The review found that the objectives of the 2005–2010 Recovery Plan were achieved in relation to assessment of the south-western population of southern right whales, however, information on the south-eastern population was found to be lacking. The review prioritised the need for long term monitoring of the south-eastern population of southern right whales. The review also noted the impacts of large scale climate change signals in the southern hemisphere on the reproductive output of Australian southern right whales[83].

The review found that objectives of the 2005–2010 Recovery Plan were not achieved in relation to expansion of southern right whales into suitable habitat. Occupancy of coastal habitats remains severely restricted in comparison to the areas occupied historically, particularly in south- east Australia. The review recommended that the Recovery Plan be updated to reflect new knowledge including mapping of aggregation area extensions. Updated maps of species range, current and emerging aggregation areas are presented in Section 4.

Key domestic protection regimes include:

- the Australian Whale Sanctuary was established under the EPBC Act to protect all cetaceans found in Australian waters. It is illegal to kill, injure or interfere with a cetacean. Similar protection is afforded to all cetaceans in state waters
- environmental impact assessment processes under the EPBC Act and state legislation
- seismic guidelines for the petroleum industry (EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales)
- Australian National Guidelines for Whale and Dolphin Watching 2005 developed by Commonwealth, state and territory governments to standardise regulation and management of commercial and recreational whale watching and provide information on the best practice
- marine bioregional plans prepared under the EPBC Act identify and manage the conservation values of marine regions in Commonwealth waters. These values include cetacean species such as southern right whales
- Commonwealth, state and territory governments collaboration with the fishing industry and the Australian Fisheries Management Authority to develop methods to minimise the impact of fishing on whales, including bycatch and entanglements
- Commonwealth and state government threatened species legislation and recovery planning processes
- the Department of Sustainability, Environment, Water, Population and Communities is working with the Australian Maritime Safety Authority, Australian Marine Mammal Centre, Department of Defence and state government agencies to develop a ship strike mitigation strategy to reduce the likelihood and severity of ship

strikes occurring in Australian waters.

1.2 Objectives and Targets of the Conservation Management Plan

Long-term recovery objective

The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.

Interim recovery objectives (2011–2021)

Recognising that the long-term recovery objective is unlikely to be achieved during the life of this plan, the following interim recovery objectives have been set for the period covered by the plan. The first three interim objectives assist in assessing the conservation status of the south-eastern and south-western populations against the EPBC Act listing criteria, and the remaining two relate to legal and management protection, and to minimising recognised threats:

1. Demonstrate that the number of southern right whales occurring off south-west Australia (nominally south-west Australian population) is increasing at or near the maximum biological rate
2. Demonstrate that the number of southern right whales occurring off south-east Australia (nominally south-east Australian population) is showing signs of increase
3. The nature and degree of difference between the south-eastern and south-western Australian populations of southern right whales is clearly understood
4. Current levels of legal and management protection for southern right whales are maintained or improved and an appropriate adaptive management regime is in place
5. Anthropogenic threats are demonstrably minimised.

Given recent research has suggested that demographically-independent populations of southern right whales may occur off south-east and south-west Australia[35], the interim recovery objectives and the associated recovery actions are structured around a two-population model.

Targets for interim recovery objectives

The effectiveness of this plan will be measured, and progress towards long-term objectives assessed, on the basis of how well the following targets for interim recovery objectives are met.

Interim objective 1:

Target 1.1: the south-western population of southern right whales is measured and monitored.

Target 1.2: an annual increase in abundance close to or at maximum biological rate is recorded off south-west Australia.

Interim objective 2:

Target 2.1: the south-eastern population of southern right whales is measured and monitored.

- Target 2.2: the number of whales off south-east Australia shows an apparent increase for the period 2011–2021 relative to 2005–2010:
- no aggregation area identified in 2011 drops to a lower category by 2021 (categories are defined by the number of whales occupying an aggregation area each year)
- aggregations categorised as *small established areas* in 2011 are used by an equivalent or increased number of whales by 2021
- aggregations categorised as *emerging areas* in 2011 meet criteria for an *established area* by 2021; OR are occupied in a greater number of years from 2011–2021 compared with 2005–2010
- historic high use areas not identified as aggregation areas in 2011 show signs of increased use by 2021.

Interim objective 3:

Target 3.1: genetic delineation of the south-west Australian population is complete.

Target 3.2: genetic delineation of the south-east Australian population is complete.

Target 3.3: a research project investigating use of feeding and non-coastal habitat areas, including migratory movements, for south-east and south-west populations is completed.

Interim objective 4:

Target 4.1: domestic and international legislation and non-binding agreements that support the recovery of the species are maintained and, where possible, improved by 2021.

Interim objective 5:

Target 5.1: robust and adaptive management regimes leading to a reduction in anthropogenically-induced southern right whale mortality in Australian waters are in place.

Target 5.2: management decisions are supported by high quality information and high priority research targets identified in this plan are achieved or underway by 2021.

A full understanding of the characteristics of the south-east and south-west populations is required to facilitate robust recovery planning, including the setting of population recovery targets. As the south-west population is larger and better studied than the south-east, it is feasible to set abundance and spatial occupancy recovery targets for the south-west population within the life of this plan. This is not possible for the south-east population due to its small size and highly variable visitation rates making population abundance, trends and habitat occupancy patterns difficult to assess. Relative numbers of whales and apparent trends will be taken as indicators of population status and trajectory during that period, and more robust abundance measures will be implemented over the longer term. Consequently, targets relating to habitat occupancy must be assessed separately for south-east and south-west Australia.

Performance of the plan and progress toward long-term objectives

At the completion of this conservation management plan, recovery progress will be assessed and given one of the performance ratings below. The performance rating attained will show how successful the plan has been in meeting interim recovery objectives, and will give an indication of the degree of progress towards long-term recovery objectives during 2011–2021. Knowledge of certain aspects of southern right whale recovery, such as spatial recovery patterns and population structure, is incomplete. Where a target is apparently not met, explanations that may be unrelated to human activities (e.g. a natural spatial shift to another location; a relative increase in abundance elsewhere) will be explored before the target is considered to have not been met.

Table 2: Performance measures for the Southern Right Whale Conservation Management Plan

Performance rating for the 2011–2021 Plan	Description	Targets	Progress towards long-term recovery objectives
Successful	Population/s recovering as well as possible; ability to more accurately measure recovery in the future enhanced	All targets met	Excellent
Moderately successful	Population/s increasing; ability to more accurately measure recovery in the future enhanced	At a minimum targets 1.1, 1.2, 2.1, 2.2, 3.3, 4.1 and 5.1 are met	Sound
Moderately unsuccessful	Population/s increasing, ability to more accurately measure recovery in the future not enhanced	At a minimum targets 1.1, 1.2, 2.1, 2.2, and 4.1 are met	Adequate
Unsuccessful	Population/s smaller than in 2010, OR current protection measures are not maintained	Any of targets 1.2, 2.2, or 4.1 not met	Failure

2. LEGAL FRAMEWORK

2.1 International Conventions and Agreements

The southern right whale is afforded a degree of international protection through its listing on Appendix I of the Convention on International Trade in Endangered Species (CITES), Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). This species is now listed as Least Concern under the World Conservation Union Red List of Threatened Species which recognises the recent increase in population as an indication that this species is not at risk at a southern hemispheric level.

In addition, Australia participates in several other international agreements that directly or indirectly relate to the conservation of marine mammals. Specifically, Australia was a founding member of the IWC, is the host country of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), and a key player in Antarctic Treaty Consultative Meetings (ATCM).

Whales are protected from commercial whaling by the International Convention for the Regulation of Whaling through the moratorium on commercial whaling implemented in 1986. The IWC has also established international sanctuaries in the Indian Ocean and Southern Ocean.

Australia is also a member of the CMS Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region (the Pacific Cetaceans MoU). Through this Pacific Cetaceans MoU, the Pacific Islands region seeks to foster cooperation, build capacity and ensure coordinated region-wide conservation for cetaceans and their habitats, as well as to safeguard the cultural values cetaceans have for the people of the Pacific Islands.

2.2 National Legislation and Management Arrangements

In Australia, southern right whales are listed as endangered under the EPBC Act. The EPBC Act established the Australian Whale Sanctuary and gives high levels of protection to cetaceans in Commonwealth waters. The Australian Whale Sanctuary encompasses the area of the Australian Exclusive Economic Zone (EEZ) outside state waters and generally extends 200 nautical miles from the coast, but further in some areas to cover the continental shelf and slope. It also includes the waters around the Australian Antarctic Territory and external territories including Christmas, Macquarie, Heard and McDonald Islands.

Within the Australian Whale Sanctuary it is an offence to kill, injure, take, trade, keep, move or interfere with a cetacean. The EPBC Act also makes it an offence for Australians to carry out any of these actions beyond the limits of the Australian Whale Sanctuary, that is, in international or foreign waters. Other than in the case of killing, taking for live display, or trading, permits may be issued by the Australian Government Minister for Sustainability, Environment, Water, Population and Communities to carry out some activities that interfere with this species (e.g. for the purpose of research).

A number of measures currently exist to manage human interactions with all species of whales. These include the Seismic Guidelines, and Commonwealth and state regulations to manage whale watching activities. The EPBC Act also establishes the framework for this Plan and the associated actions.

Marine bioregional plans have been prepared under section 176 of the EPBC Act for the South-west, North-west, North and Temperate East marine regions in Commonwealth waters around Australia. Each marine bioregional plan describes the marine environment and conservation values of the region, identifies and characterises the pressures affecting these conservation values and identifies regional priorities and outlines strategies to address them. As part of this process, southern right whales have been identified as a regional priority for the South-west Marine Region. Further information on marine bioregional planning is available at: www.environment.gov.au/coasts/mbp.

