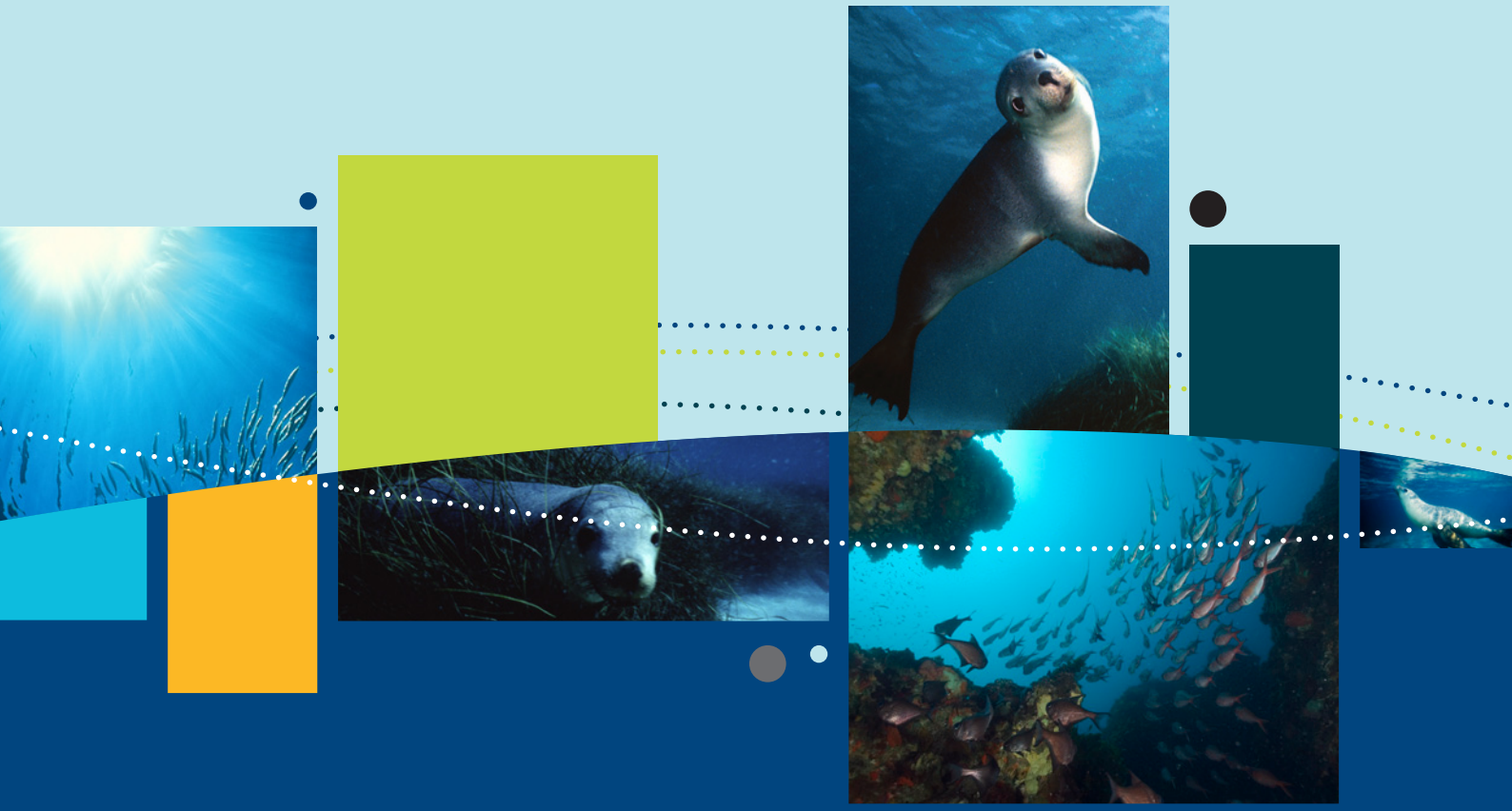
Australian Government

Department of Sustainability, Environment,
Water, Population and Communities



Species group report card –pinnipeds

Supporting the marine bioregional plan for the South-west Marine Region

prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

Disclaimer

Images:
Striped marlin and sardines – Bill Boyce, Australian Marine Life – David Muirhead (MLSSA), Australian Marine Life – David Muirhead (MLSSA), Swallow Tail Reef – Glen Cowan, Sea lion – Glen Cowan , Swallow Tail Reef – Glen Cowan, Southern calamari squid – Anthony King, Blue whale – DSEWPaC, Sea lion – Glen Cowan, Tern common – Richard Freeman

CONTENTS

SPECIES GROUP REPORT CARD—PINNIPEDS

Supporting the marine bioregional plan for the South-west Marine Region
prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

Report cards

The primary objective of the report cards is to provide accessible information on the conservation values found in Commonwealth marine regions. This information is maintained by the Department of Sustainability, Environment, Water, Population and Communities and is available online through the department's website (**www.environment.gov.au**). A glossary of terms relevant to marine bioregional planning is located at **www.environment.gov.au/marineplans**.

Reflecting the categories of conservation values, there are three types of report cards:

- species group report cards
- marine environment report cards
- heritage places report cards.

While the focus of these report cards is the Commonwealth marine environment, in some instances pressures and ecological processes occurring in state waters are referred to where there is connectivity between pressures and ecological processes in state and Commonwealth waters.

Species group report cards

Species group report cards are prepared for large taxonomic groups that include species identified as conservation values in a region; that is, species that are listed under Part 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and live in the Commonwealth marine area for all or part of their lifecycle. All listed threatened, migratory and marine species and all cetaceans occurring in Commonwealth waters are protected under the EPBC Act and are identified in the relevant marine bioregional plans as conservation values.

Species group report cards focus on species for which the region is important from a conservation perspective; for example, species of which a significant proportion of the population or an important life stage occurs in the region's waters.

For these species, the report cards:

- outline the conservation status of the species and the current state of knowledge about its ecology in the region
- define biologically important areas; that is, areas where aggregations of individuals of a species display biologically important behaviours
- assess the level of concern in relation to different pressures.

