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National Assessment of Interactions between Humans and Seals: **Fisheries, Aquaculture and Tourism**

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DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY

This report provides background information in the development of a National Strategy to mitigate adverse impacts on Australian seal populations and the fisheries, aquaculture and tourism sectors. It was compiled in 2004 and 2005. Minor changes were incorporated to the draft report in February 2006 following an official public consultation phase which extended from October 2005 to February 2006.

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National Assessment of Interactions between Humans and Seals: Fisheries, Aquaculture and Tourism

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Prepared by the National Seal Strategy Group and
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Executive Summary

In February 2003, the Marine and Coastal Committee (MACC) of the Natural Resource Management Standing Committee identified the need to address the growing issue of human and seal interactions, with a view to developing a strategy to mitigate adverse impacts on Australian seal populations and the fisheries, aquaculture and tourism sectors. The MACC established a small inter-government working group, the National Seal Strategy Group (NSSG), to develop a National Strategy. This assessment report provides background scientific information to support the development of the National Strategy to address interactions between humans and seals. It focuses only on seals breeding in continental Australia (i.e., Australian sea lion, *Neophoca cinerea*, Australian fur seal, *Arctocephalus pusillus doriferus,* and the New Zealand fur seal, *Arctocephalus forsteri*), and their interactions with fisheries, aquaculture and tourism.

Many fur seal populations appear to be recovering from over-harvesting during the late eighteenth and nineteenth centuries (although this is not evident in Australian sea lion populations), and there has been significant growth in our commercial fishing industries, marine finfish aquaculture, and seal-focused tourism. It is therefore likely that seal–human interactions will increase in these sectors, hence the need for a National Strategy. The challenge facing government and industries is how to minimise adverse interactions to protect seals, while, at the same time, maintaining sustainable and profitable business opportunities.

In Australian waters, current population estimates are 11 000 Australian sea lions, 92 000 Australian fur seals and 57 000 New Zealand fur seals. Seals are opportunistic feeders taking a variety of prey, particularly fish, squid and octopus. There is potential overlap between the species targeted by commercial fisheries and the prey species of seals.

Seals are protected under Australian Government and state Government legislation. All seals in Commonwealth waters are protected (as listed threatened and/or marine species) under the *Environment Protection and Biodiversity Conservation Act 1999*, which is administered by the Department of the Environment and Heritage. State government conservation and/or fisheries agencies are responsible under state legislation for seals on land, and in waters up to 3 n.miles off-shore, while the Australian Government is responsible for seals outside state coastal waters and within the Australian Economic Exclusion Zone.

Humans and seals interact in a number of ways. These interactions may affect the seal, the human, or both. In the fisheries sector, quantitative and independent data on the nature and extent of interactions between fisheries and seals is limited. Available data suggests that interactions are most evident in the gillnet fisheries, the southeast trawl fishery, and pot and trap fisheries. Interactions that are detrimental to fishers include damage/loss of gear, damage/loss of catch, disturbance of fishing operations, and potential injury or inter-specific transmission of disease. Interactions that are detrimental to seals include injury or harassment, fatal entanglement and modified behaviour (seals associating food with humans). Illegal shooting of seals by some fishers in certain fisheries, and entanglement in fisheries-related debris such as discarded and derelict nets, bait box straps, monofilament nets and nylon ropes, are also of concern.

In the aquaculture sector, quantitative and independent data on the nature and extent of interactions between aquaculture farms and seals is also limited. Available data suggests that interactions are most evident at the salmonid farms in Tasmania and southern bluefin tuna farms in South Australia. Interactions that are detrimental to fishers include loss of valuable stock, damage to gear, increased costs through the need to protect stock disturbance of fishing operations, and potential injury or inter-specific transmission of disease. Interactions that are detrimental to seals include injury and fatal entanglement in anti-predator nets, illegal killing of seals, and modified behaviour of individual seals due to habituation to a predictable food source. Attempts to mitigate interactions have had variable degrees of success, with the protection of farmed fish with physical barriers potentially the most effective option.

In the tourism sector, quantitative and independent data on the nature and extent of interactions between tourists and seals is limited. Available data indicates that large visitor group size, noise, and a desire to 'get close to wild animals' may result in tourists unintentionally disturbing seal populations. For seals, this can lead to interference with feeding, socialising or breeding; mortalities and injuries; and/or displacement from optimal habitat. Other concerns include an increased risk to the safety of humans with regard to seal attacks (particularly when swimming or diving with seals); the possible inter-specific transmission of disease; and a potential increase in the feeding of seals, which could change seal behaviour.

This document represents the first step in the development of the National Strategy. In reviewing human-seal interactions, documenting current management practices, and identifying the key issues, the NSSG will consult further with key stakeholder groups to formulate a strategy to mitigate adverse impacts on Australian seal populations and the fisheries, aquaculture and tourism sectors.

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1 Introduction

The objective of this Assessment Report is to provide background information for the development of a National Seal Strategy to minimise adverse interactions between humans and seals[1].

While there are ten species of seal found in Australian waters (Table 1.1), this report focuses only on the species breeding in continental Australia (i.e., Australian sea lion, *Neophoca cinerea*, Australian fur seal, *Arctocephalus pusillus doriferus,* and the New Zealand fur seal, *Arctocephalus forsteri*), and their interaction with fisheries, aquaculture and tourism.

More specifically, this report provides:

- An overview of the ecology of the Australian sea lion, Australian fur seal and the New Zealand fur seal, including information on distribution and abundance.
- A description of the nature and extent of interactions between humans and seals with respect to fisheries, aquaculture and tourism.
- An overview of the national conservation status of seals.
- An analysis of current conservation and management approaches and objectives (legislation, policy and mitigation measures) with respect to minimising adverse interactions.
- Case studies of existing technologies and practices that minimise adverse interactions, particularly with respect to seal bycatch.

Table 1.1 Seal species regularly found in Australia waters

Family	Common name	Scientific name	Breeding area
Otariidae	Australian sea lion[1]	*Neophoca cinerea*	Continental Australia
	New Zealand fur seal	*Arctocephalus forsteri*	Continental Australia
	Australian fur seal[2]	*Arctocephalus pusillus doriferus*	Continental Australia
	Antarctic fur seal	*Arctocephalus gazella*	Subantarctic islands
	Subantarctic fur seal	*Arctocephalus tropicalis*	Subantarctic islands
Phocidae	Southern elephant seal	*Mirounga leonina*	Subantarctic islands
	Leopard seal	*Hydrurga leptonyx*	Antarctic sea-ice
	Crab-eater seal	*Lobodon carcinophagus*	Antarctic sea-ice
	Weddell seal	*Leptonychotes weddellii*	Antarctic sea-ice
	Ross seal	*Ommatophoca rossii*	Antarctic sea-ice

[1] Endemic species; [2] Endemic subspecies.

This report does not specifically address Antarctic and subantarctic seal species. At present, human–seal interactions from fisheries, aquaculture and tourism in the polar and sub-polar regions are much less frequent than interactions in many of the coastal zones of Australia (Gales *et al*., 2003).

In Australia, interactions between seals and fisheries, aquaculture and tourism are currently considered to be of a high priority (National Seal Strategy Group and National NRM MACC decision); however there are other interactions that affect either seals, humans or both.

[1] For the purpose of this document, 'seals' refers to Australian and New Zealand fur seals and Australian sea lions, unless otherwise stated.

Why do we need a National Seal Strategy?

Humans and seals interact in a number of ways. These interactions may affect the seal, the human, or both (Wickens, 1995). In Australia, humans have impacted on seals since historical times. For example, Indigenous Australians traditionally hunted New Zealand fur seals for meat and skins long before the arrival of Europeans and sea lions were also probably hunted, as is evident from bones found in middens in northern Tasmania (Reeves *et al*., 1992).

Commercial sealing began soon after Matthew Flinders discovered the presence of fur seals in 1798. Fur seals and sea lions were subsequently reduced to very low numbers over much of southern Australia. For example, from 1798 to about 1825, commercial sealers killed an estimated 200 000 Australian fur seals along the southern Australian coast (Shaughnessy, 1999; Reeves *et al*., 1992; Warneke and Shaughnessy, 1985).

Historically, seals have been regarded as a natural resource to be harvested or a nuisance to be exploited or even eradicated. However, during the last 50 years, attitudes have changed, and all seals in Australian waters are now protected under Commonwealth legislation. Many scientists regard seals to be an essential and valuable component of a healthy marine ecosystem—a common inheritance to be conserved in their own right. This has led to a more conservation-oriented style of management, in which conflicting views have to be accommodated (IUCN, 1993).

Today, many fur seal populations in Australia appear to be recovering from over-harvesting during the late eighteenth and nineteenth centuries (although this is not evident in Australian sea lion populations). The proportion of the human population living in coastal zones is also increasing. Furthermore, there have been significant developments in our commercial fishing industries, marine finfish aquaculture, and seal-focused recreational/commercial tourism. These trends have placed new demands on our coastal resources for both humans and seals.

Generally, the diets of seal and sea lion species in Australia are poorly understood, however there is potential overlap between the species targeted by commercial fisheries and the prey species of seals. This inevitably leads to interactions between seals and fisheries, including marine finfish aquaculture operations. Seals are highly intelligent animals. Some have learnt to associate humans with food, as is evident from observations of individual seals following fishing vessels, and also targeting aquaculture farms.

In Australian waters, most fisheries developed when seal populations were still depleted. As commercial fisheries continue to expand, and some seal populations begin to recover, interactions are likely to increase. Interactions can be operational (seals interact with fishing gear, which may be detrimental to the seal, fishers or both) or ecological (indirect competition for common prey species) (De Masters *et al*., 2001). In this report, only operational interactions between fisheries and seals are addressed. Operational interactions detrimental to fisheries include damage/loss to catch, damage to fishing gear, and disturbance of operations. Operational interactions detrimental to seals include incidental or deliberate mortality, injury or harassment, and modified behaviour of individual seals due to habituation to a predictable food source. For most Australian fisheries, there is very little quantitative and independent information on the nature and extent of interactions. The behavioural traits of seal species, age of individuals, fishing gear and the degree to which a species range overlaps with the activities of commercial fisheries, influence the nature and extent of interactions (IUCN, 1993).

Seals also interact with marine finfish farms, notably southern bluefin tuna in South Australia and salmonids in Tasmania. Operational interactions detrimental to farms are variable, but may include damage/loss of fish, damage to nets, and costs protecting farms from seals. Operational interactions detrimental to seals include drowning of seals by entanglement in fish farm nets or entrapment in the cage; modified behaviour of individual seals due to habituation to a predictable food source; harassment or injury; and death from other causes associated with farm operations, e.g., illegal killing.

In recent years, the number of tourists viewing seals has increased at many places on the Australian coast: nearly 400 000 tourists visited seal-watching sites in 2002 alone (Orsini, 2004; Kirkwood *et al*., 2003; Marine and Marine Industries Council, 2002). The educational and recreational benefits of seal watching to the local economy are substantial (Marine and Marine Industries Council, 2002); however, this increase in visitor numbers presents new challenges to management. Large visitor group size, noise and a desire to 'get close to wild animals' may result in tourists unintentionally disturbing seal populations. For seals, this can lead to interference with feeding, socialising or breeding; mortalities and injuries; and/or displacement from optimal habitat. Other concerns include an increased risk to the safety of humans with regard to seal attacks (particularly when swimming or diving with seals); the possible inter-specific transmission of disease; and a potential increase in the feeding of seals, which could change seal behaviour.

National Seal Strategy Group

In February 2003, the Marine and Coastal Committee (MACC) of the Natural Resource Management Standing Committee identified the need to address the growing national issue of human–seal interactions. In turn, the MACC established a small inter-government working group—the National Seal Strategy Group (NSSG)—to initiate the development of a coordinated national approach to human–seal interactions.

The terms of reference for the NSSG are presented below:

The NSSG will consider current and emerging human–seal interaction issues with the view to developing strategies to mitigate adverse impacts on Australian seal populations (i.e., Australian fur seals, New Zealand fur seals and Australian sea lions), and on the fisheries, aquaculture and tourism sectors. Based on these considerations, the NSSG will develop the draft National Seal Strategy for consideration by MACC and in doing so will:

- Report to the Marine and Coastal Committee.
- Engage relevant stakeholders (including: industry, seal researchers and environmental non-government groups) in the development of the National Seal Strategy to achieve commitment to the process.
- Develop a work programme.
- Share information and experiences on the nature and extent of human–seal interactions and existing management responses, including research activities.
- Develop an Assessment Report on the nature and extent of human–seal interactions, identify issues and document existing management responses and relevant research.
- Develop a National Seal Strategy that identifies key issues relevant to interactions between humans and seals; and actions that can be implemented to manage those interactions in a coordinated way.

The objective of the National Seal Strategy is to prevent or minimise adverse interactions between humans and seals through facilitating a nationally coordinated approach to identifying and addressing key issues. In particular, it seeks to assist the commercial fishing and aquaculture industries in understanding the protected nature of seals in Australian waters and aims to guide fishers' efforts to reduce seal bycatch. The strategy will also address adverse human–seal interactions experienced in the aquaculture and tourism industry sectors.

The National Seal Strategy will identify objectives; actions to be undertaken in 2007–11; agencies and organisations responsible for implementing each action; timeframes (actions to be implemented over the five years); and performance indicators to measure progress and outcomes for each action. The strategy will be reviewed in five years against these measures and any advances in knowledge.

2 Seal Ecology

All seals and sea lions belong to the Pinnipedia order of mammals, and are classified into two families: Otariidae (eared seals) and Phocidae (earless or true seals). The Australian sea lion (Péron, 1816), Australian fur seal (Wood Jones, 1925) and the New Zealand fur seal (Lesson, 1828) are all members of the family Otariidae.

Characteristic features of the Otariidae include external ears (ear flaps); long, hairless or only partly haired fore flippers; relatively large hind flippers; and hind flippers that can be rotated beneath the body, enabling them to walk on land (Jefferson *et al*., 1993; Reeves *et al*., 1992).

Prominent features that distinguish fur seals from sea lions are:

- Fur structure: fur seals have dense underfur with long outer visible fur (guard hairs), giving a thick woolly appearance, whereas in sea lions, the fur is short and stiff (except for the mane of males).
- Facial features: fur seals have more pointed snouts than the broader, blunter snout of most sea lions, and sea lions have relatively shorter ears that lie close to the head.
- Hind flippers: all five digits of the hind flippers are of equal length in fur seals, whereas in sea lions, the first and fifth digits are longer (and the first digit is also wider) than digits 2–4.

In both sea lions and fur seals, there is marked sexual dimorphism in body size and general appearance (adult males are considerably larger and have a large, thick neck with a mane of coarse hair) (Jefferson *et al*., 1993; Reeves *et al*., 1992).

There are several detailed reviews documenting the ecology of Australian seal species (e.g., Shaughnessy, 1999). This report seeks to provide key information on species biology and ecology, rather than replicate or review all available information.

2.1 Physical characteristics

Australian sea lion

Adult males are dark blackish-brown or chocolate-brown with a creamy white wig extending from the brow above the eyes to the lower neck and shoulders. The neck and shoulders are greatly enlarged. The large head has a long, narrow snout that is blunt in profile; pale whiskers that extend just past the ears; and small ears that lie close to the head (IUCN, 1993; Péron, 1816 *modified*).

Adult females are silvery-grey after the moult and gradually fade to brown. The pale creamy white chest and throat extends to the sides of the face and above the ears (IUCN, 1993; Péron, 1816 *modified*).

Pups are chocolate brown, with a pale crown. They moult to adult female pelage by about 5 months of age.

This species is depicted in Figure 2.1. A biological summary is given in Table 2.1.

Table 2.1 Biological summary of the Australian sea lion

Biological parameters			Source
Growth and age			
Birth weight; length		6.4–7.9 kg; 62–68 cm	a, b
Weaning age		15–18 months	b
Weight:	Male	180–250 kg	a, c, d
	Female	61–104 kg (average 77 kg)	a
Length:	Male	185–250 cm	e, d
	Female	130–185 cm	b, d
Longevity:	Male	at least 25 years	c
	Female	at least 26 years	c, o
Reproduction			
Age at sexual maturity:	Male	8–9 years	b
	Female	4–6 years	b
Active gestation		about 14 months (plus 3.5–5 months delayed implantation, i.e., egg is fertilized but not immediately implanted)	f
Pupping interval		17–18 months	g
Pupping season		5–7 months (asynchronous between locations. Sub 18 month cycle means the pupping seasons will drift through all times of year and seasons).	h, i
Mating season		5–7 months (different colonies mate at different times)	c, h
Diet and foraging behaviour			
		• Principally benthic foragers (feed on ocean floor) but will exploit mid-water prey.	j, k
		• Opportunistic feeders taking a wide variety of prey, particularly squid and octopus, benthic fish species (including salmon, whiting and shark) and some crustaceans (mostly rock lobsters).	l
		• Nursing females are benthic feeders on the continental shelf generally in depths less than 40–80 m.	d
		• The estimated annual prey consumption for the Australia sea lion is 47 801 t (based on preliminary research only).	n
Natural mortality			
		• Pup mortality rate in the first two years is highly variable between colonies, but can be as high as 50 percent. Aggression from territorial males is responsible for some pup deaths.	h, m, p
		• The natural causes of death in pups and/or adults include starvation; poor mothering; predation by sharks; disease; parasites; and impacts of storms/high tides on breeding areas.	

(a) Walker and Ling (1981); (b) Shaughnessy (1999); (c) Seal Conservation Society web: http://www.pinnipeds.org/; (d) Costa and Gales (2003); (e) King (1983); (f) Gales *et al*. (1997); (g) Gales *et al*. (1994); (h) Higgins (1990); (i) Gales *et al*. (1992); (j) Gales and Cheal (1992); (k) Ling (1992); (l) Costa *et al*. (1988); (m) Higgins and Tedman (1990); (n) Goldsworthy *et al*. (2003a); (o) R. McIntosh, pers. comm.; (p) Shaughnessy (2005).

Figure 2.1 Australian sea lions at Kangaroo Island, South Australia

(left) adult female and pup; (right) adult male (© Brad Page)

Australian fur seal

Adult males are light greyish-brown with a paler chest and darker brown belly. A well-developed mane covers the thick neck, chest and shoulders of adult animals. The mane is lighter in colour in older animals. The head is very large and broad, and has little or a low brow; a rounded (dog-like) snout; forward facing nostrils that have a slight down angle; moderately long whiskers that regularly extend past the ear; and long ears that stick out slightly from the head. The flippers are large and thick. The front flippers are paddle-shaped (rounded), with obvious thickening of the trailing edge before it joins the body (Goldswothy *et al*., 1997; IUCN, 1993; Wood Jones, 1925 *modified*).

Adult females are pale fawn to lighter greyish-brown with a pale chest and brown belly. The head is smaller and narrower than that of the male's, with no obvious brow (Goldswothy *et al*., 1997; IUCN, 1993; Wood Jones, 1925 *modified*).

Pups are born black with a variable grey underside. Juveniles are much the same colour as the adult females, but often with lighter fur extending from the jaw below and behind the ears (Goldswothy *et al*., 1997).

Both males and females appear dark grey with black flippers when wet.

This species is depicted in Figure 2.2. A biological summary is given in Table 2.2.

Table 2.2 Biological summary of the Australian fur seal

Biological parameters			Source
Growth and age			
Birth weight; length		5–12 kg; 60–80 cm	a
Weaning age		10–12 months	a
Weight:	Male	218–360 kg (average 279 kg)	a
	Female	41–113 kg (average 78 kg)	a
Length:	Male	201–227 cm (average 216 cm)	a
	Female	136–171 cm (average 157 cm)	a
Longevity:	Male	at least 19 years	a
	Female	at least 21 years	a
Reproduction			
Age at sexual maturity:	Male	about 5 years (hold territories at 8–13 years)	a
	Female	3–6 years	a
Active gestation		about 9 months (plus about 3 months delayed implantation)	a
Pupping interval		12 months	a
Pupping season		Late October–late December (median date between 26 November and 1 December)	b, c
Mating season		November–January	d
Diet and foraging behaviour			
		• Principally benthic foragers (feed on ocean floor).	b
		• Opportunistic feeders taking a wide variety of prey, particularly fish, squid, cuttlefish and octopus.	d
		• Mainly feed on fish in winter and squid, cuttlefish and octopus in summer. In Tasmanian waters, the Gould's (Arrow) squid is most common.	e
		• Fish species commonly taken include leatherjackets, redbait, barracouta, jack mackerel and red cod.	f
		• Australian fur seals are known to dive to at least 164 m to feed.	
		• The estimated annual prey consumption for the Australia fur seal is 240 317 t (based on preliminary research only).	i g
Natural mortality			
		• At Seal Rocks (Victoria), at least 15 percent of pups die in their first two months.	h
		• In Tasmanian colonies, about 15 percent of pups die in their first six weeks (early January).	c
		• The natural causes of death in pups and/or adults include starvation; predation by sharks; disease; parasites; and impacts of storms/high tides on breeding areas.	

(a) Warneke (1995); (b) Warneke and Shaughnessy (1985); (c) Pemberton and Kirkwood (1994); (d) Shaughnessy (1999); (e) Gales *et al.* (1993); (f) Hume *et al.*, (2004); (g) Goldsworthy *et al.* (2003a); (h) Warneke (1982); (i) Arnould and Hindell (2001). Also see the Seal Conservation Society web: http://www.pinnipeds.org/.

Figure 2.2 Australian fur seals at Tenth Island, Tasmania

(left) adult female and pup; (right) adult male (© Roger Kirkwood)

New Zealand fur seal

Adult males are uniform dark-grey to brown with pale muzzle fur. A well-developed mane covers the thick neck, chest and shoulders of adult animals. The mane is lighter in colour in older animals. The head is large and broad, and has a distinct brow; a pointy snout (the enlarged area around the snout accentuates the pointy snout); forward facing nostrils that have a slight down angle; whiskers that extend to about the ear; and long ears that lie flat against the head. The flippers are large and thick. The front flippers are oar-shaped (long with straight sides) (Goldsworthy *et al*., 1997; IUCN, 1993; Lesson, 1828 *modified*).

Adult females are brown to dark-brown with greyish tones. The chest and throat are lighter brown, and the abdomen is dark-brown. The head is smaller and narrower than that of the male's, with no obvious brow (Goldsworthy *et al*., 1997; IUCN, 1993; Lesson, 1828 *modified*).

Pups are born dark-brown with a lighter snout and belly. Juveniles are a rich dark-brown with a pale white or cream moustache (Goldsworthy *et al*., 1997).

Both males and females appear dark grey with black flippers when wet.

This species is depicted in Figure 2.3. A biological summary is given in Table 2.3.

Table 2.3 Biological summary of the New Zealand fur seal

Biological parameters			Source
Growth and age			
Birth weight; length		4–6 kg; 60–70 cm	a
Weaning age		8–12 months	b
Weight:	Male	120–180 kg (average 126 kg)	a, c
	Female	35–50 kg (average 39 kg)	a, d, e
Length:	Male	150–250 cm	a
	Female	100–150 cm	a
Longevity:	Male	up to about 15 years	c, f
	Female	up to about 26 years	i, l
Reproduction			
Age at sexual maturity:	Male	4–5 years (hold territories at 9–12 years)	c, i
	Female	4–5 years	b, i
Active gestation		about 9 months (plus about 3 months delayed implantation)	g
Pupping interval		12 months	g
Pupping season		Late November–early January (most births in mid-December)	g
Mating season		mid-November–mid-January	f
Diet and foraging behaviour			
		• Principally epipelagic foragers (feed at surface to depths generally not exceeding 200 m), but will forage benthically at times.	h, m
		• Opportunistic feeders taking a wide variety of prey, particularly cephalopods (squid, e.g., Arrow; and octopus) and fish, especially barracouta.	b
		• Adults can dive to depths greater than 300 m to feed.	h
		• The estimated annual prey consumption for the New Zealand fur seal in Australia is 143 906 t (based on preliminary research only).	j
Natural mortality			
		• Between 19 and 3 percent of pups die within five months.	k
		• No data for post-weaning survival.	
		• The natural causes of death in pups and/or adults include starvation; predation by sharks; disease; parasites; and impacts of storms/high tides on breeding areas.	

(a) Goldsworthy and Crawley (1995); (b) Goldsworthy (1991); (c) Troy *et al*. (1999); (d) Wickens and York (1997); (e) Schulman (1996); (f) Seal Conservation Society web: http://www.pinnipeds.org/; (g) Shaughnessy (1999); (h) Harcourt *et al*. (2002); (i) Dickie and Dawson (2003); (j) Goldsworthy *et al*. (2003a); (k) Bradshaw *et al*. (2003). (l) McKenzie, Goldsworthy, Shaughnessy and McIntosh (2005); (m) Page, McKenzie and Goldsworthy (2005). Also see the Seal Conservation Society web: http://www.pinnipeds.org/.

Figure 2.3 New Zealand fur seals at Kangaroo Island, South Australia

(left) adult female and pup; (right) adult male (© Brad Page)

2.2 Distribution and population size

Australian sea lion

The breeding range of the Australian sea lion extends from the Houtman Abrolhos Islands (28°S, 112°E) in Western Australia, to The Pages Islands (34°S, 138°E) in South Australia (Figure 2.4). However, nearly half the population breeds between Port Lincoln and Kangaroo Island (Gales *et al*., 1994). The largest colonies of Australian sea lion are in South Australia at The Pages Islands, Dangerous Reef, Seal Bay on Kangaroo Island and at Purdie Island (Gales *et al*., 1994). Although most colonies are in South Australia and Western Australia, records of stragglers have also been noted in southern Tasmania, New South Wales and the West coast of Victoria.

Pup production of the Australian sea lion is estimated at 2 590 pups per breeding cycle (non-seasonal, over 17–18 months) (Gales *et al*., 1994; Shaughnessy, 1999). However, pup mortality to 7 months has been estimated to range between 14 percent and 55 percent (Shaughnessy and Dennis, 2001), depending on the year and the colony. In addition to the highly variable pup mortality, there is evidence to suggest that pup production is variable both between years and between colonies (Shaughnessy, 1999).

The mean population size of the Australian sea lion is currently estimated to be at 11 200 (Goldsworthy *et al*., 2003a). This includes the 'recently discovered colonies' in the Great Australian Bight (Dennis and Shaughnessy, 1996), and on Eyre Peninsula—Cape Blanche Island and West Waldegrave Island (Shaughnessy and Dennis, 2002). Detecting trends in abundance of Australian sea lions is difficult, due to unique life history characteristics such as breeding asynchrony across the species' range and an extended pupping season. A recent analysis of pup production at Seal Bay colony suggests it has decreased at this colony in recent years. There is also evidence of declining pup production at some of the smaller colonies in both Western Australia and South Australia (Shaughnessy *et al*., 2005). There is no evidence to suggest that the population is increasing or expanding its range.

The distribution of the Australian sea lion was historically more extensive than it is today. The range once extended into Bass Strait in the east, with breeding colonies on islands near Albany and Perth, that

are now only used as haul-out areas. In addition, the colony on the Abrolhos Islands near Geraldton, is thought to have been more extensive than it is at present. Hence it is believed that the population size today is probably still smaller than it was historically (pre-sealing) (Shaughnessy, 1999).

Australian fur seal

There are five breeding colonies of Australian fur seals on the islands of Victoria, and five on the islands of Tasmania (Figure 2.5; Appendix B and C).

The largest colonies are at Lady Julia Percy Island and Seal Rocks in Victoria. Haul-out sites extend from southern Tasmania into southern New South Wales (Montague Island, and Seal Rocks near Port Stephens) and Kangaroo Island in South Australia (Arnould and Littnan, 2000; Shaughnessy, 1999; Pemberton and Kirkwood, 1994). Seals forage throughout their range. For example, seals born on Victorian Islands forage in waters around Victoria, Tasmania, South Australia and New South Wales.

From the 2002 pupping season, it was estimated that about 20 000 pups are born each year. The total population of Australian fur seals is estimated to be 92 000 (Kirkwood *et al*., 2005; Pemberton and Gales, 2004).

The population of Australian fur seals breeding in Tasmanian waters, while variable between years, has not shown any substantial increase. Certainly, there were more breeding locations prior to sealing (Pemberton and Gales, 2004).

In Victoria, where 80 percent of pups are born, the most recent estimate is that almost twice as many pups were born in 2002, compared with in 1986. This increase in numbers is likely to be due to the gradual recovery from direct exploitation, a response to legal protection given to the species, and natural long-term population fluctuations (Pemberton and Gales, 2004; Shaughnessy *et al*., 2002; Warneke, 1988). Overall, it appears that the total Australian fur seal population has increased and it may continue to do so as more territory is occupied at the major Victorian breeding sites (Marine and Marine Industries Council, 2002).

Despite the recent increases, the population in Australian waters is probably still smaller than it was historically (pre-sealing), and may be only half the original size (Kirkwood *et al*., 1992). Several islands have not been reoccupied since their populations were removed by early commercial sealing. Known examples are Seal Rocks, near Port Stephens in New South Wales (Warneke, 1982); and Albatross Island, Councillor Island and Georges Rock in Tasmania (Pemberton and Gales, 2004).

New Zealand fur seal

New Zealand fur seals breed in southern Australia, on the coasts of Western Australia, South Australia, New South Wales, Victoria and Tasmania (Figure 2.6; Appendix C). Most of the population is concentrated between the southern tip of Eyre Peninsula and Kangaroo Island (Gales *et al*., 2000; Shaughnessy *et al*., 1995).

On the basis of a modelling exercise using known life–history parameters and theoretical models of survival, a multiplication factor of 3.95 was proposed for this species; its application led to a population estimate of 57 400 fur seals (Goldsworthy *et al*. 2003a).

On Kangaroo Island (Cape Gantheaume, Nautilus Rock, Nautilus North and Libke Cave), New Zealand fur seals have been increasing in number since 1989. In 2001, pup numbers declined markedly, but by January 2002 numbers had increased to slightly more than previously recorded (Shaughnessy and Dennis, 2002).

New Zealand fur seal populations in Western Australia are also increasing. The estimated absolute abundance of New Zealand fur seals in Western Australia has increased from about 7 100 in the 1989/90 season to about 15 100 in the 1998/99 season (Gales *et al*., 2000; Shaughnessy *et al*., 1994). Recently, New Zealand fur seals have re-established their breeding populations to include several islands in Bass Strait (Pemberton and Gales, 2004).

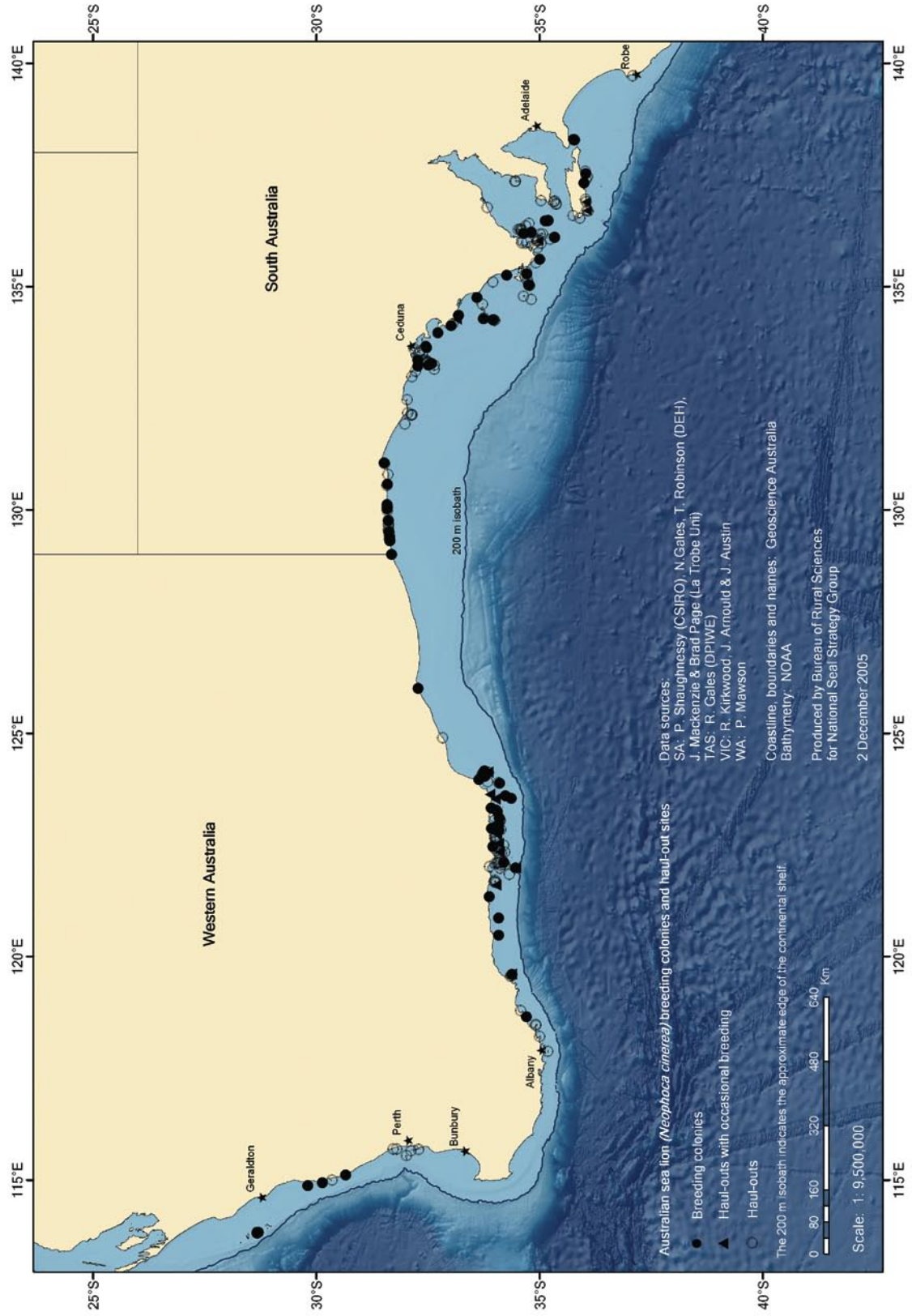
Despite the recent increases, the overall population in Australian waters is probably smaller than it was historically (pre-sealing) (Shaughnessy, 1999). Several islands have not been reoccupied since their populations were removed by early commercial sealing. Historical information presented by Warneke (1982) indicates that the range of New Zealand fur seals extended through Bass Strait and included islands in the Furneaux Group in eastern Bass Strait, where it was abundant.