Victorian legislation

In Victoria the species is considered critically endangered and is listed under the *Flora and Fauna Guarantee Act 1988*. An action statement has been prepared to protect southern right whales in Victorian waters. In addition, regulatory provisions under the *Wildlife Act 1975* are in place to protect southern right whales in the calving grounds at Logans Beach, Warrnambool by prohibiting boating in the area during southern right whale occupancy and to manage the impacts of whale watching in all Victorian coastal waters.

South Australian legislation

The South Australian Government has declared a whale sanctuary and marine park at the Head of the Great Australian Bight (Head of Bight), which is a significant aggregation and calving area. This declaration permanently excludes activities that are disruptive to habitat, and/or have the potential to conflict with the whales, and prohibits mining from the Conservation Zones in state waters. The Australian Government has declared a large extension to this sanctuary zone into Commonwealth waters creating the Great Australian Bight Marine Park. This marine park has as one of its primary purposes the conservation of southern right whales. Southern right whales are listed as vulnerable in South Australia and marine mammal regulations can be found under the *South Australian National Parks and Wildlife Act 1972*.

Western Australian legislation

Western Australia lists southern right whales under 'Schedule 1–Fauna that is rare or is likely to become extinct' of the Wildlife Conservation (Specially Protected Fauna) Notice 2010(2) from the *Wildlife Conservation Act 1950*.

New South Wales legislation

In New South Wales southern right whales are listed as an endangered species under the *Threatened Species Conservation Act 1995* and rules to limit the impact of whale watching activities are listed under the National Parks and Wildlife Amendment (Marine Mammals) Regulation 2006.

Queensland legislation

In Queensland, southern right whales are protected under the *Nature Conservation Act 1992*. Provisions regarding the protection of whales and management of human/whale interactions are defined in the Nature Conservation (Whales and Dolphins) Conservation Plan 1997.

Tasmanian legislation

The southern right whale is one of three whales listed as endangered under Tasmania's *Threatened Species Protection Act 1995.*

3. GOVERNANCE

3.1 Coordination of the Conservation Management Plan

Key stakeholders who may be involved in the development, implementation and review of the Southern Right Whale Conservation Management Plan, including organisations likely to be affected by the actions proposed in this plan include:

Australian Government

Aboriginal and Torres Strait Islander Commission

Australian Fisheries Management Authority

Australian Maritime Safety Authority

Department of Agriculture, Fisheries and Forestry

Department of Defence

Department of Foreign Affairs and Trade

Department of Resources, Energy and Tourism

Department of Innovation, Industry, Science and Research

Department of Sustainability, Environment, Water, Population and Communities

Great Barrier Reef Marine Park Authority

Indigenous Land Corporation

Industry and non-government organisations

Commercial fishers and associations

Commercial shipping

Conservation groups

Energy distribution networks

Indigenous land councils and communities

Local communities

Nature-based tourism industry

Oil and gas exploration and production industry

Marine/ocean energy industry

Recreational fishers and associations

Universities and other research organisations

Whale-watching industry and associations

Recreational boating

State / territory governments

Department of Environment and Conservation, WA

Department of Environment, Water and Natural Resources, SA

Department of Primary Industries, Parks, Water and Environment, TAS

Department of Environment and Heritage Protection, QLD

Department of National Parks, Recreation, Sport and Racing, QLD

Department of Sustainability and Environment, VIC

NSW Parks and Wildlife Service

Natural Resources, Environment, The Arts and Sport, NT

Parks Victoria

Fisheries agencies

Museums

Natural resource management bodies/catchment management authorities in coastal regions

Shipping, oil and gas exploration and development agencies

Local government in coastal regions

3.2 Duration and Cost of the Conservation Management Plan

It is anticipated that the recovery process will take longer than the life of the plan (2011–2021), which will be reviewed after five years. A Conservation Management Plan (Recovery Plan) for the species will remain in place until such time that the population of southern right whales utilising Australian waters has improved to the point that the population no longer meets threatened status under the EPBC Act.

The cost of this plan will be met through direct and indirect funding from the Australian Government, state and territory governments, researchers, conservation groups, marine based industries and the Australian public. Key mechanisms and indicative costing to achieve priority actions are outlined in Table 3.

Table 3: Key mechanisms and indicative costing to achieve priority actions

Actions	Mechanisms to Achieve Actions	Indicative Cost
A: Assessing and Addressing Threats		
A.1: Maintain and improve existing legal and management protection	• Continue or improve existing national and state legislative and management actions to minimise anthropogenic threats	Core Government Business
A.2: Assessing and addressing anthropogenic noise	• EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales 2008 (Seismic Guidelines) provides: – practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations • a framework to minimise risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours • guidance to proponents of, and operators conducting, seismic surveys about their legal responsibilities under the EPBC Act. • EPBC Act Environmental Offsets policy has measures that might compensate for environmental impacts that cannot be adequately reduced through avoidance or mitigation. • An industry partnership is funding a study on behavioural responses of humpback whales to seismic surveys. The results of this study will be relevant to other baleen whales.	Core Government Business Not less than $5 million
A.3: Reducing commercial fishing entanglements	• State government programs to disentangle whales • State government / industry partnerships to make fishing equipment whale and dolphin friendly • State government / industry Codes of Practice to reduce the risk of whale entanglements in fishing gear (e.g. WA and Tasmania) • Australian Government Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life	Core Government Business
A.4: Impacts of climate variability and change	• Australian Government climate change adaptation initiatives • Ongoing research activity • Government grants programs (AMMC, the Australian Research Council (ARC) and other) for new research priorities	Core Government Business
A.5: Addressing	• Development of the Australian Government ship strike	Core Government

Actions	Mechanisms to Achieve Actions	Indicative Cost
vessel collisions	strategy to mitigate against vessel/cetacean collisions	Business plus $80 000
A.6: Addressing infrastructure and coastal development impacts	• Australian and state government environmental assessment processes • EPBC Act Environmental Offsets policy has measures that might compensate for environmental impacts that cannot be adequately reduced through avoidance or mitigation	Core Government Business
B: Measuring Recovery		
B.1: Measuring and monitoring population recovery	• Ongoing Australian and state government monitoring programs • Ongoing research activity • Government grant programs (AMMC, ARC and other) for new research priorities	$180 000 per annum plus $280 000 one off for photo ID
B.2: Investigating the two-population model	• Ongoing Australian and state monitoring programs • Ongoing research activity • Government grant programs (AMMC, ARC and other) for new research priorities	Majority covered under photo ID plus $20 000 per annum.
B.3: Understanding offshore distribution and migration	• Ongoing Australian and state monitoring programs • Ongoing research activity • Government grant programs (AMMC, ARC and other) for new research priorities	$350 000 over 3 years
B.4: Characterising behaviour and movements	• Ongoing Commonwealth and state monitoring programs • Government grant programs (AMMC, ARC and other) for new research priorities	Addressed in above studies

4. SCIENCE

4.1 The Biology, Status and Environmental Parameters

Basic biology (feeding, reproduction and survivorship)

Southern right whales are medium to large black (or less commonly grey-brown or with white patches on the belly) baleen whales. They can be recognised by the lack of a dorsal fin, rotund body shape, and whitish callosities (patches of keratinised skin colonised by cyamids - small crustaceans) on the head. Callosities are present from birth and are unique to each individual, although a recognisable pattern may not develop for some months[73], providing a long-term means of identification used in research studies.

Southern right whales reach a maximum length of approximately 17.5 metres. With a weight of around 80 tonnes they are much heavier than other baleen whales of a similar length[65] and their bulky body form is markedly different from the more streamlined balaenopterid whales[42]. They are slower swimming[16] and have thicker blubber (23–24 centimetres)[94], with mature females slightly larger than males[94]. Right whales produce social sounds ranging in frequency from 50–600 hertz at sound levels ranging from 137–192 decibels. Modelling suggests they can hear frequencies in the range of 10 hertz to 22 kilohertz[73, 74].

Reproduction

On average, southern right whales from both the south-eastern and south-western populations have a single calf every three years[17, 79]. Gestation is thought to be 12 months[16], lactation lasts at least 7–8 months[94] with weaning occurring within 12 months[31]. If mothers lose a calf, they may calve again the following year which results in a two year calving interval[39]. Longer intervals may be due to variability in environmental conditions: calving intervals and calf production on the Australian coast are likely to be influenced by large-scale climate variability, particularly increased sea temperature[83]. Southern right whales' low and slow reproductive rate has resulted in only a gradual recovery from whaling and affects the species' capacity to withstand impacts.

Southern right whale calving grounds are found at mid to lower latitudes and are occupied during the austral winter and early-mid spring. Mating has been observed within these areas[33,79,104]. Female southern right whales show calving site fidelity, generally returning to the same location to give birth and nurse offspring. This trait impacts on the whales' ability to respond to external threats, including their ability to tolerate and respond to habitat changes. Site fidelity limits their capacity to occupy new areas, even where suitable habitat is available and abundance is increasing. Site fidelity, combined with an average three-year calving interval, causes habitat occupation and coastal visitation to vary between years[18, 84].

Reproductively mature females that calve in Australian waters are almost never recorded on the Australian coast between calving years[17, 83, 33]. The absence of these females in non-calving years suggests that conception occurs elsewhere. Although it is not known where conception takes place, surface-active groups apparently involved in mating have been observed in Australian coastal waters[104]. Reproductive maturity is reached at 6–9 years in the Australian population.