1. Pinnipeds of the South-west Marine Region

This report card focuses on pinnipeds in the South-west Marine Region, specifically the family Otariidae, which contains the fur seals and sea lions. Pinnipeds are aquatic carnivorous mammals, with a streamlined body specialised for swimming and limbs modified as flippers. Of the ten species of seals and sea lions that occur in Australian waters (including the Australian Antarctic Territory, Heard Island and MacDonald Island), three are known to occur in the South-west Marine Region: Australian sea lions, New Zealand fur seals and Australian fur seals . Another seven species have been recorded in the region and are considered vagrant species. Attachment 1 lists the pinnipeds that are known to occur in the region and those that may occur infrequently.

Pinnipeds tend to be highly mobile and opportunistic predators that utilise a wide range of benthic and pelagic foraging habitats, and base their foraging strategies on prior experience and situational decision-making (Baylis et al.2008; Staniland et al. 2007). They forage in shallow coastal waters, across the continental shelf and in oceanic waters beyond the shelf edge.

All pinnipeds found in Australian waters are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as listed marine species. Australian sea lions are also listed as a threatened species in the vulnerable category and, as such, are a matter of national environmental significance.

Australian sea lion

Australian sea lions (*Neophoca cinerea*) are endemic to Australia and occur in coastal habitats, waters and islands offshore from South Australia and Western Australia. The species is almost entirely confined to the South-west Marine Region and adjacent state waters, islands and coastal areas. Although its range extends to the Houtman Abrolhos Islands in Western Australia, most of the population is found in South Australia. Australian sea lions have an estimated population of approximately 14 700 individuals (DEWHA 2010a). Based on pup numbers, 86 per cent of the population (3 105 pups) is found in South Australia, and 14 per cent (503 pups) is in Western Australia. Australian sea lion populations have not recovered from past hunting, and it appears that populations at some breeding sites may be in decline (DEWHA 2010a).

Australian sea lions are unique among pinnipeds in having large numbers of small breeding colonies, low reproductive rates, an unusually long breeding cycle of 17–18 months (the timing varies between breeding sites that are close to each other—different colonies breed at different times), high site fidelity and poor dispersal. Genetic research into the population structure of Australian sea lions has found evidence of a strong sex bias in dispersal, with females breeding at the colony where they were born (natal site fidelity) and males dispersing

between colonies over a range of 200 km. This is highly unusual for pinnipeds (DEWHA 2010a). These findings indicate that at least some Australian sea lions are genetically isolated, and therefore constitute subpopulations. Due to natal site fidelity recolonisation is unlikely to readily occur if colonies are extirpated (entirely removed) (DEWHA 2010a).

Australian sea lions feed on the continental shelf in the region, most commonly in depths of 20–100 m (Shaughnessey 1999). They appear to be mainly benthic foragers (Goldsworthy et al. 2006) and eat a wide variety of prey, including fish, small sharks, invertebrates (such as rock lobster), cephalopods (octopus, squid, cuttlefish and nautilus) and occasionally seabirds. Recent studies (e.g. Campbell 2008; Costa & Gales 2003; Goldsworthy et al. 2007) using satellite tracking and time-depth recording techniques at a number of sites have provided detailed information about the areas where Australian sea lions forage. Generalisations are difficult because different classes of animals and animals of different colonies vary considerably in their foraging and diving behaviour. A study at Dangerous Reef and islands in the Nuyts Archipelago (Goldsworthy et al. 2009) showed that females and sub-adult males spend about one day foraging at sea, followed by a day of rest, whereas adult males typically spend longer at sea—up to 2.5 days per trip. The study showed that sea lions consistently dive to the ocean floor, with the deepest dives at just over 100 m, suggesting that they are benthic foragers.

The species 'hauls out' (or rests) and breeds on rocks and sandy beaches on the sheltered sides of islands, although there are some small colonies on the Australian mainland. As detailed in the technical issues paper to the Australian Sea Lion Recovery Plan, breeding colonies are generally defined as sites where pups have been recorded, and haul-out sites are defined as sites frequented by seals where pups are not born (DEWHA 2010a). Detailed information on methods for estimating the abundance of colonies is in this publication (DEWHA 2010a).

Australian sea lion pups have been reported at 76 sites (48 in South Australia and 28 in Western Australia) over the past 20 years. However, only 58 of these sites have enough pups recorded to be classified as breeding sites (DEWHA 2010a). Most of the known Australian sea lion colonies (42 colonies, 62 per cent) are small, producing fewer than 25 pups per breeding season. Eight breeding colonies produce more than 100 pups each year, and these are all in South Australia (Goldsworthy et al. 2007):

- Dangerous Reef and Lewis Island (Southern Eyre Peninsula)
- North and South Page Islands (which are adjacent to the South-west Marine Region)
- West Waldegrave Island (Western Eyre Peninsula)
- Seal Bay (Kangaroo Island)
- Purdie Island (Nuyts Archipelago)
- Olive Island (Western Eyre Peninsula).

Because of the closed breeding patterns of Australian sea lions and their conservation status as a threatened species, all breeding sites for Australian sea lions are considered significant.

New Zealand fur seal

Although New Zealand fur seals (*Arctocephalus forsteri*) are native to Australia, they also occur at several other islands in the Southern Ocean and around the South Island of New Zealand, where they were first described. New Zealand fur seals breed adjacent to the South-west Marine Region on rocky islands off South Australia and the southern coast of Western Australia. There are approximately 51 known breeding sites for this species in Australia, mostly in South Australia (30) and Western Australia (17). Large breeding populations, which account for more than 80 per cent of the national pup production for the species (Goldsworthy et al. 2006), are found in South Australian waters at North and South Neptune Islands, Kangaroo Island and Liguanea Island. Colonies in Western Australia are centred on the islands of the Recherche Archipelago; the westernmost population is found near Cape Leeuwin. Available information suggests that the range of the species is expanding in Western Australia, with greater numbers of animals hauling out and breeding on the south-west coast (Goldsworthy et al. 2006). New Zealand fur seals feed on fish, squid and also seabirds in pelagic waters along the continental shelf, although adult male fur seals also forage in deeper waters (Goldsworthy & Page 2009).