2.3 Visiting/vagrant seals

Apart from the Australian sea lion, Australian fur seal and New Zealand fur seal which breed on continental Australia; species that breed in the subantarctic and/or the Antarctic may also visit continental Australia:

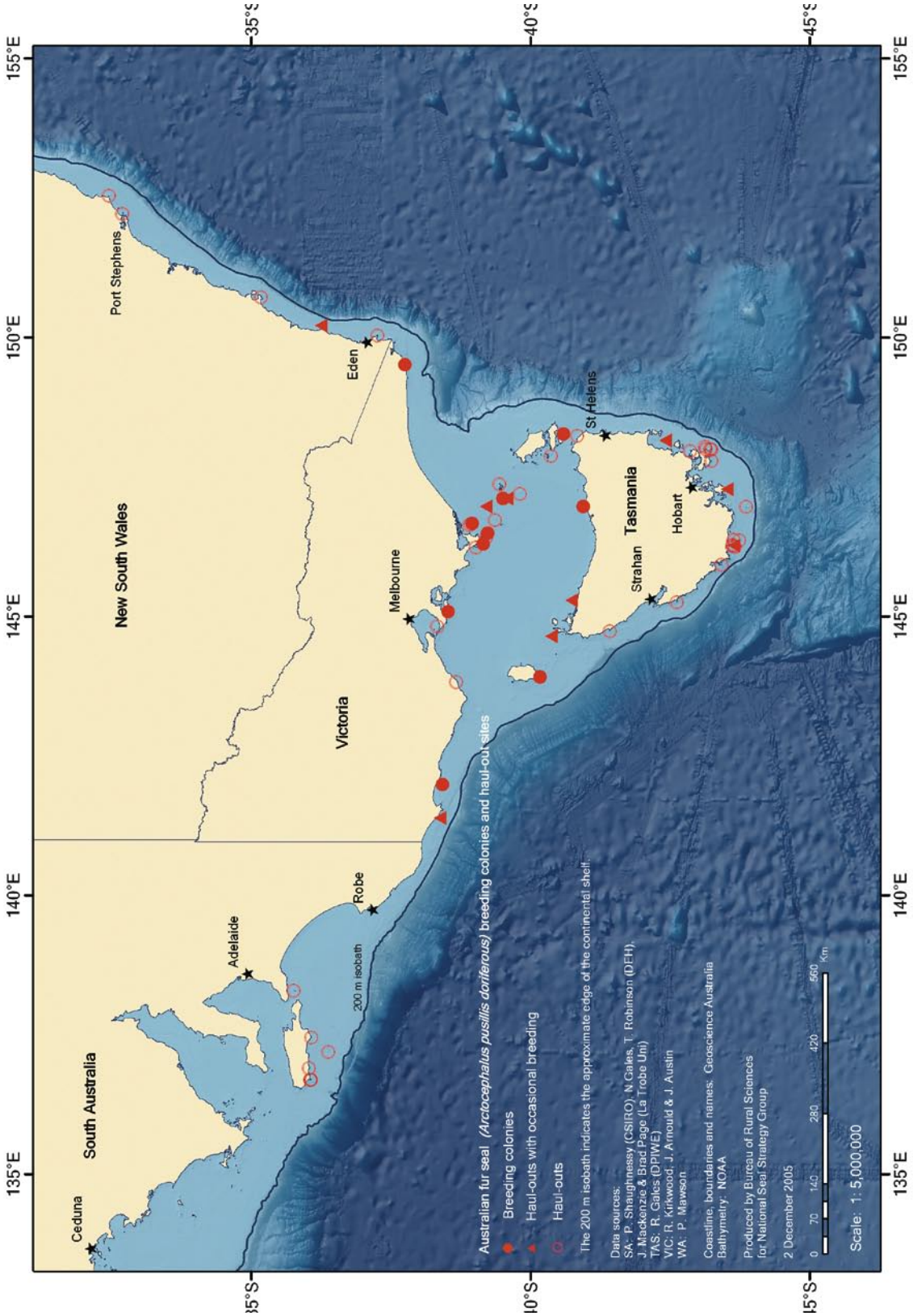
- Southern elephant seals are regular and frequent visitors–reported from Western Australia to New South Wales, particularly Tasmania (including records of births).
- Leopard seals are regular and frequent visitors–reported from Western Australia to New South Wales, particularly Tasmania (including records of births).
- Subantarctic fur seals are regular and frequent visitors–reported from Western Australia to New South Wales, particularly Western Australia.
- Crab-eater seals are occasional visitors–have been reported from Western Australia to New South Wales, particularly from Victoria.
- Weddell seals are rare visitors–one record from South Australia.
- Ross seals are rare visitors–one record from South Australia.
- Antarctic fur seals are rare visitors–one record from South Australia.
  (Shaughnessy, 1999; Phillip Gleeson, pers. comm.; Peter Mawson, pers. comm.; Barbara Baxter, pers. comm.; Jane McKenzie, La Trobe University, pers. comm.; Rosemary Gales, pers. comm.)

Figure 2.4 Distribution of breeding and haul-out sites of Australian sea lions (*Neophoca cinerea*) within Australia, excluding external territories



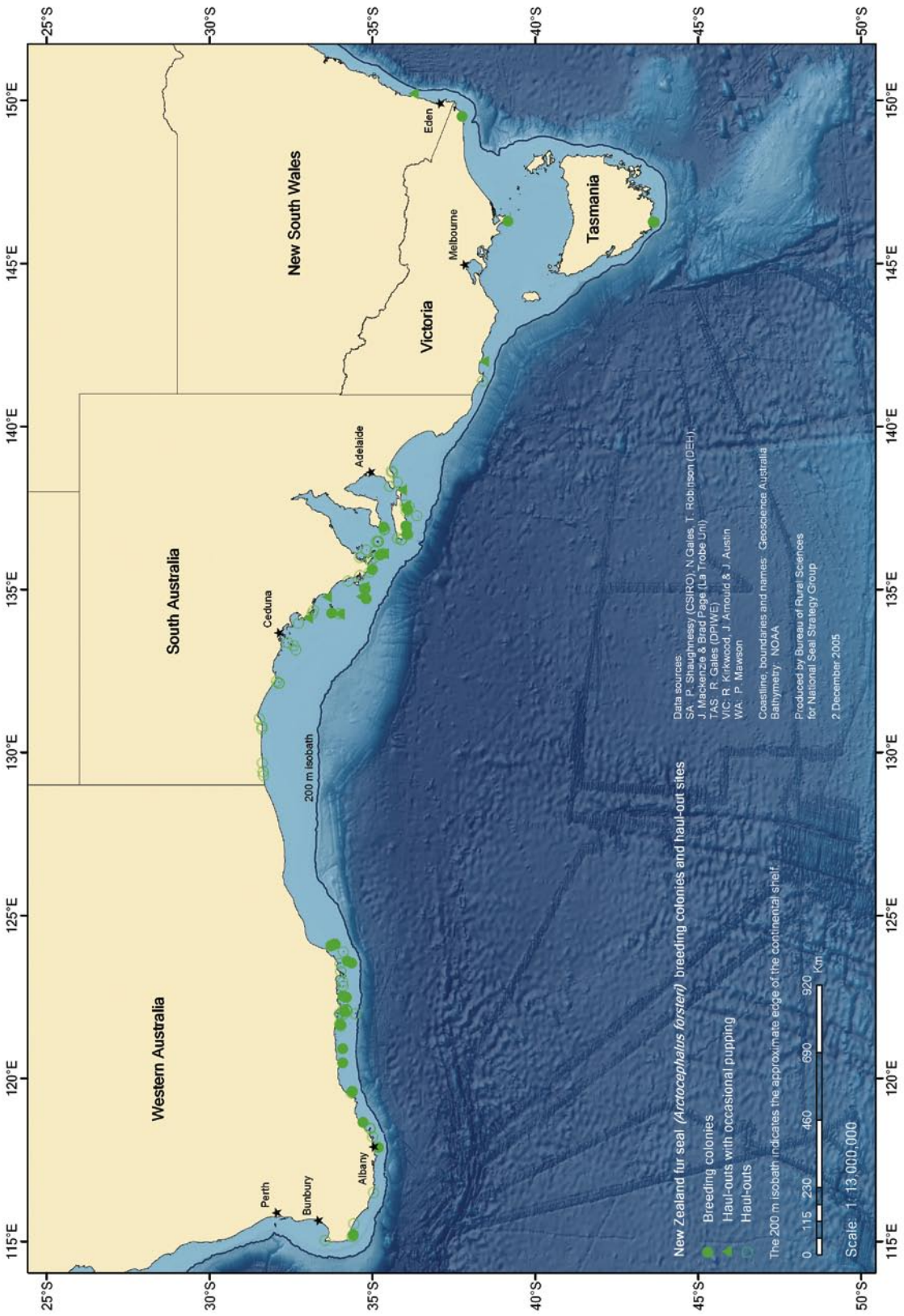
Definitions: (i) breeding colony: has at least 5 pups recorded during at least one survey over the past 20 years; (ii) haul-out with occasional pupping: has 1–4 pups recorded during at least one survey over the past 20 years; and (iii) haul-out site: sites that are frequented by sea lions. Haul-outs exclude man-made infrastructure, e.g., bellboys, oil rigs etc.

Figure 2.5 Distribution of breeding and haul-out sites of Australian fur seals (*Arctocephalus pusillus doriferus*) within Australia, excluding external territories



Definitions: (i) breeding colony: has at least 15 pups recorded during at least one survey over the past 20 years; (ii) haul-out with occasional pupping: has 1–14 pups recorded during at least one survey over the past 20 years; and (iii) haul-out site: sites that are frequented by fur seal. Haul-outs exclude man-made infrastructure, e.g., bellboys, oil rigs etc.

Figure 2.6 Distribution of breeding and haul-out sites of New Zealand fur seals (*Arctocephalus forsteri*) within Australia, excluding external territories



Definitions: (i) breeding colony: has at least 15 pups recorded during at least one survey over the past 20 years; (ii) haul-out with occasional pupping: has 1–14 pups recorded during at least one survey over the past 20 year'; and (iii) haul-out site: sites that are frequented by fur seals. Haul-outs exclude man-made infrastructure, e.g., bellboys, oil rigs etc

3 National overview of interactions between fisheries and seals

3.1 Australian Government (Commonwealth) Managed Fisheries

Interactions between seals and fisheries in Commonwealth waters occur mainly in the Commonwealth Trawl Sector (formally the South East Trawl Fishery), and 'Gillnet, Hook and Trap Fishery'[2] sectors of the Southern and Eastern Scalefish and Shark Fishery, and also in the Southern Squid Jig Fishery.

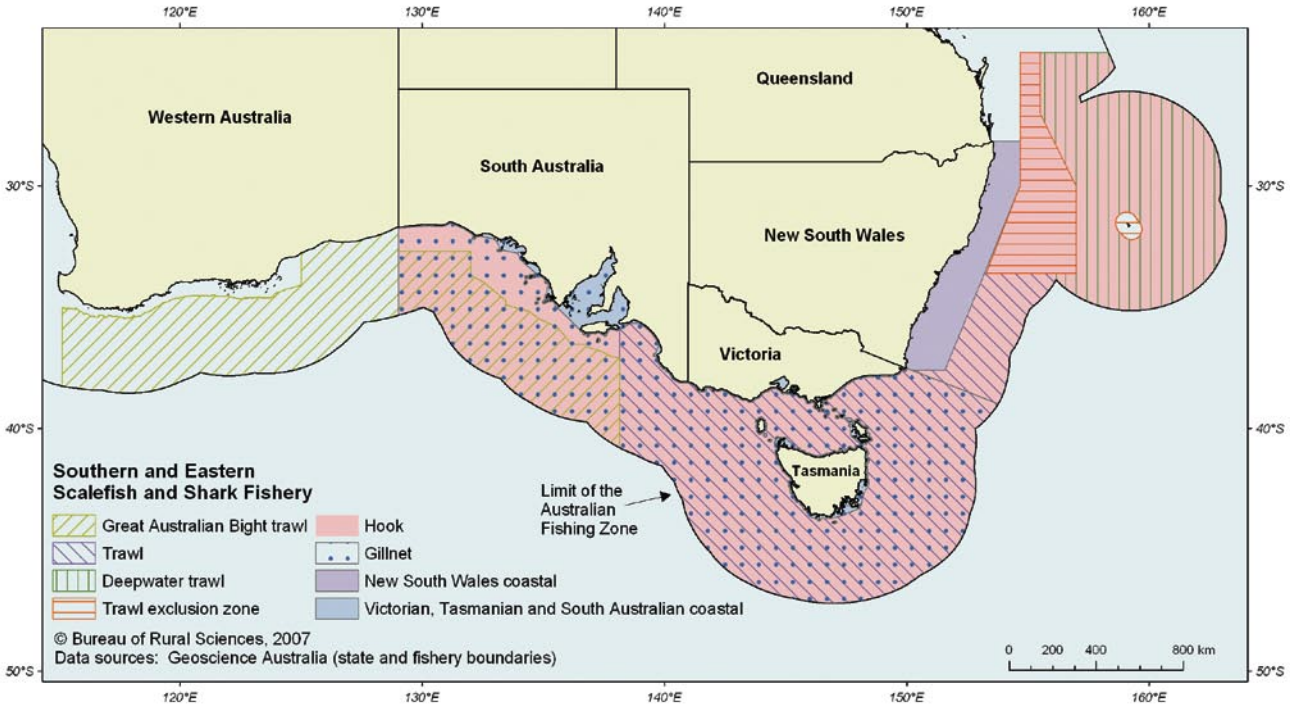
3.1.1 Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery

Description of fishery

The Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) is managed by the Australian Fisheries Management Authority. Established in 1915, the area of this fishery extends southward from Sandy Cape in southern Queensland, around the New South Wales, Victorian and Tasmanian coastlines to Cape Jervis in South Australia, and includes the Commonwealth Victorian Inshore Trawl (CVIT) Fishery (Figure 3.1). The fishery covers the take of 24 targeted quota species/species groups and numerous commercial non-quota species of fish (particularly orange roughy, ling, blue grenadier, flathead and warehou). The trawl fleet uses both otter trawl and Danish seine. Up to 118 boats may operate in the CTS, while up to 46 boats may operate in the CVIT. Most of the trawl vessels are wet boats (fishing vessels that store fresh fish on ice or brine) that use demersal trawls, but a few factory vessels operate in the winter grenadier fishery of western Tasmania using mid-water trawls. Fishing effort is around 100 000 hours of trawling per annum. In 2003–04, the catch for this sector of the SESSF was 27 906 t, valued at around A$54.1 million (ABARE, 2005).

[2] The 'Gillnet, Hook and Trap' Fishery is a term used collectively to refer to several sectors/areas of water under the SESSF Management Plan, i.e., Gillnet sector, Shark Hook sector, the Scalefish Hook sector, and stand alone permits for traps.

Figure 3.1 Management areas of the various sectors in the Southern and Eastern Scalefish and Shark Fishery



Observer coverage

The most comprehensive information on seal interactions in this fishery comes from the Integrated Scientific Monitoring Programme (ISMP). This programme was commissioned by the Australian Fisheries Management Authority in 1997. The Marine and Freshwater Research Institute, which won the tender, began work in 1998. Pilot observer programmes (e.g., scientific monitoring programme, SMP) had been conducted prior to this. The principal objective of the ISMP is to gather information on the quantity, species composition, size and age structure of both the retained and discarded catches from the trawl and non-trawl sectors of the CTS, and more recently, the Great Australian Bight Trawl Sector, across the entire fleet. A secondary function is to collect data on wildlife interactions (Stewardson and Kalish, 2003). Current ISMP coverage relevant to the CTS is 0.55 percent for Danish seine and 1.99 percent for otter trawl (including the ECDWTS) (Australian Fisheries Management Authority, pers. comm.).

Australian Fisheries Management Authority observers are used aboard the factory freezer vessels. Coverage at present targets 25 percent of the effort. The programme is designed to monitor fish processing before packaging and freezing, and to determine reliable conversion factors for the weight of whole fish caught against quota holdings. A secondary function is to collect data on wildlife interactions (only about 40 days), including monitoring seal interactions and effectiveness of mitigation techniques (Knuckey *et al*., 2002a). In addition, 100 percent observer coverage is required for new vessels operating in the fishery (Australian Fisheries Management Authority, pers. comm.).

Pinniped interactions

The Australian fur seal, and to a lesser extent the New Zealand fur seal, have been reported to interact with this fishery.

The known interactions that are detrimental to the CTS of the SESSF are:

- Loss of income attributed to seals feeding on the catch inside trawl or Danish seine gear during fishing or on retrieval.
- Loss of income attributed to seals feeding on fish protruding from trawl or Danish seine gear (tails bitten off).
- Loss of income attributed to live or dead seals inside the codend damaging fish to the point where they are unsaleable.
- Occupational hazard to crew, e.g., live seals trapped in trawls, brought aboard and released alive may attack crew (furthermore, diseases carried by seals are possibly biohazards to humans).
- Loss of fishing opportunity and increased costs when fishers have to stop fishing and steam away from the grounds when seals are present.
- Loss of fishing time when seals are caught in nets and must be cut out; repairs to the net.
- Bad publicity if seals are killed as a result of their operations.

The extent of each interaction listed above is unknown (Knuckey *et al*., 2002a; anecdotes from industry; Australian Fisheries Management Authority, pers. comm.).

The known interactions that are detrimental to seals are:

- Incidental capture in nets, often resulting in death by drowning (particularly in otter gear).
- Injury and stress if brought live aboard vessels and if not handled correctly during release; their chances of subsequent survival are unknown.
- Entanglement in net fragments when cut from nets, leading to potential injury or death.
- Changes in the natural behaviour of seals; some become attracted to a predictable food source and trail vessels and feed on discarded fish (Knuckey *et al*., 2002a; various anecdotes from industry; Australian Fisheries Management Authority, pers. comm.).

Recent quantitative data for operational interactions between seals and the CTS include reports by Tilzey *et al*. (2002; 2004; 2006), Goldsworthy *et al*. (2003b) and Hamer (2004) for factory freezer vessels in the winter blue grenadier fishery; and Knuckey *et al*. (2002a) for wet boats.

In 1999, the unprecedented capture of 87 seals (83 dead) in the winter trawl fishery for blue grenadier off west Tasmania initiated the introduction of a three-year programme aimed at mitigating seal interactions in this fishery. The key components of the programme were the introduction of fishing practices to avoid seals, and undertaking trials of Seal Exclusion Devices (SEDs) in mid-water nets of the two freezer trawlers in this fishery (refer to case study on page 66). In 2000, 40/453 trawl shots contained seal bycatch; in 2001, 26/511 trawl shots contained seal bycatch; in 2002, 41/557 trawl shots contained seal bycatch; and in 2003 19/483 trawl shots contained seal bycatch. The amended fishing practices appear to have halved the incidence of seal bycatch (Tilzey *et al*., 2004; 2006). Of the 87 of these seals caught between 2000 and 2002, all but two unidentified animals were Australian fur seals and most were sub-adult males (Goldsworthy *et al*., 2003b).

Hamer (2004) reported that the numbers of seals in the fishing ground and during fishing operations increased when the weather deteriorated (i.e., increased swell and wind speed, and decreased barometric pressure), and when the vessels operated closer to haul-out sites, e.g., Hibbs Point (n = 32 days of observation). However, seal numbers decreased at higher vessel speeds and also as fishing intensity and the number of nearby fishing vessels decreased. During this study, 13 seals were caught: (i) all were

adult males; (ii) all but one were caught during the day; (iii) six were caught during gear shooting, and all died; (iv) seven were caught during hauling and one died; (v) six of the seven seals caught during hauling were caught when haul speed was above 7.2 km h^{-1} (the mean maximum diving speed of fur seals); and (vi) twice as many seals were observed during hauling than gear shooting, both at the surface and underwater. Underwater video footage confirmed that about half the seals that became bycatch entered the net during shooting and may have been foraging on dead fish (stickers) caught in the net meshes in previous trawls. Only one seal that entered the net managed to escape by the net mouth–all others became bycatch. This suggests that the reduction in seal bycatch since the introduction of the SED may be due to a concomitant reduction in the incidence of net entry, rather than successful ejection through the escape hatch alone (Hamer, 2004).

Knuckey *et al*. (2002a) investigated seal interactions in the wet boat component of the CTS during the 2001 spawning blue grenadier fishery. Eight trips, incorporating 59 sea-days, 38 fishing days and 99 individual shots were monitored. Nine seals were captured, of which five were released alive and four were dead (one animal had been dead for several days and was excluded from subsequent analysis). All were Australian fur seals. The total seal capture rate was 0.081 seals per shot (one seal per 12 shots) and, the mortality rate was 0.030 seals per shot (one seal per 33 shots).

Knuckey *et al*. (2002a) also examined ISMP and SMP data for the wet boat component of the CTS from 1993–2000. The records showed that fur seals were caught in shelf waters throughout all regions of the SEF in all months of the year (n = 121 seals). Seal-capture rates varied considerably, with an average of about 720 fur seals caught each year across the fishery (0.02 seals per shot; one seal in every 50 shots). Catch rates were slightly higher off western Tasmania and western Victoria. About 240 seals (a third) were released alive, and about 480 seals drowned. This may be an under-representation because there was no information on the survival rate of seals released after 'capture' in trawl gear, and there is potential underreporting on vessels without observers on board.

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise interactions between seals and the CTS:

(i) Strategic assessment report

The Environment Protection and Biodiversity Conservation Act 1999 (EBPC Act) requires that all Australian Government managed fisheries be strategically assessed and that all fisheries with an export component undergo export assessment. The strategic assessment relates to the impact of the fishery on the Commonwealth marine environment.

The assessment report for the Southern and Eastern Scalefish and Shark (SESS) Fishery has been completed and was endorsed by the Minister for the Environment and Heritage on 30 September 2003.

The **assessment report for the Southern and Eastern Scalefish and Shark (SESS) Fishery** includes a number of recommendations for improving the ecological sustainability of the fishery. There are three recommendations for the SESSF which relate to seals and sea lions.

Recommendation 6 applies to outcomes of the Environmental Risk Assessment (ERA) which have yet to be finalised and therefore could apply to seals and sea-lions depending on the outcomes of the ERA:

- Within 3 years AFMA will identify and implement management responses to fishing impacts identified from the ecological risk assessment process, taking into account known fishing impacts on: vulnerable and/or overfished species; listed threatened species under the EPBC Act in the fishery; species with low productivity; key species in the food chain such as squid and jack mackerel; areas of localized depletion; cumulative gear impacts across the life cycles of species in the SESSF and adjoining fisheries; species with increasing levels, or significant potential for increased levels, of catch landings.

Recommendation 10 applies to spatial and temporal management and applies to species identified by the ERA as high risk which therefore potentially includes seals and sea-lions:

- AFMA will develop and implement within 3 years a system of spatial and temporal management to assist the fishery to be managed in an ecologically sustainable manner. The system of strategic closures will take account of impacts of fishing on species and populations identified by the ecological risk assessment process as high risk; the recovery of overfished stocks; important spawning/pupping/juvenile/feeding/refuge grounds; benthic habitats and associated impacts on productivity of quota and non quota species; species vulnerable to particular methods of fishing such as deepwater dogfish; various stages of the life cycle of species e.g., ling, blue eye trevalla and sharks; and species and associated habitats taken as target species by other fisheries; species or habitats fished at particular depth ranges by particular gear types.

Recommendation 18 applies to seals and sea lions and includes specific requirements and timing for implementation:

- AFMA, in consultation with industry, EA, researchers and other stakeholders, to further assess and reduce the extent of interactions of seals, cetaceans and seabirds across all sectors of the SESSF (and interactions with syngnathids in the trawl sectors and white sharks in the gillnet and hook sector). AFMA will, for all of the above species: within 12 months, establish robust data collection and reporting systems to quantify the extent of interactions; and within 3 years assess, trial and implement as appropriate mitigation or avoidance measures including further trials of bycatch exclusion devices and spatial or temporal closures. For seals and sea lions, AFMA will, within 18 months, extend across the trawl sectors management measures assessed as effective to help reduce interactions with seals and sea lions.

(ii) Voluntary industry codes of practice/conduct

- A Code of Conduct for a Responsible Seafood Industry. Australian Seafood Industry Council, 1998 (*note: broad application only*).
- Industry Code of Conduct for Responsible Fishing: South East Trawl Fishery. South East Trawl Fishery Industry Association, 2000.
- Code of Fishing Practice to Minimise Incidental Bycatch of Marine Mammals in the South East Trawl Fishery. South East Trawl Fishery Industry Association, 2000.

The **Code of Conduct for a Responsible Seafood Industry** sets out principles and standards of behaviour for responsible practice in the seafood industry to help ensure the conservation, management and development of living marine resources.

Although the recommendations of this code have broad application throughout the fishing industry, the recommendations with relevance to seals are:

- Minimise the incidental catch of marine mammals, and minimise impacts on associated or dependent species using measures such as gear modifications, closed areas or closed seasons.
- Participate in the development and application of selective fishing gear and methods, including those that reduce unwanted bycatch and discards.
- Ensure appropriate monitoring of all fishing apparatus when in use.
- Ensure that the time any fishing apparatus is in the water is such that the seafood quality is maximised and catch of non-target species minimised.
- Cooperate in developing and applying technologies and methods that would contribute to minimising the loss of fishing gear and the ghost-fishing effects of lost or abandoned fishing gear.
- Retain material, such as derelict fishing gear and other garbage recovered during routine operations for disposal on shore.

The **Industry Code of Conduct for Responsible Fishing in the South East Trawl Fishery** provides an overall strategy to achieve responsible fishing and fisheries activities.

The code reiterates reporting requirements for marine mammal interactions and encourages operators to adhere to the *Code of Fishing Practice to Minimise Incidental Bycatch of Marine Mammals*.

Recently, industry liaison officer Ian Knuckey and SETFIA embarked on an industry-based education and monitoring programme, to encourage more accurate and regular reporting of seal/fisheries interactions in the CTS, and ensure adherence to the *Industry Code of Practice*. The educational programme includes a booklet about seals and guidelines for reporting interactions in the AFMA logbook; a revised *Industry Code of Conduct for Responsible Fishing*; a revised *Code of Fishing Practice to Minimise Incidental Bycatch of Marine Mammals*; a seal identification poster; and educational DVD/video about seals, reporting requirements and data collection.

The educational booklet, *South East Trawl Fishery: Seal Bycatch–Guidelines for Reporting and Data Collection* (Stewardson and Knuckey, 2005) was launched at a dedicated SETFIA seal workshop on 20 June 2005.

The seal DVD/video (Stewardson and Knuckey, 2006) and poster, *Seals of Australia* (Bureau of Rural Sciences, 2006) shall be launched by the Hon. Gary Nairn MP, Federal member for Eden-Monaro and Special Minister of State, with industry, in 2006. The *Code of Conduct for Responsible Fishing* is currently being reviewed.

The **Code of Fishing Practice to Minimise Incidental Bycatch of Marine Mammals in the South East Trawl Fishery** was developed in response to an unusually high bycatch of seals in the blue grenadier sector in 1999. The code aims to minimise accidental bycatch of seals and other marine mammals by entrapment or entanglement in commercial trawl fisheries, and to ensure all operators comply with the code and laws and regulations governing fisheries and bycatch. The code establishes a broad range of measures designed to meet these objectives.

Specific actions to minimise interactions with seals include:

- Delay net deployment if seals are sighted near the stern.
- Where possible, release seals brought aboard in fishing gear.
- Deploy and haul gear rapidly to minimise the time that the gear is in the top 150 m of the water column.
- When possible, close the trawl opening when hauling to minimise the opportunities for seals to enter the net.
- Where difficulties arise, the headline and ground rope should be hauled on board as quickly as possible.
- During the course of a shot, the vessel should not execute turns or changes of direction with the doors deployed and the net mouth open near the surface.
- Watch-keepers should be posted during deployment and recovery of trawls (both day and night) to detect marine mammals that become caught at the surface.
- During night trawling the after-gantry lights should be turned off when not required in order to minimise attracting seals.
- Where possible, fish offal should be converted to meal or incinerated, or alternatively dumped whilst moving, but not when deploying or hauling gear.
- All flammable domestic waste should be incinerated, and non-biodegradable products should be stored in suitable containers and returned to port.

This Code of Practice is currently being reviewed.

(iii) Fishery management plans

- Southern and Eastern Scalefish and Shark Fishery Management Plan 2003, Australian Fisheries Management Authority.

On 19 December 2003 the Minister for Environment and Heritage accredited the **Southern and Eastern Scalefish and Shark Fishery Management Plan 2003** under the EPBC Act. As a result, interactions with protected species listed in Part 13 of the EPBC Act do not constitute an offence provided operators act in accordance with this plan. Jurisdiction of this plan extends to include the CTS; Gillnet, Hook and Trap Fishery; and the Great Australian Bight Fishery.

The plan imposes obligations on concession holders to take all reasonable steps to avoid interactions with listed threatened species, listed migratory species and listed marine species (s 47). The plan also sets out provisions to facilitate continued improvement of management measures. Concession holders must permit the Australian Fisheries Management Authority's nominated observers to travel on vessels operating in the fishery and give the Australian Fisheries Management Authority reasonable access to biological, economic or technical information, or biological samples (s 46). The Australian Fisheries Management Authority must also develop and implement a Bycatch Action Plan, or Bycatch Action Plans, for the fishery (s 8) (see below).

In accrediting the SESS Fishery Management Plan 2003, the Minister for Environment and Heritage recommended the Australian Fisheries Management Authority further improve the ecologically sustainable management of the fishery. The Australian Fisheries Management Authority accepted the recommendations and is working to implement them. Recommendations relating to interactions with seals and sea lions are:

- AFMA, in consultation with industry, DEH, researchers and other stakeholders, to further assess and reduce the extent of interactions of seals, cetaceans and seabirds across all sectors of the SESS. AFMA will, for all of the above species:
  - within 12 months, establish robust data collection and reporting systems to quantify the extent of interactions; and
  - within three years, assess, trial and implement, as appropriate, mitigation or avoidance measures, including further trials of bycatch-exclusion devices and spatial or temporal closures.
- For seals and sea lions, AFMA will, within 18 months, extend across the trawl sectors management measures assessed as effective in reducing interactions with seals and sea lions.

(iv) Bycatch action plans

- The South East Trawl Fishery Bycatch Action Plan (AFMA, 31 March 2001).
- Southern and Eastern Scalefish and Shark Fishery Bycatch Action Plan 2006–2008.

The **South East Trawl Fishery Bycatch Action Plan (BAP)** was developed to meet the Australian Fisheries Management Authority's obligations under the *Commonwealth Policy on Fisheries Bycatch* and is now a requirement under the SESS Fishery Management Plan 2003 (s 8). In doing so the Australian Fisheries Management Authority must take into account the requirements under the EPBC Act for the protection of listed, threatened, migratory and marine species. The Australian Fisheries Management Authority must also review each bycatch action plan, at least once every second year, while it is in force.