Foraging

The foraging ecology of southern right whales is poorly understood and observations of feeding whales are rare. As in the northern hemisphere[70, 21], broad-scale foraging patterns are almost certainly determined by the location of oceanographic fronts and features that concentrate their planktonic food resources. Most feeding probably occurs when productivity is high – in the austral spring and summer. Feeding may also extend into autumn and occur opportunistically in winter nursery areas where suitable prey densities occur[52]. Satellite tagging and stable isotope analysis show right

whales off South Africa feed both at, and south of, the Sub-Tropical Front in both Sub-Antarctic and Polar Frontal zones[1, 29] and in a high productivity coastal upwelling system[26]. Isotopic and genetic analysis has shown that southern right whales return to their maternal feeding grounds suggesting that they may have limited capacity to explore new feeding grounds[98].

Southern right whales from Australian populations probably forage between about 40°S and 65°S, generally south of Australia[3, 15, 72, 94]. Feeding whales have been observed in the region of the Sub-Tropical Front 41–44°S in January[65] and December[15]. In that region they mainly consume copepods, while at higher latitudes (south of 50°S) krill is the main prey item[94]. Coastal Australian waters are not generally used for feeding, but other parts of the Australian EEZ - where environmental conditions are suitable - may be used.

Right whales feed by surface skimming[66] or shallow dives, trapping plankton on fine baleen fibres. In the northern hemisphere fine-scale foraging patterns of other right whale species are related to prey density and the vertical distribution of zooplankton[20, 22, 105]. Similar fine-scale foraging is likely for southern right whales, although this has not been observed or investigated to date.

Survivorship

As southern right whales have a long lifespan with a relatively low reproductive rate, adult mortality (particularly adult females) can have a significant effect on the overall population. Southern right whales have few natural predators, although calves, juveniles or weakened adults may be killed by sharks (principally great white sharks), which are common in some Australian calving grounds. Shark bite wounds are evident on all population classes (males, non-calving females, juveniles, sub-adults), though in adults these are confined to the flukes and are unlikely to cause death in healthy, mature individuals. Scars consistent with wounding by killer whales are evident on adult and juvenile whales, but not on calves. Southern right whales may be more vulnerable to killer whale attack in the open ocean, e.g. on migration or at higher latitudes where killer whales are more common[16].

Adult southern right whales rarely strand, but small numbers of calves are regularly found dead or stranded near calving grounds. Neonatal mortality at the Head of Bight has been estimated to be at least 3 per cent during the first three months of life[32]. Poor environmental conditions can cause nutritional stress[98] and may affect calf survivorship, but this has not been measured.

Mortality rates for adult southern right whales from the southwest Australian population are assumed to be low and survivorship high, given their recent consistent rate of population increase of approximately 6.8 per cent each year. Mortality and survivorship rates differ for the south-east Australian population, where recovery has been poor[35]. Poor recovery in the south-east may be a result of the more severe historical local extirpation there[84], rather than low survivorship.

Population structure

Southern right whales are the sole representative of the family Balaenidae in the southern hemisphere. They are closely related to northern hemisphere right whales *E. glacialis* (North Atlantic) and *E. japonica* (North Pacific)[90], and although very similar, the species of the two hemispheres are reproductively isolated from one another by the geographic separation of calving grounds and asynchronous breeding seasons[95].

Australian southern right whale populations have different mtDNA haplotype frequencies from other southern hemisphere populations although nuclear DNA structuring is very low[8, 35, 77]. This genetic pattern is consistent with mating in offshore feeding areas, coupled with females showing strong fidelity to calving grounds, although small numbers of females calve in both Australian and New Zealand waters.

Southern right whales in Australian waters were until recently considered to be one population. It is now proposed, based on differentiation in mtDNA haplotype but not nuclear gene frequencies, that south-east Australian right whales may be demographically separate from those in south-west Australia, although they may interact for the purposes of mating[35]. This means conservation management needs to be based around the existence of two populations in Australian waters with different recovery rates, rather than the single population model that was assumed previously.

Abundance and population trends

The population of Australian southern right whales has been monitored annually since 1976. Abundance estimates and trends for Australian southern right whales are available from the south-west Australian population for the area between Cape Leeuwin, WA and Ceduna, SA [10, 11, 12, 13]. The minimum size of that population is estimated at 2900 with a 6.79 per cent increase each year (95 per cent confidence intervals 3.88–9.78)[11]. The south-west population is therefore recovering at, or near, the maximum rate of population growth biologically possible.

No reliable abundance estimate or trend is available for the south-east Australian population but the total Australian population – that is, the south-west and the south-east populations – is estimated to be in the vicinity of 3500 individuals[11]. There are some signs of slow recovery in the south-east Australian population, with sightings apparently increasing gradually over the last 10 years in a few locations in NSW, Victoria and Tasmania[35]. However, sighting records for the Warrnambool region -a principle calving area- show no increase in the numbers of mothers and calves using the area since 1985[104] and abundance in south-eastern Australia remains very low in comparison with expectations based on historical evidence of occupation[84].

In addition to abundance trends, spatial and temporal occupancy of habitat are important measures of the species recovery (see below).

Distribution, habitat occupancy and function

Southern right whales have a circumpolar distribution in the Southern Hemisphere between about 16°S and 65°S. Calving/nursery grounds occur in a broad latitudinal band between 16°S and 52°S[53]. Calving/nursery areas appear to be exclusively coastal, either off continental land masses or oceanic islands. These are occupied during late autumn, winter and early spring and other near-shore waters connecting calving/nursery areas are also occupied at that time. Foraging and feeding occurs in a similarly broad, but slightly more southerly latitudinal band between at least 32°S[84] and 65°S[85]. Foraging/feeding is coastal or offshore, depending on oceanographic features, although most is probably offshore associated with large-scale features such as the Sub-Tropical and Polar Fronts[15, 28, 63, 72].

Considerable latitudinal overlap of calving/nursing and foraging/feeding areas means that migration between the two is not necessarily one from lower to higher latitudes as traditionally thought. To date, satellite tagging indicates westward migration from Auckland Island wintering grounds[37]; both northward and southward migration from South African wintering grounds[26,64]; and southward migration from Australian (one tag) wintering grounds[3]. An offshore distribution is expected throughout the year for the component of the population that does not migrate to the coast in winter.

Temporal

In Australia, calving/nursery grounds are occupied from May to October (occasionally as early as April and as late as November), but not at other times. Female-calf pairs generally stay within the calving ground for 2–3 months[33]. Other population classes stay for shorter and variable periods[33], moving about more from place to place on the coast[31] and generally departing the coast earlier than female-calf pairs (most have left by September).

Coastal visitation varies between years probably due to cohort structured breeding and environmental variability[18, 83, 84]. Substantial changes in the number of whales recorded on the coast from year to year[18] and the absence of reproductively mature females in virtually all years between calving events, indicates that not all whales migrate to the coast each year[83]. The winter distribution of whales not appearing on the Australian coast is unknown, and the absence of reproductively mature females indicates that this winter distribution may include offshore breeding (conception) habitat.

Spatial

In Australian coastal waters southern right whales occur along the southern coastline of Australia including Tasmania, generally as far north as Sydney (33°53'S, 151°13'E) on the east coast and Perth (31°55'S, 115°50'E) on the west coast. There are occasional occurrences further north, with the extremities of range recorded as Hervey Bay (25°00'S, 152°50'E)[42] and Exmouth (22°23'S, 114°07'E)[13]. In coastal habitat these whales are generally within two kilometres off shore.

Across the coastal range spatial distribution is distinctly clumped and whales aggregate in predictable locations as illustrated in Section 4.2[17,18]. Aggregation areas are well known with the largest being Doubtful Island Bay area in WA (38°15'S, 119°32'E), Israelite Bay area in WA (33°37'S, 123°53'E) and Head of Bight in SA (31°28'S, 131°08'E); several

smaller established areas (regularly occupied) occur at Yokinup Bay in WA (33°53'S, 123°05'E) and the Warrnambool region in Vic (38° 25'S, 142°30'E); and emerging aggregation areas (sporadically used at present) occur at Flinders Bay (34°20'S, 115°15'E), Hassell Beach (34°49'S, 118°24'E), Cheyne/Wray Bays (34°32'S, 118°55'E), and Twilight Cove (32°17'S, 126°02'E) in WA, Fowlers Bay (31°59' 132°28'E) and Encounter Bay (35°35'S, 138°40'E) in SA[84]. A number of additional areas for southern right whales are emerging which might be of importance, particularly to the south-eastern population. In these areas, small, but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria; Great Oyster Bay and Frederick Henry Bay in Tasmania; Storm Bay and Sleaford Bay in South Australia; and Twofold Bay and Jervis Bay in NSW[48,60,91,104].

Calving aggregations occur over a wide environmental range, but habitat providing some degree of protection from prevailing weather conditions is generally preferred[84]. Southern right whales vary their habitat use according to local environmental conditions, optimising their distribution within aggregation areas on high energy coastlines to minimise exposure to rough sea conditions[84]. Depth is the most influential determinant of habitat selection at a fine-scale within aggregation areas, with whales preferentially occupying water less than 10 metres deep[84]. Habitat selection at a fine-scale is also affected by internal population factors, with differential use of habitat according to breeding status and behaviour[84].