Australian fur seal

Australian fur seals (*Arctocephalus pusillus*) have been common visitors to the eastern part of the region for many years. They are known to haul out among and near New Zealand fur seal colonies on Kangaroo Island and are sometimes seen around the Neptune Islands. Recently, small numbers of Australian fur seals have bred in the region—for example, on North Casuarina Island (off Kangaroo Island), 29 pups were produced in February 2008 (Shaughnessy et al. 2010). Like Australian sea lions, Australian fur seals feed mainly in the waters of the shelf. They are known to dive to at least 164 m to feed. Australian fur seals are generally benthic foragers, which is unusual for a fur seal, and take a wide variety of prey, particularly fish, squid, cuttlefish and octopus (DAFF 2007).

Biologically important areas

Biologically important areas are areas that are particularly important for the conservation of the protected species and where aggregations of individuals display biologically important behaviour such as breeding, foraging, resting or migration. The presence of the observed behaviour is assumed to indicate that the habitat required for the behaviour is also present. Biologically important areas have been identified for some EPBC Act listed species found in the South-west Marine Region, using expert scientific knowledge about species' distribution, abundance and behaviour in the region. The selection of species was informed by the availability of scientific information, the conservation status of listed species and the importance of the region for the species. The range of species for which biologically important areas are identified will continue to expand as reliable spatial and scientific information becomes available.

Biologically important areas have been identified only for Australian sea lions in the region. Biologically important areas have not yet been identified for New Zealand fur seals and Australian fur seals. These will be identified when spatial information on these species is available. Biologically important areas are included in the South-west Marine Region Conservation Values Atlas (**www.environment.gov.au/cva**).

2. Vulnerabilities and pressures

Vulnerabilities

Populations of Australian sea lions, Australian fur seals and New Zealand fur seals were substantially reduced by commercial sealing in the 18th, 19th and early 20th centuries. Fur seal populations have recently shown evidence of recovery since the cessation of commercial sealing, while Australian sea lions appear to have remained stable or to have declined.

Population trends for Australian sea lions are difficult to obtain due to the large number and inaccessibility of breeding sites, although the few observations of population trends indicate that most are stable, some are declining and only one is increasing (Goldsworthy et al. 2007; Hamer et al. 2009; Shaughnessy et al. 2011).

The life history characteristics and population structure of Australian sea lions are unusual among seals and sea lions (see above), and make the species vulnerable to the impacts of human activities. These characteristics and the species' lack of recovery mean that even small levels of human-induced mortality could have a significant impact on the species.

Analysis of pressures

On the basis of current information, pressures have been analysed for the Australian sea lion and New Zealand fur seal. This is because the South-west Marine Region is particularly important for the conservation of these two species. Both species have large proportions of their breeding populations at colonies inshore of the region, and they use Commonwealth waters of the region for foraging. Pressures to the Australian fur seal were not considered due to the relatively lower importance of the region for their conservation. A summary of the pressure analysis for pinnipeds is provided in Table 1. Only those pressures identified as *of concern* or *of potential concern* are discussed in further detail below. An explanation of the pressure analysis process, including the definition of substantial impact used in this assessment, is provided in Part 3 and Section S1.1 in Schedule 1 of the plan.

Table 1: Outputs of the pinniped species pressure analysis for the South-west Marine Region

Note: To maintain uniformity among all bioregions, this table has been added subsequently to the review by independent experts.

Pressure	Source	Species	
		Australian sea lion	New Zealand fur seal
Sea level rise	Climate change		
Changes in sea temperature	Climate change		
Changes in oceanography	Climate change		
Ocean acidification	Climate change		
Chemical pollution/ contaminants			
Nutrient pollution			
Changes in turbidity			
Marine debris	Aquaculture infrastructure Fishing boats Land-based activities Oil rigs Renewable energy infrastructure Shipping Urban development Vessels (other)		
Noise pollution	Aquaculture infrastructure Defence/surveillance activities Onshore and offshore construction Onshore and offshore mining operations Renewable energy infrastructure Seismic exploration Shipping Urban development Vessels (other)		

Legend of concern | of potential concern | of less or no concern

Table 1 continued: Outputs of the pinniped species pressure analysis for the South-west Marine Region

Note: To maintain uniformity among all bioregions, this table has been added subsequently to the review by independent experts.

Pressure	Source	Species	
		Australian sea lion	New Zealand fur seal
Light pollution			
Physical habitat modification			
Human presence at sensitive sites	Recreational and charter fishing (burleying) Research Tourism		
Nuisance species	Aquaculture operations		
Extraction of living resources	Commercial fishing – prey depletion		
Bycatch	Commercial fishing		
Oil pollution	Oil rigs Onshore and offshore mining operations Shipping Vessels (other)		
Collision with vessels			
Collision/entanglement with infrastructure	Aquaculture infrastructure Oil and gas infrastructure Renewable energy infrastructure		
Disease			
Invasive species			

Legend of concern; of potential concern; of less or no concern

Sea level rise—climate change

Global sea levels have risen by 20 cm between 1870 and 2004 and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5 to 1 m by 2100, relative to 2000 levels (Climate Commission 2011).

Sea level rise was assessed as *of potential concern* for Australian sea lions and New Zealand fur seals. Sea level rise may reduce the usable area of many colonies of Australian sea lions, rendering low-lying colonies unviable. Many breeding colonies are on highly exposed rocky shores, and breeding and nursing often take place on small ledges. Rising sea levels, accompanied by more intense and frequent severe storms, are likely to affect pup survival rates. Whether sea lions can adapt to these changes is uncertain (DEWHA 2010a). With its similar life history characteristics, New Zealand fur seals are likely to be affected by climate change in a similar way to Australian sea lions. However, this species may be more resilient because its population is increasing.