Seal management actions listed in the 2001 BAP include the development of effective seal-exclusion devices (SEDs) and improved accuracy of recorded interactions with protected species.

In accordance with the SESS Fishery Management Plan 2003, the Australian Fisheries Management Authority is reviewing the BAP. Each sector of the SESF has its own BAP. Currently, the BAPs are being amalgamated into a single BAP that will be released for public comment in October 2006.

(v) Fishing permit conditions specific to reducing interactions with pinnipeds

The Australian Fisheries Management Authority recently implemented a policy in the winter blue grenadier fishery that included the following fishing permit conditions:

- Mandatory to complete the EFT01 daily-catch-and-effort logbook and record details about capture of listed marine species.
- Mandatory use of top-opening SEDs in the winter blue grenadier processing/freezing sector of the CTS (but is allowing further trials of SEDs–on, and SEDs–off, on one boat).
- Mandatory protocols for offal discharge in the winter blue grenadier processing/freezing sector of the CTS.

(vi) Mitigation of interactions through technology and changes in fishing gear

- Seal-exclusion devices

A three-year project was initiated in 2000 to determine the cause of seal captures in the blue grenadier fishery and assess potential mitigation options. The project—Assessment of interactions between seals and freezer trawlers in the winter blue grenadier fishery off western Tasmania and the development of seal-exclusion devices (SEDs) and fishing practices to minimise seal bycatch by trawlers—will enable management to make informed decisions about the success of this device as a mitigation tool. A top-opening grid device positioned before the cod-end appears to be effective in reducing the incidence of drowned seals, by ejecting them before they become trapped; however, SED performance remains largely unquantified (Australian Fisheries Management Authority, pers. comm.) (refer to case study on page 66).

3.1.2 Gillnet, Hook and Trap sector of the Southern and Eastern Scalefish and Shark Fishery

Description of fishery

The Gillnet, Hook and Trap Fishery (GHATF) sector is managed by the Australian Fisheries Management Authority. It is the result of the merger (1 January 2003) of the South East non-trawl Fishery and the Southern Shark Fishery. The area of this fishery extends from waters 80 n.mile off Sandy Cape (Queensland) to the West Australian–South Australian border, including all coastal waters of Tasmania and South Australia (Figure 3.1). In 2004, there were 244 managed fishing licences (permit packages) in this fishery, 115 of which landed catch in 2004. Gillnets mainly operate in shelf waters targeting gummy shark, and a few hook operators also target gummy shark. Drop-line and automatic-longline fish mainly at 300–700 m depth targeting blue-eye trevalla and ling. Some operators are permitted to use fish traps to target ling, although effort is small. Fishing effort for gillnets has averaged around 40 000 km net lifts per year. Fishing in the automatic-longline sector has expanded from 1 660 000 hooks in the first half of 2003 to 3 990 000 in the first half of 2004. Some operators are permitted to use fish traps to target ling, although effort is small. In 2003–04, the catch for this sector of the SESSF was 4926 t, valued at around A$23.5 million (ABARE, 2005).

Observer coverage

The ISMP (see section 3.1) provides observer coverage for hook and trap vessels operating in the GHATF. Current ISMP coverage is 7.7 percent for Scalefish Hook and 25 percent for automatic longlines. The Australian Fisheries Management Authority is now in the process of extending observer coverage to the gillnet sector where interactions are know to occur (Australian Fisheries Management Authority, pers. comm.).

Pinniped interactions

Australian fur seals, New Zealand fur seals and Australian sea lions have been reported to interact with this fishery.

The known interactions that are detrimental to the GHATF are:

- Loss of income attributed to fur seals taking fish from hooks (longlines and droplines), or from gillnets, including taking the livers from sharks (Australian Fisheries Management Authority observers, ISMP observers, Australian Fisheries Management Authority Logbooks, MAC discussions).
- Loss of income attributed to loss or damage of gear or equipment.

To date, observers have reported low levels of seal interaction (e.g., fish taken off hooks and out of gillnets). Observations suggest that the depredations do not substantially disrupt fishing (Australian Fisheries Management Authority, pers. comm.).

The known interactions that are detrimental to seals are:

- Incidental capture of seals/sea lions in gillnets that may result in death by drowning or injury.
- Entanglement of seals/sea lions in fragments of monofilament, resulting in injury or death.

The sea lion's high site-fidelity and low dispersal means that animals lost from a colony are unlikely to be replaced by immigrants. The loss of just a few animals from a population can significantly impact on pup production.

Recent quantitative data for operational interactions between seals and the GHATF is limited, e.g., Walker *et al*. (2004); Australian Fisheries Management Authority logbook records. There is no independent observer programme, and under-reporting of interactions with seals in the existing logbook programme is likely. An observer programme is proposed for the fishery.

Walker *et al*. (2004) analysed catch composition and catch rates by demersal monofilament gillnets and demersal longlines in the shark fishery of southern Australia between 1998 and 2001. They reported that two Australian fur seals were caught and drowned in gillnets in Bass Strait (n = 91 sites in Bass Strait and n = 62 sites off South Australia). This is consistent with the anecdotal information that the bycatch for these species is small, although actual rates of interaction may differ from this, due to likely underreporting. In 1988, targeted shark fishing was prohibited within Victorian coastal waters (extending to 3 n.mile). This closure may have reduced the unintentional fishing mortality of Australian fur seals around four major seal-breeding colonies (Lady Julia Percy Island, Seal Rock, Kanowa Island, and The Skerries off Croajingalong National Park) and other haul-out sites. Closure of other important seal habitat is under consideration in other states (Walker *et al*., 2004).

The Australian Fisheries Management Authority logbook records indicate that in 1998, three fur seal were entrapped in shark gillnets set in Commonwealth waters, of which one was recorded dead (n = 14 243 shots); and in 1999, one fur seal (species not identified) was entrapped in shark gillnets and reported dead (n = 12 696 shots) (Australian Fisheries Management Authority, pers. comm.). Once again, these figures probably represent absolute minimum levels of interaction.

More recently there have been concerns about interactions between Australian sea lions and gillnets in South Australia. Although logbooks and limited observer coverage have not recorded any injury or mortality, this is unlikely to be an accurate reflection of the number of interactions (Department of the Environment and Heritage, pers. comm.). Anecdotal reports from shark fishers suggest that entanglement of sea lions occurs in inshore rather than offshore waters (Shaughnessy *et al*., 2003). The fishery operates in inshore waters in many areas under the Offshore Constitutional Settlement.

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise interactions between seals and the GHATF:

(i) Strategic assessment report

The strategic assessment report for the SESSF has been completed and has been endorsed by the Minister for the Environment and Heritage on 30 September 2003 (section 4.1), with a number of recommendations for improving the ecological sustainability of the fishery.

(ii) Voluntary industry codes of practice/conduct

- The Gillnet, Hook and Trap Fishers Code of Conduct for Responsible Fishing (South East Fisheries Association, October 2002).

The **Gillnet, Hook and Trap Fishers Code of Conduct for Responsible Fishing** provides guidelines and standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of resources, with due respect for the ecosystem and biodiversity. Specifically, the guidelines state that interactions with seals and sea lions should be avoided where possible or minimised through the following measures:

- If a seal or dolphin is caught on a longline hook, fishers should attempt to remove the hook before releasing the animal unharmed, or, if this is not practical to cut the line as close to the hook as possible. In the event that a seal or dolphin becomes entangled in a net, it should be disentangled and released alive if possible.
- If a seal, sea lion or marine mammal is sighted near the vessel when gear is about to be deployed, deployment should be delayed until the animals move away.
- Seals, sea lions and marine mammals may be attracted to vessels to feed on offal and discarded fish from cleaning operations. To minimise interactions, offal should be dumped when the vessel is moving and not during setting or hauling.

(iii) Fishery management plans

- Southern Eastern Scalefish and Shark Fishery Management Plan (AFMA, 2003).

Operations in the GHATF are managed under the SESS Fishery Management Plan. Implications of this management arrangement are described in section 4.1.

(iv) Bycatch action plans

- Southern Eastern Scalefish and Shark Fishery Bycatch Action Plan (AFMA, in preparation).

In accordance with the SESS Fishery Management Plan 2003, the Australian Fisheries Management Authority is reviewing the BAP. Each sector of the SESF has its own BAP. Currently, the BAPs are being amalgamated into a single BAP that will be released for public comment in October 2006.

(v) Area closures

- In 1988, targeted shark fishing was prohibited within Victorian coastal waters (extending to 3 n.miles) to protect pupping female school and gummy sharks. These closures also serve to minimise interactions with seals and the occasional sea lion in the region.
- In January 2004, area closures around Pages Island and west coast of South Australia (Eyre Bluff to the West Australian border) were established to protect breeding school and gummy sharks and reduce interactions with Australian sea lions, whales and great white sharks. As well as protecting known sea lion ranges, the Pages Island closure protects one of the largest breeding colonies of sea lions.

3.1.3 Southern Squid Jig Fishery

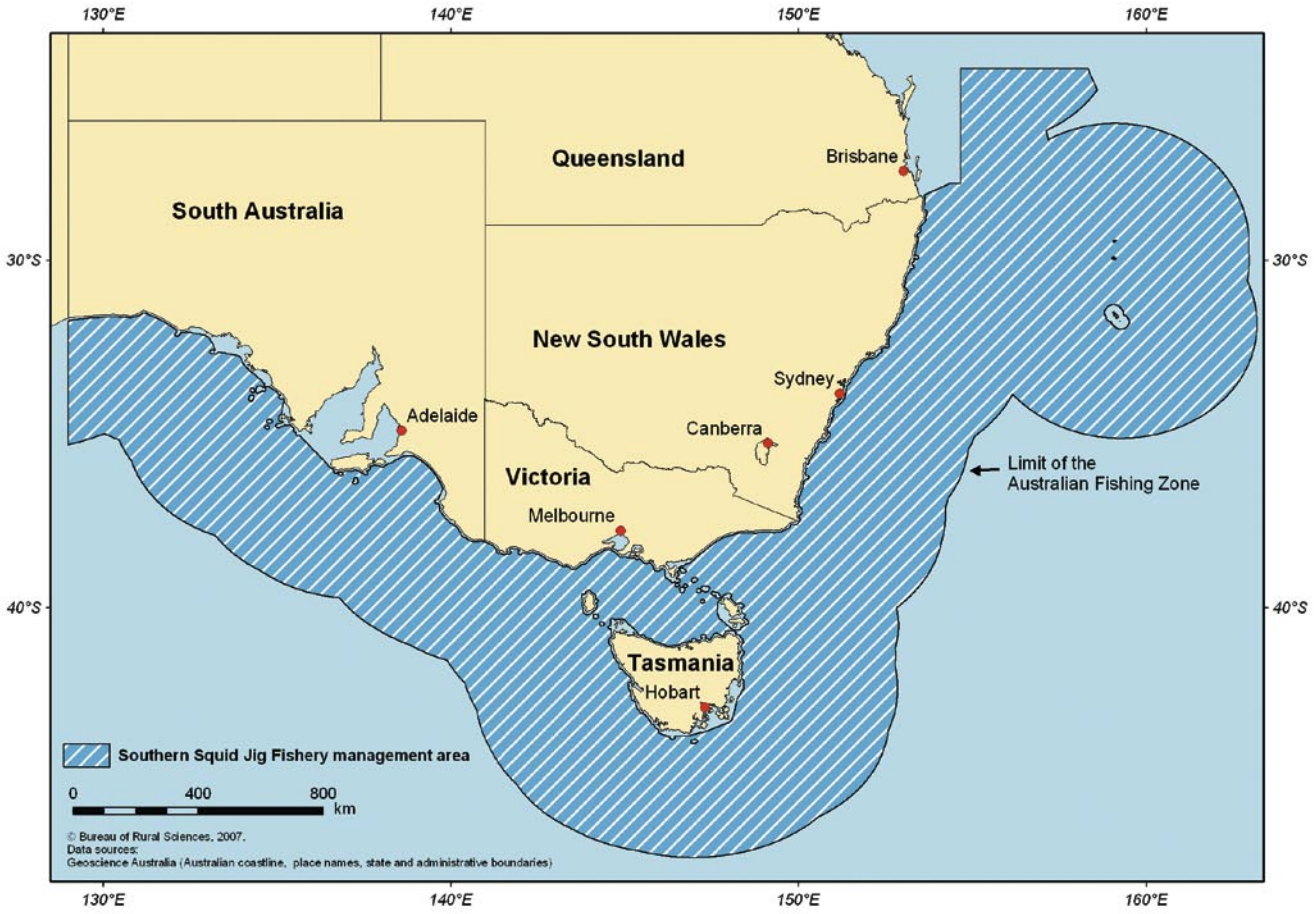
Description of fishery

The Southern Squid Jig Fishery (SSJF) is managed by the Australian Fisheries Management Authority on behalf of the Australian Government. Established in 1986–87, the area of this fishery extends from Sandy Cape, Fraser Island (Latitude 24°30'S), to the South Australian–Western Australian border (Longitude 129°00'E) and includes all Commonwealth waters around Tasmania (Figure 3.2). Virtually all squid jigging occurs off the Victorian coastline between Queenscliff (38°16'S, 144°40'E) and Portland (38°20'S, 141°36'E) and off Lakes Entrance (37°52'S, 147°59'E). Jigs are used to target Arrow squid (*Nototodarus gouldi*). To date, there are 80 fishing permits granted in this fishery. Fishing effort in the financial year 2002–03 totalled 5889 jigging hours (Lynch, 2004). In 2003–04, the catch for this fishery was 1567 t, valued at around A$1.9 million (ABARE, 2005).

Observer coverage

There is no formal observer coverage of fishing activities specific to interactions with seals. However, under a coordinated research programme, independent observers were placed in April and May 2002 (see below).

Figure 3.2 Management area of the Southern Squid Jig Fishery



Virtually all squid jigging occurs off the Victorian coastline between Queenscliff (38°16'S, 144°40'E) and Portland (38°20'S, 141°36'E) and off Lakes Entrance (37°52'S, 147°59'E). © Bureau of Rural Sciences (2004).

Pinniped interactions

Australian fur seals have been reported to interact with this fishery.

The known interactions that are detrimental to the SSJF are:

- Loss of income attributed to seals taking squid from jig lures and from loss of gear when seals break lines and take lures.
- Loss of income attributed to lost fishing time when seals entangle lines or cause schools to disperse from the immediate area (Industry, pers. comm.; Arnould, 2002).

The known interactions that may be detrimental to seals are:

- Potential for seals to become hooked on the jig lure or entangled in fishing line when taking squid from the lure, resulting in injury or drowning.

Recent quantitative data for operational interactions between seals and squid jigging operations is limited to a study by Arnould (2002). In April/May 2002, observers monitored the fishing activity of eight squid jig vessels during 22 fishing trips (26 nights of jigging). The vessels operated out of Portland and Port Fairy on the southwest coast of Victoria. A total of 777 Australian fur seals were observed within a range of 0–60 m from the vessels. Only 3.6 percent of observations were seals targeting squid caught on jig lures, while 29 percent were of seals foraging within 40 m of the vessel. Damage to fishing gear attributed to seals was recorded on only three occasions. On two occasions, lines from adjacent machines became entangled and, on one occasion, a line broke after seals dived to capture squid near the lines. There was no evidence of negative impacts on seals from vessel operations. Most of the seals were adult females. The report concluded that the current level of interaction between Australian fur seals and the SSJF was minor.

In 2001, the recording of fishing interruptions (including interruptions attributed to wildlife interactions) was introduced in this fishery through the SQ05 logbook programme in May 2001. An interruption was defined as an 'event that delays or affects fishing activities during a trip'. In 2002–03, 36 interruptions attributed to seals were recorded in the SQ05 logbooks (n = 16 active vessels; 5889 hours jigging) (Lynch, 2004).

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise interactions between seals and the SSJF:

(i) Strategic assessment report

The strategic assessment of the fishery was completed in November 2004 and the fishery was accredited by the Minister for the Environment and Heritage in April 2005.

(ii) Voluntary industry codes of practice/conduct

- Draft Southern Squid Jig Fishery Code of Practice (SeaNet Victoria, 13 September 2004).

To meet industry standards required by the SSJF draft code, vessel operators must:

- Remain up-to-date and comply with legislative responsibilities under Commonwealth laws (EPBC Act 1999 and *Fisheries Management Act 1991*) regarding interactions with marine mammals while at sea as a licensed commercial fisher.
- Remain alert and observant to the presence of seals and dolphins, particularly during fishing operations.
- If seals or dolphins are attracted to the vessel during jigging operations, it is important operators remain watchful for gear interactions and be ready to respond if an entanglement occurs.
- Report all gear and vessel interactions with seals or dolphins to the Department of the Environment and Heritage and record the interactions in the Daily Fishing Logbook (supplied by the Australian Fisheries Management Authority).

- Endeavour to provide accurate details when reporting marine mammals sighted during fishing operations. Collecting this information will help develop an understanding of marine mammals and will help to identify methods to minimise interactions with commercial operations.
- Not dispose of offal or actively feed seals or dolphins, as feeding can encourage these species to rely on fishing vessels as a food source.
- Maintain a copy of the Protected Species Handling Manual (second edition) onboard, and ensure crews are familiar with the guidelines for handling and protecting seal and dolphin species. Vessel crews should be familiar with handling guidelines if an entangled or injured animal has to be brought onboard.

(iii) Fishery management plans

The *Southern Squid Jig Fishery Management Plan 2005* came into effect in January 2006.

(iv) Bycatch action plans

- Southern Squid Jig Fishery Bycatch Action Plan, AFMA 2004.

The **SSJF Bycatch Action Plan** was developed to ensure that the impacts of bycatch on the ecosystem are sustainable and consistent with legislative requirements.

Independent observer data, and observations made during trials of 'crackers' to deter seals, suggested that: (a) seals do not have a major impact on catch rates, and (b) there is no evidence that seals have ever, or are ever likely to, become entangled in squid jig gear. Therefore, the plan does not stipulate any mitigation measures relevant to seals.

The plan does stipulate that ongoing monitoring and education (with respect to seals) is required.

Furthermore, should data on bycatch collected in this fishery indicate that bycatch species and populations are not maintained as a result of fishing operations, action will need to be taken to reduce bycatch.

In accordance with the SESS Fishery Management Plan 2003, the Australian Fisheries Management Authority is reviewing the BAP. Each sector of the SESF has its own BAP. Currently, the BAPs are being amalgamated into a single BAP that will be released for public comment in October 2006.

(v) Ecological risk assessment

An ecological risk assessment of the SSJF is being compiled to evaluate the risk of fishing impacts on target species and wider ecosystem components, including threatened, endangered or protected species. The assessment will enable the development of effective management responses to quantified risks.

(vi) Mitigation technologies

- Seal 'crackers' to deter seals from the immediate vicinity of squid jig vessels.

During 2002, the Australian Fisheries Management Authority sourced seal 'crackers' from the Tasmanian Department of Parks and Wildlife (imported from USA) and distributed them to operators to trial. As the effectiveness in the squid fishery was inconclusive, the Australian Fisheries Management Authority concluded that there was no benefit in continuing the trial.

3.2 State Government Managed Fisheries: New South Wales

As part of the New South Wales Biodiversity Strategy, New South Wales Department of Primary Industries is undertaking a project to identify the broad-scale interactions that could occur between fishing and mammals, reptiles and avifauna in New South Wales marine and estuarine waters. This project includes a description of the fishing activities and marine wildlife in these waters. The project also documents accounts of interactions between wildlife and local fishing activities and incorporates a pilot observer-based study. The findings from this project will assist the implementation and preparation of threat-abatement plans and recovery plans for any threatened marine wildlife.

3.2.1 Ocean Trawl Fishery

Description of fishery

The New South Wales ocean-trawl fishery consists of the use of an otter trawl net to take prawns from any inshore waters, offshore waters, and the waters off Coffs Harbour and Jervis Bay; and the use of an otter trawl net to take fish from ocean waters that are north of a line drawn due east from Barrenjoey Headland (Sydney), other than the waters in which use of an otter trawl net (fish) is prohibited.

The New South Wales ocean-trawl fishery, managed by the New South Wales Department of Primary Industries, extends from the Queensland border in the north to the Victorian border in the south. North of Barrenjoey Point (Sydney) the boundary of the fishery extends from the coastal baseline out to the 4000 m.mile depth contour (approximately 80 n.mile to sea). South of Barrenjoey Point the seaward boundary of the fishery is 3 n.miles from the coastal baseline (trawling outside this boundary is managed by the Commonwealth).

The ocean-trawl fishery catches a large number of species (prawn trawlers and fish trawlers combined), the most common being eastern king, school and royal red prawns, school whiting, silver trevally, tiger flathead, redfish, john dory and some species of sharks, cuttlefish, southern calamari and octopus.

In 2003–04, the catch for the ocean prawn-trawl fishery was about 3063 t, valued, at first point of sale, at about A$24.7 million. The catch for the ocean fish trawl-fishery for 2003–04 was about 1429 t, with a value at first point of sale of about A$4.49 million.

Observer coverage

Onboard observer studies have been carried out in both the prawn trawl and fish trawl sectors of the fishery (e.g., Kennelly *et al*., 1998; Liggins, 1996).

A scientific observer programme is being introduced across all commercial fisheries in New South Wales. In the ocean-trawl fishery, the programme is to be used to document interactions of trawl fishing with non-retained and threatened species and to collect information on the use and effectiveness of bycatch reduction devices.

Scientific observation has commenced. A framework to determine priorities for observer studies takes into account the potential impacts of each of the fishing methods, as well as what is known of the impacts of particular activities.

Once the fishery management strategy for the Ocean Trawl Fishery has been finalised, the method of trawling will be a high priority for the programme.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.1). The limited observer data make it difficult to comment on pinniped interactions.

There are anecdotal reports that fur seals take or damage fish protruding from the nets, take or damage fish inside the nets, and disturb fishing operations. Hickman (1999) reported that seals feed on the catch of trawl fishers on the south coast of New South Wales and that trawl fishing gear is damaged in the process. Although damage was generally reported to be minor, fishers spent time fixing the net and sometimes had to return to shore early as a result of the damage.

Hickman (1999) reported that most trawl fishers on the New South Wales south coast considered seal interactions to be a major problem, and that the frequency and intensity of seal interference with trawling activities was greater in the south of the state than around Montague Island, further north.

Seals may also sometimes become entrapped in nets (industry, pers. comm.). However, the only documented incidental catches of seals in fishing gear off New South Wales are from observations of fish-trawling where two seals were caught in the 897 observed shots (0.22 percent) off Ulladulla and 27 seals were caught in the 1109 observed shots (2.43 percent) off Eden (species were not recorded). The mortality rates of these captures are unknown (G. Liggins, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

The draft Ocean Trawl Fishery Management Strategy proposes to manage and monitor interactions between the ocean-trawl fishery and protected and threatened species. Generally this may encompass developing a code of practice on litter disposal; best handling methods for releasing any protected fish, birds, reptiles or mammals; handling and returning bycatch; guidelines on operating in the vicinity of threatened species populations and ecological communities; and recording impacts of fishing activities on protected and threatened species. The level of interaction between the fishery and seals will be determined through an on-board observer programme. Based on the outcomes of this programme, and any other relevant data and risk assessments, the need to introduce seal-excluder devices, or other measures to minimise impacts of seals will be assessed in consultation with the Ocean Trawl Management Advisory Committee.

A specific reporting form being introduced will require all commercial fishers in New South Wales to report interactions (including sightings and incidental capture) with threatened or protected species. The threatened species unit within New South Wales Department of Primary Industries will collect this information.

3.2.2 Ocean Trap and Line Fishery

Description of fishery

The New South Wales ocean trap and line fishery licences the use of a fish trap to take fish from ocean waters; the use of a line with hooks attached to take fish from ocean waters; and the use of a spanner crab net to take spanner crabs from ocean waters north of a line drawn due east from Korogoro Point (Hat Head).

The New South Wales ocean trap and line fishery, managed by the New South Wales Department of Primary Industries, extends from the Queensland border in the north to the Victorian border in the south, and from the coastal baseline out to the 4000 m depth contour (approximately 80 n.miles to sea). The ocean trap and line fishery is a multi-method, multi-species fishery targeting demersal and pelagic fish. It uses demersal fish traps (snapper, silver trevally, rubber-lip morwong and leatherjackets); setlines/trotlines (snapper and wobbygong shark); driftlines (spotted mackerel); hand-held lines (mulloway, yellowtail kingfish and bonito); droplines (blue-eye and hapuku); trolling (yellowtail kingfish, mackerel and tuna); jigging (kingfish and bonito); poling (tuna and bonito); and spanner crab nets, known as a ‘dilly’.

In 2003–04, the catch for this fishery was about 1445 t, valued at around A$8.55 million.

Observer coverage

Until recently, there has been no independent observer coverage for this fishery. A scientific observer programme is being introduced across fisheries in New South Wales. A framework to determine priorities for observer studies takes into account the potential impacts of each of the fishing methods, as well as what is known of impacts of particular activities.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.1). The limited observer data make it difficult to comment on pinniped interactions.

Hand-lining (especially for kingfish around Montague Island) and demersal fish traps are the methods most likely to cause interactions with seals.

There are anecdotal reports that fur seals take or damage fish from gear and disturb fishing operations (industry, pers. comm.). Hickman (1999) reported that seals feed on and damage the catch of dropline and handline activities on the south coast of New South Wales. They also scare away the catch of handliners in the area. 'Problem seals' (individual seals that harass a fisher all day) sometimes force dropline fishers to return home early to cut losses. Handliners have reported extra petrol costs to move away from interfering seals. Trappers in the area reported that seals steal and sometimes damage their catch, and that damage to trapping gear is a major problem. Longliners on the south coast of New South Wales operate far offshore, away from seal interactions. Some longliners reported seals taking their catch, but overall longline fishers in the area considered seals to have a negligible effect on their fishing activities.

Hickman (1999) reported that some dropline, handline and trap fishers on the south coast of New South Wales considered seal interactions to be a major problem. From Montague Island south, dropliners reported frequent, mostly daily, interactions with seals during winter. Interactions between seals and handlining activity on the south coast of New South Wales have been frequently recorded around the main seal haul-out sites at Jervis Bay, Montague Island and Eden. While the frequency of seal interactions with trappers was lower than other methods, trappers around Montague Island and Jervis Bay reported frequent interactions with seals during winter.

Current management requirements relevant to minimising interactions with pinnipeds

An Environmental Impact Statement (including a fishery management strategy) is currently being drafted for the Ocean Trap and Line Fishery. It is proposed, under the fishery management strategy, to manage and monitor interactions between the ocean trap and line fishery and protected and threatened species. Generally this may include developing of a Code of Practice on litter disposal issues; best handling methods for releasing protected fish, birds, reptiles or mammals; handling and returning bycatch; guidelines on operating in the vicinity of threatened species, populations and ecological communities; and recording impacts of fishing activities on protected and threatened species. The level of interaction between the fishery and protected and threatened species, including seals, may be determined through an on-board observer programme. Based on the results of this programme, and any other relevant data, the need to introduce measures to minimise impacts will be assessed in consultation with the Ocean Trap and Line Management Advisory Committee.

A specific reporting form being introduced will require all commercial fishers in New South Wales to report interactions (including sightings and incidental capture) with threatened or protected species. The threatened species unit within New South Wales Department of Primary Industries will collect this information.

3.2.3 Ocean Hauling Fishery

Description of fishery

The New South Wales ocean-hauling fishery licences the use of a hauling net or purse seine net to take fish from any of the following waters: ocean waters within 3 n.miles of the natural coast line; the waters of Jervis Bay; and the waters of Coffs Harbour.

The ocean-hauling fishery extends to the use of any prescribed net by the method of hauling to take fish from any waters referred to above.

Five types of nets are prescribed in the *Fisheries Management (General) Regulation 2000* for use in the ocean-hauling fishery: garfish bullringing net (garfish); garfish hauling net (garfish); general purpose hauling net (sea mullet); pilchard/anchovy/bait net (pilchard, whitebait, blue mackerel); and purse seine net (blue mackerel and yellowtail). Ocean-hauling gear is considered target-specific, as fishers usually observe schools of fish before deploying their nets.

In 2003–04, the catch for this fishery was approximately 4099 t, valued at around A$9 million.

Observer coverage

A scientific observer programme is being introduced across fisheries in New South Wales. In the ocean-hauling fishery, the scientific observer programme will be designed to achieve the following objectives (management response 1.1(a) of the Ocean Hauling Fishery Management Strategy):

- Document rate and species composition of bycatch for each gear type in the fishery.
- Estimate the accuracy of reporting, using standard catch returns that include both the quantity caught (and released) and the identity of the bycatch recorded (including threatened and endangered species).
- Document the interaction with ocean-hauling fishing methods on fish habitats and on threatened species.

Scientific observation has commenced. A framework to determine priorities for observer studies takes into account the potential impacts of each of the fishing methods as what is known about the impacts of particular activities.

The first priority for the observer programme will be the beach-hauling method.

The programme may be relevant to the methods of purse seining and beach-hauling that are used in the Ocean Hauling Fishery.

Pinniped interactions

The limited observer data make it difficult to comment on pinniped interactions. There are limited anecdotal reports that seals take or damage fish from purse seine net operations, damage nets and disturb fishing operations (industry, pers. comm.) (Table 3.1).

Current management requirements relevant to minimising interactions with pinnipeds

A fishery management strategy has been prepared for the Ocean Hauling Fishery. The strategy, with respect to managing and monitoring interactions between the fishery and protected and threatened species, requires the following:

- Modification of fishing methods identified as having a detrimental impact on fish habitats, threatened species populations or ecological communities (Management Response 1.2(b)). The independent observations of fishing practices generated by the observer studies will provide important information to assist this process.

- A voluntary Code of Practice has been developed for the fishery for both boat-based activities (e.g., purse seine) and hauling on sea beaches and adjacent waters. The code requires fishers in the ocean-hauling fishery to, among other things, return any captured individual of an endangered or threatened species to the water in a manner that causes the least harm; report the incident to the New South Wales Department of Primary Industries; be aware of and avoid operating in areas of importance to threatened or endangered species at relevant times; and remove all litter associated with the fishing operation.
- Implementation, in consultation with the Ocean Hauling Management Advisory Committee, of the provisions of any relevant threatened species recovery plans or threat-abatement plans.
- A reporting form will require all commercial fishers in New South Wales to report interactions (including sightings and incidental capture) with threatened or protected species. The threatened species unit within New South Wales Department of Primary Industries will collect this information.

3.2.4 Lobster Fishery

Description of fishery

The New South Wales lobster fishery consists of eastern rock lobster (*Jasus verreauxi*), southern rock lobster (*Jasus edwardsii*) and tropical rock lobster (*Panulirus ornatus*) taken by any prescribed method from any waters.

The New South Wales lobster fishery, managed by the New South Wales Department of Primary Industries, extends along the coastline of New South Wales from the Queensland border to the Victorian border and from the coastal baseline out to the 4000 m depth contour (about 80 n.miles to sea). The target species is the eastern rock lobster; minor catches of southern and tropical rock lobster are also taken. The fishery is a quota management fishery with a total allowable commercial catch (TACC) set annually for eastern rock lobster. In 2003–04, the catch for this fishery was about 107.8 t, valued at around A$4.1 million.

Lobsters may be taken by hand-picking (diving without use of underwater breathing apparatus) or in a commercial lobster trap. In waters 10 m deep or less, a lobster trap must consist of a rectangular base or floor not exceeding 1.2 m by 1.2 m (or a circular base not exceeding 1.2 m in diameter). In waters greater than 10 m in depth, a lobster trap must not exceed 2 m in length, 2 m in width and 2 m in height and must consist of mesh that measures at least 50 mm having a measurement from one plain wire to the opposite plain wire.

Observer coverage

An observer programme for the lobster fishery between 1999 and 2002 (Liggins *et al*., 2000; Liggins *et al*., 2001; Liggins *et al*., 2002) was revived for the 2004–05 fishing season on the north coast of New South Wales only.

Pinniped interactions

The limited observer data make it difficult to comment on pinniped interactions. The deepwater (greater than 10 m) lobster traps used in this fishery are essentially the same as fish traps used in the ocean trap and line fishery, so the impacts of these gear types may be similar (Table 3.1).