Spatial recovery

Soviet whaling fleets are thought to have illegally taken over 3000 southern right whales in the 1960s[94], which is estimated to have removed more than half the remaining population and substantially delayed the recovery of the population [53, 87]. Habitat occupancy contracted substantially as a result of commercial whaling, and current Australian coastal distribution patterns are those of much depleted/remnant populations[84]. Although southern right whales are tolerant of a wide range of environmental conditions, are highly mobile, are recorded throughout their former known coastal distribution, and can form successful breeding aggregations in a range of habitats, their strong site fidelity and social cues are likely to constrain their capacity to establish regular aggregations in new or previously used locations, even where apparently suitable habitat is available[84]. So far, the increase in abundance has been reflected principally as an increase in whale numbers in already occupied aggregation areas in the south-west part of the range, although several additional areas are now emerging[84] and may become established as known aggregation sites.

In terms of spatial recovery the south-west population is recovering moderately well – three large, well established calving areas exist and there is evidence of a number of smaller and emerging calving areas being more regularly, if variably, occupied[84]. The south-east population, from Ceduna to Sydney, including Tasmania is not recovering well, with very low regular habitat occupancy, particularly when considered in relation to expectations from historical ecology[84]. Adequate suitable habitat is likely to be available in both the south-east and south-west, and since social cues and memory are likely to play a role in spatial recovery, it will be important to ensure that spatial recovery is facilitated in that context[84].

Migration and movements

As a highly mobile migratory species, southern right whales travel thousands of kilometres between habitats used for essential life functions. Australian coastal movements are reasonably well understood, but little is known of migration travel, non-coastal movements and offshore habitat use.

Southern right whales from the Australian coast are known to travel at least as far south as about 65°S[3, 14] presumably whilst foraging. Both non-calving and calving whales also move occasionally between Australia and sub-Antarctic New Zealand coastal habitat between years. The purpose of those movements is unknown[83].

On the Australian coast individual southern right whales use widely separated coastal areas (200–1500 kilometres apart) within a season, indicating substantial coast-wide movement[31, 58]. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 kilometres apart within a single season[31, 58]. Such movements indicate that connectivity of coastal habitat is important for southern right whales[84]. Connectivity may be disrupted temporarily or permanently by human activities[84] and as functional connections between habitat areas are essential, conservation planning should consider the importance of connecting habitat as well as aggregation areas.

Exactly where whales approach and leave the Australian coast from, and to, offshore areas is not well understood. A defined near-shore coastal migration corridor is unlikely given the absence of any predictable directional movement of

southern right whales such as that observed for humpback whales[84, 99]. A predominance of westward movements amongst long-range photo-identification re-sightings may indicate a seasonal westward movement in coastal habitat[31,50, 58]. More-or-less direct approaches and departures to the coast are also likely. Southern right whales are thought to be solitary during migration, or accompanied by a dependent calf or occasionally a yearling offspring. Culturally inherited fidelity to feeding areas, as is apparent for South American right whales[98], combined with the well known maternally directed and natal fidelity to breeding locations, may play a role in governing migratory travel in Australian populations.

4.2 Biologically Important Areas for the Southern Right Whale

Critical habitat under the EPBC Act is undefined for southern right whales. Through the development of marine bioregional plans, Biologically Important Areas (BIAs) have been identified for southern right whales. BIAs are not defined under the EPBC Act, but they are areas that are particularly important for the conservation of protected species and where aggregations of individuals display biologically-important behaviour such as calving, foraging, resting or migration. BIAs have been identified using expert scientific knowledge about species' distribution, abundance and behaviour. The presence of biologically-important behaviour is assumed to indicate that the habitat required for this behaviour is also present. The conservation status of southern right whales and the significance of southern Australian waters to this species suggest that the BIAs identified are necessary for southern right whales' essential life functions. These include:

- Large established aggregation areas used for calving and nursing - These are important for recovery as they currently contribute most to overall abundance increases by being the sites of highest calf production.
- Small and potentially emerging aggregation areas used for calving and nursing - These are important for recovery in terms of expanding the habitat occupancy of southern right whales and contributing to the maintenance of genetic diversity as site fidelity may lead to small scale genetic differences. These areas will contribute to overall population increases and enable calf production to regularly occur at a greater number of sites as recovery progresses.
- Coastal connecting habitat, which may also serve a migratory function or encompass locations that will emerge as calving habitat as recovery progresses (some locations within connecting habitat are occupied intermittently but do not yet meet criteria for aggregation areas).
- Historic high use areas or suitable habitat in parts of the coastal range currently not used or under-used and potentially important to support full spatial recovery.

Incidental sighting records suggest a number of additional BIAs for the south-eastern population of southern right whales are emerging, mostly within historic high use areas. These are areas of importance, where small, but growing numbers of mostly non-calving southern right whales regularly aggregate for short periods of time such as Peterborough, Port Campbell, Port Fairy and Portland in Victoria, east coast and southern Tasmania, including Great Oyster Bay, Frederick Henry Bay and Storm Bay, Sleaford Bay in South Australia, and Twofold Bay and Jervis Bay in NSW[48,60,91,104].

Maps presented later in this section identify these areas. Data for the maps were provided by Rebecca Pirzl, Skadia Pty Ltd under contract to the department. Additional data were provided by Mandy Watson, DSE Victoria. BIA maps and descriptions are available in the conservation values atlas at: www.environment.gov.au/coasts/mbp/atlas/index.html.

4.3 Attributes to be Monitored

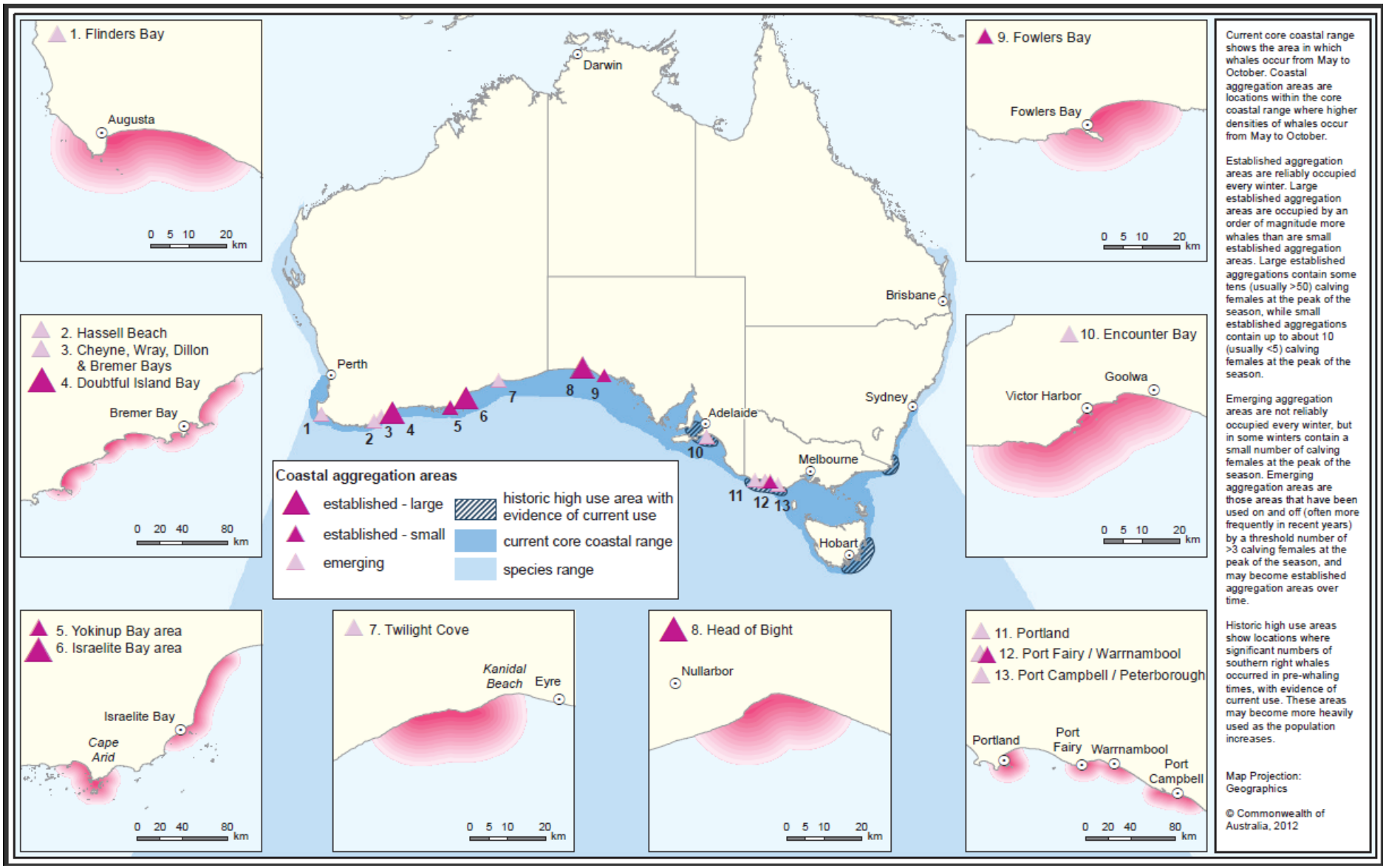
The abundance, population trend and habitat occupancy of both the south-east and south-west southern right whale populations will be monitored as indicators of recovery. These attributes have been selected as the most relevant attributes to investigate considering the current conservation status, life history and population structure of southern right whales in Australian waters.

Measuring population abundance and trends will require continuation of the ongoing monitoring started in 1976, with an annual data series required to ensure variability in coastal visitation caused by a three year reproductive cycle, and fluctuations in environmental or other conditions is appropriately considered[9]. Habitat occupancy is determined by the level of use of aggregation areas. Established aggregation areas are reliably occupied every year. Large established aggregations contain some tens (usually greater than 50) of calving females at the peak of the season, while small established aggregations contain up to about 10 (usually less than five) calving females at the peak of the season. Emerging aggregation areas are not occupied every winter, but in some winters contain a small number (around three) of

calving females at the peak of the season. Emerging aggregation areas are those areas that have been used on and off (often more frequently in recent years) by a small number of calving females, and so may become established aggregation areas over time. Historic high use areas show locations where significant numbers of southern right whales occurred in pre-whaling times, with evidence of current use. These areas may become more heavily used as the population increases.