Changes in sea temperature—climate change

Sea temperatures have warmed by 0.7° C between 1910–1929 and 1989-2008, and current projections estimate ocean temperatures will be 1° C warmer by 2030 (Lough 2009). Changes in sea temperature were assessed as *of concern* for Australian sea lions and *of potential concern* for New Zealand fur seals. Research has already identified a link between higher sea surface temperatures and lower rates of pup survival (Goldsworthy et al. 2004; McIntosh et al. 2007).

Changes in oceanography—climate change

Change in oceanography is assessed as *of potential concern* for both Australian sea lions and New Zealand fur seals. Pinnipeds are important predators in the region, and they are likely to be affected by changes in productivity and shifts in trophic processes and structure. The strength of the Leeuwin Current has decreased slightly since the 1970s. The weakening of the Leeuwin Current is likely to have implications for the productivity of the region, with effects on a broad range of species
(Feng et al. 2009).

Ocean acidification—climate change

Ocean acidification is assessed as *of potential concern* for both Australian sea lions and New Zealand fur seals. Driven by increasing levels of atmospheric carbon dioxide and subsequent chemical changes in the ocean, acidification is already underway and detectible. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009).

Furthermore, climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009).

The effects of ocean acidification on marine life are highly uncertain. Whereas some organisms might be able to adapt (Orr et al. 2009), the anticipated changes to phytoplankton and zooplankton could have a detrimental effect on ecosystem processes and the structure of ecological communities.

Marine debris

Marine debris is assessed as *of concern* for Australian sea lions and *of potential concern* for New Zealand fur seals. A number of studies have shown that entanglement in marine debris is likely to be a significant source of mortality for Australian sea lions and may be contributing to their lack of recovery across parts of their range (Page et al. 2004; Shaughnessy et al. 2006). It is estimated that 0.2–1.3 per cent of the population becomes entangled in debris (Page et al. 2004; Shaughnessy et al. 2003). The Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life (DEWHA 2009) lists Australian sea lions as being adversely affected by ingestion of, or entanglement in, harmful marine debris. Based on a study at Kangaroo Island, Page et al. (2004) estimated that approximately 64 sea lions and 295 New Zealand fur seals die each year in southern Australia from entanglement, mostly in lost or discarded fishing gear. Because of the threat to pinnipeds, the southern rock lobster industry is phasing out the use of bait supplied in packaging that requires strapping.

Noise pollution

Noise pollution has been assessed as a pressure *of potential concern* for Australian sea lions. Pinnipeds are likely to be susceptible to increased noise levels or increased noise pollution—for example, from seismic survey, construction or operational activities. The impacts of noise disturbance on Australian pinnipeds have not been investigated. Studies from elsewhere and on similar species indicate that they may be impacted by seismic surveys and other sources of noise, such as shipping or construction (Gordon et al. 2003). Harbor seals display strong avoidance behaviour (swimming rapidly away from the source) and cessation of feeding in response to air-gun explosions of the type generated through seismic surveys (Thompson et al. 1998). Similar avoidance responses were documented during trials with grey seals: they changed from making foraging dives and moved away from the source, and some seals hauled out, possibly to avoid the noise. Responses to more powerful commercial arrays may be more extreme and longer lasting, and occur at greater distances. Given the status of Australian sea lions and in light of likely increases in noise generating activities within or in proximity to Australian sea lion habitats, this pressure is *of potential concern*.

Human presence at sensitive sites

Human presence at sensitive sites has been assessed as *of potential concern* for Australian sea lions because of the conservation status of the species, its lack of recovery, and the absence of monitoring information to assess the effectiveness of mitigation practices. Australian sea lions could be disturbed at sea by tourism and recreational activities (DAFF 2007; McKenzie et al. 2005). Tourism and disturbance at colonies has the potential to disrupt breeding behaviour but most colonies are on offshore islands and generally are difficult to access (Goldsworthy & Gales 2008). Tourism-based activities take place at Australian sea lion breeding colonies and haul-out sites in both Western Australia and South Australia. In Western Australia, tourism activities occur at sea lion colonies in the Perth region, in the Jurien Bay area and along the south coast in the Recherche Archipelago near Esperance. In South Australia, tourism activities at colonies of Australian sea lions, Australian fur seals and New Zealand fur seals occur at Baird Bay, Kangaroo Island (two locations), Neptune Islands, Point Labatt, Encounter Bay, Rapid Bay and islands in the Spencer Gulf. Activities that could affect seals and sea lions are boat cruises, swimming, snorkelling and scuba diving with seals, and land-based viewing of colonies. Some Australian sea lion colonies receive large numbers of visitors each year, particularly the Seal Bay colony on Kangaroo Island. Measures are in place at Seal Bay to regulate tourism activities to mitigate disturbance to breeding sites. The impact of visitors on Australian sea lions is unknown, but studies from overseas have found that continual disturbance from seal-watching activities can result in reduced feeding and in females moving away from the colony (DEWHA 2010a). Wildlife watching activities in the region are expected to increase.

Extraction of living resources

Extraction of living resources is assessed as *of potential concern* because of the effects it has on availability of prey species important for Australian sea lions. Little is known about trophic interactions in Australian waters between fisheries and sea lions, either through direct competition for the same stocks or through more subtle competition involving alteration of the trophic structure. However, it is considered that commercial fishing operations may have reduced the availability of prey for Australian sea lions (DEWHA 2010a). Australian sea lions are known to prey on rock lobsters, and there are some concerns about rock lobster populations in the South-west Marine Region. Stocks of the southern rock lobster appear to be declining in the northern zone of the South Australian fishery, which includes Kangaroo Island and the Eyre Peninsula (Ward et al. 2004, in DEWHA 2010a).