Current management requirements relevant to minimising interactions with pinnipeds

An Environmental Impact Statement (including a fishery management strategy) is currently being drafted for the Lobster Fishery. The fishery management strategy proposes to manage and monitor interactions between the lobster fishery and protected and threatened species. It may include developing a Code of

Practice on litter disposal; best handling methods for releasing protected fish, birds, reptiles or mammals; handling and returning bycatch; guidelines on operating in the vicinity of threatened species, populations and ecological communities; and recording impacts of fishing activities on protected and threatened species. The level of interaction between the fishery and any protected and threatened species, including seals, may be determined through an on-board observer programme. Based on the outcomes of this programme, and any other relevant data, the need to introduce measures to minimise impacts will be assessed in consultation with the Lobster Management Advisory Committee.

A reporting form being introduced will require all commercial fishers in New South Wales to report interactions (including sightings and incidental capture) with threatened or protected species. The threatened species unit within New South Wales Department of Primary Industries will collect this information.

3.2.5 Recreational fisheries

An estimated one million people in New South Wales fish for recreational purposes at least once a year in offshore, coastal, and estuarine waters, freshwater rivers and freshwater lakes and dams. They use lines, pots, traps or nets, and dive or use other hand-collecting methods.

There is little published information on interactions with pinnipeds and the recreational fishing sector in New South Wales but they are likely to be similar to those of commercial hand lining operations (Ocean Trap and Line Fishery). Disturbance to haul-out sites may also occur.

There are numerous reports of seals taking, and becoming mouth-entangled in, multi-hook pelagic fish lures used by recreational fishers. At least two percent of fur seals at Montague Island have been observed entangled in some form of fishing gear or hooks (Shaughnessy, pers. comm.). Between 1995 and 2003 National Parks and Wildlife Service staff has to shoot two seals per year that were entangled and would otherwise have died from strangulation or starvation (Ross Constable, pers. comm.).

An Environmental Impact Statement (including a fishery management strategy) is currently being drafted for the recreational fishery. Management and monitoring of interactions between the fishery and protected and threatened species is expected to be included.

3.2.6 Fisheries–related entanglement

Since January 1995, a total of 136 Australian fur seal sightings have been recorded in the Atlas of New South Wales Wildlife. One seal (0.7 percent) was observed with fishing net around its neck, and three seals (2.2 percent) were observed with fishing hooks lodged in their mouth or intestine. In one of the three cases, a witness observed two fishers using a game rod to hook the seal and play with it as if it were a game fish (New South Wales National Parks and Wildlife Service, Phillip Gleeson, pers. comm.). These records exclude sightings of seals made at colonies.

Currently there are no programmes to systematically access rates of entanglement of seals in lost or discarded fishing gear. Observations are mostly opportunistic. Therefore, rates of entanglement and subsequent mortalities are likely to be underestimated. Any animal noted to be injured or entangled is captured if possible and either treated or euthanized by The Department of Environment and Conservation according to State policy.

Table 3.1 Human–seal interactions in State Government managed fisheries: **New South Wales**

Name of Fishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
	Hand	Personal gear	Dropline	Longline	Other line	Gillnet	Mesh (seines)	Traps (pots)	Trawl	Dredge	Other		Take fish from net or directly from lines; pull squid from jig; take lobster from pot[2]	Loss or damage to fishing gear[3]	Disturbance of fishing operations[4]	Entanglement in fishing gear (bycatch) or in consumables (e.g., bait boxes)	Entanglement in discarded/lost fishing gear	Other	
Abalone	X												N	N	U	N	N		
Estuary General	X				X	X	X	X					U	U	U	U	U		
Estuary Prawn Trawl									X				N	N	N	N	U		a, c, c
Ocean Trawl									X			1, 4	Y	Y	Y	Y	U		b, d, e
Ocean Hauling							X						U	U	U	U	U		
Ocean Trap and Line			X	X	X			X				4	Y	Y	Y	U	U		b
Lobster	X							X					U	U	U	U	U		

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal, 4 = fur seal species (species not identified), 5 = species unidentified.

[2] Resulting in a lost catch; reduced catch; damage to catch; or reduced sale price.

[3] Resulting in cost of repairs or lost fishing time.

[4] Resulting in lost fishing time and/or loss of catch attributed to pinnipeds causing fish/squid to scatter; pinnipeds removing bait from pots; live pinnipeds aboard, etc.

Y, yes; N, no; U, unknown.

(a) Gray *et al.* (1990); (b) Hickman (1999); (c) NSW Fisheries, pers. com.; (d) Liggins G., New South Wales Fisheries, pers. comm.; (e) Shaughnessy *et al.* (2001).

3.3 State Government Managed Fisheries: Victoria

3.3.1 Ocean Fishery

Description of fishery

The Ocean fishery in Victoria is managed by the Department of Primary Industries, Fisheries Victoria. Although it has 368 ocean fishery access licence holders; many of the licences are not utilised. The equipment includes longlines, mesh nets and seine nets. The total catch for 2003–04 was about 1286 t (mainly scale fish, shark and bait fish), and its value was around A$17 62 615.

In addition, mesh netting for banded morwong is a developing fishery, with two permit holders based east of Lakes Entrance (147°58' E). It was declared a developing fishery in 2000. Although the species is found elsewhere in the State, there are insufficient quantities for a commercial fishery. Mesh nets, or a combination of mesh nets, must not exceed 400 m in length. Nets are generally shot for less than 30 minutes at a time. The fishery is closed in March and April each year. There is a daily limit of 50 banded morwong per day. Fishers must report before a fishing trip and before landing the catch. As there were less than five licence holders, data on the amount of landed banded morwong in 2003–04 cannot be reported for confidentiality reasons.

Observer coverage

Observers monitored a few days of fishing between July 1999 and June 2002 in the banded morwong mesh net fishery. No catches of seals were recorded, but seal interactions were observed and are not uncommon in some areas. Seals take fish from nets, kill fish in the nets, and their presence is believed to reduce catches (Unpublished data).

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.2). The limited observer data make it difficult to comment on pinniped interactions.

There are anecdotal reports that fur seals take or damage fish protruding from the nets, take or damage fish inside the nets, and disturb fishing operations. Seals become entrapped in nets and may drown or suffer injuries on occasions (industry, pers. comm.).

Based on the limited information, interactions appear sporadic during the year. When seal activity is detected, fishing stops or moves elsewhere. Nets are spread over wide areas to mitigate interactions. Fishing is avoided in areas around the seal colony at The Skerries. There have been occasional deaths in the past of a few juvenile seals through entanglement (anecdotes from industry).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.3.2 Bays and Inlets (Port Phillip Bay–Westernport Bay)

Description of fishery

The Bays and Inlets fishery is managed by the Department of Primary Industries, Fisheries Victoria. Port Philip Bay has the highest concentration of net fishing of Victoria's bays and inlets. Commercial fishing began in the 1820s. Purse seine, haul seine, demersal longlines, squid jigs, mesh and flounder nets are used, with a variety of prescribed restrictions on the length, configuration and the type of equipment.

The total licences for both Port Phillip and Westernport bays is capped at 52. The main species targeted are snapper, King George whiting, pilchards, southern calamari, anchovies, and to a lesser extent other scalefish. In 2003–04, the total catch in Port Phillip Bay was 603 t, valued at around A$3 126 000, and in Westernport Bay was 26 t, valued at around A$136 000.

Other Bay and Inlet Fisheries include Corner Inlet (20 licences) and the Gippsland Lakes (18 licences).

Observer coverage

There are few independent observer data for this fishery. For the haul-seine sector, observers monitored 37 shots in Corner Inlet and 43 shots in Port Phillip Bay between July 1997 and October 1998. No catches of seals or interactions with seals were recorded. These shots would have comprised 1.0–1.5 percent of shots in these fisheries over this time (Knuckey *et al*., 2002b).

There has been no observer work on other fishing methods (mesh net, purse seines, longlines, etc.).

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.2). The limited observer data make it difficult to comment on pinniped interactions.

Captures of seals in purse seines in Port Phillip Bay have been reported in low numbers. In an anonymous survey of 'wildlife interactions in Victoria's commercial inshore fisheries' during 1996, 14–16 seals in the mouth in Port Phillip Bay were reported captured and released alive. Seals were reportedly routinely freed alive on these occasions. Some fishers using nets felt that seals posed a particular and continuing problem in their operations, but such comments were few (Norman, 1999). Recent personal communications with industry members from Port Phillip Bay indicated that seals can be a problem for mesh net fishers in the Corio Bay area of Port Phillip Bay. As a result, most fishers use seine nets rather than mesh net.

The Environmental Management Strategy for Victoria's Bays and Inlet Fishery (released in March 2005) states 'the growing populations of black cormorants and Australian fur seals are increasingly interfering with commercial fishing (and recreational fishing)' (pg 43). 'Seals affect our work by predating and/or damaging fish caught in nets and on lines and by damaging fishing equipment' (pg 43) and hampering or interrupting fishing (pg 44). In relation to the impact on seals it states 'our fishing methods do not cause injury to seals and Australian fur seals, the only seals to come close to our fishing equipment, easily enter and exit haul seines and purse seines and easily tear off mesh nets' (pg 33).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures currently in place specific to seal interactions; however, the Bay and Inlet Fishery Association's Environmental Management Strategy (EMS) lists actions for reducing the impact of fishing on seals, and seals on fishing, in their action plan including actions to minimise marine debris. More specifically it includes the following actions:

- Avoid areas/times when birds and seals in the area.
- Retrieve mesh nets as soon as seals are spotted.
- Avoid excess slack in buoy line.
- Carefully free and release any wildlife species that may be caught in fishing gear (The Protected Species Handling Manual is being distributed to licence holders).
- EMS waterproof reference Booklet (which depicts Aust, NZ fur seal leopard and elephant seal) to be carried on board.

The EMS is a voluntary initiative and members have signed to demonstrate their commitment to the actions and objectives.

3.3.3 Inshore trawling

Description of fishery

The inshore trawl fishery is managed by the Department of Primary Industries, Fisheries Victoria. It is based in a small area off Lakes Entrance in the east of the State at least 60 n.miles from The Skerries seal haul-out site. Separate licences for this fishery were created in 1984, although it has been trawled for the last 100 years. Otter-board trawls (generally three small trawl nets used at once), with no more than a maximum head-line length of 33 m for combination or single mesh nets are used. Prawns (Eastern King prawn *Penaeus plebejus* and school prawn *Metapenaus macleayi*) are the target species, and to a lesser extent bugs (*ibacus peronii*) and crabs (sand crab *Portunus pelagicus*, spider crab and others), are taken as byproduct. There is limited access to a bycatch of scale-fish (assorted) and a two carcass maximum bycatch of school and gummy shark combined.

The inshore species of bug (*Ibacus peronii*) makes up the bulk of bugs landed as byproduct from the catches of prawn trawlers over summer months. The species is distinct from the smaller deep water bug (*Ibacus altricrenatus*), however they are often marketed together as 'Balmain bugs'.

There are 61 licences issued for the fishery (capped by regulation). However, most are semi active with the fleet involved mainly working in other fisheries and only targeting prawns if and when the season is good. The total catch for 2003–04 in the fishery across all species was 118 398 kg with a total value of A$835 257.

Observer coverage

There are few independent observer data for this fishery. On-board monitoring was undertaken on a total of 32 shots over 6 day trips between February and April 2003 on two different vessels operating out of Lakes Entrance. No catches of seals or seal interactions were recorded. This was probably 2–5 percent of the inshore trawl shots in that year (unpublished data).

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.2). The limited observer data make it difficult to comment on pinniped interactions.

There are anecdotal reports that fur seals take or damage fish protruding from the nets, take or damage fish inside the nets, and disturb fishing operations. Seals become entrapped in nets on occasions, where they may be injured or drown, but are usually released alive (industry, pers. comm.).

An anonymous survey of commercial fishermen across a range of inshore commercial fisheries in the late 1990s indicated an overall low total number of seal capture instances (10–24 in 12 months) across the range of inshore fisheries included in this research (Norman, 1999). The survey found that 'inshore (or deep water) trawls occasionally took seals'. While deaths occur, seals often escape capture by jumping over-head ropes or by damaging nets (Norman, 1999).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.3.4 Rock lobster fisheries

Description of fisheries

The rock lobster fishery is managed by the Department of Primary Industries, Fisheries Victoria.
The Victorian Government has jurisdiction over the commercial fishery in Commonwealth waters adjacent to Victoria under an Offshore Constitutional Settlement. Southern rock lobster (*Jasus edwardsii*) has

been harvested under management for more than 100 years. Individual Transferable Quotas were introduced in 2001. The number of licence holders is capped at 85 in the Western Zone with a 450 t TAC and 54 in the Eastern Zone with a 60 t TAC. The fishery spans most of the Victorian coast; however, effort is concentrated on the west coast (the Western Zone), where abundance and catch rates are highest. The total catch is valued at around A$21 million. Southern rock lobster is taken by 'bee hive' style pots with a legislated maximum size. Fishing effort information is collected by 'pot-lifts'. Input controls also include pot numbers capped at 5162 for the Western Zone and 2081 for the Eastern Zone, management zones, and closed seasons.

Observer coverage

A new three-year research programme funded by Fisheries Victoria will involve onboard observers on rock lobster (and giant crab boats). Observers will record all bycatch and byproduct caught in lobster and giant crab pots and record detailed information on wildlife interactions and observations (Given the depths of approximately 100 m in which giant crab are targeted, it is highly unlikely that seals would interact with the giant crab fishery). This work will supplement the ongoing rock lobster and giant crab stock assessment programmes which also incorporates monitoring of byproduct from the two fisheries through fisher catch logbooks.

The annual fixed-site rock lobster survey has also been extended recently to include observations of wildlife interactions. During 2004–05, approximately 150 observer days over both fishing Zones monitoring wildlife interactions are anticipated (1.5 percent coverage).

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) interact with the rock lobster fishery (Table 3.2).

There are anecdotal reports that fur seals take rock lobsters from pots and disturb fishing operations. Juvenile seals become entrapped in pots on occasions (Norman, 1999; industry, pers. comm.; Victorian Rock Lobster Management Plan). A survey of Victorian inshore commercial fishermen (Norman, 1999) identified lobster pots as occasionally being responsible for the capture of seals. Seal mortality rates in pots are estimated to be less than one seal per 1000 thousand pot-lifts across the fishery in all depths (Norman, 1999, anecdotes from industry; Victorian Rock Lobster Fishery Management Plan; Roger Kirkwood, Philip Island Nature Park, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

The Victorian Rock Lobster Fishery Management Plan (June 2003) lists a range of actions, including the development of an industry Code of Practice to minimise wildlife interactions and a monitoring programme to collect data on any fishery interactions with protected species. The observer programmes discussed above have commenced collecting this information recently (no deleterious interactions with seals recorded in these programmes to date). It is anticipated that in the near future, fishery logbooks will include a protected species interaction form to be filled out by licence holders in the event of an interaction. In the rock lobster fishery, seal-exclusion devices on the necks of rock lobster pots are already used by some fishers, as well as such voluntary measures as shorter pot lines and baiting with carp, which is less attractive to seals.

3.3.5 Wrasse fishery

Description of fishery

The wrasse fishery is managed by the Department of Primary Industries, Fisheries Victoria. It is concentrated in key central and western coastal areas, including the heads of Port Phillip and Western

Port bays, Wilsons Promontory, Portland and Port Fairy. Both Bluethroat wrasse (*Notolabrus tetricus*) and to a lesser extent, Saddleback wrasse (*Notolabrus fucicola*) are taken. The fishery developed in the early 1990s in response to the establishment of a live Bluethroat wrasse domestic market. The fish are generally taken by handline and usually in water less than 40 m depth. There is significant latent effort at present in the fishery, which is capped at 51 licence holders, and is currently the subject to a review to remove the latent effort. The total catch in 2003–04 was 45 t, with a value of about A$449 600.

Observer coverage

There is no independent observer data for this fishery.

Biological data of the Bluethroat wrasse were collected between August 1997 and January 1999. No catches of seals or seal interactions were recorded by observers during the project, but industry did report that seal interactions may be a problem for some operators (Smith *et al*., 2003).

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.2).

There are anecdotal reports that fur seals take or damage fish from gear; damage or take gear, and disturb fishing operations (industry, pers. comm.).

The level of interactions may be dependant on location, but is likely to be low. However, interactions occur regularly at Port Phillip Bay Heads and east of Westernport Bay (industry, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.3.6 Recreational fisheries

An estimated 550 000 Victorians fish for recreation at least once a year. About 55 percent of the total recreational fishing effort in Victoria is in estuarine or coastal marine waters.

Some saltwater recreational fishers, both boat- and land-based, experience seals taking hooks, lines and squid jigs, particularly around piers in some areas. It is thought that individual seals regularly visit particular fishing locations. Anecdotal reports indicate that the main problem areas are Port Phillip and Western Port bays, and popular coastal fishing spots in southwest Victoria.

3.3.7 Fisheries–related entanglements

Regular studies of seal populations around Seal Rocks over time indicate nearly all marine entanglement material is fishing-derived and that over 60 percent comes from trawl net (pers. com. Roger Kirkwood, Philip Island Nature Park). Some entanglements with monofilament and squid jigs have also been observed. Of the entangled seals observed, 60 to 70 percent are juvenile and are therefore easier to release. Every year members of the public report seals on man-made structures in Port Philip Bay with fishing net or some other material around their necks. If the seals can be caught, this material is removed by Fisheries or Wildlife Officers.

Currently there are no programmes to systematically assess rates of entanglement of seals in lost or discarded fishing gear. As observations are mostly opportunistic, the rates of entanglement and subsequent mortalities are likely to be underestimated.

Table 3.2 Human–seal interactions in State Government managed fisheries: **Victoria**

Name of Fishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
	Hand	Personal gear	Dropline	Longline	Other line	Gillnet	Mesh (seines)	Traps (pots)	Trawl	Dredge	Other		Take fish from net or directly from lines; pull squid from jig; take lobster from pot[2]	Loss or damage to fishing gear[3]	Disturbance of fishing operations[4]	Entanglement in fishing gear (bycatch) or in consumables (e.g., bait boxes)	Entanglement in discarded/lost fishing gear	Other	
Bays and Inlets (Western Port and Port Phillip bays)	X	X	X	X	X	X	X					4	Y	Y	Y	Y	U		a, e
Ocean (General) inc. Banded Morwong Developing Fishery				X	X	X	X						Y	Y	Y	Y	U		
Ocean (Purse Seine)							X						U	U	U	U	U		
Ocean (Wrasse)					X							4	Y	Y	Y	N	N		b
Rock Lobster								X				4	Y	U	Y	Y	U		a, c, d
Trawl (Inshore)									X			4	Y	Y	Y	Y	U		a, b

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal, 4 = fur seal species (species not identified), 5 = species unidentified.

[2] Resulting in a lost catch; reduced catch; damage to catch; or reduced sale price.

[3] Resulting in cost of repairs or lost fishing time.

[4] Resulting in lost fishing time and/or loss of catch attributed to pinnipeds scattering fish/squid ; pinnipeds removing bait from pots; live pinnipeds on board, etc.

Y, yes; N, no; U, unknown.

(a) Norman (1999); (b) Licence holder, pers. comm.; (c) Rock Lobster licence holders, pers. comm.; (d) Victorian Rock Lobster Management Plan; (f) Bay and Inlets industry, pers. comm. (catch and effort fishing return)

3.4 State Government Managed Fisheries: Western Australia

3.4.1 Abalone

Description of fishery

The abalone fishery is a diver-based fishery managed by the Department of Fisheries, Western Australia. Established in the 1960's, the area of this fishery currently extends to all waters off Western Australia out to the limits of the Australian Fishing Zone. Only a small portion of the licence area forms the functional fishery. The fishery for Greenlip/Brownlip abalone (*H aliotis laevigata/H. conicopora*) is based primarily on the south coast of Western Australia, while that for Roe's abalone (*H. roei*) occurs between Shark Bay and the Western Australia/South Australian border. There are 42 managed fishing licences in this fishery. In 2004, 205 t of Greenlip/Brownlip abalone was landed in 1268 diver days, and 107.5 t of Roe's abalone in 734 diver days. The combined value of the abalone fishery for 2003–04 was A$12.9 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Australian sea lions have been reported to interact with this fishery (Table 3.3).

Abalone divers report occasional aggressive behaviour from adult male Australian sea lions while diving. Younger animals occasionally play with the diver's surface supply air-line. This interaction is a fairly infrequent occurrence (Anthony Hart, pers. comm.) and may be influenced by fishers targeting areas close to sea lion breeding colonies and key foraging areas.

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.2 Australian Herring

Description of fishery

The Australian Herring Fishery is managed by the Department of Fisheries, Western Australia. Established in the 1930s, the practical area of the commercial fishery currently extends from south of Perth to Hopetoun on the South coast. Australian herring (*Arripis georgianus*) is targeted using beach seine nets and (on the south coast of the State) 'G' trap nets. There are 10 fishing boats from which G trap nets may be used. Since the mid 1990s, the level of potential fishing effort in the fishery has been reduced by 47 percent through a series of Government buy-back initiatives. In 2004, the catch for this fishery was 366.5 t, valued at around A$147 000.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.3).

Fishers report that sea lions and New Zealand fur seals sometimes target fish caught in G-nets, and in the process sometimes damage gear. On such occasional, seals may also become injured. Anecdotal evidence suggests that there may be low-level harassment of sea lions thought to be responsible for loss of catch (Shaughnessy *et al*., 2003; Peter Collins, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.3 Joint Authority Southern Demersal Gillnet and Demersal Longline

Description of fishery

The Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery is managed by a Joint Authority arrangement between the Commonwealth Minister and the Western Australian Minister for Fisheries under Western Australian law, which is administered by the Department of Fisheries, Western Australia. Established in 1988, the area of this fishery extends to waters within the Australian Fishing Zone situated on the west and south coasts of the State between 33° S and 129° E. Demersal gillnets and demersal longlines are used to target whiskery, dusky whaler, gummy sharks and scalefish species. Currently, one time/gear unit equates to either 90 demersal longline hooks or 270 m of demersal gillnet and there are a total of 2515 units in the fishery. There are 57 managed fishing licences in this fishery; however 27 vessels reported active fishing returns in 2003–04. Fishing effort during 2003–04 was estimated at 197 466 km gillnet hours (an increase from 2002–03 of 22.9 percent). In 2003–04 the shark catch for this fishery was 959 t and 182 t of scalefish, valued at around A$4.875 million.

Observer coverage

The Department of Fisheries, Western Australia, monitored the bycatch of all species between 1994 and 1999. There was a single recorded capture of a sea lion and a fur seal (presumed New Zealand fur seal) on the south coast. About two percent of the fishing effort was monitored during this period (McAuley and Simpfendorfer, 2003).

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.3). The limited observer data make it difficult to comment on pinniped interactions.

Fishery managers and conservation officers have stated that few sea lions and fur seals have been caught in demersal gillnets. Interactions with sea lions usually occur near breeding or haul-out sites, though they are fairly infrequent; anecdotal information suggests 1–2 animals are caught every year. Fishing effort is concentrated away from breeding colonies on open ground to limit interaction with sea lions (Penn *et al*., 2003). The interaction with fur seals is quite low, with only a few fur seal mortalities having been recorded. Interactions are often claimed to be due to one or two seals that have habituated to fishing operations (Shaughnessy et. al., 2003).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.4 South Coast Purse Seine

Description of fishery

The South Coast Purse Seine fishery is managed by the Department of Fisheries, Western Australia. Established in 1994, the area of this fishery extends to all Western Australian waters off the south coast of Western Australia between Cape Leeuwin and the WA/SA border at 129° E. The south coast fishery consists of three primary management zones, with each zone in the fishery allocated a set amount of transferable quota units whose values change depending on stock assessment data. The Albany zone extends from Point D'Entrecasteaux to Cape Knob. The King George Sound zone is a subset of this area and the two zones are reported together. The Bremer Bay zone extends from Cape Knob to longitude 120° E, and the Esperance zone from 120° E to the WA/SA border. A further zone exists between Cape Leeuwin and Cape D'Entrecasteaux but has not been significantly fished to date. The south coast fishery management arrangements are currently based on limited entry, capacity settings, individually transferable quota and controls on gear and boat size, with 33 licences holders. Purse seines are used to target pilchards (*Sardinops sagax*), and other small pelagic fish such as scaly mackerel (*Sardinella lemuru*), yellowtail scad (*Trachurus novaezelandiae*) and anchovies (*Engraulis australis*). Fishing effort in 2003/04 varied from 1181 fishing days in Albany, 286 fishing days in Bremer Bay and 100 fishing days in Esperance. In 2003–04, the catch for this fishery was 1496 t, valued at around A$1.34 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.3). However, the limited observer data make it difficult to comment on pinniped interactions.

Fishers and fisheries research staff report that both sea lions and fur seals are adept at foraging for fish inside purse seines, usually escaping without harm by jumping over the float line as the purse is drawn (Penn *et al*., 2003; Shaughnessy *et al*., 2003; Tim Leary, pers. comm.). From the limited information available, interactions appear to be at a fairly low level, with a maximum of 1–4 animals associated with a shot, and foraging from the net may take place every 100–200 shots (Tim Leary, pers. comm.). Occasionally, an adult Australian sea lions will target purse seine operations and bite fish through the net after the purse is drawn, resulting in holes in the net and a loss of catch (Tim Leary, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

A voluntary industry Code of Practice for this fishery has been distributed to members, which provides details of reporting requirements for pinniped captures and provides details on release techniques of entangled animals.

3.4.5 South Coast Salmon

Description of fishery

The South Coast Salmon fishery is managed by the Department of Fisheries, Western Australia. Established in 1936, the area of the South Coast Salmon fishery currently extends to Cape Beaufort to the border of Western Australia and South Australia, below high water mark. Australian salmon (*Arripis truttaceus*) is targeted using beach seine nets. There are currently 18 managed fishery licences in this fishery, each operating at different beaches. In 2004, the catch for this fishery was 1654 t, valued at around A$676 000.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.3).

Sea lions, and to a lesser extent New Zealand fur seals, chase and feed on salmon schools in South coast embayments, occasionally becoming encircled by beach seine nets when a fishermen 'shoots' a school of salmon. Because the netting operation is an active method of fishing involving fishers setting the net and immediately retrieving it, encircled sea lions (or fur seals) are released immediately by the fishermen. Some fishermen in this fishery have been interested in developing methods to prevent sea lions and seals from entering salmon nets. There have been reports of a few sea lions being shot in the past.

Fishers can request licences from the Department of Conservation and Land Management to 'shoot to scare' offending animals. This means that blank cartridges or Brid Frite® cartridges can be use. Live ammunition cannot be use to scare offending animals. Anecdotal reports suggest that sea lions and fur seals have previously been targeted for shooting both on site at fishing areas and nearby haul-out areas. Published reports of mortalities due to gunshot are not attributable to any specific industry, but anecdotal evidence suggests that operators in the salmon industry may be responsible (Penn *et al*.,2003; Shaughnessy *et al*., 2003; Mawson and Coughran 1999).

Based on the limited information available, sea lions are thought to interact with this fishery on a low to moderate level: possibly every 10–20 shots. Usually a few sub-adult and adult males are involved. Occasionally, animals become habituated to fishing areas and may continually interact with fishing operations until fishers move or the animal/s are encouraged to leave the area (Kim Brooks, pers. comm.; Peter Collins, pers. comm.)

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.6 West Coast Demersal Gillnet and Demersal Longline

Description of fishery

The West Coast Demersal Gillnet and Demersal Longline fishery is managed by the Department of Fisheries, Western Australia. An interim management plan was established in 1997 and the area of this fishery extends to Western Australian waters off the west coast between 26° S and 33° S. Demersal gillnets and demersal longlines are used to target species including sandbar and dusky shark, and scalefish species including dhufish and pink snapper. One time/gear unit currently equates to 180 demersal longline hooks or 540 m of demersal gillnet and there are a total of 667 units in the fishery. There are currently 26 managed fishing licences in this fishery, however only 16 vessels recorded active fishing returns in 2003–04. Fishing effort was 84 652 km gillnet hours in 2003–04, a 43.1 percent increase on the previous year. In 2003–04, the shark catch for this fishery was 482 t and 105 t of scalefish valued, at around A$2.15 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions. An average of five percent of fishing effort on the west coast was monitored during 1994–1999, but no interactions with pinnipeds were recorded (McAuley and Simpfendorfer, 2003).

Pinniped interactions

Australian sea lions have been reported to interact with this fishery (Table 3.3). The limited observer data make it difficult to comment on pinniped interactions.

There are anecdotal reports over time of mortalities of sea lions in demersal gillnets along the west coast. The interactions appear to be concentrated around three sea lion breeding colonies on the mid-west coast (Beagle Island, North Fisherman Island, Buller Island). Current estimates suggest that at least 1–2 sea lions may be caught every season. There are no estimates of the loss of catch due to sea lions removing fish from nets, but it is assumed that they are attracted to the nets by the captured fish. In addition, sea lions may become trapped in the gillnets incidentally during foraging, resulting in injury and drowning. There is little documentation on the level of interaction between this fishery and seals.

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.7 West Coast Rock Lobster

Description of fishery

The West Coast Rock Lobster Fishery (WCRLF) is managed by the Department of Fisheries, Western Australia. The area of the West Coast Rock Lobster Fishery extends to the waters situated on the west coast of the State bounded by a line commencing at the intersection of the high water mark and 21° 44' S drawn due west to the intersection 21° 44' S and the boundary of the Australian Fishing Zone; thence due east along 34° 24' S to the intersection of 115° 8' E, thence due north along 11° 8' E longitude to the high water mark; thence along the high water mark to the commencing point. Western rock lobsters (*Panulirus cygnus*) are targeted using a variety of pot designs (bee-hive, batten and stick pots). There are currently 601 managed fishery licences and 559 vessels operating in this fishery. Fishing effort is 10.33 million pot lifts. The catch for this fishery average 11400 t per year, valued at around A$300 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions. However, a scientific observer programme with around one percent observer coverage has operated since 1970; it is yet to record an incidental seal mortality.

Pinniped interactions

Australian sea lions have been reported to interact with this fishery (Table 3.3).

Sea lions have been observed foraging from pots on both bait and lobster. Fishermen report significant numbers of bait lids removed from pots and bait being eaten by sea lions. They remove lobsters from pots via the neck of the pot as well as through the battens and escape gaps. Several techniques are used to make bait lids seal-proof. A few young sea lions are reported drowned in pots every fishing season. Estimates of the number of incidental mortalities per fishing season vary between 2–12. The Environmental Management Strategy (Department of Fisheries, WA, 2004) outlines plans to eliminate the incidental bycatch, and the preliminary phases of this plan have been completed. Reports of shooting of sea lions are mostly anecdotal and refer to events at least 20–30 years ago. It is believed that shooting of animals does not occur in this industry today (Shaughnessy *et al*., 2003; Department of Fisheries, WA, 2004).

Sea lions interact with the fishery in a fairly localised area. Incidental mortalities are confined to areas close to breeding colonies on the mid-west coast (Beagle Island, North Fisherman Island, Buller Island). Concern for the viability of these colonies has prompted fisheries management to target elimination of this bycatch by means of pot modification. Most reports of bait and lobster theft are also from this area.

There have been few interactions reported at the Houtman Abrolhos Islands, although there is a small remnant population of sea lions. The level of bait theft is not thoroughly documented but preliminary estimates of the consumption of rock lobster from pots by sea lions may be as much as 50 000 kg per year (R. Campbell, unpublished data).

Current management requirements relevant to minimising interactions with pinnipeds

As a requirement of the West Coast Rock Lobster Fishery ecological risk assessment process and Department of Environment and Heritage and the Marine Stewardship Council certification/accreditation, it was necessary to investigate and implement the best possible mitigation measure that would eliminate the bycatch of Australian sea lion pups from rock lobster pots while minimising the impact on commercial fishing operations. A stakeholder consultation paper has been developed and released, encouraging comment on the proposed recommendation to implement the mandatory use of sea lion exclusion devices in the WCRLF. Public comment period concludes on Friday 24 June 2005. If the recommendation is supported, it is proposed that the use of SLEDs will be mandatory in specific areas (proximity to breeding and haul out sites) of the fishery.

The target is to eliminate the incidental mortality of Australian sea lion pups in all rock lobster pots. A number of monitoring programmes are currently underway to collect information regarding the interaction of the fishery with all protected species of wildlife as well as bycatch of finfish and other species.

3.4.8 South Coast Estuarine

Description of fishery

The South Coast Estuarine Fishery is managed by the Department of Fisheries, Western Australia. The fishery is a multi-species fishery that operates in 13 of the 25 inlets and estuaries along the south coast of Western Australia, between Cape Beaufort and the WA/South Australian border. Gillnets are used to primarily target Cobbler (*Cnidoglanis macrocephalus*) and black bream (*Acanthopagrus butcheri*) in the western estuaries, and comprise about 50 percent of the annual catch. There are 25 permit holders in this fishery, and each can operate in all of the estuaries and inlets, except Beaufort Inlet where access is restricted to only three permit holders each year. Fishing effort measured in average number of boats fishing per month is currently about 18 boats per month. In 2004 the catch for this fishery was 180 t, valued at around A$555 000.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.3).