See Section 1.2 for objectives and targets.

Figure 2: Coastal aggregation areas for southern right whales



5. THREATS

5.1 Description of Threats

A: Entanglement

Entanglements occur when whales inadvertently make contact with materials such as fishing lines, ropes and nets and parts of their body become tangled in the material. A minimum of one fatal entanglement and 12 non-fatal entanglements of southern right whales occurred during the period 1950–2006[57], however, this figure is likely to be an underestimate. Entanglement can also reduce the fitness of an individual by restricting mobility and impairing breathing, swimming or feeding ability. Entanglement in nets and lines often cause physical damage to skin and blubber. These wounds can then expose the animal to infection. Entanglement can also result in amputation, e.g. of a flipper or tail fluke, and death over a prolonged period.

As the number of whales increases, the potential for interactions between whales and material that may cause entanglement is likely to increase unless appropriate mitigation strategies are developed. Entanglement is unlikely to have population scale impacts in the south-west but the risk to the population is higher in the south-east, as any entanglement affecting mortality or fitness of even a low number of animals in that region may have a significant impact on recovery of this population. Studies of right whale mortality in the northern hemisphere show that entanglement is second only to vessel strike as being responsible for documented right whale deaths[36, 96].

Commercial fisheries or aquaculture equipment

During the period 1950–2010 the number of reported southern right whale entanglements in fishing gear increased. The source of much of the gear involved in entanglements was related to crustacean fishing[57] and the proximity of lobster fisheries to calving areas in south-east Australia is of concern. Recreational use of lobster pots may also be of concern. A southern right whale has died in Australian waters after becoming entangled in a longline[57]. At least one non-fatal entanglement involved a fish farm in Tasmania.

Marine debris

'Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris' has been listed as a key threatening process under the EPBC Act. Harmful marine debris consists of plastic garbage washed or blown from land into the sea, fishing gear abandoned by recreational and commercial fishers, and solid non-biodegradable floating materials (such as plastics) disposed of by ships at sea. In many existing southern right whale aggregation areas, such as the Great Australian Bight, the primary source of marine debris tends to be marine activities (shipping, remote industrial platforms etc). In possible expansion areas near cities around 75–80 per cent of marine debris comes from land based activities[44]. However, ingestion is thought to be unlikely in Australian coastal waters as whales are less likely to be feeding.

B: Vessel disturbance

Vessel disturbance can occur in the form of collisions or by disrupting the behaviour of animals, and the type of vessels involved can range from large commercial vessels to recreational vessels, including personal watercraft. Southern right whales appear to be the primary species involved in vessel collisions in the southern hemisphere although there are low numbers of recorded strikes in Australasian waters[100]. Vessel collision can lead to mortality or significant injury and vessel collision is one of the main reasons why the North Atlantic right whale population has failed to recover [34,67,96]. Although collisions in Australian waters are much rarer this does highlight the issue as one of concern, particularly as whale numbers increase and especially for the south-east population. Chronic disturbance leading to increased energetic costs as individual animals try to avoid vessels may result from activities such as boat-based whale watching, particularly by recreational boats.

Vessel collisions

Vessel collisions fall into four categories: indeterminate collisions with the bow or hull of a vessel where the animal suffers blunt trauma; bow bulb draping where animals become wedged on the front of ships; propeller strike; and collisions where animals bump into vessels.

There were two fatal vessel collisions and three non-fatal collisions with southern right whales recorded in Australian waters in the period 1950–2006[57], albeit this is likely to be under-reported and therefore an underestimate of the incidence of vessel collisions. Two additional fatal collisions with southern right whales were recorded in Australian waters in the period 2007–2010 in Australia's report on ship strikes to the IWC.

Vessel collision is a greater risk for southern right whales when they are in the coastal zone due to the higher probability of encountering vessels. It is likely that this risk will increase as shipping traffic grows and the impact on an individual, especially in south-east Australia, is likely to have a significant, potentially population-scale effect, if further evidence confirms this as a small demographically discrete population.

Whale Watching

Commercial whale watching is recognized by the IWC and others as a potentially "sustainable use" of whales and other cetaceans and as an activity that provides significant flow-on benefits for whale conservation and the preservation of the marine environment. However, concerns have been raised about collisions and disturbance from boat noise[45], particularly in regard to the impact on resting mother and calf pairs. Repeated exposure of individuals with long residency periods may also be problematic. Detailed analysis of the behavioural response of southern right whales to boats in Australian waters is not yet available but boat avoidance has been demonstrated in other areas[63].

Commercial and private boat based whale watching targeting southern right whales is currently located primarily in Flinders Bay and off Albany in southern Western Australia, around the Fleurieu Peninsula in South Australia, in south-west Victoria off Portland, Port Fairy and Warrnambool (although an exclusion zone around Logan's Beach applies) and in Eden, New South Wales. Opportunistic whale watching also occurs in Tasmania, Western Australia and New South Wales. As opportunistic whale watching occurs where the numbers of whales are lowest and most inconsistent, there may be a more significant impact on the animals if the activity causes disturbance and is not actively managed.

Whale watching from low-flying aircraft and helicopters also has the potential to cause disturbance, particularly to mother and calf pairs that spend a significant amount of time at the surface in geographically constrained calving areas.

C: Whaling

The impacts of commercial hunting on southern right whales have been well documented. While currently banned under the IWC moratorium on commercial whaling and due to classification by the IWC of all southern right whale populations as Protected Stocks, the potential for other countries to recommence commercial whaling exists and pressure may well increase as the population recovers.

An additional area of concern is the potential expansion of lethal whaling purportedly undertaken under Article VIII of the International Convention for the Regulation of Whaling. That provision allows member states to issue special permits to kill, take and treat whales for purposes of scientific research. Since 1986, Japan and Iceland have issued special permits for several whale species as part of their purported scientific whaling research programs. Part of Japan's lethal whaling program has taken place in the area covered by the Southern Ocean Sanctuary, which is also where Southern Right Whales occur.

While not likely in the near future, there is no guarantee that right whales will not be included in Japan's or some other country's lethal whaling programs at some point in the future.

D: Climate variability and change

There is evidence that climate variability affects reproductive output in southern right whales calving in Australia[83] and South America[56], with El Niño events being shown to lead to decreased calf production in a later year. Environmental fluctuations probably impact on reproduction by affecting body condition/ health through changes in foraging conditions. Measuring responses to shorter-term climate variability provides insight into the possible effects of longer-term climate

change, and indicates that southern right whales may be sensitive to warming events. The likelihood of a negative impact from climate change is hard to quantify as much is unknown about the impact of climate change on Southern Ocean ecosystems and the food webs on which southern right whales rely.

Significant changes in the Southern Ocean may alter ecosystem trophic interactions and reduce prey availability. Southern right whales rely on krill and copepods as a major food source and require adequate supplies of food to accumulate energy reserves for migration and breeding. Changes to climate and oceanographic processes may also lead to decreased productivity and different patterns of prey distribution and availability. Such changes would certainly affect dependant predators such as southern right whales. The extent to which dietary shifts could compensate for any reduction in krill availability is unknown. Currently, the krill fishery is managed through the CCAMLR on an ecosystem basis, which takes into account the needs of predators such as whales, and fishing is believed to occur well within precautionary limits[41,68,69,71].

Climate change is also predicted to increase ocean acidification which may affect the calcium carbonate structure of animals at the base of the southern right whale food web. This may in turn affect prey availability. The consequences of any negative response may be substantial because climate change impacts would likely be broad-scale and population-wide with no option for mitigation in a suitable timeframe.

E: Noise interference

Noise in the marine environment is a recognised threat to marine mammals[4, 93]. Loud noises or long exposure can lead to call masking, interrupting communication between individuals. Although the extent of vocal communication in breeding areas is unknown, right whales are known to respond to high noise conditions by changing the frequency and volume of calls, call duration, and call rate[38, 73, 74]. Noise may make preferred habitats and migration routes less suitable and, in extreme situations, can cause physical damage[84].

Noise interference is of particular concern within or close to southern right whale aggregation areas where young calves are present and whales are resident for long periods of time. Noise may also deter whales from establishing aggregations in otherwise suitable but currently unused habitat and disrupt migratory movements, thereby preventing individuals from using preferred habitats.

Potential forms of noise interference in Australian southern right whale habitat include seismic and drilling exploration operations, mining, some types of dredging, infrastructure construction and operation (particularly pile driving and explosives), defence activities (particular exercises using low and mid frequency sonar), vessel noise, and low flying airplanes and helicopters.

Some forms of noise will be temporary (e.g. during construction of onshore and offshore facilities) while some forms may effectively be permanent (e.g. ongoing mining operations). The impacts of cumulative impacts of all sources of noise interference need to be considered, particularly in or near current and emerging aggregation areas and migration routes.

Seismic surveys

Seismic surveys used for oil and gas exploration, are one of the main sources of noise interference in the marine environment. Impacts can be classified as physical (e.g. permanent or temporary hearing loss), which can occur only if individuals are very close to the seismic survey, and behavioural (e.g. avoiding key aggregation areas, disruption to calving behaviour, stress), which may occur many kilometres from the seismic survey, and may have the potential to impact on many individuals at one time.