Bycatch

Bycatch has been assessed as *of concern* for Australian sea lions. Among the anthropogenic threats to Australian sea lions, fisheries interactions are recognised as the major contributor to the species' lack of recovery. Specifically, interactions with bottom-set gillnet fisheries and rock lobster fisheries can result in death or injury to sea lions (DEWHA 2010b). Gillnets used across the Australian sea lion's range typically target gummy sharks, which are caught using a mesh size that may also catch sea lions. Recent research has shown that rates of mortality might have been underestimated in the past due to high levels of 'drop-out', i.e. instances where the animal falls from the net while the net is retrieved. Interaction with the demersal gillnet fishery off South Australia is considered the key impediment to recovery of the species (Goldsworthy et al. 2010; Hamer et al. 2010). Recent research using information from an independent observer program in the Southern and Eastern Scalefish and Shark Fishery and from modelling suggests that bycatch mortality is likely to be limiting population growth and impeding recovery (DEWHA 2010a). Mitigation measures for the gillnet fishery are in place (AFMA 2010), but the extent of their effectiveness is not yet fully understood.

An observer program has not been established in the Western Australian Temperate Shark Fishery, so the impacts of possible bycatch off the Western Australian coastline are not known. However, gillnet fishing occurs adjacent to sea lion colonies off the Western Australian coastline. Campbell (2008) reviewed information on Australian sea lion foraging effort and gillnetting activity in Western Australia and found there is almost complete spatial overlap.

In rock lobster fisheries, juvenile sea lions die after being caught in the lobster pots while trying to eat the lobsters or the bait. Although these fisheries have low rates of encounters with and mortality of sea lion pups, the small size of most Australian sea lion colonies means that even these low rates may have adverse effects on subpopulations (McKenzie et al. 2005). Spatial analysis by Campbell (2005) and Campbell et al. (2008) of incidental mortality of sea lions in the Western Rock Lobster Fishery indicated that captures were localised around breeding colonies and haul-out sites, and occurred within shallow water (<20 m), with the majority occurring in less than 10 m. Using fishery-dependent sources of data on incidental catch, Campbell (2005) and Campbell et al. (2008) estimated that at least 4–5 sea lions were killed in the fishery during every fishing season. Incidental mortality of Australian sea lions in the West Coast Rock Lobster Fishery was identified as one of the key threatening processes for the distinct subpopulation of about 700 animals on the west coast of Australia (Campbell et al. 2008). Mitigation measures for lobster pots have shown some effectiveness in reducing deaths. No quantitative data on bycatch rates are available for the South Australian Southern Rock Lobster Fishery.

Oil pollution

Oil pollution is assessed as *of potential concern* for the Australian sea lion and New Zealand fur seal. Australia has a strong system for regulating industry activity that is the potential source of oil spills and this system has been strengthened further in response to the Montara oil spill. While oil spills are unpredictable events and their likelihood is low based on past experience, their consequences, especially for threatened species at important areas, could be severe.

Many colonies of Australian sea lions and New Zealand fur seals occur in proximity to major shipping lanes and are therefore vulnerable to oil spills caused by shipping accidents. The sinking of the bulk ore carrier *Sanko Harvest* off the Recherche Archipelago in 1991 led to oil fouling of fur seal pups in at least two breeding colonies in Western Australia. Prompt action enabled fouled pups to be captured, restrained in holding pens and cleaned (Gales 1991; Shaughnessy 1999). New Zealand fur seals are known to be vulnerable to oil spills because of their dependence on their thick fur for thermoregulation (Gales 1991). The impact of an oil spill on wildlife is also affected by where the spilled oil reaches. For example, fur seal pups are affected more than adults by oil spills because pups swim in tidal pools and along rocky coasts, whereas the adults swim in open water where it is less likely for oil to linger (AMSA 2010). The intensity and distribution of activities implicated in oil spills – such as oil production and transport – are likely to increase in the region.

Collision or entanglement with marine infrastructure

Collision or entanglement with infrastructure is assessed as *of potential concern* for Australian sea lions. Marine-based aquaculture occurs in coastal areas within state jurisdictions; however, recent improvements in technology to enable open-ocean operations have led to increased interest in aquaculture in Commonwealth waters. Seals and Australian sea lions are known to interact with tuna farm infrastructure near Port Lincoln in South Australia (adjacent to the region) but data about the current levels of interaction are limited (McKenzie et al. 2005).

Offshore installations such as wind farms and wave energy converters are other forms of infrastructure that might become common in the region in the future and have the potential to interact with and affect Australian sea lions. The potential impact of these installations on marine mammals is currently being assessed overseas.

3. Relevant protection measures

All pinnipeds are listed as marine species under the EPBC Act. Under the EPBC Act it is generally an offence to kill, injure, take, trade, keep, or move listed marine, migratory or threatened species on Australian Government land or in Commonwealth waters without a permit.

Alongside the EPBC Act, a broad range of sector-specific management measures to address environmental issues and mitigate impacts apply to activities that take place in Commonwealth marine areas. These measures give effect to regulatory and administrative requirements under Commonwealth and state legislation for activities such as commercial and recreational fishing, oil and gas exploration and production, port activities and maritime transport. In some instances, as in the case of shipping, these measures also fulfil Australia's obligations under a number of international conventions for the protection of the marine environment from pollution and environmental harm.

Protection and conservation measures administered under the EPBC Act and that are relevant to the conservation values described in this Report Card are listed below.

EPBC Act conservation plans and action plans

- Action Plan for Australian Seals (Shaughnessy 1999)
- Draft Recovery Plan for the Australian sea lion (*Neophoca Cinerea*) (DEWHA 2010b)
- Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life (DEWHA 2009)

Other particularly relevant management plans and strategies for these species that are not administered under the EPBC Act include:

- National Strategy to Address Interactions between Humans and Seals: Fisheries, Aquaculture and Tourism (DAFF 2006)
- National Assessment of Interactions between Humans and Seals: Fisheries, Aquaculture and Tourism (DAFF 2007)
- Australian Sea Lion Management Strategy Southern and Eastern Scalefish and Shark Fishery (SESSF) (AFMA 2010)

For more information on conservation listings under the EPBC Act, and related management objectives and protection measures, visit the following sites:

- **www.environment.gov.au/coasts/species/marine-species-list.html** (listed marine species)
- **www.environment.gov.au/epbc/protect/species-communities.html** (listed threatened species and ecological communities)
- **www.environment.gov.au/cgi-bin/sprat/public/sprat.pl** (species profile and threats database).