Both species are reported to take fish from, and damage nets. There are no documented entanglements, but there have been several anecdotal reports of fishers shooting at sea lions and encourage others to shoot at seals. There is little documentation of the ongoing levels of interaction. It is believed that a few animals may occasionally enter the estuaries and feed from the nets for a few days at a time (Penn *et al*., 2003; Peter Collins, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

There are no management measures specific to minimise seal interactions.

3.4.9 Recreational Fisheries

An estimated 600 000 West Australians go marine recreational fishing at least once a year. Around 30 000 of these participate fish for rock lobster with pots, a couple of thousand take out licences for beach haul nets while the remainder are line fishermen. Although it is likely that sea lions take lobsters from recreational lobster pots as they do from commercial pots, there are no clearly identifiable sectors or geographical areas in which seal interactions are deemed significant.

3.4.10 Fisheries–related entanglements

Observation and surveying of the three breeding colonies on the west coast of Western Australia over the last 10–15 years suggest that entanglement is relatively uncommon, 1–2 percent. There have been four reported entanglements of young sea lions in 2004 to date. The materials found included fishing net (possibly deep-water trawl), a shock cord loop (possibly fishing-sourced) and a plastic pool ring (associated with tourist activity). The monitoring programme is based on ad–hoc observations by rangers and scientists. If the seals can be caught, this material is removed by Fisheries or the Department of Conservation and Land Management (CALM) Officers. All incidences are recorded on a database by CALM (S. Sherrington, Dept. of Fisheries and J. Edwards, CALM, pers. comm.).

Mawson and Coughran (1999) also reported the deaths of 19 Australian sea lions (and three Sub-Antarctic Fur seals and one Leopard seal) due to entanglements in fishing gear (nets, line, pot ropes and plastic bait straps) during the period 1980–1996 inclusive.

Table 3.3 Human–seal interactions in State Government managed fisheries: **Western Australia**

Name ofFishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
	Hand	Personal gear	Dropline	Longline	Other line	Gillnet	Mesh (seines)	Traps (pots)	Trawl	Dredge	Other		Take fish from net or directly from lines; pull squid from jig; take lobster from pot[2]	Loss or damage to fishing gear[3]	Disturbance of fishing operations[4]	Entanglement in fishing gear (bycatch) or in consumables (e.g., bait boxes)	Entanglement in discarded/lost fishing gear	Other	
Abalone	X											2	N	N	Y	N	N	N	a
Australian Herring							X					2	Y	Y	Y	U	N	N	b
Australian Herring							X					3	Y	Y	Y	U	N	N	b
Cockburn Sound Fish Net						X	X						U	U	U	U	U	U	
Esperance Rock Lobster								X					U	U	U	U	N	N	
West coast Estuarine						X	X						U	U	U	U	N	N	
Joint Authority Southern Demersal Gillnet and Demersal Longline				X		X						2,3	Y	N	Y	Y	Y	N	b
South Coast Purse Seine							X					2	Y	N	Y	N	N		b
South Coast Purse Seine							X					3	Y	N	Y	N	N		b
South Coast Rock Lobster								X				5	U	U	U	Y	N		
South Coast Salmon							X					2	Y	Y	Y	Y	N		b, d, e
South Coast Salmon							X					3	Y	Y	Y	Y	N		b, d, e

Name ofFishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
South West Beach Seine							X						U						
South West Coast Salmon							X						U						
West Coast Demersal Gillnet and Demersal Longline				X		X						2	Y	N	Y	Y	Y		
West Coast Rock Lobster								X				2	Y	Y	Y	Y	N		
Windy Harbour–Augusta Rock Lobster								X					U	U	U	U	U		
South Coast Estuarine												2	Y	Y	Y	N	Y		
South Coast Estuarine												3	Y	Y	Y	N	Y		

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal, 4 = fur seal species (species not identified), 5 = species not identified.

[2] Resulting in a lost catch; reduced catch; damage to catch; or reduced sale price.

[3] Resulting in acost of repairs or lost fishing time.

[4] Resulting in lost fishing time and/or loss of catch attributed to pinnipeds causing fish/squid to scatter; pinnipeds removing bait from pots; live pinnipeds on board, etc.

Y, yes; N, no; U, unknown.

(a) Anthony Hart, Department of Fisheries, Western Australia, pers. comm.; (b) Penn *et al.* (2003); (c) D. Harriss, Department of Fisheries, Western Australia, pers. comm.;

(d) Mawson and Coughran (1999); (e) Peter Collins, Department of Conservation and Land Management, Western Australia, pers. comm.

3.5 State Government Managed Fisheries: South Australia

3.5.1 Rock Lobster (North and South)

Description of fishery

The fishery is based on the capture of a single species: the southern rock lobster (*Jasus edwardsii*). Fishing has been undertaken since early European settlement, but commercial fishing took off in the 1940s when a market for frozen bait tails developed in the United States. Under a Offshore Constitutional Settlement with the Commonwealth Government, the South Australian Government has management jurisdiction for southern rock lobster taken in waters adjacent to the South Australian coastline, from the low-water mark out to 200 n.miles. The fishery's two zones (north and south) are separated by the mouth of the River Murray, near Goolwa. Southern Rock Lobster is taken with 'bee hive' style pots with the maximum size legislated. The season is closed from 1 May to 30 September in the southern Zone and from 1 June to 31 October in the northern zone. There are 181 commercial fishing licences in the southern zone and 69 in the northern zone. Recreational fishers are permitted to take rock lobster with pots (maximum of two per person), drop nets, hoop nets and by diving. Both fishing zones are managed under ITQ management systems. In the 2003–04 fishing season, catch and effort in the northern zone was 504 t from 598 028 pot lifts, valued at around A$12 million, and in the southern zone catch and effort were 1896 t from 1042 352 pot lifts, valued at around A$49.3 million.

Observer coverage

There has been no formal observer coverage of fishing activities specific to seal interactions. However, South Australia is currently examining a method of quantifying interactions with endangered and protected species through a generic commercial fishery research logbook.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.4).

There are anecdotal reports that Australian sea lions and New Zealand fur seals take rock lobsters from pots, damage gear, and disturb fishing operations. Furthermore, sea lions may be attracted to bait in pots or attempt to feed on octopus or lobsters in pots. Seals may prey on undersized rock lobsters that are returned to the water by fishers, and on discarded bait and bycatch. In addition, fur seals may be attracted to bait in pots or attempt to feed on fish in pots. However, the extent of the interaction of seals with rock lobster fishing gear is difficult to assess, as there is no independent verifiable programme for monitoring interaction levels (Page et. al., 2004; Shaughnessy *et al*., 2003; PIRSA, 2003c: Robinson and Dennis, 1988).

There have been no official reports of New Zealand fur seal pups or juveniles caught in set lobster pots. However, it is known that fur seal pups can enter pots fitted with exclusion devices (i.e., spikes), so there is a potential for them to drown. For example, in May 2002, four pups drowned in a pot that had washed into a rock pool at Cape Gantheaume. It was believed that the pups entered the pot after it had been washed into the colony at high tide (Page *et al*., 2004).

Records of seal entanglements in South Australia suggest that both New Zealand fur seals and Australian sea lions interact with bait straps (used on bait packaging) and rope from rock lobster floats, which is likely to come from commercial Rock Lobster Fisheries (Page *et al*., 2004). Bait straps were the most common material (30 percent) observed entangling New Zealand fur seals during a six-year study on Kangaroo Island, and accounted for 11 percent of material identified entangling Australian sea lions during a 15-year study (Page *et al*., 2004). As bait straps are also used in the shark and long-line tuna fisheries and non-Australian fisheries, it is not known what proportion of entanglements is due to the State Rock Lobster Fishery. In recognition of possible impacts on seals, the southern rock lobster industry in South

Australia has proposed to stop using bait supplied in packaging that requires strapping from October 2004. Continued monitoring of the entanglement of seals at key sites is required to identify any change in entanglement rates following changes in industry practices.

Current management requirements relevant to minimising interactions with pinnipeds

Recording of interactions with protected species is currently not a compulsory requirement; however, an on-board monitoring study has been proposed by Primary Industries and Resources, South Australia (PIRSA) to report the nature and extent of interactions. Several methods have been trialled to reduce interaction of seals with lobster pots, e.g., seal-exclusion devices (a metal spike placed vertically in the neck of the pot, and attaching bait containers to the side of the pot entrance). These measures are not regulated in South Australia, but are widely used in the fishery. However, the efficiency of deterrents is unknown and has not been quantified. Management Plans for both zones will be reviewed during 2004–05 and will aim to include specific strategies to minimise interactions. The commercial industry has developed a code of conduct, which includes a set of auditable standards, to minimise the overall environmental impacts of fishing operations. These standards require the use of seal-exclusion devices when vessels are operating near seal colonies.

3.5.2 Shark Fishery (State Waters)

Description of fishery

In 2001, an Offshore Constitutional Settlement between South Australia and the Commonwealth was made to bring school and gummy shark stocks in the waters adjacent to South Australia under Commonwealth jurisdiction. South Australia retained jurisdiction for these species in State internal waters in the Gulf of St. Vincent, Spencer Gulf and a number of west coast bays (Steve Shanks, PIRSA, pers. comm.).

School and gummy shark in the fishery are taken by longlines and gillnets. There are currently 655 licence holders. Longline fishers are restricted to 400 hooks and gillnet fishers are restricted to a maximum of three large mesh nets (1800 m). In 2003–04, fishing effort was 947 boat-days. Total catch of school shark was 4 t valued, at around A$16 000. The total catch of gummy shark was 46 t, valued at around A$181 000.

Observer coverage

An observer programme has recently commenced on shark fishing boats specific to seal interactions (Derek Hammer, pers. comm.). South Australia is currently examining a method to quantify interactions with endangered and protected species through research logbook programmes.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.4).

Anecdotal reports from shark fishers suggest that seals are attracted to fish trapped in set gill-nets and may also become entrapped, resulting in animals either drowning, tearing out a section of net or being cut free by fishers (Robinson and Dennis 1988; Shaughnessy *et al*., 2003). Although there are few official records of seal interactions with the State shark fishery, there are a number of anecdotal reports of shark fishers finding drowned seals in demersal shark nets set near breeding colonies, in State waters (Shaughnessy and Dennis 2002). In 1996 a fisher from South Australia reported to P. Shaughnessy that he caught 20 sea lions a year in his shark nets set off Neptune Islands and Kangaroo Island (Shaughnessy *et al*., 2003). In 2001 a juvenile Australian sea lion was reported entangled and released alive from a shark net set close to Jones Island (Shaughnessy and Dennis, 2002). Other published reports of seal interactions with gillnets in Commonwealth waters for the Southern Shark Fishery and the South East non-trawl Fishery include one dead seal and two released alive in 14 243 shots and one seal recorded dead

and none caught alive in 12 696 shots in 1999 (Shaughnessy *et al*., 2003). These reports are likely to be an underestimate, as reporting was voluntary.

Records of seals entangled in marine debris also indicate that a significant level of interaction occurs with set nets and lost monofilament netting throughout the State, and that Australian sea lions are entangled more than New Zealand fur seals. Australian sea lions have been recorded entangled in sections of commercial shark net at a number of sites in South Australia, including Sea Bay (Page *et al*., 2004), the Pages Islands (Shaughnessy and Dennis, 2001), Dangerous Reef (Shaughnessy, 1998; Shaughnessy and Dennis, 2001), English Island (Shaughnessy, 1998), Jones Island (Shaughnessy and Dennis, 2002) and Nicolas Baudin Island (J. McKenzie, pers. comm.).

During a 15-year study at Seal Bay, 55 percent of entangling material observed on Australian sea lions was monofilament netting, whereas one percent entangled New Zealand fur seals at Cape Gantheaume (Page *et al*., 2004). Australian sea lions are thought to encounter bottom set monofilament nets or debris more frequently than do New Zealand fur seals, as sea lions are benthic foragers and are more likely to forage in areas where nets are set or have been lost on the benthos (Page *et al*., 2004). It is not known, however, what proportions of entanglements observed are due to interactions with recreational, state or Commonwealth fisheries, although the gillnets found by Page *et al*. (2004) were the mesh size used in the Commonwealth Southern Shark Fishery. Further observer coverage and research into the foraging sites of sea lions is required to determine what proportions of interactions involve set nets.

Current management requirements relevant to minimising interactions with pinnipeds

- Sea Food Industry Code of Conduct (broad application only).

3.5.3 Purse-seine fishery/pilchard fishery

Description of fishery

Established in 1991, this fishery extends throughout all waters adjacent to South Australia, with the exception of aquatic reserves and marine protected areas. In recent years, fishing operations have focused on Southern Spencer Gulf. Within this fishery, 14 licence holders have been granted exclusive access rights, as of 2000, to take species from the families Engraulidae and Clupeidae (mainly pilchards, *Sardinops sagax*). In 2003–04, the landed catch was about 33 160 t, with a landed value of around A$22.5 million.

Observer coverage

As defined in the *Ecological Assessment of the South Australian Pilchard Fishery*, independent observer coverage of interactions with protected and endangered species will be implemented over the next year. Trials to identify the best method to achieve wide-ranging observer coverage in the fishery have already been undertaken.

This work will also lead to research logbooks in the fishery being modified to ensure that all interactions with endangered and protected species are being recorded accurately.

Pinniped interactions

Australian sea lions and New Zealand fur seals have been reported to interact with this fishery (Table 3.4).

The pilchard fishery operates in water adjacent to a number of New Zealand fur seal and Australian sea lion breeding colonies and haul-out sites. The most frequently reported interaction is seals feeding on pilchard aggregations within the purse-seine net (PIRSA, 2004). Impacts include injury due to entanglement in gear and drowning of entrapped seals (PIRSA, 2004). Interactions with the Pilchard

Fishery are considered rare by fishers (PIRSA, 2004). Data collected through SARDI research logbooks (1999–2002) indicate that in 1999 one seal was released alive; in 2001 four seals were released and eight died; and in 2002 seven seals were released alive (PIRSA, 2004). An independent study by the South Australian Research and Development Institute (SARDI), including an observer programme began in 2004. It aims to qualify and quantify the interactions of seals and the South Australian Pilchard Fishery, including ecological impacts on seal populations (T. Ward, SARDI, pers. comm.)

Current management requirements relevant to minimising interactions with pinnipeds

- Sea Food Industry Code of Conduct (voluntary).
- Marine Scalefish Fishery Code of Conduct.
- Marine Scale Inshore Net Fishery Code of Practice.

3.5.4 Recreational fisheries

A total of 328 674 people participated in all forms of recreational fishing in South Australian waters in 2000–01. Of these, 77.5 percent of their total effort (9.77 million hrs) was undertaken in marine waters. Line fishing was by far the most important method (84 percent of all effort), with pot fishing (active and passive) being the next most important (10.7 percent). Currently, there is little documented information on interactions between seals and recreational fishing activities; however, a project is currently underway to collect information on interactions. In August 2005, a managed recreational charter boat fishery was initiated, with charter boat operators required to report (using research log) their catch and effort as well as any wildlife interactions with their operations. The information obtained from these records will be monitored, and reported annually to the Charter Boat Fishery Management Committee.

3.5.5. Fisheries–related entanglements

Entanglement of New Zealand fur seals and Australian sea lions in lost fishing gear and other marine debris is of growing concern in South Australia. A 15-year study based on Kangaroo Island, South Australia reported that the entanglement rate of Australian sea lions (1.3 percent in 2002) and the New Zealand fur seal (0.9 percent in 2002) are the third and fourth highest rates reported for any seal species in the world (Page *et al*., 2004). Despite attempts by governments and industry to reduce the interactions of marine mammals and fishing gear (including lost fishing gear), entanglement rates have shown an increasing trend in recent years (Page *et al*., 2004). Observations of entangled seals are not restricted to Kangaroo Island. Entangled seals or entanglement scars have been observed at almost all Australian sea lion and New Zealand fur seal breeding colonies and haul-out locations visited throughout South Australia (P. Shaughnessy, J. McKenzie, B. Page pers. comm.). The most often observed entangling materials were bait box straps, trawl netting, monofilament netting, lobster float rope and fishing line and hooks (Page *et al*., 2004). All of these materials and gear types are used by regional State fisheries, but the fishery responsible cannot always be identified. It is not known to what degree Commonwealth and recreational fisheries also contribute to the entanglements observed; however, the gillnets found by Page *et al*., (2004) were the mesh size used in the Commonwealth Southern Shark Fishery. Some proportion of entanglements may also be the result of seals being cut free from nets by fishers and may provide indirect evidence of interactions between seals and set or operating nets. It is estimated, based on the most recent entanglement rates observed on Kangaroo Island, that about 64 Australian sea lions and 295 New Zealand fur seals die each year in southern Australia. Such high entanglement rates are most likely contributing to the slow recovery of seals in Australia, especially the Australian sea lion (Page *et al*., 2004).

Table 3.4 Human–seal interactions in State Government managed fisheries: **South Australia**

Name of Fishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
	Hand	Personal gear	Dropline	Longline	Other line	Gillnet	Mesh (seines)	Traps (pots)	Trawl	Dredge	Other		Take fish from net or directly from lines; pull squid from jig; take lobster from pot[2]	Loss or damage to fishing gear[3]	Disturbance of fishing operations[4]	Entanglement in fishing gear (bycatch) or in consumables (e.g., bait boxes)	Entanglement in discarded/lost fishing gear	Other	
Rock Lobster (North and South)								X				5	Y	Y	Y	Y	Y		a, b, c, e
Rock Lobster (North and South)								X				3	Y	Y	Y	Y	Y		a, b, c, e
Marine Scalefish							X					5	U	U	U	Y	Y/U		c, d
Shark Fishery (State Waters)						X						2	Y	U	U	Y	Y		a, b, c
Shark Fishery (State Waters)						X						3	Y	U	U	Y/U	Y		a, b, c

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal, 4 = fur seal species (species not identified), 5 = species not identified.

[2] Resulting in a lost catch; reduced catch; damage to catch; or reduced sale price.

[3] Resulting in cost of repairs or lost fishing time.

[4] Resulting in lost fishing time and/or loss of catch attributed to pinnipeds causing fish/squid to scatter; pinnipeds removing bait from pots; live pinnipeds on board, etc.

* Hoop and drop net minor in commercial sector, but recreational sector use this method.

(a) Page *et al*. (2004); (b) Robinson and Dennis (1988); (c) Shaughnessy *et al*. (2003); (d) PIRSA (2004); (e) PIRSA (2003 b, c).

3.6 State Government Managed Fisheries: Tasmania

3.6.1 Small Pelagics (Jack Mackerel)

Description of fishery

The Small Pelagic Fishery (previously known as the Jack Mackerel Fishery) is managed jointly by the Department of Primary Industries, Tasmania and the Commonwealth. Established in 1986, the area of this fishery (referred to as Zone A) reaches the extent of the AFZ in the south, east and west of Tasmania. Zones B, C and D are off the southern States of New South Wales and Queensland (to the extent of the AFZ) and are managed under sole Commonwealth jurisdiction. In the initial stage of the fishery's development, most of the catch was taken with purse-seine fishing gear. However, most is now taken with mid-water trawl gear. Currently only one commercial operator participates in the 'industrial' fishery in Zone A, but fewer than 20 valid permits are inactive or 'latent' in the fishery.

The current TAC for the Small Pelagics fishery in Zone A is 34 000 t. The Tasmanian inshore diversified scalefishing sector is managed under a 3 800 t trigger for the season 2004–05.

Observer coverage

There is no formal independent observer coverage of fishing activities specific to seal interactions; however, scientific monitoring of commercial fishing in Zone A is undertaken regularly by personnel from the Tasmanian Aquaculture and Fisheries Institute. Information from the last two fishing seasons indicates that, although seals are present during fishing operations, they are not taken or killed as a direct result of fishing.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.5).

There are anecdotal reports that fur seals take or damage fish protruding from nets, take or damage fish caught in nets, and disturb fishing operations (Marine and Marine Industries Council, 2002).

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise the interactions of seals and the Small Pelagics Fishery include:

- Observer coverage.
- Seal-exclusion devices.
- Limited entry.
- A specific management plan for small pelagic species is being developed in conjunction with the Commonwealth.

3.6.2 Rock Lobster

Description of fishery

The Tasmanian rock lobster fishery has been managed by the Government for over 100 years and has been an important component of the State's fishing industry for over 150 years. The area of this fishery extends out to the boundary of the AFZ in the west, south and east off Tasmania. Rock lobsters (*Jasus edwardsii*) are targeted with 'bee hive' style pots of legislated maximum size. As of June 2003, there were 314 issued licences and 229 vessels active in the rock lobster fishery; the remaining licences leased their

quota to the active vessels/licences in the fishery. The approximate number of pot lifts for the fishery was 1 407 128. In the 2003–04 financial year the catch for this fishery was approximately 1596 t. The total value of the fishery was A$44.6 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.5).

There are anecdotal reports that fur seals take lobsters from pots, damage gear and disturb fishing operations. Shooting of seals, and deliberate injury to or harassment of seals, have also been reported in this fishery (Marine and Marine Industries Council, 2002).

The most frequently reported types of interactions include seals pulling bait out of savers, eating or damaging undersize rock lobsters when released, or eating 'softshellers' during the non-fishing season. Inadequate information precludes an accurate assessment of interactions, as rock lobster pots are often set overnight and at considerable depth. Therefore, while some bait loss may be attributable to seal predation, other predators (e.g. octopus) and the loosening of bait skewers during the setting of pots or rough weather, may be equally responsible (Marine and Marine Industries Council , 2002).

Seals may become entangled in pots. One rock lobster fisher on the west coast of Tasmania reported 2–3 juvenile fur seals per year drowned in their rock lobster pots. The extent of seal interactions with rock lobster fishing gear is difficult to assess but is likely to be small. Many operators report having either no interaction with seals or having low and sporadic levels of interaction (Marine and Marine Industries Council, 2002).

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise interactions between seals and the rock lobster include:

- Limited entry (quota managed fishery).

Whilst this fishery is managed under a formal management plan, there is no specific reference to managing interactions between rock lobster fishers and seals.

3.6.3 Scalefish

Description of fishery

The Department of Primary Industries and Water, Tasmania manages the commercial scalefish fishery. Gear types such as gillnets, hooks and squid jigs are used to target a variety of finfish, shark and cephalopod species. Other gear types such as Danish seine nets, traps, dipnets and spears are less frequently used to target particular species groups. Many scalefish are also important to Tasmania's recreational fishery. In 2003–04, the catch for the commercial scalefish fishery was approximately 1032 t, valued at around A$4.2 million

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.5).

There are anecdotal reports that fur seals take fish from gear, damage gear and disturb fishing operations. Specifically, interactions with gillnet fishers range from no interaction, to taking fish from nets, and damaging fish, gear and nets. In addition, seals have been sighted taking fish from gillnets during hauling and incidental catches (entangled) of seals have been reported. Shooting, deliberately injuring and harassing seals have also been reported (Marine and Marine Industries Council, 2002).

Current management requirements relevant to minimising interactions with pinnipeds

Management measures to minimise the interactions of seals and the scale fishery:

- Limited entry (input controls, including spatial/temporal restrictions).
- Scalefish management plan.

The scalefish management plan is currently being reviewed for fisheries issues. It proposes to include changes to buoy specifications (in response to industry trials) in an attempt to reduce interactions between banded morwong fishers and seals.

3.6.4 Abalone

Description of fishery

The abalone fishery is managed by the Department of Primary Industries and Water, Tasmania. Established in the 1960s, this fishery extends to the extent of the AFZ, and to latitude 39°12' N; however, the fishery is concentrated around near-shore reef systems. There are 125 managed fishing licences in this fishery. Catch rates in 2002 approximated 50 kg per diver hour, with a total of 2509.5 t whole weight taken. In the 2003–04, the catch for this fishery was 136 t for greenlip abalone and 2508 t for blacklip abalone. The total value of the fishery was A$88.7 million.

Observer coverage

There is no formal observer coverage of fishing activities specific to seal interactions.

Pinniped interactions

Fur seal species (presumably Australian and/or New Zealand fur seals) have been reported to interact with this fishery (Table 3.5).

One diver reported seals attract sharks, so abalone divers may be in danger when seals are nearby. Some divers report being frightened by seals swimming at high speed near them (Marine and Marine Industries Council, 2002).

Current management requirements relevant to minimising interactions with pinnipeds

There is no specific reference to managing interactions between abalone fishers and seals.

3.6.5 Recreational Fisheries

Tasmania has the highest boat ownership and participation rate in recreational fishing in Australia. Around one in three Tasmanians (approximately 120 000) fish at least once a year in marine, estuarine or inland waters. The most common form of fishing is angling in marine waters, an activity for which no licences are required. Inland fishing is by angling only. Other forms of recreational sea fishing require licences. In 2005 there were around 17 000 licences issued for hand collection and/or potting of rock lobster, 10 000 licences issued for hand collection of abalone, 3000 licences issued for hand collection of scallops and 8000 licences issued for beach seine and gillnets.

Seals are known to interact with the recreational fishery. Interaction can be direct such as the removal of rock lobster from pots and fish from gillnets through to indirect with the release of significant numbers of exotics from aquaculture cages caused by seal damage. The entanglement of seals in recreational equipment is not documented and is considered rare. The major regions in which interactions occur are in the south east around Storm Bay and in Bass Strait.

3.6.6 Fisheries–related entanglement

In Tasmania, 1–2 percent of fur seals are observed entangled, most frequently in trawl net. Entanglement material is removed from seals when possible (Pemberton *et al*., 1992).

Table 3.5 Human–seal interactions in State Government managed fisheries: **Tasmania**

Name of Fishery	Fishing Gear											Seal species[1]	Seal–Fisheries Interactions (Yes/No/Unknown)						Source
	Hand	Personal gear	Dropline	Longline	Other line	Gillnet	Mesh (seines)	Traps (pots)	Trawl	Dredge	Other		Take fish from net or directly from lines; pull squid from jig; take lobster from pot[2]	Loss or damage to fishing gear[3]	Disturbance of fishing operations[4]	Entanglement in fishing gear (bycatch) or in consumables (e.g., bait boxes)	Entanglement in discarded/lost fishing gear	Other	
Abalone	X											4	N	N	N			Y	a
Jack Mackerel							X					4	Y	Y	Y				a
Rock Lobster								X				4	Y	Y	Y	Y			a, b
Scalefish	X	X	X	X	X	X	X	X				4	Y	Y	Y	Y	Y		a
Trawl							X		X			4	Y	Y	Y	Y	Y		a

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal, 4 = fur seal species (species not identified), 5 = species not identified.

[2] Resulting in a lost catch; reduced catch; damage to catch; or reduced sale price.

[3] Resulting in cost of repairs or lost fishing time.

[4] Resulting in lost fishing time and/or loss of catch attributed to pinnipeds causing fish/squid to scatter; pinnipeds removing bait from pots; live pinnipeds on board, etc.

Y, yes; N, no; U, unknown.

(a) Marine and Marine Industries Council (2002); (b) Shaughnessy *et al.* (2003)

3.7 Shooting

Some fishers in certain fisheries illegally shoot seals (e.g., Marine and Marine Industries Council, 2002). The extent of this problem is unknown and it is logistically difficult to identify fishers responsible for such actions. Shooting of protected wildlife (including seals) is prohibited under the *Wildlife Regulations 1999* and the *Threatened Species Protection Act 1995*. The maximum fine for shooting seals is A$10 000.

CASE STUDY: Reducing interactions with seals in the winter blue grenadier fishery, using a seal-exclusion device and top-mounted escape hatch fitted to a trawl net

Background

The winter fishery for blue grenadier off west Tasmania is now the most valuable in the Commonwealth Trawl Sector of the SESSF. Freezer trawlers entered this fishery in 1997 and seal bycatch by three such vessels in 1999 caused the deaths of 83 seals. Under the *Environment Protection and Biodiversity Act 1999*, fishers must operate in a manner that will minimise the risk of such accidental bycatch. The 1999 seal deaths prompted the development of a programme to mitigate seal bycatch in this fishery, the principal components of which were a Code of Fishing Practice aimed at avoiding seals, and trials to test Seal Exclusion Devices (SEDs) in trawl nets.

During the 2000 fishing season, the programme was funded by the fishing companies operating the freezer trawlers–Petuna/Sealord and OceanFresh/Simunovich–under a joint venture agreement. These fishing companies, the Fisheries Research and Development Corporation (FRDC) and the Bureau of Rural Sciences (BRS) funded the programme during the 2001 to 2003 seasons. Fishing operations were conducted under a permit issued by the Australian Fisheries Management Authority and (then) Environment Australia that limited seal deaths to 30 a season. However, seal bycatch during SED trials was not debited against this total. Permit conditions also stipulated full and independent onboard observer coverage from 2000 to 2002. SED trials were conducted on the only two large freezer trawlers in the fishery during 2000 to 2003–the *FV Aoraki and FV Ocean Dawn*.

The main components of the Code of Fishing Practice were actively steaming away from seals before shooting the trawl net, removing meshed fish ('stickers') from the net before use, and not discarding unwanted fish or offal on the fishing grounds. The fishing permit limit on seal deaths prevented quantitative assessment of the code's components. However, comparison between fisheries data for the 1999 season and equivalent data for the 2000–03 seasons indicated that adopting the code had halved the incidence of seal bycatch per trawl shot.

2000 SED trials

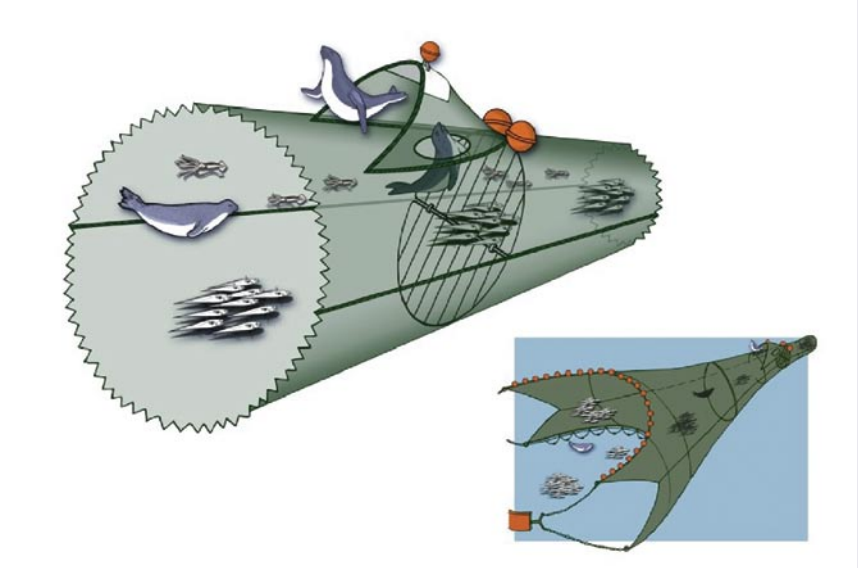
The SED design used in 2000 had much in common with the Turtle Exclusion Devices used in prawn fisheries, with a square, backward-sloping exclusion grid and a backward-facing escape hatch. Loss of blue grenadier catch via the escape hatch was significant. Of 453 trawl shots observed, 40 contained seal bycatch. The incidence of seal bycatch in nets with a SED was about double that for nets without a SED, suggesting that seals were entering the net by the escape hatch. The survival rate for seal bycatch in SED nets was 66 percent, compared with 22 percent for nets without a SED. Seal bycatch in bottom-trawl nets was lower than that for the larger mid-water trawl nets.

2001 SED trials

In 2001, several SED designs were trialled. All had forward-facing escape hatches to minimise fish loss, and larger square grids. Two basic design features were either a top-mounted, or a bottom-mounted escape hatch. Trials were also conducted on a closed 'grid-only' SED to assess whether denying seals

access to the net's codend sufficed to reduce seal bycatch mortality. SED trials were confined to mid-water trawls from 2001 onwards. Seal numbers on the fishing grounds were comparatively low and only 26/511 trawl shots contained seal bycatch. The bycatch survival rate (eight percent) was also low. The incidence of seal bycatch in SED nets was again about double that for nets without a SED. Fish loss via open SED escape hatches appeared to be minimal, but problems were experienced with fish building-up and blocking the SED grid.

Figure 3.3 Diagram of the SED and top-mounted escape hatch fitted to a trawl net



Seals encounter the SED while pursuing fish toward the cod-end of the net, but are forced to exit by the escape hatch. The SED prevents the seal from entering the cod-end, where it is likely to become smothered by fish and die, while the escape hatch negates the need for the seal having to swim against the water current to escape through the net mouth (Derek Hammer, pers. comm.). © Martin Cawthorn.