As migratory movements to and from the calving grounds remain unknown, individuals may currently be exposed to noise interference from seismic surveys, however the risk of physical impacts is minimised by implementation of the practical measures outlined in the seismic guidelines.

While the seismic guidelines advise that seismic surveys should be undertaken outside of biologically important areas at biologically important times, it is not known at what distance from a seismic source, behavioural impacts may occur or the extent of any behavioural impact. A seismic survey has the potential to have behavioural impacts on many individuals at one time, should the survey lead to behavioural effects in calving or aggregation areas.

Chronic and acute industrial noise

An increasing potential risk is interference from construction noise from onshore and offshore developments. This can include the exploration and development of oil and gas infrastructure, marinas, or new or expanding port facilities. Acute noise comes from activities such as pile driving, some forms of dredging, use of explosives, blasting, and sonar. Sources of chronic noise include drilling, tender vessels, laying pipelines etc. Some noise is temporary but some activities or development produce continuous, loud noise in the marine environment (chronic noise) e.g. mining units that operate on the ocean floor or in the water column have the potential to produce large amounts of noise[7]. Attenuation of noise and therefore the scale of any impact will vary depending on the volume and frequency of the sound and the dispersal characteristics of the local environment.

New forms of industry with the potential to create underwater noise include near-shore renewable energy technologies such as wind farms and tidal turbines, and further work on the underwater noise levels produced from these developments is needed.

Shipping noise

Chronic noise exposure is primarily due to increased shipping activity, including the use of tender vessels. Over 45 000 port calls per year are made in Australian southern right whale habitat areas, particularly in the south-east[2]. Shipping movements in south-eastern Australia are highest in areas that the animals will need to expand into if the south-east population is to recover.

Aircraft noise

Low-flying airplanes and helicopters, such as those used for scenic tours or naval exercises, propagate large amounts of sound along the ocean surface and into the water column. The volume and extent of propagation vary depending on the type of aircraft and the length of time the aircraft is in the area[62]. Although these sounds are usually of short duration and limited to the area below the aircraft, these sound sources could have an impact in areas of high aggregation or where there is repeated exposure, especially when whales are spending significant time at the surface, e.g. resting mother and calf pairs.

F: Habitat modification

Habitat modification can result in a range of impacts from physical displacement of individuals to minor disturbances which, if long term or disruptive to the breeding cycle, can ultimately reduce a population's fitness.

Infrastructure / coastal development

Habitat modification through the development of infrastructure such as ports, marinas, aquaculture facilities, and marine/ocean energy production facilities could lead to the physical displacement of southern right whales from preferred habitats and disrupt movements. This displacement has the potential to reduce breeding success[27] by forcing animals to reproduce in more marginal environments and by increasing their exposure to other risks such as entanglement, predation, vessel disturbance and pollution. Associated industrial activities in the coastal zone may also reduce habitat suitability.

Chronic chemical pollution and acute chemical discharge

Southern right whales may be exposed to pollution and high nutrient loads both during their time in Australian waters and on their feeding grounds, although the extent and implications of this exposure remain largely unknown. However, given that southern right whales feed primarily in the mid-high latitudes waters of the southern ocean, the impact of toxins from chemical discharge is likely to be low.

While in Australian waters they may encounter chemical pollution in the form of sewage and industrial discharges, and run off from onshore activities such as agriculture. This is most likely to create impacts in coastal aggregation areas. In their feeding grounds they are most at risk from bioaccumulation of human-made chemicals such as organochlorines most commonly from herbicides and pesticides and industries such as dry cleaning, tanneries and electrical equipment.

Southern right whales could also be exposed to acute chemical discharge, such as from accidental oil or condensate spills from oil rigs and other at sea operations.

G: Overharvesting of prey

Southern right whales rely on krill and copepods as a major food source and require adequate supplies of food to

accumulate energy reserves for migration and breeding. Depletion of prey through over harvesting may be a potential future threat for the Australian population of southern right whales. Changes to climate and oceanographic processes may also lead to decreased productivity and different patterns of prey distribution and availability. Such changes would certainly affect dependant predators such as southern right whales. The extent to which dietary shifts could compensate for any reduction in krill availability is unknown. Currently, the krill fishery is managed through the CCAMLR on an ecosystem basis which takes into account the needs of predators such as whales, and fishing is believed to occur well within precautionary limits[41,68,69,71].

5.2 Threat Prioritisation

Each of the threats outlined above has been assessed using a risk matrix in order to determine their impact on each of the south-west and south-east populations. This in turn determines the priority for action outlined in Section 6. The risk matrix considers the likelihood of occurrence of a threat relevant to southern right whales, and the consequences of that threat or impact considering existing mitigation measures. The precautionary principle dictates that the threat category is determined by the group at highest risk. Population-wide threats are generally considered to present a higher risk but the low numbers in the south-east population mean that threats acting at the individual level may also present a high risk for that population.

The risk matrix uses a qualitative assessment drawing on peer reviewed literature and expert opinion. Levels of risk and the associated priority for action are defined as follows:

- Very High – immediate additional mitigation action required
- High – additional mitigation action and an adaptive management plan required, the precautionary principle should be applied
- Moderate – obtain additional information and develop additional mitigation action if required
- Low – monitor the threat occurrence and reassess threat level if likelihood or consequences change.

Table 4: Risk Prioritisation

Likelihood of occurrence (relevant to species)	Consequences				
	No long-term effect	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Moderate	Very high	Very high	Very high
Likely	Low	Moderate	High	Very high	Very high
Possible	Low	Moderate	High	Very high	Very high
Unlikely	Low	Low	Moderate	High	Very high
Rare or unknown	Low	Low	Moderate	High	Very high

Categories for likelihood are defined as follows:

- Almost certain – expected to occur every year
- Likely – expected to occur at least once every five years
- Possible – might occur at some time
- Unlikely – such events are known to have occurred on a worldwide basis but only a few times

- Rare or unknown – may occur only in exceptional circumstances; OR it is currently unknown how often the incident will occur.

Categories for consequences are defined as follows:

- No long-term effect – no long-term effect on individuals or populations
- Minor – individuals are affected but no affect at population level
- Moderate – population recovery stalls or reduces
- Major – population declines
- Catastrophic – population extinction.

Table 5: South-west Population Residual Risk Matrix

Likelihood of occurrence (relevant to species)	Consequences				
	No long term effect	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain		Commercial fisheries or aquaculture equipment Shipping noise* Whale watching	Seismic surveys*		
Likely		Chronic industrial noise* Infrastructure/ coastal development			
Possible		Marine debris Vessel Collisions Acute Industrial noise Aircraft noise		Climate variability and change	
Unlikely		Chronic chemical pollution Acute chemical discharge		Whaling#	
Rare or unknown			Overharvesting of prey		

* Given the behavioural impacts of noise on southern right whales are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

Within the Australian Whale Sanctuary it is an offence to kill, injure, take, trade, keep, move or interfere with a cetacean. Currently no country is whaling southern right whales.

Table 6: South-east Population Residual Risk Matrix

Likelihood of occurrence (relevant to species)	Consequences				
	No long term effect	Minor	Moderate	Major	Catastrophic
Almost certain		Whale watching Shipping noise *	Seismic surveys *		
Likely			Infrastructure/ coastal development Acute Industrial noise Chronic industrial noise Commercial fisheries or aquaculture equipment		
Possible		Marine debris Aircraft noise	Vessel Collisions	Climate variability and change	
Unlikely		Chronic chemical pollution Acute chemical discharge		Whaling[#]	
Rare or unknown			Overharvesting of prey		

* Given the behavioural impacts of noise on southern right whales are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

Within the Australian Whale Sanctuary it is an offence to kill, injure, take, trade, keep, move or interfere with a cetacean. Currently no country is whaling southern right whales.

6. ACTIONS

6.1 Summary and Implemented Actions

The aim of this section is to prioritise activities that will assist recovery of southern right whales and support achievement of the Interim Recovery Objectives. It is recognised that during the life of the plan new issues may arise or knowledge may increase requiring change to some of the priorities listed here. Where appropriate the Australian Government will work with key stakeholders in each area to develop implementation plans for groups of actions.

Table 7: How recovery actions address interim recovery objectives and threats

Interim Objective	Threats Addressed	Recovery Targets	Actions Area	Priority
			A: Assessing and Addressing Threats	
1, 2, 4, 5	A, B, C, D, E, F, G	1,1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A.1: Maintain and improve existing legal and management protection	Very High
1, 2, 4, 5	B, E, F	1,1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A.2: Assessing and addressing anthropogenic noise: shipping, industrial and seismic surveys	Very High
1, 2, 4, 5	A	1,1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A.3: Reducing commercial fishing entanglements	Very High
1, 2, 3, 4, 5	D, F	1,1, 1.2, 2.1, 2.2,3.1, 3.2, 3.3, 4.1, 5.1, 5.2	A.4: Impacts of climate variability and change	High
1, 2, 4, 5	B	1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A.5: Addressing vessel collisions	High
1, 2, 4, 5	A, B, E, F	1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A.6: Addressing infrastructure and coastal development impacts	High
			B: Measuring Recovery	
1, 2, 3, 4	A, B, C, D, E, F, G	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1	B.1: Measuring and monitoring population recovery	Very High
1, 2, 3, 5	D, F	1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 3.3, 5.2	B.2: Investigating two-population model	High

Interim Objective	Threats Addressed	Recovery Targets	Actions Area	Priority
3, 4, 5	A, B, C, D, E, F, G	3.3, 4.1, 5.1, 5.2	B.3: Understanding offshore distribution and migration	High
1, 2, 3, 4, 5	A, B, D, E, F	1.1, 2.1, 2.2, 3.3, 4.1, 5.1, 5.2	B.4: Characterising behaviour and movements	High