REFERENCES

Australian Fisheries Management Authority (AFMA) 2010, *Australian Sea Lion Management Strategy*

Southern and Eastern Scalefish and Shark Fishery (SESSF), AFMA, Canberra viewed 21 March 2011, <**www.afma.gov.au/wp-content/uploads/2010/07/sea_lion_management_strategy_2010.pdf**>

AMSA (Australian Maritime Safety Authority) 2010, *The effects of oil on wildlife*, viewed 10 March 2011, <**www.amsa.gov.au/marine_environment_protection/educational_resources_and_information/teachers/the_effects_of_oil_on_wildlife.asp**>.

Baylis, AMM, Page, B & Goldsworthy, SD 2008, '**Effect of seasonal changes in upwelling activity on the foraging locations of a wide-ranging central-place forager, the New Zealand fur seal**', *Canadian Journal of Zoology*, vol. 86, pp. 774–89.

Campbell, R 2005, *Report for the Sea Lion Scientific Reference Group*, interim report prepared for the Rock Lobster Industry Advisory Committee and the Sea Lion Interaction Scientific Reference Group, Fisheries Occasional Paper no 16, Western Australian Department of Fisheries, Perth, viewed 21 March 2011, <**www.fish.wa.gov.au/docs/op/op016/fop016.pdf**>.

Campbell, R 2008, *Interaction between Australian sea lions and the demersal gillnet fisheries in Western Australia*, report prepared by the Department of Fisheries Research Division to the Australian Centre for Applied Marine Mammal Science, Hobart.

Campbell, R, Holley, D, Christianopoulos, D, Caputi, N & Gales, NJ 2008, 'Mitigation of incidental mortality of Australian sea lions in the West Coast Rock Lobster Fishery', *Endangered Species Research*, vol. 5, pp. 345–58.

Church, JA, White, NJ, Hunter, JR, McInnes, KL, Mitchell, WM, O'Farrell, SP & Griffin, DA 2009, 'Sea level', in ES Poloczanska, AJ Hobday & AJ Richardson (eds), *A marine climate change impacts and adaptation report card for Australia 2009*, National Climate Change Adaptation Research Facility, viewed 9 March 2011, <**www.oceanclimatechange.org.au**>.

Climate Commission 2011, *The critical decade. Climate science, risks and responses*, Department of Climate Change and Energy Efficiency, Canberra.

Costa, DP & Gales, NJ 2003, 'Energetics of a benthic diver: seasonal foraging ecology of the Australian sea lion, *Neophoca cinerea*', *Ecological Monographs*, vol. 73, no. 1, pp. 27–43.

DAFF (Australian Government Department of Agriculture, Fisheries and Forestry) 2006, *National strategy to address interactions between humans and seals: fisheries, aquaculture and tourism*, DAFF, Canberra, viewed 21 March 2011, <**www.daff.gov.au/fisheries/environment/bycatch/seals**>.

DAFF (Australian Government Department of Agriculture, Fisheries and Forestry) 2007, *National assessment of interactions between humans and seals: fisheries, aquaculture and tourism*, DAFF, Canberra, viewed 21 March 2011, <**www.daff.gov.au/__data/assets/pdf_file/0009/159381/sealassessment.pdf**>.

DEWHA (Australian Government Department of the Environment, Heritage, Water and the Arts) 2009, *Threat abatement plan for the impacts of marine debris on vertebrate marine life*, DEWHA, Canberra, viewed 10 March 2011, <**www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris.html**>.

DEWHA (Australian Government Department of the Environment, Heritage, Water and the Arts) 2010a, *Australian sea lion (*Neophoca cinerea*) recovery plan—technical issues paper*, DEWHA, Canberra, viewed 21 March 2011, <**www.environment.gov.au/biodiversity/threatened/publications/recovery/sea-lion.html**>.

DEWHA (Australian Government Department of the Environment, Heritage, Water and the Arts), 2010b, *Draft recovery plan for the Australian sea lion (*Neophoca cinerea*)*, DEWHA, Canberra, viewed 29 October 2010, <**www.environment.gov.au/biodiversity/threatened/publications/recovery/sea-lion.html**>.

Feng, M, Weller, E & Hill, K 2009, 'The Leeuwin Current', in ES Poloczanska, AJ Hobday & AJ Richardson *(eds), A marine climate change impacts and adaptation report card for Australia 2009,* National Climate Change Adaptation Research Facility, viewed 9 March 2011, <**www.oceanclimatechange.org.au**>.

Gales, NJ 1991, *New Zealand fur seals and oil: an overview of assessment, treatment, toxic effects and survivorship. The 1991 Sanko Harvest oil spill*, report to the West Australian Department of Conservation and Land Management, Perth.

Goldsworthy, SD, Campbell, R & McKenzie, J 2006, 'Pinnipeds', in S McClatchie, J Middleton, C Parriaratchi, D Currie & G Kendrick (eds), *The South-west Marine Region: ecosystems and key species groups*, report to the Department of the Environment and Water Resources, Canberra, 386–9.

Goldsworthy, SD & Gales, N 2008, '*Neophoca cinerea*', in *IUCN red list of threatened species,* version 2010.3, International Union for Conservation of Nature and Natural Resources, United Kingdom, downloaded 4 October 2010, <**www.iucnredlist.org**>.

Goldsworthy, SD, Hamer, DJ & Page, B 2007, *Assessment of the implications of the interactions between fur seals and sea lions and the southern rock lobster and gillnet sector of the Southern and Eastern Scalefish and Shark Fishery (SESSF) in South Australia*, South Australian Research and Development Institute (Aquatic Sciences) publication no. F2007/000711-1, Adelaide.