2002 SED trials

Throughout the 2002 season, one vessel conducted trials with a 'top-hatch' SED (Figure 3.3) and the other vessel a 'bottom-hatch' SED. The SED grid structure of both designs was improved with a threefold increase in area and a near-circular shape. Seal numbers on the fishing grounds were greater than in 2001 and 41/557 trawl shots contained seal bycatch. The bycatch survival rate was moderate (24 percent). With the bottom-hatch SED, seal bycatch in nets with a SED (12.3 percent) was again greater than that for nets without a SED (3.9 percent). With the top-hatch SED, the incidence of seal bycatch in nets with a SED (3.1 percent) was much lower than that for nets without a SED (20.7 percent), indicating that this design was successfully expelling seals and denying them access to the net via the escape hatch.

2003 SED trials

One vessel conducted trials on the top-hatch SED design used in 2002. The other vessel conducted trials on a closed 'grid-only' SED, as the 2001 results from this design were ambiguous. Seal numbers on the fishing grounds were comparatively low and only 19/483 trawl shots contained seal bycatch. Bycatch survival was moderate (32 percent). The SED results were ambiguous because of the low incidence of seal bycatch. Although the top-hatch SED again had a low incidence of seal bycatch (3.0 percent), the overall incidence was also low (3.9 percent). There was little difference between the seal bycatch of nets with or without a closed 'grid-only' SED.

Overall SED performance

Whereas general additive model (GAM) analyses clearly showed that the 2002 top-hatch SED had a significantly lower occurrence of seal bycatch than other SED designs and nets without a SED, SED performance remains largely unquantified. The actual numbers of seals interacting with the trawl net and seals successfully exiting the net via the SED escape hatch are unknown. Many more direct observations with underwater camera equipment are needed. Obtaining significant results on SED performance by comparing replicate sets of trawl shots with and without a SED is confounded by the low level of seal bycatch and the complex suite of factors influencing seal interactions with the trawl net. The use of SEDs clearly enhances the survival rates of seal bycatch by preventing entry into a net's codend where most seal drownings probably occur. An overall (2000–03) seal bycatch survival rate of 48 percent occurred in mid-water nets with an open SED, as against zero for nets without a SED. The *FV Aoraki* has conducted more trials of the top-hatch SED in 2004, as this design merited further appraisal.

GAM analyses found the following factors to significantly affect the probability of seal bycatch: trawl shot position (latitude and proximity to seal colonies or haul-out sites); time of day (seal bycatch peaked during the late morning); and catch composition (seal bycatch increased with higher spotted warehou bycatch). Other factors influencing seal counts around the trawlers included vessel speed, number of vessels within 2 n.miles, swell height and visibility. Seal abundance on the fishing grounds also varied from year to year.

Net entry by seals

Mechanical problems were experienced with underwater camera use throughout this project, largely because of the depths fished and the rigours of commercial fishing activities. Hence direct video observations of seal behaviour were fragmented. Surface counts of seals indicated most net foraging to occur when a trawl was being hauled. However, limited video footage showed that some seals entered the net when it was being shot, despite the seal avoidance aspects of the Fishing Code of Practice. If becoming entrapped, such seals will certainly drown, whereas a large proportion of seal bycatch during hauling survived. More direct underwater observations with better camera equipment are needed to more fully understand where and when seals enter trawl nets.

Seal biology

All bycatch seals unambiguously identified were Australian fur seals. Most (94 percent) were subadult males. Most age classes contributed to the seal bycatch, including juveniles (2–4 years), subadults (5–7 years) and adult males (8^{+} years). Stomach analyses showed bycatch seals to have been foraging almost exclusively on trawl-caught fish.

A novel, crane-operated, dip-net was used to capture adult seals for attaching satellite tags. Tag-life varied widely, but all tagged seals actively foraged on the blue grenadier fishing grounds during the fishing season. Seals that hauled-out at Reid Rocks or Hibbs Point returned straight to the fishing grounds after resting. At the end of the fishing season, seals generally dispersed southwards. The tracking study demonstrated the habitual nature of seals foraging on the fishing grounds. The seal population interacting with the fishery is probably comparatively small and intransient during the fishing season.

(by Richard Tilzey, richard.tilzey@brs.gov.au)

CASE STUDY: Reducing interactions with Australian sea lions in the rock lobster fishery, using a t-bar mounted in pots

The Australian sea lion is a rare, endemic species found between the Houtman Abrolhos Islands on the west coast of Western Australia and The Pages near Kangaroo Island in South Australia. The population on the west coast of Western Australia was probably much larger before colonization and commercial sealing and whaling between the 18th and 20th centuries. About 800 sea lions make their home along the west coast, and they are genetically distinct from those living along the south coast. Females of this species appear to be extremely loyal to their birth site, and always return there at breeding times. This means that each breeding colony has a distinct population of breeding females. Australian sea lions are now under consideration by the Federal government to be listed as 'Vulnerable' under the *Environmental Protection Biodiversity Conservation Act (1999)*. Given the precarious state of the species, even low levels of incidental mortality may affect the population.

The western rock lobster fishery (WRLF) is often cited as an example of one of the best managed fisheries in the world. The Marine Stewardship Council (MSC), which certified the rock lobster fishery as the world's first ecologically sustainable fishery, raised concern in 2002 over the incidental drowning of young Australian sea lions in lobster pots. The sea lions are attracted to the pots by both captured lobsters and bait.

Figure 3.4 Australian sea lion removing a rock lobster from a pot in Western Australia

A Scientific Reference Group (SRG) was established to provide the knowledge and research required to address this issue. Key findings from this group suggested that the low level of reported interactions is of significant concern to the small population of this species along the western coast of Western Australia. Young sea lions between 6–24 months were particularly vulnerable to capture and all captures occurred in relatively shallow waters (< 20 m) at distances up to 25 km from a breeding colony. Estimates of the rate of capture vary between 2–12 sea lions per season based on volunteer reports from commercial fishermen. There were no reported captures at the Houtman Abrolhos Islands, a very

small breeding colony approximately 40 n.miles off the coast, or around the haul-out areas near Perth. It was decided that the elimination of all mortalities associated with the industry by means of a pot modification was the most suitable resolution. The vulnerable age range of sea lions coupled with the non-annual breeding season of the sea lion meant that the pot modifications would need to be used for the entire fishing season.

Extensive video trials were conducted to determine the efficacy of a number of sea lion exclusion devices (SLEDs). Commercial trials of these devices in fishing operations were conducted to establish their impact on the catch rate of lobsters, as industry were concerned over the possible loss of catch due to the pot modifications. Results have indicated that the initial device resulted in an overall drop in catch but subsequent designs had little effect on catch rates of legal size lobster. Through the video and commercial trialling process, two designs for SLEDs have been finalised as recommended for use in the industry. The first device consists of a metal bar (minimum diameter 6 mm) placed through the widest part of the neck of the pot. The device can be placed through at any height within the neck and does not need to be horizontal to the pot, but must pass through at the maximum width. This applies to all pots such as redneck, fingerneck or stickpots. The second device consists of a single straight upright, a minimum of 10 mm diameter, attached to the bottom of the pot, which finishes at the base of the neck structure.

The proposed area for the mandatory use of the SLED encompasses all known captures of sea lions and represents the area where sea lions are vulnerable to capture as determined by the best available scientific knowledge. It includes the waters less than 20 n.miles within approximately 25 km of the three breeding colonies on the west coast. The northern boundary is just to the north of Freshwater Bay and the southern boundary of the zone is just to the south of Wedge Island. A stakeholder consultation paper has been developed and released, encouraging comment on the proposed recommendation to implement the mandatory use of sea lion exclusion devices in the WCRLF. Public comment period concluded June 2005. If the recommendation is supported, it is proposed that the use of SLEDs will become mandatory in the specified area from the start of the 2004–05 season.

(by Richard Campbell, rcampbell@fish.wa.gov.au)

4 National overview of the interactions of marine finfish aquaculture and seals

Several species of marine finfish are farmed in coastal waters of Australia, notably southern bluefin tuna in South Australia and salmonids in Tasmania. Australian fur seals, New Zealand fur seals and Australian sea lions predate caged marine finfish and damage gear, resulting in economic loss. Fatal entanglement of seals and sea lions in anti-predator nets, and illegal killing of seals and sea lions near finfish operations has been reported. Attempts to mitigate interactions have had variable degrees of success, with the protection of farmed fish potentially the most effective option.

4.1 New South Wales

In New South Wales, three marine finfish species are currently farmed commercially: snapper (*Pagrus auratus*), yellow bream (Acanthopagrus australis) and mulloway (*Argyrosomus japonicus*) at one lease site at Kurnell, Botany Bay (34° 00' S, 151° 12' E); and snapper at one lease site 3 km off the coast of Port Stephens (32° 40' S, 152° 13' E). Floating cage culture is used in both operations. The cages at Port Stephens are circular; at Botany Bay there is a combination of circular and rectangular cages (Peter Scanes, pers. com.).

Both farms have a marine mammal entanglement protocol (framework only), and are required to undertake a rigorous environmental monitoring programme that includes reporting of any interaction with marine mammals. The future expansion of the marine finfish farming industry in the short term will depend on the outcome of the environmental monitoring programme. To date, there have been no reported interactions with seals at these sites (Graeme Bowley and Mick Murphy, pers. comm.).

The snapper farm at Port Stephens off Myall Lakes Beach, Hawks Nest, was recently sold after the original company went into receivership. The original farm organised an entanglement committee with New South Wales Fisheries and key stakeholders, including National Parks and Wildlife Service. For the first two years, the farm provided regular reports on fauna issues to the committee. No seal interactions were mentioned. However, for the past two years the farm fell into disrepair and there was no monitoring of the nets or reporting. In March 2004, National Parks and Wildlife Service found one of the nets from this farm on the beach in Myall Lakes National Park. There were no fauna caught in the nets. It appears the net pulled free of the moorings during a storm (Mick Murphy, pers. comm.).

4.2 Victoria

Currently, there is no marine finfish aquaculture industry in Victoria. However, Fisheries Victoria is implementing twelve marine aquaculture fisheries reserves, one of which will permit the culture of finfish. This reserve is in Portland Harbour, where there are reported sightings of seals. A management plan is being prepared for the Portland Aquaculture Fisheries Reserve. It will identify potential interactions between aquaculture activities and threatened, endangered, migratory and protected species, and specify the requirements for managing, auditing and reporting such interactions.

4.3 Western Australia

Currently, there is no marine finfish aquaculture industry in Western Australia.

4.4 South Australia

Description of aquaculture operation

In South Australia, four marine finfish species are currently farmed commercially: southern bluefin tuna (*Thunnus maccoyii*), yellowtail kingfish (*Seriola lalandi*), Atlantic salmon (*Salmo salar*) and mulloway (Figure 4.1) (Love and Langenkamp, 2003; Carina Cartwright, pers. comm.).

Southern bluefin tuna farming in South Australia began in 1991. Currently, there are 21 tuna farms on 32 lease sites (Figure 4.1). Farms range in size from 5–40 hectares (average: 30 hectares). Polar circle pens (flexible sea cages hung from circular pontoons) are used. The sea cages are 40–50 m in diameter and the holding nets drop 15–20 m into the water. Only tuna farmers are permitted to include dead pilchards in the stock food. Stock food is mainly dead pilchards, although some pellets are used. In 2001–02 and 2002–03, the farms produced 9245 t and 9102 t of tuna (live weight), valued at around A$260.5 million and A$266.9 million respectively (Knight *et al*., 2004; Love and Langenkamp, 2003; Carina Cartwright, pers. comm.). Tuna farms are stocked for six months of the year.

Yellowtail kingfish farming in South Australia began in 1998. There are currently 21 marine finfish licences for finfish other than southern bluefin tuna. The five main farms for yellowtail kingfish are in Boston Bay, Arno Bay, Franklin Harbour and Fitzgerald Bay (Figure 4.1). Farms are mostly 20 hectares (range: 5–20 hectares). Polar circles pens (diameter 20–30 m; drop 10–15 m into the water) are used. Only pellets are used as stock food. In 2001–02, the farms produced 1200 t of yellowtail kingfish (live weight) valued at A$13 million (Hernen and Hutchinson, 2003; Love and Langenkamp, 2003; Carina Cartwright, pers. comm.).

The Atlantic salmon and mulloway operations in South Australia both use sea cages. The former has one operator at Cape Jaffa with a production estimate for 2001–02 at 64 t, worth around A$0.6 million. The three mulloway farms are at Arno Bay and Boston Bay. No production or value estimates are available for this sector (Carina Cartwright, pers. comm.).

Observer coverage

There is no observer data of farming activities specific to minimize seal interactions. However, observer coverage is underway as part of FRDC project 2004/201 by PIRSA (Goldsworthy, pers. comm.).

Pinniped interactions

Southern bluefin tuna farmers experience various interactions with Australian sea lions and New Zealand fur seals in South Australia (Table 4.1). Interactions with yellowtail kingfish appear to be negligible based on current observations.

The known interactions detrimental to tuna farms are:

- Seals biting dead tuna that are lying against the netting, causing damage to nets (James Findlay, pers. comm.).
- Seals entering net enclosures and killing and damaging tuna or chasing the fish, decreasing fish energy levels and/or increasing fish stress levels.
- Seals basking on the net rings, potentially stressing the fish inhibiting feeding and subsequently reducing fish growth rates.
- Occasionally large aggressive seals attack or bite farm workers while working around nets or when trying to remove seals from net enclosures (O'Sullivan, 2003; James Findlay, pers. comm.).

The extent of each of the interactions listed above is unknown.

The known interactions detrimental to seals are:

- Entanglement of seals in fish-farm nets, which may result in drowning or injury (Carina Cartwright, pers. comm.).
- Entrapment in the cage.
- Modified behaviour of individual seals habituated to a predictable food source.

Two issues are of particular concern:

- Interactions between aquaculture and Australian sea lions (including entanglement), may reduce the survival rate of the juveniles and adult females of this species, thereby compounding slow population recovery.
- Potential and real interactions between aquaculture and New Zealand fur seals may result in loss of production due to disturbance or death of fish; and increased costs through the need to protect stock from seals (Lindsay Best and Michael Deering, pers. comm.).

Interactions with Australian sea lions are perceived to be uncommon, compared to those with New Zealand fur seals, although there are no independent observer data for this fishery. However, even low levels of incidental mortality may be a threat to Australian sea lions (Lindsay Best and Michael Deering, pers. comm.). A study by the South Australian Museum (Kemper and Gibbs, 1997) noted the deaths of two Australian sea lions and one unidentified pinniped, which were reported officially between 1994–1996, when anti-predator nets were in use. These nets are not thought to pose a risk of entanglement with their large mesh sizes, holes not repaired, nets not enclosed at the bottom, and nets often loose and baggy (Pemberton 1996 in Kemper *et al*., 2003). Consequently, their use has been phased out on tuna farms and there have been no subsequent official reports of entanglement (Carina Cartwright, pers. comm.).

New Zealand fur seals are likely to be responsible for most seal attacks on tuna farms in South Australia because of their ability to climb over the handrails into the cages. Seals typically chew along the backbone of the tuna (much like eating a cob of corn), but tend not to eat the whole fish. Evidence of attacks is the presence of dead fish at the bottom of the cage with gashes along the back, and also other damaged fish with similar marks. Additionally, other tuna may die later from stress caused by the presence of seals (whether the seal is inside or outside the cage) (Carina Cartwright, pers. comm.).

Interactions with New Zealand fur seals are expected to increase with an increase in both industry activity and seal numbers.

Most mulloway and Atlantic Salmon farms are some distance from the seal colonies and have been established only recently (Carina Cartwright, Lindsay Best and Michael Deering, pers. comm.). There are reports of interactions with New Zealand fur seals at mulloway at Pork Lincoln (Goldsworthy, pers.comm.).

Current management requirements relevant to minimising interactions with pinnipeds

PIRSA Aquaculture is responsible for the sustainable development of aquaculture. Licences and leases are granted and renewed under the *Aquaculture Act 2001*. Development approvals are required under the Development Act 1993. Seals are protected animals under the *National Parks and Wildlife Act 1972* and the *Fisheries Act 1983*.

Finfish aquaculture operators are required under the *Aquaculture Act 2001* to report any interactions with protected species. The State Government Marine Mammal–Marine Protected Area Aquaculture Working Group has been appointed to make recommendations for policy. This group is currently drafting a paper on the reduction of risk to seal species by improving the siting of finfish aquaculture (tuna and yellow-tailed kingfish) in relation to non-breeding haul-outs and breeding seal colonies. This Group's recommendations will be considered in future Aquaculture Policies (Carina Cartwright, pers. comm.). Prohibited areas for aquaculture development can be prescribed under the *Aquaculture Act 2001* (Lindsay Best, pers. comm.).

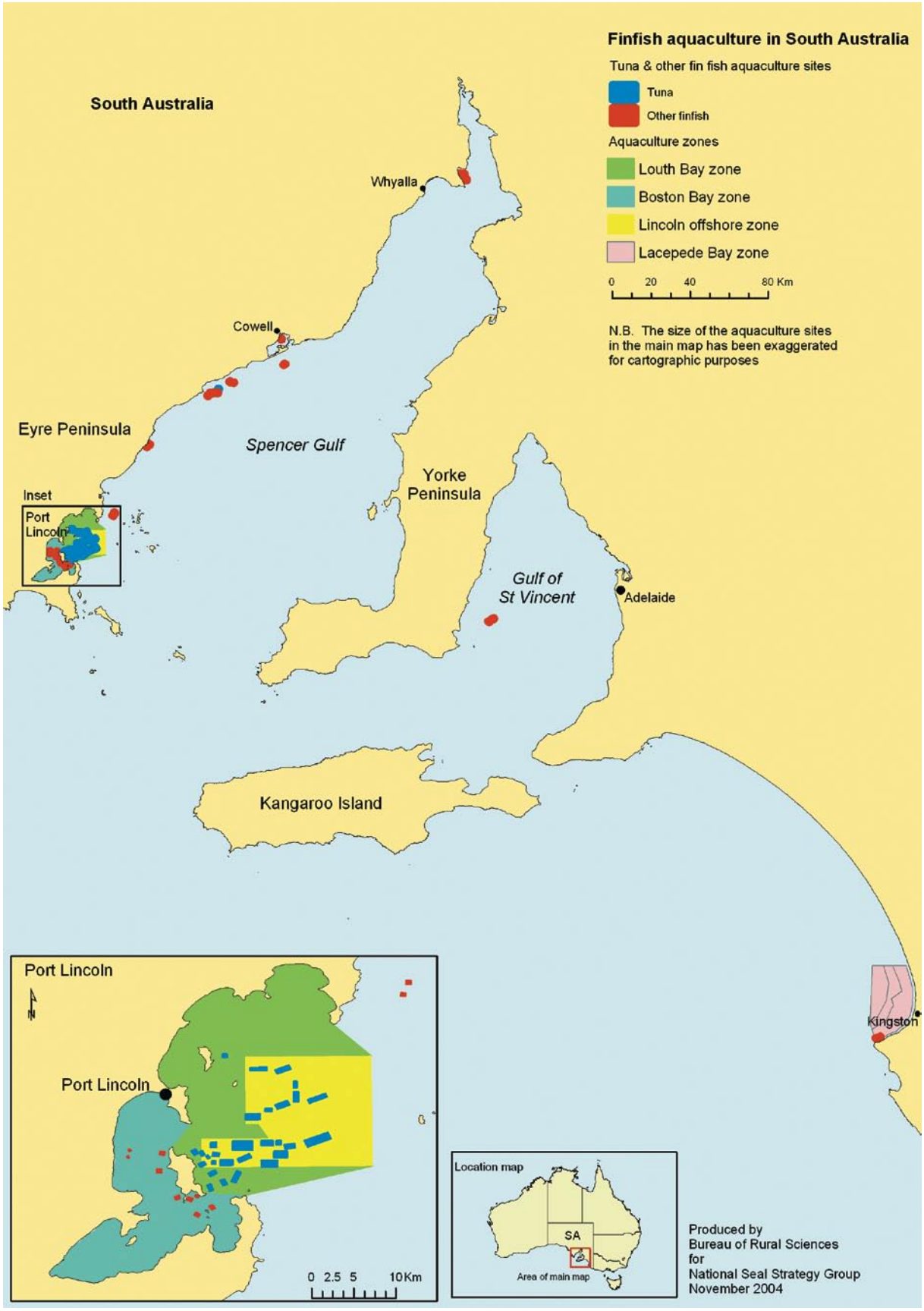
Both the tuna and other finfish aquaculture industry in South Australia are currently drafting voluntary codes of practice, which will include means of reducing seal interactions through improved farm

management practices. All reasonable measures must be taken to reduce interactions with wildlife and any interactions must be reported immediately to PIRSA Aquaculture. Incidents must also be reported in annual environmental monitoring reports. Proposed farms in areas where interactions are considered likely will be required to submit and adhere to a Wildlife Interaction Avoidance Strategy as part of their environmental management and monitoring conditions. If wildlife continues to interact with the farm, the operator may be required to use different cage structures (Carina Cartwright, pers. comm.).

Various measures have been used to reduce adverse interaction with seals and sea lions but with varying success. Successful mitigation measures used on tuna farms in South Australia include:

- *Well-maintained stock nets*: Pinnipeds can readily gain access to caged fish through holes in the net attributed to poor maintenance or shark attack. It is therefore important to monitor the condition of nets regularly for billowing and holes, and repair damaged nets immediately (Kemper *et al*., 2003; O'Sullivan, 2003; Pemberton, 1996).
- *Large round cages with very low stocking densities*: The tuna's accessibility to seals is reduced if larger cages are used and/or the number of fish per cage is reduced. Round cages also help, as seals can manipulate the corners of square cages, which are the points of weakness. Low stocking density (up to 4 kg/m^3) means the tuna can get away from a seal that is inside or outside of the cage, probably reducing the tuna's stress levels (Carina Cartwright, pers. comm.).
- *Electric fencing*: An electric fence known as Seal Guard which is manufactured and distributed by Lincoln Rural Supplies has a high voltage/low amperage current constantly pulsing through the wire. When a seal touches it, the wire transfers an electric shock (7000 volts) that immediately repels the seal. At the beginning of 2003, 90 percent of the 140 tuna cages in Port Lincoln and all local yellowtail kingfish farms used Seal Guard (O'Sullivan, 2003).
- *Raised railing, jump nets and bird netting*: New Zealand fur seals can scramble over fences that are 1.5 m above water level, but cannot access the pen from the top when the railing (jump fence) is raised to 2 m above sea level (Kemper *et al*., 2003). Nets (jump nets and/or bird netting) that are raised above the rails prevent seals accessing the cage over the top of the rails. Jump fences are an extension of the grow-out netting. Their standard working height of approximately 1 m is now 3 m because seals used to jump over the jump fence into the pen or roll onto the pen pipe to bend the handrail down into the water, and then roll into the grow-out net with the tuna (Carina Cartwright, pers. comm.).
- *Predator nets in the marine finfish farming sector (excluding tuna farms)*: Predator nets are not used by the tuna industry; however, the other marine finfish farms use them to deter sharks. Even though the marine finfish farmers have had negligible interaction with seals to date, the nets would assist in providing a barrier between the stock and the seal (Carina Cartwright, pers. comm.).
- *Research into Australian sea lion habitat use is being conducted to inform future planning for fish farms in South Australia* (FRDC: 2004/201 PIRSA Aquaculture–FRDC 'Innovative Solutions for Aquaculture: addressing seal interactions in the finfish aquaculture industry'). The siting of tuna farming pens away from seal colonies and haul-outs is thought to reduce potential interactions.

Figure 4.1 Locations of marine finfish aquaculture farms in South Australia



Mitigation methods not supported by PIRSA Aquaculture include acoustic devices and removal or culling of the offending animal. Perimeter fencing, false bottoms and net stiffening have not been practical for use in South Australia (Carina Cartwright, pers. comm.).

Acoustic devices have been trialled at marine finfish farms in South Australia. The tuna industry has tested several types of seal scarers (e.g. AirMar db plus II, Poseidon T88 (Renton, 1996)), but did not adopt them. The farmers thought the devices were working more as a 'dinner bell' than a repellent. There is also concern that the seal scarers might cause some habituation and selection for seals that are deaf, at least in the frequency band within which they operate. The preferred ultimate device would make a sound only when a seal is in the act of attacking a fish. A device operating solely by triggering a sensor would probably have maximum startling effect on the seal and minimal impact on the environment (Carina Cartwright, pers. comm.).

4.5 Tasmania

Description of aquaculture operation

In Tasmania, three marine finfish species are currently farmed commercially: Atlantic salmon (*Salmo salar*), rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*). All are of the family Salmonidae. Rainbow trout grown in saline waters are marketed as 'ocean trout'. In 2002, Tasmania farms produced approximately 15 000 t of finfish (head on gilled and gutted), valued at around A$120 million (Marine Farming Branch and Nature Conservation Unit, DPIWE, pers. comm.).

Finfish aquaculture has been operating in the State since the 1980s. There are eight salmonid farms on 45 lease sites in the southeast, northern and western areas of Tasmania; two rainbow trout farms on two lease sites in western Tasmania; and one brook trout farm on one lease site in western Tasmania (Figure 4.2). Sixteen farms are currently licensed for both Atlantic salmon and rainbow trout. The farms vary in size from 1.5–100 hectares (average: 20–30 hectares) (Marine Farming Branch and Nature Conservation Branch, DPIWE, pers. comm.).

Most farms in Tasmania operate with polar circles (diameter 60–120 m; drop 10 m into the water). System farms and Onesteel Marine mesh are also used. Predator nets are typically used in the salmon industry when the fish attain 300 g weight. Predator nets surround the stock nets, forming a physical barrier and buffer between marine predators and the stock (Schotte and Pemberton, 2002). The stock feed is pellets.

Observer coverage

Since 1990, the Wildlife Operations Unit of DPIWE has operated a seal-relocation programme, which is overseen by the Nature Conservation. This programme traps and relocates seals that repeatedly attack marine finfish farms; all details are entered on a database (Hume *et al*., 2002). Between 1990 and May 2000, 353 individual seals had been trapped in 672 trapping events. Most of the identified seals were non-breeding male Australian fur seals. In the 586 trapping events (where individual seals were identified) 52 percent of individuals had been captured more than once. The number of seals captured increased throughout the years, usually in winter months, peaking in 1998, with 164 captures (Hume *et al*., 2002). The number of seals captured increased throughout the years, usually in winter months, peaking in 1998 with 164 captures. This trend was difficult to interpret (Hume *et al*., 2002), as it followed an increase in the size of the farms, an increase in the production of salmon, and a change in trapping effort between farms through time. In addition, on some farms, predator nets have become more prolific. Individual seals that were recaptured were, on average, captured the second time 25 days after the initial relocation (Hume *et al*., 2002).

A marine biologist has been appointed to analyse seal–fisheries interaction data in Tasmania and continue focussed observations on the nature of seal and finfish farm interactions (Marine and Marine Industries Council, 2002; Marine Farming Branch and Nature Conservation Branch, DPIWE, pers. comm.).

Pinniped interactions

Salmonid fish farmers experience various interactions with Australian fur seals, mostly juvenile and adult males (Pemberton *et al*., 1991). Although the Australian fur seal is the main predator interacting with salmonid fish farms, they may also have been joined recently by the New Zealand fur seals. These seals are more agile than Australian fur seals and are more capable of climbing over conventional protection systems (Schotte and Pemberton, 2002) (Table 4.1).

The extent of interactions with fur seals on salmonid farms in Tasmania is greater than on tuna farms in South Australia. The known interactions detrimental to salmonid farmers are:

- Seals pushing the anti-predator and stock nets together and biting fish through the combined netting.
- Seals entering net enclosures and killing or damaging fish or chasing fish, potentially decreasing the fish's energy levels and increasing their stress which inhibits feeding and subsequently reduces growth rates.
- Seals in the general proximity of nets or boarding farming superstructure potentially cause an increase in fish stress levels.
- Net damage resulting in the release of fish and costly repairs.
- Occasionally seals have been aggressive to farm workers working around nets or removing seals from net enclosures (one reported instance of a seal biting a worker).
- Seals attracted to farms by escaped salmon, oil slicks from feed or increased wild fish outside pens, which encourages further interactions.

The extent of each interaction listed above is unknown (Kemper *et al*., 2003; Hume *et al*., 2002; Marine and Marine Industries Council, 2002; Schotte and Pemberton, 2002; Pemberton *et al*., 1991; Pemberton and Shaughnessy, 1993; Ross, 1988). However, the estimated seal-induced losses at fish farms (primarily loss of fish) is around A$1000 per tonne of salmon produced, or 10 percent of the cost of production. For 2000 and 2001, estimated losses were A$11.5 million and A$12.1 million respectively (Marine and Marine Industries Council, 2002).

The known interactions detrimental to seals are:

- Entanglement of seals in fish-farm nets (i.e., live seals caught between the nets), or in anti-predator nets, leading to possible death or injury.
- Trapped in the seal trap.
- Change in the behaviour of seals habituated to a predictable food source.
- Deaths from other causes associated with farm operations, e.g., illegal killing of both Australian and New Zealand fur seals (Kemper *et al*., 2003; Kemper and Gibbs, 1997).

Confirmed reports of fatal entanglements at marine finfish farms: one New Zealand fur seal pre-1998; two Australian fur seals in 1998, four Australian fur seals in 1999, and 27 Australian fur seals in 2000 (Marine and Marine Industries Council, 2002; Kemper *et al*., 2003). These figures include Australian fur seals found floating on farm leases.

Current management requirements relevant to minimising interactions with pinnipeds

In Tasmania, the *Marine Farming Planning Act 1995* requires the preparation of environmental impact statements to mitigate the impacts of marine farming development. Negative interactions with seals are identified during this process.

Marine Farming Branch, DPIWE, is responsible for the sustainable development of aquaculture. Furthermore, a Seal-Fishery Management Strategy has been completed for Tasmania. This provides guidance for the Seal Forum and the Nature Conservation Branch to guide management of the

interactions between seals and fishery operations. In the preparation of Marine Farming Development Plans, consideration is given to maximising the distance between marine farming zones and known seal colonies and haul-outs (Marine Farming Branch and Nature Conservation Branch, DPIWE; Rosemary Gales, pers. comm.).

Various measures have been used to reduce adverse interaction with seals, but with varying degrees of success. Successful mitigation measures used on salmon farms in Tasmania include:

- Well-maintained stock nets (see Section 5.3 for tuna).
- Structural modification of nets: mesh net size 6 cm; false bottoms on nets; spectra or dyneema framleinge net material; and tensioning of the stock net and predator net.
- Steel predator nets around the fish-holding nets: MarineMesh™ is a steel woven wire netting that currently is most suitable for system farms. A single layer of the MarineMesh™ acts as both a grower and predator net, replacing the need for multiple fibre nets (refer to case study for full details).
- Fences and railings (2 m in height): to prevent seals interacting with farm personnel and entering the pens.
- Aerial netting: to help prevent seals from interacting with farm personnel and entering the pens.
- Electric fencing: possibly effective when used with other measures and with system farms.
- Trapping and relocation as a temporary measure and short-term management tool: under the 1998 system of accreditation, only farms that meet certain standards are permitted to trap seals. This method is most effective when seals have entered pens. Translocation will be phased out as better management tools become available.
- Sedation and removal under exceptional circumstances.
- Seal crackers: Crackers are effective under certain circumstances when used properly. Trained farm workers will be authorised to use these small explosives providing they follow A Code of Practice. Use of non-lethal deterrents requires permits, training and adherence to deployment protocols.

(Marine and Marine Industries Council, 2002)

Mitigation methods with limited long-term effect include acoustic harassment devices; emetics such as Lithium chloride; visual predator models; imitation of killer whale sounds; boat pursuit; and trapping and relocation (Kemper *et al*., 2003; Marine and Marine Industries Council, 2002).

Trapping and relocation of seals was introduced as a temporary management tool (Marine and Marine Industries Council, 2002). Many individual seals within the vicinity of the marine finfish farms are not trappable. It is only effective for certain individuals. Furthermore, trapping is costly (A$550 for one seal). Trapping and relocation is not appropriate as a broad-scale management tool (Marine and Marine Industries Council, 2002; Hume *et al*., 2002).

Seal crackers have been used in Tasmania since 1986. They are available from DPIWE to fishers that meet minimum defined standards, apply for permits, undertake training and adhere to protocols. These small explosives are considered to be effective under certain circumstances and with proper use; however individual seals may become habituated (Marine and Marine Industries Council, 2002).