Existing management actions

Australia has a long-standing commitment to the conservation and management of cetaceans. While this plan focuses on actions to be undertaken to improve the recovery of southern right whales, it is important to recognise the context of existing international agreements and national mitigation / management measures that are important to southern right whale recovery. These include:

- Combating climate change - meeting Australia's international commitments for the reduction in greenhouse gas emissions and ensuring any new research linking impacts of climate change and / or climate variability on southern right whale is provided to relevant sections within the Australian Government and the Intergovernmental Panel on Climate Change.
- International Whaling Commission (IWC) - ensuring that southern right whales receive appropriate levels of protection outside Australian waters through involvement in the IWC and improving understanding and management of all southern hemisphere right whale populations.
- Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) - monitoring and managing the potential impacts of prey depletion due to over-harvesting and supporting regional ecosystem approaches to krill management.
- Australian Whale Sanctuary - maintaining the legislative protection afforded to southern right whales by the Australian Whale Sanctuary.
- Marine bioregional planning - increasing our understanding and improving our management of Australia's unique marine environment as well as improving the way decisions are made under the EPBC Act. For example, each bioregional plan will describe regional conservation values, including threatened species such as the southern right whale thereby contributing to their recovery and protection by supporting strategic, consistent and informed decision making and providing a framework for strategic intervention and investment by government. Importantly, the plans will contribute towards a more preventive approach to managing the environmental impacts of human activities. People planning to undertake activities within a marine region can use the information provided in marine bioregional plans and supporting information tools to determine how to mitigate the potential environmental impacts of their proposal and whether their proposal should be referred in accordance with the EPBC Act.
- Marine reserves - ensuring that southern right whale habitat requirements are considered in the establishment and management of marine conservation areas and reserves through the Commonwealth marine bioregional planning process and through state and territory processes.
- EPBC Act Referrals - ensuring that proposals are adequately assessed and reviewed and that appropriate measures are in place to mitigate any potential impacts on southern right whales from approved activities, including using the seismic guidelines. Under the referrals process, proposed seismic surveys may also have timing restrictions imposed such that the survey cannot take place in the vicinity of southern right whale calving areas during the southern right whale calving period.
- State and territory legislative arrangements - regulating activities occurring in state or territory waters.
- State and territory government partnerships - working with state and territory governments to improve knowledge and maintain and improve existing protection for southern right whales. Partnerships include data sharing,

community awareness raising, whale watching regulations, seasonal closures (such as the closures at the Head of Bight and Logans Beach at Warrnambool), the Development of a National Guidance Document for Cetacean Incidents (disentanglement, strandings and euthanasia), support for the informal national disentanglement network, standardising relevant legislation and cross-jurisdictional processes, management of coastal development and the necropsy of carcasses, including retaining genetic samples for population analyses. New initiatives include activities such as the state- based development of seismic survey guidelines currently occurring in Western Australia and Victoria. The Australian Government will work with state and territory agencies to develop agreement on the roles and responsibilities of each partner in implementing recovery actions for southern right whales.

Existing research actions

At the time of writing, the following southern right whale research projects that will improve knowledge on key threats and provide information that will be required for future recovery actions were completed or underway. These include:

- Monitoring population dynamics of right whales off southern Australia – continuing long-term monitoring for the south-west population.
- Census and photo identification at Head of Bight, South Australia – continuing a long-term photo-identification and breeding site census at Head of Bight, South Australia.
- Surveys of the south-east region - status, structure and distribution of southern right whales in south-east Australia - improving understanding of status of the population within south-east Australia via ongoing collection and analysis of genetic samples and photo-identification data.
- Australasian Right Whale Photo-identification Catalogue – producing a single Australasian southern right whale photo-identification catalogue to assist in combining the current Australian photo-identification datasets and gain further knowledge about southern right whale movements[81, 101].
- Habitat use and distribution patterns of southern right whales and sperm whales discerned from spatial analyses of 19th century whaling records – developing a spatially and temporally explicit model over large scales that is capable of reliable predictions of modern-day habitat use and potential resettlement areas.
- Southern right whales and stable isotopes: Research to define southern right whale habitat and trophic ecology – designed to investigate the use of stable isotopes in skin collected during biopsies of free-ranging whales to identify the foraging grounds and trophic level of primary prey species at those foraging grounds.

Assessing and addressing threats

Action Area A.1	Priority
Maintain and improve current levels of legal and management protection	Very High
Action	
Continue or improve existing legislative management actions as listed under sections 1.1, 2.1, 2.2 and 6.1.	
Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A, B, C, D, E, F, G
Description	
Refer to discussion of domestic and international protection regimes in sections 1.1, 2.1, 2.2 and 6.1 of this Plan. Within the life of this Plan *Measure of success:* Australia continues to implement domestic legislation to protect southern right whales and actively promote appropriate protection for southern right whales outside Australian waters through involvement in the IWC. *Risks*: Changes to environmental assessment processes may result in inconsistent approaches to mitigating the impacts of threats to southern right whales. This risk may be mitigated by continuing communication with state agencies and industry through bi-annual meetings. *Likelihood of success:* Moderate-High	

Action Area A.2	Priority
Assessing and addressing anthropogenic noise	Very High

Action

Improve the understanding of what impact anthropogenic noise may have on southern right whale populations by:

a) assessing anthropogenic noise in key calving areas
b) assessing responses of southern right whales to anthropogenic noise
c) if necessary, developing further mitigation measures for noise impacts.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	B, E, F

Description

Management practices included in the Seismic Guidelines focus on the prevention of temporary or permanent injuries to the hearing of large baleen whales. In respect to behavioural impacts, rather than specific management practices, the seismic guidelines advise that seismic surveys should be undertaken outside of biologically important areas at biologically important times, otherwise they may require further assessment under the *EPBC Act*. Although there is increasing body of science assessing the behavioural response of whales to anthropogenic sound, knowledge in this area is still limited. In particular, very little is known about the sensitivity of southern right whales to anthropogenic noise and so there is a need to better understand:

- acoustic properties of preferred aggregation areas
- southern right whale responses to sound, including vessel noise and seismic surveys
- overlap between southern right whale distribution and potential sources of significant anthropogenic sound.

Within the life of this plan

Measure of success: An improved understanding of the exposure and behavioural responses of nursing and migrating southern right whales to various forms of anthropogenic sound.

Risks: Due to the difficulties in assessing the long-term impacts that sound may have on aspects such as fitness and habitat occupancy, definitive statements about life-history effects may still not be possible.

Likelihood of success: Moderate

Action Area A.3	Priority
Reducing commercial fishing entanglements	Very High

Action

Minimise the risk of entanglements by:

a) where necessary, exploring with the crustacean and cephalopod (primarily octopus) fishing industries the option to develop codes of conduct that minimise interactions between commercial fishers and southern right whales

b) improve reporting for entanglement incidents for all fisheries likely to interact with southern right whales

c) investigate alternative fishing techniques and technologies to reduce the risk of entanglement.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A

Description

At least five entanglements since the 1980s are likely to be a result of interactions with crustacean fishing operations and the use of pots in operations for octopus fishing is growing, and it is possible that other incidents have not been reported. These industries operate primarily within state waters and are managed under state legislation, however any industry that wishes to export product must also obtain a Wildlife Trade Operation (WTO) approval and any interaction with cetaceans triggers provisions under the EPBC Act. WTO approvals last for a maximum of three years providing an opportunity for the Australian Government to work with state governments and industry to develop appropriate mechanisms for minimising entanglements.

A code of conduct for industry (potentially based on examples of rock lobster fisheries from Western Australia and Victoria) aimed at reducing entanglements should assist. The code may also consider adopting strategies to reduce entanglements in commercial crustacean fishing industries developed in North America. To successfully measure the implementation of the code of conduct, improved reporting of entanglements will be required. This will also allow an appropriate disentanglement response to be implemented when required.

Within the life of this plan

Measure of success: Codes of conduct developed by relevant state governments and relevant fishing sectors to minimise the risk of entanglement. Improved entanglement reporting system in place.

Risks: Not all relevant fisheries approvals may be due for WTO renewal at a time that allows for the development of an agreed Code of Conduct within the life of this plan and the voluntary nature of the Code would need to be monitored for effectiveness.

Likelihood of success: Moderate

Action Area A.4	Priority
Preparing for potential impacts of climate variability and change	High
Action	
Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.	
Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 5.1, 5.2	D, F
Description	
Climate change has the potential to change the productivity of the Antarctic region and impact the recovery of southern right whales. Cetaceans in the Southern Ocean will be directly impacted by changes in sea ice patterns, sea temperature as well as indirectly by changes in their principal prey, Antarctic krill. Australia's broader actions to combat climate change and regulate the krill fishery in Antarctica will play a role in the recovery of southern right whales. Australia's commitments to combating climate change and participation in the Convention on the CCAMLR are described in section 6.1.	
Within the Life of this Plan	
Measure of success: Australia continues its commitment to combat climate change and retains strong engagement within the CCAMLR to regulate the krill fishery in Antarctica. *Risks*: It is unclear to what extent southern right whales will be able to adjust to the impacts of climate change. *Likelihood of success:* Moderate	

Action Area A.5	Priority
Addressing vessel collisions	High

Action

Develop a national ship strike strategy that quantifies vessel movements within the distribution ranges of southern right whales and outlines appropriate mitigation measures that reduce impacts from vessel collisions.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	B

Description

Reducing ship strike mortality can be most easily done either by reducing vessel speed or by separating vessels and whales. The majority of information needed to identify commercial shipping movements is already available through the Automatic Identification System (AIS) data of the Australian Maritime Safety Authority (AMSA). Working with AMSA, it will be possible to map international and domestic shipping routes that affect southern right whale aggregation areas and understand vessel transit times and speeds within these areas. It will then be possible to identify the degree of overlap between shipping channels and southern right whale habitat and, if necessary, whether there are any alternative shipping routes available and whether speed limitations need to be considered in specific regions during southern right whale occupancy.