Goldsworthy, SD, Lowther, AD, Shaughnessy, PD, McIntosh, RR & Page, B 2007, *Assessment of pup production and the maternal investment strategies of the Australian sea lion* Neophoca cinerea *at Dangerous Reef in the 2006–07 breeding season*, report to the South Australian Department for the Environment and Heritage, South Australian Research and Development Institute (Aquatic Sciences) Research Report series no. 249, Adelaide.

Goldsworthy, SD & Page, B 2009, *A Review of the Distribution of Seals in South Australia*, South Australian Research and Development Institute (Aquatic Sciences), Adelaide, SARDI Publication No. F2009/000368-1, 21pp.

Goldsworthy, SD, Page, B, Shaughnessy, PD, Hamer, DJ, Peters, KD, McIntosh, RR, Baylis, AMM & McKenzie, J 2009, *Innovative solutions for aquaculture planning and management: addressing seal interactions in the finfish aquaculture industry*, South Australian Research and Development Institute Research Report series no. 288, Adelaide.

Goldsworthy, SD, Page B, Shaughnessy, PD & Linnane, A 2010, *Mitigating seal interactions in the SRLF and the Gillnet Sector SESSF in South Australia, report to the Fisheries Research and Development Institute, South Australian Research and Development Institute (Aquatic Sciences*), publication no. F2009/000613-1, Research Report Series no. 405, Adelaide.

Goldsworthy, SD, Peters, KJ & Page, B 2007, *Foraging ecology and diet analysis of Australian sea lions*, final report to the Department of the Environment and Water Resources, South Australian Research and Development Institute Research Report series no. 251, Adelaide.

Goldsworthy, SD, Shaughnessy, P & McIntosh, R 2004, 'Plasticity in gestation length in response to environmental conditions in Australian sea lions *Neophoca cinerea*: new hypotheses to an enigmatic life history', abstract presented at the 22nd Lowell Wakefield Fisheries Symposium, Sea lions of the world: Conservation and research in the 21st century, Anchorage, Alaska, 30 September to 3 October, 2004.

Gordon, J, Gillespie, D, Potter, J, Frantzis, A, Simmonds, MP, Swift, R and Thompson, D 2003, *A review of the effects of seismic surveys on marine mammals*, Marine Technology Society Journal 37: 16-34.

Hamer, DJ, Ward, TM, Goldsworthy, SD & Shaughnessy, PD 2009, *Effectiveness of the Great Australian Bight Marine Park in protecting the Australian sea lion (*Neophoca cinerea*) from by-catch mortality in shark gill nets*, final report to the Great Australian Bight Marine Park Steering

Committee, South Australian Research and Development Institute Research Report series no. 357, Adelaide.

Hamer, DJ, Ward, TM, Goldsworthy, SD & Shaughnessy, PD 2010, *Mitigating the impact of shark gill-nets on Australian sea lions in South Australia using spatial management options, part B of the final report to the Fisheries Research and Development Corporation, South Australian Research and Development Institute (Aquatic Sciences)* Research Report series no. 357, Adelaide.

Hobday, AJ, Okey, TA, Poloczanska, ES, Kunz, TJ & Richardson, AJ (eds) 2006, *Impacts of climate change on Australian marine life*, report to the Australian Greenhouse Office, Canberra.

Howard, WR, Havenhand, J, Parker, L, Raftos, D, Ross, P, Williamson, J & Matear, R 2009, 'Ocean acidification', in ES Poloczanska, AJ Hobday & AJ Richardson (eds), *A marine climate change impacts and adaptation report card for Australia 2009*, National Climate Change Adaptation Research Facility, viewed 3 April 2011, <**www.oceanclimatechange.org.au/content/index.php/site/report_card_extended_2/category/ocean_acidification/**>.

Lawrence, M, Ridley, J & Lunty K 2007, 'The impacts and management implications of climate change for the Australian Government's protected areas', discussion paper, Australian Government Department of the Environment and Water Resources, Canberra, p. 326.

Lough, JM 2009, 'Temperature', in ES Poloczanska, AJ Hobday & AJ Richardson (eds), *A marine climate change impacts and adaptation report card for Australia 2009,* National Climate Change Adaptation Research Facility, viewed 5 June 2011, <**www.oceanclimatechange.org.au/content/index.php/site/report_card_extended_2/category/ocean_acidification/**>.

McIntosh, RR, Arthur, T, Dennis, T, Berris, M, Shaughnessy, PD & Goldsworthy, S 2007, 'Age- and sex-specific survival estimates for the Australian sea lion: negative effects of an extreme El Niño event on cohort survival', 17th Biennial Conference on the Biology of Marine Mammals, Cape Town, South Africa, 29 November to 3 December 2007.

McKenzie, J, Goldsworthy, SD, Shaughnessy, PD & McIntosh, R 2005, *Understanding the impediments to the growth of Australian sea lion populations*, South Australian Research and Development Institute (Aquatic Sciences) publication no. RD04/0171, Adelaide.

Orr, JC, Caldeira, K, Fabry, V, Gattuso, J-P, Haugan, P, Lehodey, P, Pantoja, S, Pörtner, H-O, Riebesell, U, Trull, T, Hood, M, Urban E & Broadgate, W 2009, *Research priorities for ocean acidification*, report from the Second Symposium on the Ocean in a High-CO2 World, Monaco, 6–9 October 2008, convened by SCOR, UNESCO-IOC, IAEA and IGBP, viewed 3 March 2011, <**ioc3.unesco.org/oanet/Symposium2008/ResearchPrioritiesReport_OceanHighCO2WorldII.pdf**>.

Page, B, Mckenzie, J, Mcintosh, R, Baylis, A, Morrissey, A, Calvert, N, Haase, T, Berris, M, Dowie, D, Shaughnessy, PD & Goldsworthy, SD 2004, 'Entanglement of Australian sea lions and New Zealand fur seals in lost fishing gear and other marine debris before and after government and industry attempts to reduce the problem', *Marine Pollution Bulletin*, vol. 49, pp. 33–42.