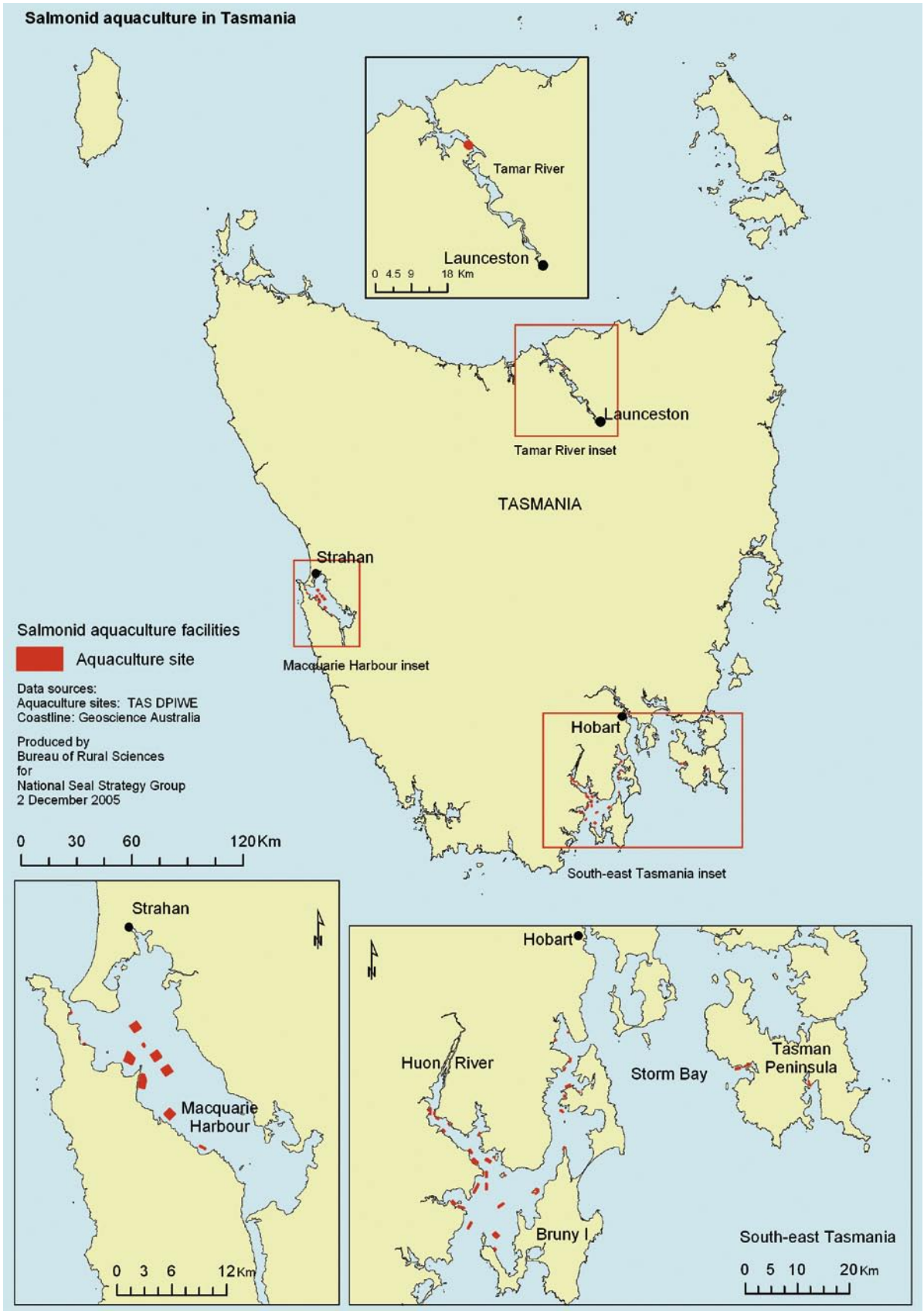
A study of whether a stock-protection system of flexible oceanic pens was suitable for Tasmanian and South Australia marine finfish farming identified two prominent areas of weakness: low tension through the base of the nets, as represented by depth present in typical grow-out and predator net bases; and insufficient buffer between the stock and predator nets at the sides and base when using flexible netting materials such as nylon or polyester (Schotte and Pemberton, 2002). The authors recommended maximising the tensioning weight hung on the predator nets (and possibly grow-out nets); and increasing the typical buffer distance between the grow-out net and the predator net at least 2 m.

The study also recommended:

- Minimum of 2.4 Te weighting on typical pen predator netting.
- Separation stick between grow-out and predator net.
- Investigating predation methods of seals.
- False bottom in the grow-out net to prevent 'easy' predator access to any mortalities that may occur.
- Jump fences (2 m in height) and aerial fences.
- Implementing common quality-control systems across the salmon and tuna industries.
- Investigate further by physical and computer modelling.
- Further independent research on netting and acoustic deterrent devices (Schotte and Pemberton, 2002).

Interactions with seals in Tasmania are likely to increase as seal numbers continue to recover and the aquaculture industry continues to grow (Marine and Marine Industries Council, 2002).

Figure 4.2 Locations of marine finfish aquaculture farms in Tasmania



Note: Tamar farm is northwest of Launceston.

Table 4.1 Interactions of seals and finfish aquaculture

State	Finfish species	Seal species	Seals attracted to farm[1]	Proximity of seals to pens[2]	Damage to net/gear[3]	Grab fish through predator and internal net or enter nets[4]	Boarding of boats or farming superstructure[5]	Live seals trapped between nets[6]	Entanglement of seals in anti-predator nets[7]	Source
SA	Southern bluefin tuna	Australian sea lion	Y/?	?	Y	Y	?	?	Y	a, b, c, d, e
SA	Southern bluefin tuna	New Zealand fur seal	Y/?	?	?	Y	Y	Y	?	a, f, g
SA	Southern bluefin tuna	Australian sea lion or New Zealand fur seal	Y/?	Y	Y	Y	Y	Not recently, as no nets to trap between	Not recently as no nets to trap between	c, d
SA	Yellowtail kingfish	Australian sea lion or New Zealand fur seal	N	N	N	?	N	N	N	c
SA	Mulloway	New Zealand fur seal	Y	Y	?	?	?	?	?	h
Tas.	Atlantic salmon	Australian and New Zealand fur seal	Y	Y	Y	Y	Y	Y	Y	e, i
Tas.	Rainbow trout	Australian and New Zealand fur seal	Y	Y	Y	Y	Y	Y	Y	e, i
Tas.	Brook trout	Australian and New Zealand fur seal	Y	Y	Y	Y	Y	Y	Y	e, i

Southern bluefin tuna (Thunnus maccoyii); yellowtail kingfish (Seriola lalandi); Atlantic salmon (Salmo salar); rainbow trout (Oncorhynchus mykiss) and brook trout (Salvelinus fontinalis).

[1] Seals attracted to farm by escaped fish, oil slicks from feed or increased wild fish outside pens (encourages further interactions);

[2] Proximity of seals to pens (stress; reduced feeding rates);

[3] Damage to net/associated gear (release of fish; cost of repair; increased costs through the need to protect stock from seals);

[4] Grab fish through predator and internal net or enter nets (fish mortality; lost or reduced market value of damaged fish; increased effort of divers removing dead fish; increased susceptibility to disease, etc);

[5] Boarding of boats or farming superstructure (stress and risk to personnel safety);

[6] Live seals trapped between nets (decreased feeding rates; risk to workers in releasing seals; work time lost in dealing with seals); and

[7] Entanglement of seals in predator nets (seal mortality).

Y, yes; N, no; U, unknown.

(a) Cath Kemper, pers. comm. (South Australian Museum); (b) Ross Allan, pers. comm. (NPWS, Port Lincoln); (c) Michael Deering, pers. comm. (PIRSA); (d) Kemper and Gibbs (1997);

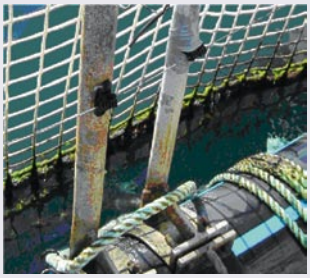
(e) Kemper *et al.* (2003); (f) Tony Flaherty, pers. comm. (Marine and Coastal Community Network); (g) Pemberton (1996); (h) Simon Goldsworthy, pers.comm.), and (i) Marine and Marine Industries Council (June 2002).

CASE STUDY: Reducing interactions with seals at southern bluefin tuna farms, using Solar Seal Guard®

Six years ago, southern bluefin tuna farmers off Port Lincoln had heavy losses of stock due to interactions with seals. Seals were biting tuna through the nets and entering the sea cages, killing and damaging tuna. It was not unusual for a seal to take bites from several fish before selecting an individual fish to feed upon. Divers checking the nets and fish would often find several fish with bite wounds, and 2–3 pieces of one or more half-consumed fish.

In the early days of farming, the sides of the net cages were quite loose. Seals could push the netting inwards to corral the fish, making them easier to catch. Industry then improved the net weighting to keep the sides taut.

Figure 4.3 to 4.5 Solar Seal Guard® on a southern bluefin tuna farm, north of Boston Island, Port Lincoln



Note: the feeding pontoon in the cage, and the Insulators holding the 'hot wire' off the stanchions. © Marc Dickie.

As farming techniques and products developed, it became more difficult for seals to penetrate nets below the water surface. However, seals quickly learnt that if they jumped onto the floating net ring they could then either chew through or leap over the jump net that extended 60–80 cm above the top of the net ring and enter the cage.

Seals were also using the net rings for basking on, which was causing stress to the bluefin tuna, as was their presence in, on or near the farms. Frightened fish do not feed regularly.

Mr Dave Ellis, who was then working for Stolt Sea farms, was keen to try electric fencing (similar to those found on land farms) to keep seals off of the net rings. It was supplied by the local farm-merchandising store (Lincoln Rural Supplies). It had limited success with standard electric fencing energisers. Salt water and air rapidly corroded fence units which had to be replaced up to three times a season.

Lincoln Rural Supplies, with feedback from Dave and the industry, then developed a standalone unit that was robust enough to endure the rigours of the open ocean, and reliable enough to be in constant operation. The product is called Seal Guard® and is manufactured and distributed by Lincoln Rural Supplies (Figure 4.3; Figure 4.5).

The Seal Guard® is powered by a 12 volt sealed battery, with an optional solar unit. It imparts an electric current (high voltage/low amperage) constantly through wires running around the net ring (Figure 4.4). When a seal contacts the wire, it receives a shock and is immediately repelled. The seals learn very quickly that sea cage is not a feeding ground for them.

Over 85 percent of fish farms in the Port Lincoln waters currently use Seal Guard® as part of their fish farm protection strategy. Furthermore, some 30 units are currently operating off the coast of Chile and Mexico, with excellent testimonies returning.

(by Marc Dickie, lincolnrural@ruralco.com.au)

CASE STUDY: Reducing interactions with seals on salmon farms, using One Steel MarineMesh™ anti-predatory nets

Background to the need for seal protection

Van Diemen Aquaculture (VDA) established a salmon and trout farm in the Tamar River in the late 1990s. At present the farm is producing over 1000 t of salmon from 10 square 24 m x 24 m steel pens. The company is planning to double its operation in the future (about 2400 t), it installed eight more pens in August 2004.

VDA originally used a large single-fibre anti-predator net to stop seals attacking salmon in the 10 fibre grower nets. In addition, electric fencing system was used to stop the seals climbing onto the pens and jumping in. However, the seals could still attack the salmon below the water, by either breaking through the fibre nets or ramming the nets to deflect the netting. The seals could then strike at the fish with their claws or teeth, killing and wounding many salmon. Bruce Hogarth, the owner/director of VDA said 'the seals were able to cause absolute carnage by being able to kill up to 300–400 salmon per night'. The dead and injured fish would then be eaten through the bottom of the netting, providing the seals with a reward of fish for their behaviour.

Figure 4.6 Atlantic salmon killed by seals in Tasmania

In addition to the loss of fish (Figure 4.6), the seals began harassing divers who were removing dead fish from the fibre nets. Divers were sometimes forced from the water, especially by the larger aggressive bull seals. Employers have a 'duty of care' to provide a safe work environment for their employees, so the issue of seals and diver safety needed to be resolved. The operation managers commented that the seals' harassment was also not conducive to 'happy employees'.

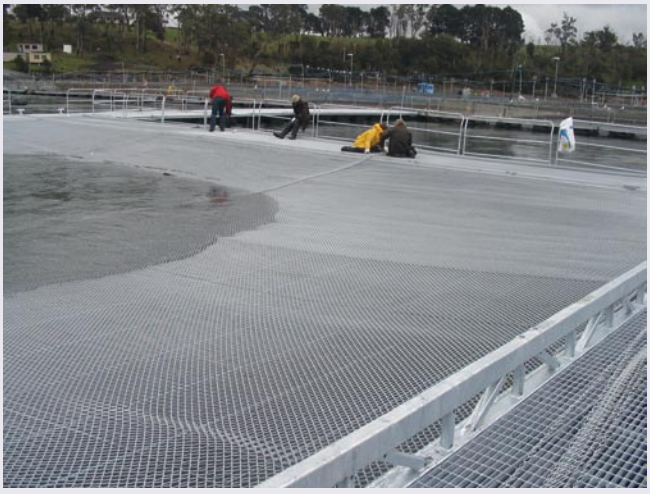
Introduction of steel-mesh cages

After visiting the MarineHarvest barramundi operation (on Bathurst Island, NT) to observe how MarineMesh™ nets stopped shark and crocodile attacks on a similar farming system, VDA decided to install two steel MarineMesh™ nets in April 2003 (Figure 4.7; Figure 4.8). The trial was to last 12 months; however, Herb Mitton, the operations manager said, 'we couldn't wait for the trial to finish'. VDA believed the steel-mesh nets to be so effective against predation, they installed eight more steel nets by September of that same year. In August 2004, the VDA farm expanded by an additional eight pens, all of which were fitted with the MarineMesh™ steel nets.

Figure 4.7 Van Diemen Aquaculture farm site at Tamar, Tasmania

The outcome of the MarineMesh™ installation is simply that the seals are no longer penetrating the nets. The seals have learnt that there is little to gain from attacking either the nets or divers. By reducing the seal's ability to gain access to the salmon, the interactions between the seals and the farm have been reduced. In fact, Bruce Hogarth has stated, that 'since the introduction of the MarineMesh™ nets, we've had no losses to seal attacks'. Furthermore, the operators of the farm have noticed a general reduction in the number of seals close to the farm. They once had at least 12 to 13 seals in residence; however, the few that swim past the farm now are simply tourist attractions, rather than a threat to the business.

Figure 4.8 MarineMesh™ net being constructed at Van Diemen Aquaculture



As well as preventing fish losses, infrastructure damage and worker harassment, there appear to be additional benefits from using MarineMesh™ nets to stop seal attacks. Whilst it too soon to quantify this, Bruce Hogarth has reported that fish growth has been positive since the steel mesh pens were introduced, as the fish are no longer in flight mode.

In March 2004, Aquatas installed four MarineMesh™ nets on their 30 m x 30 m square steel pens at Margate south of Hobart. Since their introduction there have been no salmon losses to seals in the MarineMesh™ nets at Aquatas.

MarineMesh™ description and construction

MarineMesh™ is a steel woven-wire netting that is suitable for most round and square pens. A single layer of the MarineMesh™ acts as both a grower and predator net, replacing the need for multiple fibre nets. Manufactured in Australia by OneSteel, MarineMesh™. It is supplied as rolls to the fish farm, where it is then joined on-site to form a net. The rolls of mesh have a special edge knuckle to give the net greater strength and the wire has a special coating of zinc. A range of mesh sizes is available from 25 mm up to 100 mm. It is recommended that anodes be fitted to the nets as soon as they are placed in the water.

(by Matt Condon, CondonM@OneSteel.com)

5 National overview of interactions between tourism and seals

In recent years the number of tourists interacting with seals and sea lions has increased throughout the states (Kirkwood *et al*., 2003; Orsini 2004). This has raised some issues of concern:

- The potential for seal populations to be disturbed by tourists, particularly during the breeding season are possible, particularly for the Australian sea lion. Disturbance may lead to mortalities and injuries, especially with regard to pups.
- With an increased number of interactions there is an increased risk to the safety of humans from seal attacks.

Several recent studies have examined the interactions of seals and tourists. However, they are all limited spatially and temporally; there is a definite need for more research into the effects of these interactions over time. Furthermore, regulations are limited, variable between the states and often location-specific.

5.1 New South Wales

Description of tourist operations

There is little relevant information on the tourist operations in this State (but see Kirkwood *et al*., 2003). Montague Island and Steamer's Head (Jervis Bay) both offer boat tours and swimming or snorkelling with Australian and New Zealand fur seals. Montague Island has eight operators (Kirkwood *et al*., 2003), while Steamer's Head has 10 commercial permits that specifically list seals as part of the operation. The main purpose of five of these operators is charter fishing (two of which are local): three are sight seeing, and two are specific marine mammal cruise boats. There are also four local dive charter operators that conduct tours to seal haul-outs. In addition, haul-out site for seals appears to be developing on Cabbage Tree Island (John Gould Nature Reserve). A few of the local tour charter boat operators include this site in their operations (Ron Gibbs, pers. comm.).

Pinniped interactions/research

Little research has been conducted on the impacts of tourists on seals in the New South Wales area. It has been shown, however, that tourist approaches on fur seals at Montague Island have little effect, unless large numbers of 'small seals' are present (Shaughnessy *et al*., 1999). The 'small seals' are more likely to return to the water in response to boat activity or if boats appear unexpectedly rather than approaching in full view (Kirkwood *et al*., 2003). In contrast, negative impacts have been suggested at Steamer's Head (Burleigh, 1999), where it has been noted that both Australian and New Zealand fur seals have been:

- Disturbed by human presence (change in behaviour due to close approaches or loud noises, etc.).
- Frightened by human presence (move away or numbers decrease).
- Frightened by sudden movement or noise caused by tourists (stampede into the water).

No negative impacts on visitors have been reported or noted.

Current management requirements relevant to minimising interactions with pinnipeds

Minimum approach distances to marine mammals (including seals), are prescribed in the National Parks and Wildlife Regulations 2002. This aspect of the regulations is currently under review.

In addition, seal conservation and management of human–seal interactions come under the *Marine Parks Act 1997*. The main objective is to conserve marine biodiversity and marine habitats through the declaration and management of marine parks. The interactions of seals and tourists can be managed within marine parks under the Act. Permits are required for activities such as commercial tour operations—seal watching and diving—in marine parks and can carry conditions suitable for managing interactions (Rodney James, pers. comm.). These permits are issued by the Jervis Bay Marine Parks (JBMP).

5.2 Victoria

Description of tourist operations

There are currently eight sites in Victorian waters of which tourism operations observe and interact with seals and sea lions (Table 5.1). Cape Bridgewater, Lady Julia Percy Island, Marango Reef off Apollo Bay, Port Phillip Bay, Seal Rocks, Kanowna Island, Cliffy Group and the Skerries. The types of activities offered to tourist are listed below:

Cape Bridgewater–boat cruises and viewing from adjacent areas

Lady Julia Percy Island–boat cruises

Marango Reef–boat cruises and sea kayak tours

Port Phillip Bay–boat cruises and swimming and/or scuba diving with seals

Seal Rocks–boat cruises, viewing from adjacent areas and viewing from aircraft

Kanowna Island–boat cruises

Cliffy Group–boat cruises

The Skerries–sea kayak tours viewing pinnipeds, and viewing from adjacent areas.

The number of visitors is extremely variable and somewhat seasonal. However, at least 250 000 visitors either go on boat tours or observe the seals from adjacent viewing platforms. Three sites each have over 9000 visitors a year. Cape Bridgewater, Seal Rocks and Port Phillip Bay. Cape Bridgewater offers an eight-seater zodiac launched from the beach; it carries about 4000 customers per year. In addition, about 5000 non-paying walkers view the seals from platforms on the cape. Seal Rocks is easily the most frequented site for viewing seals in Victoria. One tour operator visits it almost daily with a 150-seat vessel, and at least three other tour operators offer fishing or diving in addition to seal viewing. Combined they carry about 12 000–15 000 customers a year. However, most of the tourists at this location are made up of people viewing seals from the Nobbies (Phillip Island) where more than 200 000 people visit each year. Port Phillip Bay has 5–10 tour operators, with several offering snorkelling and diving with seals. In addition, several are licensed to operate swim tours with dolphins. Together, the tour operators in this location have 25 000–30 000 customers a year. Other sites–Lady Julia Percy Island, Marango Reef off Apollo Bay and Kanowna–receive approximately 1000–2000 visitors a year. The remaining two sites–Cliffy Group and The Skerries–receive about 500 and 40 visitors a year respectively.

Pinniped interactions/research

No research has been conducted. However, it has been noted that pinnipeds have been disturbed by humans (either by close approaches or loud noises), and changed their behaviour. This has been noted at four of the eight sites visited by tourists. At Cape Bridgewater, seals around the ledges panic and stampede into the water when the tour boat enters a large sea-cave. In Port Phillip Bay, seals may be occasionally encouraged to enter the water so customers can swim with the animals. At Seal Rocks and

Kanowna, there are anecdotal accounts of boats approaching closely and stampeding seals into the water. At three of the four sites, where disturbances have been noted, seals have also apparently become habituated. There is no information on disturbances at the remaining four sites.

No records of any negative impact on humans have been noted.

Current management requirements relevant to minimising interactions with pinnipeds

As yet there are no laws to regulate tour operations around pinnipeds and consequently no programme to monitor effectiveness of any laws. The current management requirements relevant to minimising interactions with pinnipeds are outlined in the *Wildlife Act 1975* and Amendments to that Act. Kanowna Island, however, is within the Wilsons Promontory Marine National Park, which is a 'no-take' fishing zone with recently drafted guidelines restricting close approaches to the island.

5.3 Western Australia

Description of tourist operations

Viewing Australian sea lions in Western Australia involves both commercial tourists and people engaged in recreational boating. Viewing can take place on land, from boats or in the water, at or around islands used by sea lions as either haul-out sites or, rarely, breeding colonies (Jurien Bay). At several sites, swimmers, snorkellers or divers interact with sea lions. Sea lions are very inquisitive and often initiate these interactions with people in the water.

Recreational and commercial interactions with seals and sea lions are regulated in Western Australia by the *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998*. Commercial interactions are further regulated by way of licences issued pursuant to the *Wildlife Conservation Regulations 1970*.

Perth region

Sea lions are viewed from land by recreational visitors and commercial tourists, mainly at Carnac Island Nature Reserve. The commercial tourists at Carnac Island are brought in by several 'eco-cruise' and charter boat operators.

At Little Island (a very small island) in the Marmion Marine Park, sea lions are viewed from the land only by recreational visitors arriving on boats or in kayaks. Several 'eco-cruise' operators also carry out boat-based viewing there.

In Shoalwater Islands Marine Park, boat-based sea lion viewing by both commercial tourists and recreational visitors takes place at Seal Island (land access is prohibited on the tiny island). Commercial tourism at Seal Island involves several kayak-based tour operators and one 'eco-cruise' operator. Land-based viewing takes place at nearby Penguin Island, but is not the focus of either tour operators or recreational visitors there.

Recreational boating takes place around Burns Rock (Marmion Marine Park) and Dyer Island (part of Rottnest Island A-class Reserve), where sea lions are viewed mainly during snorkelling or diving.

Jurien Bay area

Two tour operators are active in the area, visiting Essex Rocks (haul-out site), North Fisherman Island (breeding site), and (formerly) Beagle Island (breeding site). Commercial tourists mainly view the sea lions from boats and sometimes in the water.

South Coast

Most viewing involves commercial 'eco-cruise' tours in the Recherche Archipelago near Esperance, Princess Royal Harbour near Albany, and the Doubtful Island Nature Reserve off Bremer Bay. However, there are some recreational visitors. These are all boat-based operations (no land access).

In addition to viewing Australian sea lions, there are three general locations where New Zealand fur seals are viewed:

Bunker Bay–boat-based viewing in waters off Dunsborough, targeting a single haul-out site

Flinders Islet, St Alouran Island Nature Reserve, Seal Island Nature Reserve–boat-based viewing in waters off Albany, targeting both breeding and haul-out sites." Should be amended to show that the boat-based viewing occurs in waters off Augusta.

Seal Rock, Doubtful Island Nature Reserve–boat-based viewing in waters off Bremer Bay, targeting both breeding and haul-out sites.

Research on pinniped interactions

There is limited research on the impacts, positive or negative, to either the seals or tourists in this State. However, a study by Orsini (2004) on the interactions of tourists and sea lions at Carnac Island Nature Reserve highlighted two types of impacts of humans upon sea lions:

- A state of awareness or vigilance that was different from the sea lions' behaviour profile when tourists were absent.
- An actual impact resulting from direct disturbance by visitors.

The latter was usually the result of 'inappropriate' human activity—to induce an 'active' response—which resulted in sea lions retreating, leaving the beach or displaying aggressive behaviour (Orsini, 2004). The potential impacts of these responses could include physiological stress as a result of sea lions becoming deprived of important resting periods. In addition, and in the longer term, this poses the risk of sea lions abandoning the site altogether. However, the results also suggested that the number of sea lions on the beach and their rate of return did not appear to be affected by an increase in the numbers of tourists. This observation needs to be treated with caution, as the study was short (over four months). Longer-term research was recommended.

In addition to the interactions on Carnac Island Nature Reserve, anecdotal evidence suggests there are interactions between recreational fishers and Australian sea lions at jetties and groynes in many places along the Western Australian coast (Jean-Paul Orsini, pers. comm.). Furthermore, sea lions are fed from these jetties, and also from boats. CALM has produced a brochure with guidelines for the general public on interactions between humans and sea lions.

With regard to the impacts of sea lions upon humans, there have been nine documented attacks upon humans in the Essex Rocks, North Fisherman Island, Buller Island and Beagle Island group between 1982 and 2004, and six documented attacks in the Little Island, Dyer Island, Carnac Island Nature Reserve, Seal Island group between 1978 and 2004 (unpublished data from CALM). Orsini (2004) noted that at Carnac Island Nature Reserve visitors (including unsupervised children) approached to within 2.5 m. of a sea lion. As the sea lions can move quickly over short distances on land, and at times will bite each other, such close approaches are a public safety risk. A survey of tourists showed that most visitors had little awareness of the risk and were also unaware that they might disturb the animal, but greatly valued their sea lion viewing experience (Orsini, 2004).

Recommendations of Orsini. (2004) study:

- Implement a long-term strategy to reduce disturbance to the sea lions by visitors.

- Control the number of visitor to the island through an equitable allocation to user groups.
- Develop on-site interpretation and implement public education and awareness programmes.
- Implement a sea lion sanctuary zone.
- Continue monitoring sea lion and visitor numbers.
- Train and accredit guides employed by tour operators.

No negative impacts or adverse effects on either New Zealand fur seals or humans have been reported in the three locations in Western Australian. However, tuberculosis has been cited as a concern (Cousins, 1993; Peter Mawson, pers. comm.)

There is significant potential for adverse effects of human disturbance to Australian sea lion breeding colonies. During the extended breeding season (4–5 months) unsupervised visitation to breeding colonies can result in considerable disturbance to the animals and would most likely result in increased mortality of newborn pups. This can occur via the re-establishment of adult male competition for access to post-parturient females and the inadvertent mortality of their newborn pups, and greater vulnerability of unattended young pups to adult and sub-adult male aggression. Mortality of newborn pups due to aggressive interactions with conspecifics has been recorded in this species and may account for up to 40 percent of pup mortality or higher (Higgins and Tedman, 1990; R. McIntosh, pers. comm.). There also appears to be a density-dependent relationship between the level of pup production and the rate of pup mortality, consistent with the observation of high rates of mortality caused by conspecifics (Campbell and Gales, in prep.). In addition, the entanglement of a young sea lion pup in a toy pool ring at the North Fisherman Island breeding colony highlights the dangers of interaction between humans and seals even without access to the island itself (R. Campbell, pers. comm.).

Current management requirements relevant to minimising interactions with pinnipeds

The current management requirements for Western Australia are location-specific (Jean-Paul Orsini, pers. comm.). They are as follows:

Carnac Island

CCWA and CALM (2003). Carnac Island Nature Reserve Management Plan. Management Plan No. 47. Conservation Commission of Western Australia and Department of Conservation and Land Management, Crawley, Western Australia.

Seal Island and Penguin Island

CALM (1992). Shoalwater Bay Islands Management Plan 1992–2002. Department of Conservation and Land Management for the National Parks and Nature Conservation Authority, Bentley, Western Australia.

Little Island and Burns Rock

CALM (1992). Marmion Marine Park Management Plan 1992–2002. Department of Conservation and Land Management for the National Parks and Nature Conservation Authority, Bentley, Western Australia.

Dyer Island

Government of Western Australia (2003). Rottnest Island Management Plan 2003–08. Rottnest Island Authority, Perth, Western Australia. No mention of pinnipeds (fur seals or sea lions) in the plan.

North Fisherman Island and Essex Rocks

MPRA and CALM (2000). Indicative Management Plan for the Proposed Jurien Bay Marine Park. Marine Parks and Reserves Authority and Department of Conservation and Land Management, Crawley, Western Australia." Can be updated to read "MPRA and CALM (2004). Turquoise Coast Island Nature Reserves Management Plan 2004–2013. Marine Parks and Reserves Authority and Department of Conservation and Land Management, Crawley, Western Australia.

Beagle Island

No management plan (outside the Jurien Marine Park) relevant to interactions with pinnipeds.

Recherche Archipelago

No management plan relevant to interactions with pinnipeds.

Albany

No management plan relevant to interactions with pinnipeds.

Bunker Bay

Commercial licences issued by the Western Australian Department of Conservation and Land Management, pursuant to Regulation 15 of *Wildlife Conservation Regulations 1970*.

Flinders Islet, St Alouran Island Nature Reserve, Seal Island Nature Reserve

Commercial licences issued by the Western Australian Department of Conservation and Land Management, pursuant to Regulation 15 of *Wildlife Conservation Regulations 1970*.

Seal Rock, Doubtful Island Nature Reserve

Commercial licences issued by the Western Australian Department of Conservation and Land Management, pursuant to Regulation 15 of *Wildlife Conservation Regulations 1970*.

As Kirkwood *et al*. (2003) considered the regulations controlling commercial and non-commercial interactions with seals and sea lions in Western Australia to be more thorough than elsewhere, they duplicated the regulations as three appendices, which fall under the banner of the:

- Western Australian *Wildlife Conservation Act 1950*, *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998*, made by the minister under section 14(2)(a).
- Further conditions for marine mammal (seal and sea lion) interaction licenses issued pursuant to Wildlife Conservation Regulation 15 and the *Wildlife Conservation Act 1950*, applying to commercial wildlife interaction tour operations.

The relevant sections of the above three regulations can be found in Appendix E of the present report.

5.4 South Australia

Description of tourist operations

There are eight locations off the coast of South Australia where tourist-operations observe seals and sea lions. Australian sea lions and/or New Zealand fur seals are viewed at most locations (Table 5.1). Only Cape de Couedic on Kangaroo Island offers the opportunity to observe Australian fur seals (< 500

individuals), but even here sightings are not common. The types of activities that are offered to tourists at each of the eight locations are as follows:

Baird Bay–boat cruises, swimming and/or snorkelling with sea lions, and viewing from adjacent areas

Cape de Couedic, Kangaroo Island–viewing a colony of New Zealand fur seals as well as Australian fur seals and Australian sea lions from cliff-top lookouts and an extended boardwalk that leads down the cliff face

Neptune Island–boat cruises and cage viewing of seals

Point Labatt–walking without a guide along the coast and viewing Australian sea lions from a cliff-top viewing platform

Seal Bay Conservation Park, Kangaroo Island–either taking a guided beach tour for controlled close-up viewing (minimum approach distance of 6 m) or accessing a viewing platform via a boardwalk to observe Australian sea lions

Encounter Bay–boat cruises and viewing from adjacent areas

Rapid Bay–sea kayak tours viewing pinnipeds

Spencer Gulf Islands–boat cruises and swimming and/or scuba diving with seals

At two of the locations–Neptune Island and the Spencer Gulf Islands–boat cruises offer with the possibility of observing and/or swimming with seals or sea lions, but have the principal purpose of observing great white sharks and fishing respectively.

The annual total of tourists (all sites) is at least 115 000, most of whom (about 100 000) visit Cape de Couedic and Seal Bay, both on Kangaroo Island.

Pinniped interactions/research

There are two main concerns about interactions of pinnipeds and tourists. The first is whether there are any detrimental effects to the animals. The second relates to safety concerns for humans.