Within the life of this plan

Measure of success: Completion of nationally agreed ship strike strategy.

Risks: It is likely that mapping can be complete within the time frame of this plan but subsequent actions to adjust vessel movements and speed may fall outside of this plan period. Further, expanding aggregation areas and changes to shipping priorities may mean that this information quickly becomes out of date.

Likelihood of success: Moderate

Action Area A.6	Priority
Addressing infrastructure and coastal development impacts	High

Action

Principle actions addressing impacts of coastal development are covered under anthropogenic noise and shipping collisions.

Improve management systems designed to minimise the impact of infrastructure development and operation and coastal development on southern right whales, by ensuring that existing information about coastal habitat requirements, environmental suitability of coastal locations, historic high use and emerging areas is available to coastal planning and approvals areas in all levels of government.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 4.1, 5.1, 5.2	A, B, E, F

Description

The most effective way to protect southern right whales from inappropriate infrastructure and coastal development is to ensure that habitat requirements are considered at an early stage of development applications. This means relevant information should be available at local levels in a readily accessible format, e.g. guidelines supported by geographic information system spatial layers. Once information on offshore distribution is available there will be a need to update this information to ensure all biologically important areas are considered.

Within the life of this plan

Measure of success: Planning and approvals sections of all levels of government are provided with southern right whale habitat requirement information.

Risks: Competing priorities are taken into consideration in planning and assessment processes. Changes to environmental assessment processes may result in inconsistent approaches to mitigating the impacts of threats to southern right whales. These risks may be mitigated by continuing regular meetings with state agencies and industry.

Likelihood of success: Moderate

Measuring recovery

Action Area B.1	Priority
Measuring and monitoring population recovery	Very High

Action

Continue to obtain and refine population abundance and trends for the south-west population and develop firm population and rate of increase estimates for the south-east population. This can be implemented by the following projects:

a) Maintain long-term aerial survey and photo-identification monitoring of the south-west coastal region (Cape Leeuwin to Ceduna) on an annual basis.

b) Initiate long-term aerial survey and photo-identification monitoring of the south-east coastal region (Ceduna to Sydney including Tasmania) on an annual basis.

c) Build and populate a Right Whale Photo-Identification Catalogue.

d) Continue monitoring the population at Head of Bight.

e) Review the conservation status of southern right whales against threatened species listing criteria under the EPBC Regulations.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 5.1, 5.2	A, B, C, D, E, F, G

Description

Long-term monitoring is required to understand ongoing population abundance estimates, trends, spatial distribution, and occupancy of coastal habitat. It is important to maintain an annual data series, given the variability in coastal visitation caused by a three year reproductive cycle, fluctuations in environmental or other conditions and to maintain consistency with existing data collection[10]. Monitoring should include detailed information on the reproductive output of southern right whales, quantitative information on the number and age class of right whales using coastal waters including aggregation areas, and broad-scale spatial distribution and habitat occupancy information. This information is necessary to review the conservation status of southern right whales under the EPBC Act.

Within the life of this plan

Measure of success: Recovery targets developed for each population based on population estimates, rates of recovery and habitat occupancy of each population.

Risks: The monitoring can be completed within the time frame of this plan. The lack of a long term data set for the south-east population may make it difficult to obtain an absolute measure of some parameters for that population within the life of this plan, but establishing the long-time series dataset will assist to ameliorate the problem in the life of the next plan and provide interim indications of use levels.

Likelihood of success: Moderate - High

Action Area B.2	Priority
Investigating two-population model	High

Action

Carry out comprehensive genetic and photographic identification studies to further investigate differences between the south-eastern and south-western populations of southern right whales within Australian waters including:

a) determining the nature and degree of differences between the south-eastern and south-western populations and implications for population recovery
b) ascertaining rates of genetic interchange amongst the south-east and south-west populations
c) ascertaining geographic range and habitat occupancy for the two populations
d) improving the understanding of interchange between populations from Australia and New Zealand waters.

Recovery Targets Addressed	Threats to be Mitigated
1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 3.3	D, F

Description

This action is fundamental to effective conservation management of southern right whales in Australian waters. Research, including further genetic analysis on increased sample sizes and photo identification, to define population boundaries will be necessary to better understand the appropriate management unit for southern right whales in Australian waters and the likely effect of impacts on the overall Australian population and on individual populations in Australian waters. This information will ensure recovery efforts are appropriately targeted.

Within the life of this plan

Measure of success: Southern right whale populations delineated and genetic interchange defined.

Risks: New research begun during the life of this plan may not be completed during the life of this plan.

Likelihood of success: High

Action Area B.3	Priority
Understanding offshore distribution and migration	High

Action

Investigate the offshore distribution of southern right whales, specifically:

a) offshore distribution within Australian waters

b) movements between feeding and breeding grounds

c) winter distribution of the component of the population that does not migrate to the Australian coast.

Recovery Targets Addressed	Threats to be Mitigated
3.3, 4.1, 5.1, 5.2	A, B, C, D, E, F, G

Description

Currently there is limited knowledge of southern right whales' non-coastal distribution in Australian waters and how they approach the Australian coastline on migration between feeding and breeding grounds. Biologically Important Areas (identified in marine bioregional plans) include aggregation, calving and coastal corridor areas, but vital life functions such as feeding and mating are occurring outside these regions. Without knowledge of the areas being used, it is difficult to provide appropriate advice to industry on the likelihood of encountering southern right whales in Australian waters. This increases the risk of approving new maritime activities without sufficient safeguards. Increased understanding of offshore distribution and migratory movements through satellite tracking for example, would address this information gap. This action will increase the ability to minimise anthropogenic threats to individuals and the population outside the coastal zone.

Within the life of this plan

Measure of success: Indicative maps and/or models providing improved information about offshore distribution and migratory movements between breeding and feeding grounds are developed.

Risks: It may be difficult to generalise offshore distribution from small samples and a very large effort may be required to develop a comprehensive picture of migratory movements and offshore distribution.

Likelihood of success: Moderate – low

Action Area B.4	Priority
Characterising behaviour and movements	High
Action	
Extend behavioural studies and further review existing behavioural and fine-scale movement data to characterise behaviours and movements that may be affected by the known and potential threats identified in this plan.	
Recovery Targets Addressed	Threats to be Mitigated
1.1, 2.1, 2.2, 3.3, 4.1, 5.1, 5.2	A, B, D, E, F
Description	
At present the capacity to monitor impact on southern right whales from human activities is hampered by the lack of a robust baseline for behaviour in the absence of human activities. Studies elsewhere have demonstrated behavioural changes in response to human activities, particularly in response to noise, but the scale of these impacts in Australian waters and the biological significance of any changes remain unknown. This action addresses that information gap.	
Within the life of this plan	
Measure of success: Behaviour in coastal habitat in the absence of human activity is characterised. *Risks*: Minimal *Likelihood of success*: High	

Cumulative impact

Successful ongoing management of southern right whale populations will require the consideration of the cumulative impact of the threats listed here. Consideration of the impacts of infrastructure and coastal development in particular, will require assessment to be made in the context of other activities in the region.

6.2 Reporting Process

A comprehensive monitoring regime for this Conservation Management Plan includes two aspects:

1. monitoring of the population
2. monitoring of the progress of actions in the plan and detailing the adaptive management for the next plan.

Monitoring the population

Monitoring of the population will occur if Action Areas B1 and B2 are undertaken. The aim of this monitoring is to understand the extent of habitat occupancy and at what rate, if any, each population is increasing, remaining stable, or decreasing over time. This will determine whether the objectives of recovery, as defined in Section 1.2 of this document, are being met.

An important complement to this monitoring is the development of an adaptive management regime for the population. Should it be found that numbers of southern right whales start to decrease or increase at a slower rate, it will be necessary to identify the causes of this change and determine whether additional management action needs to be taken. A series of thresholds will be developed during the life of this plan, at which review or changes to management measures must be undertaken will be developed.

Monitoring progress towards Conservation Management Plan actions

Monitoring of the plan itself will require tracking the progress of actions designed to improve management of the population and reduce threats. To facilitate this, a midterm review of the plan will be conducted. This review will use the measures of success for each action area to identify which actions have been completed, which are underway, which are on track for completion by 2016 and which actions have not been sufficiently progressed.

Data management

Data collected on southern right whales in Australia to date falls into the following categories:

- Sightings data
- Photo-identification data
- Georeferenced broad-scale (range wide) and fine-scale (within aggregations) spatial distribution data
- Genetic samples
- Behavioural data
- Stranding, entanglement and injury data
- Skeletal material and other tissue collections
- Satellite tag data.

Currently data are archived principally by individual researchers and/or research organisations and government agencies. Metadata for southern right whale datasets are listed in the Report of the National Southern Right Whale Workshop, Hobart 2009. New data collection is summarised annually in Australia's Progress Report to the IWC.

Linkages between datasets are improving. A centralised database for stranding and sightings data is being built by the AMMC. An Australasian Right Whale Photo-Identification Catalogue is currently being developed. The catalogue's purpose is to integrate southern right whale photo-identification collections and related data in Australia and New Zealand so that data are archived and accessible from one web-based portal.

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