Shaughnessy, PD 1999, *The action plan for Australian seals*, Environment Australia, Canberra, viewed 11 March 2011, <**www.environment.gov.au/coasts/publications/seals-action-plan.html**>.

Shaughnessy, PD, Goldsworthy, SD, Hamer, DJ, Page, B & McIntosh, RR 2011, 'Australian sea lions *Neophoca cinerea* at colonies in South Australia: distribution, abundance and trends, 2004–2008', *Endangered Species Research*, vol. 13, pp. 87–98.

Shaughnessy, P, Kirkwood, R, Cawthorn, M, Kemper, CM & Pemberton, D 2003, 'Pinnipeds, cetaceans and fisheries in Australia: a review of operational interactions', in N Gales, M Hindell & R Kirkwood (eds), *Marine mammals: fisheries, tourism and management issues*, CSIRO Publishing, Melbourne, pp. 124–40.

Shaughnessy, PD, McIntosh, RR, Goldsworthy, SD, Dennis, TE & Berris, M 2006, 'Trends in abundance of Australian sea lions, *Neophoca cinerea*, at Seal Bay, Kangaroo Island, South Australia', in AW Trites, SK Atkinson, DP DeMaster, LW Fritz, TS Gelatt, LD Rea & KM Wynne (eds), *Sea lions of the world*, Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska, 325–51.

Shaughnessy, PD, McKenzie, J, Lancaster, ML, Goldsworthy, SD & Dennis, TE 2010, 'Australian fur seals establish haulout sites and a breeding colony in South Australia', *Australian Journal of Zoology*, vol. 58, no. 2, pp. 94–103.

Staniland, IJ, Boyd, IL & Reid, K 2007, 'An energy-distance trade-off in an central-place forager, the Antarctic fur seals (*Arctocephalus gazella*)', *Marine Biology*, vol. 152, pp. 233–41.

Thompson, D, Sjoberg, M, Bryant, ME, Lovell, P & Bjorge, A 1998, *Behavioral and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys*, report to the European Commission of BROMMAD Project MAS2 C7940098.

ATTACHMENT 1: PINNIPED SPECIES OCCURRING IN THE SOUTH-WEST MARINE REGION

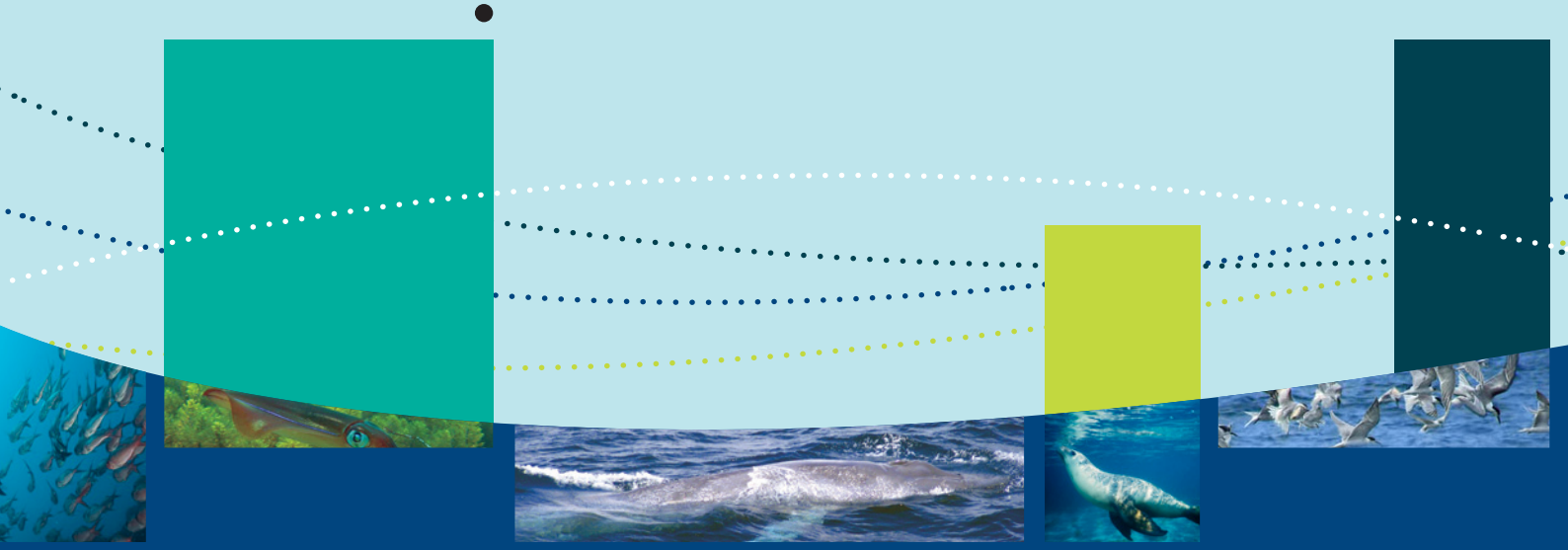
Table A1: Pinniped species known to occur in the South-west Marine Region

Species (common name/ scientific name)	Conservation status
Australian sea lion (*Neophoca cinerea*)	Vulnerable, marine
Australian fur seal (*Arctocephalus pusillus*)	Marine
New Zealand fur seal (*Arctocephalus forsteri*)	Marine

Table A2: Pinniped species known to occur in the South-west Marine Region[1] on an infrequent basis

Species (common name/ scientific name)	Conservation status
Sub-Antarctic fur seal (*Arctocephalus tropicalis*)	Vulnerable, marine
Southern elephant seal (*Mirounga leonina*)	Vulnerable, marine
Antarctic fur seal (*Arctocephalus gazella*)	Marine
Crab-eater seal (*Lobodon carcinophagus*)	Marine
Leopard seal (*Hydrurga leptonyx*)	Marine
Ross seal (*Ommatophoca rossi*)	Marine
Weddell seal (*Leptonychotes weddelli*)	Marine

1 These are considered vagrant species in the region.



MAR172.0612