Two recent studies at Baird Bay examined the question of whether the behaviour of pinnipeds changed as a consequence of interactions with tourists. Martinez (2003) reported that while Australian sea lions on the beach react to loud noises from the tourists or the tour operator's boat by looking up, sitting up or moving further up the beach, in general, individual animals showed no significant behavioural changes with respect to presence and activity of boat-based tours (see Martinez case study on page 98). The preliminary findings of Terijo Arianna-Lovasz (pers. comm.) were that neither levels of activity, or aggressive behaviour of female Australian sea lions between beaches, were significantly different with and without regular human disturbance. However, while there was no difference in sea lion density between the beaches during the breeding/pupping season, outside of that season, there were significantly more sea lions on the beach with human disturbance. This may reflect a decrease in sea lion abundance at the visited beach during breeding/pupping. This contrasts with an apparent habituation to human visitation by breeding/pupping sea lions at Seal Bay, Kangaroo Island (Jane McKenzie, pers. comm.).

There is little evidence of any negative impacts on humans of seal viewing activities. In 2004, a tourist swimming with sea lions during a guided tour was bitten on the leg by a male sea lion (Jane McKenzie pers. comm.). However, it was thought that the bite was playful, as seals regularly bite each other during 'play' or when another animal is too close. Sea lions often display interest in 'playing' with humans in the water. Incidents of this type may be repeated.

The interaction between seals and tourists also has potentially positive impacts. Research has suggested that while tourists were unlikely to leave seal areas with increased knowledge of these animals or their environment, or change their a-priori attitude towards seals, they did leave with an 'emotional connection'

to them (Martinez, 2003). A positive attitude change could be important to the conservation of Australian sea lions and the marine environment in general.

Current management requirements relevant to minimising interactions with pinnipeds

There is a draft policy specifically associated with recreational and commercial tourism interactions in South Australia (Appendix D). The current regulations, which are site-specific, are as follows:

Baird Bay

At present, seal viewing tour operations are not required to be licensed, but operate under a letter of approval. Commercial licences are only required if tours are operating in conservation reserves (Department of the Environment and Heritage, South Australia).

Cape Du Couedic

As this site is in Flinders Chase National Park, therefore tourists and tour operators are restricted to viewing platforms. Commercial licences are issued by Department of the Environment and Heritage, South Australia pursuant to the National Parks and Wildlife Act, 1972 (Department of the Environment and Heritage, NPWS South Australia).

Neptune Island

Boating, diving and tourists ashore are managed by the State Government. Commercial licences (Department of the Environment and Heritage, NPWS, South Australia) are required to operate White Shark tours in park waters. Prohibited area (NPWS) permits are required for tourists ashore; however; there are currently no applications for permits. Permit conditions require white shark tourist operators to submit logbook records to NPWS and CSIRO. The operations are regularly inspected. Exemption permits for berleying are issued by PIRSA.

Point Labatt

A prohibited area managed by the State.

Seal Bay

Seal Bay Conservation Park prohibited area is managed by the State. NPW staff or accredited staff from commercial tour operations conduct guided tours. Licences for commercial tour operations are managed by the State. Non-guided tourists are restricted to the raised walkways and look-out points. Tourists are prohibited from breeding areas.

Encounter Bay

Whale-watching tour operators are managed by the State Government. Commercial licences set out regulations for whale watching and wildlife observations (including dolphins and seals). Operators must comply with *National Parks and Wildlife (Whales and Dolphins) Regulations 2000*. Swimming or diving with marine mammals (Part 4 Section 17) is not permitted under the licence, and movement of boats near islands and land based marine mammals must be at 'no wake' speed. Commercial operators are monitored from land by NPW staff.

Rapid Bay and Spencer Gulf Islands

Commercial licences are issued by the Department of the Environment and Heritage, South Australia pursuant to the *National Parks and Wildlife Act 1972*.

5.5 Tasmania

Description of tourist operation

There are nine island locations around Tasmania from where tourist operations view pinnipeds (Table 5.1). Most operators offer maritime seascape and wildlife tours, of which seals are one element. All comprise boat cruises with no land-based tourism. The largest operation makes about 200 trips a year to the Friars on Bruny Island which an estimated 10 000⁺ people visit annually. Most other locations are visited by 1000–3000 people a year. Tenth Island and Wright Rocks have fewer than 200 visitors a year.

Pinniped interactions/research

There is no published research on interactions between pinnipeds and tourists in the Tasmanian region.

Current management requirements relevant to minimising interactions with pinnipeds

The Tasmanian Government supports responsible boat-based seal viewing opportunities and has published a brochure with guidelines to minimise disturbance. These include minimum approach distances for boats. Eco-tour ventures to haul-outs are recommended over visiting breeding colonies. Permits are required to land on the major seal-breeding colonies. However, there are currently no laws to specifically regulate tour operations around seal colonies. The Nature Conservation Branch of the Department of Primary Industries Water and Environment provides advice and guidelines for eco-tour operators.

Table 5.1 Locations within each state where tourist operations view seals, including the species of seal, the number of operators and the number of tourists at each location.

State	Site	Lat. (S)	Long. (E)	Seal species[1]	Site type (Breeding/ Haul-out)[2]	No. of operators	Approach type[3]	No. of visits/ year	Tourists per visit	Tourists/year	Established	Source
NSW	Montague Island	-36.251	150.225	1, 3	Haul-out (OP)	8	1, 7				At least April 1991	a
	Steamer's Head	-35.176	150.726	1, 3	Haul-out	10 commercial permits	1, 7					b
Vic.	Cape Bridgewater	-38.380	141.400	1, 3	Sp. 1–Haul-out (OP) sp 3–Haul-out		1, 5	daily in summer		9 000 (4 000 in boat, 5 000 from platform)		c, d
	Lady Julia Percy Island	-38.427	141.996	1, 3	Sp. 1–Breeding sp. 3–Haul-out (OP)	at least 2	1	near weekly		1 000–2 000		c, d
	Marango Reef, Apollo Bay	-38.670	143.830	1	Small haul-out		1, 2	daily in summer		1 000–2 000		c, d
	Port Phillip Bay	-38.330	144.830	1	Small haul-out	5–10	1, 7	near daily		25 000–30 000		c, d
	Seal Rocks	-38.300	145.000	1	Breeding	at least 4	1, 5, 6	near daily		~12 000–15 000 boat, >200 000 adjacent platform		c, d
	Kanowna Island	-39.155	146.310	1, 3	Breeding	~2–3	1	near monthly		~2 000		c, d
	Cliffy Group	-38.955	146.679	1	Breeding	1	1	several times		~500		c, d
	The Skerries	-37.750	149.520	1, 3	Breeding		2, 5	several times		~40 (kayak tours)		c, d
WA	Carnac Island	-32.121	115.662	2	Haul-out	<10	1, 2, 3, 4, 5	Seasonally high (summer and autumn)		13 000 (land), 20 000–30 000 (private boats)		e, f
	Seal Island	-32.293	115.691	2	Haul-out	<10 (**14**)	1, 2, 5			**7 000**		e, f
	Penguin Island			2		<10	4			80 000		e, f
	Little Island	-31.800	115.700	2	Haul-out	<3	1, 2, 4, 5			Thousands (no accurate data)		e, f
	Burns Rock	-31.717	115.700	2	Haul-out	None	-			few		e, f
	Dyer Island	-32.019	115.551	2	Haul-out	None	1, 2, 5			very small		e, f

State	Site	Lat. (S)	Long. (E)	Seal species[1]	Site type (Breeding/ Haul-out)[2]	No. of operators	Approach type[3]	No. of visits/ year	Tourists per visit	Tourists/year	Established	Source
	North Fisherman Island	-30.130	114.944	2	Breeding	<3	1	-				e, f
	Essex Rocks	-30.35	115.00	2	Haul-out	<3	1	-				e, f
	Beagle Island	-29.808	114.877	2	Breeding	None currently	1, 7	-				e, f
	Recherche Archipelago	-33.64–-34.47	120.87–124.16	2	Breeding/Haul-out	<3	1	-				e, f
	Albany	-35.00	118.20	2, 3	Haul-out/ breeding	<5	1	**500**				e, f
	Bunker Bay	-33.543	115.035	3	Haul-out							f
	Flinders Islet	-34.413	115.207	3	Breeding							f
	St Alouran Island Nature Reserve	-34.400	115.183	3	Haul-out							f
	Seal Island Nature Reserve	-34.383	115.150	3	Haul-out							f
	Seal Rock, Doubtful Island Nature Reserve	-34.350	119.567	2, 3	sp 2–Haul-out sp 3–Breeding/Haul-out							f
SA	Baird Bay	-33.10	134.31	2	Breeding	1	1, 5, 7	100	15–20	1 500	1992	c, g, h
	Cape de Couedic, Kangaroo Island	-36.058	136.708	1,2,3	sp 1–Haul-out sp 3–Breeding/Haul-out	Many	3, 4, 5	Numerous		97 000	1993	c
	Neptune Island	-35.330	136.112	2,3	Breeding/Haul-out	2	1	~35	8–20			c, i
	Point Labatt	-33.152	134.261	2,3	Haul-out with occasional pupping	–	4	Daily		15 000	1994	c
	Seal Bay, Kangaroo Island	-35.996	137.327	2	Breeding/Haul-out	Many (80 CTO licences issued)	3, 4	Daily		100 000	1950s	c, j
	Encounter Bay	-35.58	138.64	3	Haul-out	4 Commercial Tour Operators	1, 5	Seasonal (May-October)				k
	Rapid Bay	-35.52	138.91	3	Haul-out	1	2	Seasonal and weekly	4			l
	Spencer Gulf Islands	-34.61	136.29	2,3	Breeding/Haul-out	1	1, 7					i

State	Site	Lat. (S)	Long. (E)	Seal species[1]	Site type (Breeding/ Haul-out)[2]	No. of operators	Approach type[3]	No. of visits/ year	Tourists per visit	Tourists/year	Established	Source
Tas.	Bruny Island The Friars	-43.526	147.292	1, 3	sp 1–Haul-out (OP)		1	200		11 000		m
	Bull Rock	-40.738	145.297	1	Haul-out (OP)	1 (assumed)	1	350		1 800		m
	Ile des Phoques	-42.644	147.976	1, 3	sp 1–Haul-out (OP)	1 (assumed)	1					m
	Tasman Island	-43.240	148.002	1, 3	Haul-out	1 (assumed-could be the same tour vessel as Cape Pillar)	1	30		1 000		m
	Tenth Island	-40.944	146.984	1	Breeding	1 (assumed)	1, 7	30		150		m
	Cape Raoul	-43.244	147.798	1	Haul-out	1 (assumed)	1	60		3 000		m
	Cape Pillar	-43.223	148.008	1	Haul-out	1 (assumed-could be the same tour vessel as Tasman Is)	1	30		1 000		m
	The Hippolytes	-43.123	148.051	1, 3	Haul-out	1 (assumed)	1, 7	150 (projected)		900 (projected)	Jan-04	m
	Wright Rocks	-39.581	147.129	1	Haul-out (OP)	1 (assumed)	1	15		80		m

[1] 1 = Australian fur seal, 2 = Australian sea lion, 3 = New Zealand fur seal

[2] Definitions (Australian fur seal and New Zealand fur seal):

Breeding: at least 15 pups 'recorded during at least one survey over the past 20 years'

Haul-out (OP): haul-out with occasional pupping–has 1–14 pups 'recorded during at least one survey over the past 20 years'

Haul-out: sites that are frequented by seals

Definitions (Australian sea lion)

Breeding: at least 5 pups 'recorded during at least one survey over the past 20 years'

Haul-out (OP): haul-out with occasional pupping–has 1–4 pups 'recorded during at least one survey over the past 20 years'

Haul-out: sites frequented by seals

[Note: For sea lions, we may find that 3 or 4 pups may be more appropriate here once we have analysed data from smaller colonies]

[3] 1 = Boat cruises (viewing pinnipeds), 2 = Sea kayak tours (viewing pinnipeds), 3 = Tourists ashore with guide (controlled close-up viewing pinnipeds), 4 = Tourists ashore without a guide (viewing pinnipeds from platform/fenced area, etc), 5 = Viewing from adjacent areas, 6 = Viewing from aircraft, 7 = Swimming and/or scuba diving with pinnipeds, 8 = Feeding pinnipeds

(a) Shaughnessy *et al.* (1999); (b) Burleigh (1999); (c) Roger Kirkwood, pers. comm.; (d) Kirkwood *et al.* (2003); (e) Jean-Paul Orsini, pers. comm.; (f) Peter Mawson, pers. comm.; (g) Martinez (2003); (h) Jane McKenzie, pers. comm.; (i) Ross Allan, pers. comm. (DEH, SA); (j) Seal Bay Conservation Park; (k) John Bracken, pers. comm. (DEH, SA); (l) Blue Water Sea Kayaking, pers. comm.; (m) Andrew Irvine, pers. comm.

Data bold and underlined were taken directly from Kirkwood *et al.*, (2003).

CASE STUDY: Impacts of tourism on Australian sea lion at Baird Bay, South Australia, and suggested measures to reduce interactions

From November 2002 to May 2003, Anna Martinez examined whether 'Ocean Ecotours', a tourism operation offering boat cruises, swimming and/or snorkelling with sea lions, had any impact on a colony of Australian sea lions on Jones Island (Baird Bay; South Australia), and on the participating tourists. More specifically, the study examined whether tourism had any impact on the sea lions' behaviour and whether the tourists changed their attitude towards the sea lions after their observations.

'Ocean Ecotours' is at present the only tour operator in South Australia that takes tourists out to swim with Australian sea lions. Since this tourist destination is between the exploration and involvement stage (the first two stages of Butler's tourist area life cycle), it offers an excellent opportunity to collect data on the positive and negative consequences of tourism early in the development of this site.

Figure 5.1 Tourists from Ocean Ecotours snorkeling near Jones Island at Baird Bay

Over the seven months of the study, the sea lion colony was observed 28 times–20 when a tour was scheduled and eight while no tour was present. The observations were either from the tour boat *The Investigator* or independently from a canoe anchored off Jones Island. To detect any changes in behaviour, the sea lions were observed three times: one hour before the tour, during the tour (usually an hour) and one hour after the tour. Sea lion locations and behaviours were recorded, as were the activities of the tour operator and tourists. There were no significant behavioural changes in the animals on the beach. There was also no correlation between the number of tourists in the water and the number of sea lions interacting with them. However, individual animals did show reactions (looking up, sitting up and moving further up the beach) to loud noise from the tour operator's dinghy and tourists.

After swimming with the sea lions, the tourists were asked to complete a survey to find out wether they had any additional knowledge about Australian sea lions and wether their attitude towards them had changed. Positive attitude changes could be important to the conservation of the Australian sea lions and their marine environment. The evaluation of the survey showed they did not gain any concrete information about the Australian sea lion and their marine life, and the tour did not significantly change their attitudes towards making specific contributions to environmental conservation. However, the tourists did experience an emotional connection with the sea lions.

This study gives recommendations on how to provide quality information to the tourists, guidelines for swimming interactions with the sea lions and future monitoring of the sea lions' behaviour.

The suggested guidelines are:

- to prohibit unrestricted access to Jones Island—as animals may flee into the water when people land on the island.
- to publicise guidelines on how to interact with the sea lions through signs in Baird Bay.
- to set up exclusion zones for boats and swimmers along the sea lions' resting beach.
- to minimise the noise associated with tours.
- to stop people chasing after and touching the sea lions.

The subsequent guidelines for the tour operator are:

- to minimise the noise from tourists and boats.
- to prevent swimming and interacting with sea lions too close to the beach.
- to provide more quality information about sea lion biology and conservation.
- to give tourists 'take home messages' on environmental care.

(by Anna Martinez, anna@annamartinez.info)

6 National and international species survival status

6.1 National Legislation

In Commonwealth areas, all relevant departments and agencies, including the Departments of the Environment and Heritage; Agriculture, Forestry and Fisheries; and Australian Fisheries Management Authority, are responsible for the protection and conservation of pinnipeds.

All marine mammals (including all Otariidae and Phocidae) are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act recognises four categories of protected species: cetaceans, listed threatened species, listed migratory species and *listed marine species* (s 248). All Otariidae and Phocidae are listed marine species. The Australian Government Minister for the Environment and Heritage has authority to change (add, remove, update) this list as required, after considering advice from the Threatened Species Scientific Committee (s 249, 251).

Under the EPBC Act, the same species may appear on more than one list; for example the Australian sea lion, subantarctic fur seal, southern elephant seal and Australian sea lion are also listed as threatened (vulnerable) species (s 178). Under the EPBC Act, a vulnerable species is one that is '*not critically endangered or endangered; and is facing a high risk of extinction in the wild in the medium-term future* (s 179(5)).

In addition to the EPBC Act, some seal species are also afforded protection under State legislation. State conservation agencies are responsible for seals on land, and in waters up to 3 n.miles off-shore, whereas the Commonwealth is responsible for seals outside State coastal waters and within the Australian Economic Exclusion Zone. The different protection status at a State and Commonwealth level, even though they both use the IUCN criteria, is due to the scale on which they are assessed. For example, at the Commonwealth level, assessment is undertaken on a national basis, i,e., includes seal populations in all states and Commonwealth waters. In contrast, at the state level, assessment is based on the seal population only in a given state (Marine and Marine Industries Council, 2002).

6.2 State Legislation

6.2.1 New South Wales

In New South Wales, the State Department of Environment and Conservation is responsible for the conservation of pinnipeds.

The Australian fur seal and New Zealand fur seal are listed as vulnerable in New South Wales under the *Threatened Species Conservation Act 1995* (TSC Act) (s 7). Under this Act, a vulnerable species is one that is '*likely to become endangered in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate*' (s 14).

Section 9 (1) of the TSC Act also allows for the addition of nationally threatened species (i.e., listed under the EPBC Act) to the New South Wales list if the species is indigenous in New South Wales.

6.2.2 Victoria

In Victoria, the State Department of Sustainability and Environment is responsible for the conservation of pinnipeds.

All indigenous wildlife (excluding fish) are protected under the Victorian *Wildlife Act 1975* unless specifically exempted, therefore the Australian fur seal, New Zealand fur seal and Australian sea lion can be considered to fall within the protection of this Act.

6.2.3 Western Australia

In Western Australia, the State Department of Conservation and Land Management is responsible for the conservation of pinnipeds.

All fauna in Western Australia are protected under section 14 of the *Wildlife Conservation Act 1950*. The Australian sea lion and New Zealand fur seal are both listed as otherwise specially protected under the *Wildlife Conservation (Specially Protected) Fauna Notice 2005 (WA)*. In defining specially protected fauna, section 14(2)(ba) specifies that: fauna may declared if it is 'fauna that likely to become extinct, or is rare, or otherwise in need of special protection'.

6.2.4 South Australia

In South Australia, the State Department of the Environment and Heritage is responsible for the conservation of pinnipeds.

All indigenous animals are protected under the South Australian *National Parks and Wildlife Act 1972* (NPW Act), including the New Zealand fur seal. The Australian fur seal, Australian sea lion, southern elephant seal and leopard seal are listed as rare under the *National Parks and Wildlife Act 1972* (SA) (the status of threatened species in South Australia is currently under review). Under this Act, rare species are those '*that occur in small populations in South Australia, that are not at present endangered or vulnerable but are at some risk due to their low numbers*'.

The subantarctic fur seal was 'proposed' endangered under the review of the *National Parks and Wildlife Act 1972* (SA) (the nomination is currently under consideration). The Australian sea lion recently listed was listed as vulnerable under the EPBC Act. The Australian sea lion may be assessed under this *National Parks and Wildlife Act 1972* (SA) Act as vulnerable in line with the recent EPBC Act listing.

6.2.5 Tasmania

In Tasmania, the State Department of Primary Industries, Water and Environment is responsible for the conservation of pinnipeds. All pinnipeds are protected species in Tasmania.

The New Zealand fur seal is listed as rare, while the subantarctic fur seal and southern elephant seal are listed as endangered under the *Threatened Species Protection Act 1995* (s 13). Rare species are those '*with a small population in Tasmania that are at risk*' and endangered species are defined as those '*in danger of extinction because survival is unlikely while the factors causing them to be endangered continue operating*' (s 15).

6.3 International Protection

6.3.1 Convention on International Trade in Endangered Species

The Australian fur seal and the New Zealand fur seal are listed under Appendix II of the *Convention on International Trade in Endangered Species* (CITES). These are species not necessarily now threatened with extinction, but that may become so unless trade is closely controlled.

6.3.2 World Conservation Union Red List Categories

The Action Plan for Australian seals (1999) assessed Australian seal species against the World Conservation Union Red List Categories (formerly the International Union for the Conservation of Nature and Natural Resources (IUCN).

- Australian and New Zealand fur seals were subsequently classified as *lower risk, conservation dependent* because the cessation of a habitat-specific conservation programme could lead to each of them qualifying for a Threatened category if ready access by humans to breeding sites were permitted during the breeding season (Shaughnessy, 1999).
- The Australian sea lion was subsequently classified as *lower risk, near threatened* because the number of mature individuals was below the limit of 10 000 (Shaughnessy, 1999).

Table 6.1 Survival status of pinniped species in Australia and external territories

Pinniped Species	New South Wales	Victoria	South Australia	Western Australia	Tasmania and Macquarie Island
Australian fur seal *(Arctocephalus pusillus doriferus)*	Listed as vulnerable under the *Threatened Species Conservation Act 1995*	Protected under the *Wildlife Act 1975*	Listed rare under the *National Parks and Wildlife Act 1972* (SA)		
New Zealand fur seal *(Arctocephalus forsteri)*	Listed as vulnerable under the *Threatened Species Conservation Act 1995*	Protected under the *Wildlife Act 1975*		Listed specially protected under the *Wildlife Conservation (Specially Protected Fauna) Notice 2005 (WA)*	Listed as rare under the *Threatened Species Protection Act 1995*
Australian sea lion *(Neophoca cinerea)*		Protected under the *Wildlife Act 1975*	Listed as rare under the *National Parks and Wildlife Act 1972* (SA)	Listed specially protected under the *Wildlife Conservation (Specially Protected Fauna) Notice 2005 (WA)*	
Subantarctic fur seal *(Arctocephalus tropicalis)*		Protected under the *Wildlife Act 1975*	Proposed endangered under the review of the *National Parks and Wildlife Act 1972* (SA)		Listed as endangered under the *Threatened Species Protection Act 1995*
Southern elephant seal *(Mirounga leonina)*		Protected under the *Wildlife Act 1975*	Listed rare under the *National Parks and Wildlife Act 1972* (SA)		Listed as endangered under the *Threatened Species Protection Act 1995*
Antarctic fur seal *(Arctocephalus gazella)*		Protected under the *Wildlife Act 1975*			
Leopard seal *(Hydrurga leptonyx)*		Protected under the *Wildlife Act 1975*	Listed rare under the *National Parks and Wildlife Act 1972* (SA)		
Crabeater seal *(Lobodon carcinophagus)*		Protected under the *Wildlife Act 1975*			
Weddell seal *(Leptonychotes weddellii)*		Protected under the *Wildlife Act 1975*			
Ross seal *(Ommatophoca rossii)*		Protected under the *Wildlife Act 1975*			

7 Conservation and management measures: approaches and objectives

All seals are protected (as listed threatened and/or marine species) under the EPBC Act, which is administered by the Department of the Environment and Heritage. State conservation and/or fisheries agencies are responsible under State legislation for seals on land, and in waters up to 3 n.miles offshore while the Australian Government is responsible for seals outside State coastal waters and within the Australian Economic Exclusion Zone.

7.1 Government Agencies: Commonwealth

7.1.1 Department of the Environment and Heritage

Environment Protection and Biodiversity Conservation Act 1999

A list of protected species has been established under section 248 of the EPBC Act. Species on this list are protected to help ensure their long-term survival. Under the Act it is an offence to kill, injure, take, trade, keep or move a member of a listed threatened species, listed migratory species or listed marine species in a Commonwealth area unless the action is covered by a permit issued by the Minister for the Environment and Heritage (s 254). It is also an offence to 'not report' any interactions with listed species (s 256). Under the EPBC Act any action that is likely to have a significant impact on a matter of national environmental significance, undergoes a rigorous assessment and approvals process.

The Act specifies that certain actions are not offences (s 255). These include actions authorised by a permit, taken in accordance with a wildlife conservation plan made under the Act, covered by an approval in operation under Part 9 the Act or undertaken in accordance with an accredited management plan or regime. In addition, specified actions such as humanely killing an animal to relieve or prevent suffering or to prevent a risk to human health or serious threat to human life are not offences. However, interaction occurring through non-adherence to an accredited management regime is an offence (e.g., deliberate acts of malice such as shooting, clubbing or gaffing a seal).

The sections of the EPBC Act dealing with threatened species also provides for the listing of Key Threatening Processes (s 183). Once a process has been listed, the Minister must then decide whether to develop a threat-abatement plan (s 270A, 270B), the general content which is specified in section 271.

In August 2003, the Minister for the Environment and Heritage declared that: 'Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris', is a Key Threatening Process under the EPBC Act. The nomination for the listing recognised the entanglement of seals in plastic debris and fishing gear as one of the key risks to wildlife. As seals and sea lions are listed marine wildlife under the EPBC Act, interactions and impacts on these animals were a major factor in this nomination being supported. The DEH has engaged a consultant to draft a threat-abatement plan for this Key Threatening Process.

The EPBC Act also specifies:

- That all Australian Government (Commonwealth) managed fisheries undergo strategic environmental impact assessment before new management arrangements are brought into effect (s 147).
- That all fisheries with an export component undergo assessment to determine the extent to which management arrangements will ensure the fishery is managed in an ecologically sustainable way (s 303FN (10A)).

Once a fishery is identified as requiring an assessment, the responsible management agency (either the Australian Fisheries Management Authority or the State fisheries agency) assesses the fishery against the *Guidelines for the Ecologically Sustainable Management of Fisheries* developed by Australian Government. Principal 2 of the guidelines states '*Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem*' and sets out as its first objective that '*The fishery is to be conducted in a manner that does not threaten bycatch species' and in its second objective that 'The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities*'. In the case of seals, the fishery must demonstrate that its management arrangements achieve this objective and the response is proportional to the risk of death, injury, etc., to individual seals or the seal/sea lion populations.

The Act provides, through the above fisheries assessment process, for the accreditation of management plans or regimes that can exempt fishers from having to obtain permits under Part 13 of the Act for interactions with protected species. Additionally, for fishers operating in Australian Government managed fisheries, the assessments may provide accreditation for management plans that exempt individual fishers from further assessment under the Act of the impacts of their actions on the environment in a Commonwealth marine area.

Provided a fisher is operating within the management arrangements of a plan or regime accredited under Part 13 of the Act, the capture or interaction with a seal during commercial fishing operations is not an offence. However, fishers operating in accordance with an accredited management plan or regime are still required to report an interaction that occurs within the Commonwealth jurisdiction.

Heard Island and McDonald Islands Act 1953 (Environment Protection and Management Ordinance 1987)

The Heard Island and McDonald Islands Act 1953 establishes a legislative framework for the governance of Heard and McDonald Islands (note the Territory, as defined in the Act includes only Land, not water, areas). While there are no specifics in the Act for the management of pinnipeds, the Act does provide for making ordinances for the good governance of the Territory (s 10). The Environment Protection and Management Ordinance 1987 lists as a purpose '*to preserve and manage the Territory so as to protect the environment and the indigenous wildlife of the Territory*'. It has provisions for issuing permits for interactions with animals (including pinnipeds), offences for interactions that occur without a permit, and making management plans.

Antarctic Treaty (Environmental Protection) Act 1980 (Antarctic Seals Conservation Regulations 1986) (including Convention for the Conservation of Antarctic Seals and the Madrid Protocol 1991)

The Antarctic Treaty (Environmental Protection) Act 1980 relates to the protection and conservation of the environment of the Antarctic, and in particular the implementation of Australia's obligations under the 'Convention for the Conservation of Antarctic Seals' (included as schedule 1 to the Act) and the 'Protocol on Environmental Protection to the Antarctic Treaty' (the 'Madrid Protocol') 1991 (included as schedule 3 to the Act). The Act provides for environmental assessment of activities and also the regulation of activities that may impact on the Antarctic environment, in particular the seal species listed in the conventions. The regulation of activities relating to seals under the Act can be found in the Antarctic Seals Conservation Regulations 1986.

Antarctic Marine Living Resources Conservation Act 1981

The *Antarctic Marine Living Resources Conservation Act 1981* relates to the conservation of all marine living resources in the Antarctic and surrounding seas. In the main it provides the vehicle for the domestic

implementation of Australia's obligations under the 'Convention on the Conservation of Antarctic Marine Living Resources' (CCAMLR) (included as a schedule to the Act). Whereas the *Antarctic Treaty (Environmental Protection) Act 1980* contains specific objective relating to seals, this Act covers all marine organisms within the Antarctic area more broadly.

Australia's Oceans Policy (Commonwealth of Australia, 1998)

In 1998 the Australian Government released its Oceans Policy, which sets out the framework for the implementation of integrated oceans planning and management within the context of ecologically sustainable development of the ocean. Oceans Policy will be delivered through a system of regional marine planning, integrating the management of conservation objectives and existing uses within marine eco-regions. Australia's Oceans Policy includes objectives for the conservation of marine biological diversity, including improved protection of marine species, largely through implementing the provisions of the EPBC Act described above. Similarly improved management of ocean uses and impacts, for example through the implementation of national fisheries bycatch policy, will also address issues such as wildlife–fisheries interactions.

Environmental Code of Conduct for Australian Activities in Antarctica

The Australian Antarctic Division has developed environmental codes of conduct for the operation of Australian field activities in Antarctica to assist in minimising environmental impacts while working and travelling in Antarctica. The guidelines include details for the treatment and management of waste, and for interactions with wildlife, including minimum distances to be maintained from wildlife (including seals).

7.1.2 Australian Fisheries Management Authority

Fisheries Management Act 1991

The responsibilities of AFMA in relation to the pursuit of ecologically sustainable development (ESD) are clearly set out in the legislative objectives under the Act. AFMA sees this objective as requiring it to manage the long-term sustainability of fisheries resources for the benefit of all users and interest groups both now and in the future. This requires that stocks be maintained at a sustainable level and, where necessary, rebuilt to ensure maximum inter-generational equity. It also requires managing fisheries so as to minimise the impact of fishing on biological diversity and ecosystem habitat. Research into environmentally friendly fishing methods and bycatch minimisation is seen as a priority.

There are provisions under the Act (s 14) regarding the making of regulations for the conservation of the marine environment, including specific actions to prevent or minimise bycatch (including marine mammals).

7.1.3 Department of Agriculture, Fisheries and Forestry

The Department of Agriculture, Fisheries and Forestry is the lead Commonwealth Agency with responsibilities for implementing directions coming out of the United Nations Food and Agriculture Organisation, e.g., FAO's Committee on Fisheries Code of Conduct for Responsible Fisheries, International Plans of Action for the Conservation and Management of Sharks, and Reducing the Incidental Catch of Seabirds in Longline Fisheries.

Looking to the future: A Review of Commonwealth Fisheries Policy (DAFF 2003)

The 1989 policy statement *New Directions for Commonwealth Fisheries Management in the 1990s* set the framework for the management of Australian Government fisheries that continues today (including the establishment of the Australian Fisheries Management Authority). However, the changing policy environment of Australia's fisheries during the intervening years requires that it be updated. *Looking*

to the Future: A Review of Commonwealth Fisheries Policy identifies the drivers of fisheries policy and management for today and into the future, summarises previous Australian Government fisheries and presents the of a review of fisheries policy. The two documents should be read together to give the full framework for the management of Australian Government fisheries.

One of the key drivers for the future was the need to integrate Commonwealth fisheries policy with other strategic marine initiatives within the context of pursuing ecosystem based-fisheries management. National marine polices, including Oceans Policy, the Commonwealth and National Bycatch policies and Coastal Policy, have all evolved since the 1989 Policy statement and '*Looking to the Future*' reaffirms AFMA's and DAFF's commitment to integrating fisheries policy with new and emerging marine policy initiatives, consistent with ESD outcomes highlighted in the original policy statement.

Among the new initiatives outlined in '*Looking to the Future*' the Australian Government is committed to the developing improved management arrangements between jurisdictions. This is a recognition of the need to move towards ecosystem-based approaches to fisheries management and will be important in issues such as bycatch mitigation and marine protected area management, where we are looking to protect species that range across traditional fishery or even political boundaries.

7.2 State Government Agencies

7.2.1 New South Wales

- *National Parks and Wildlife Act 1974*
- *Threatened Species Conservation Act 1995*
- *Protection of Environment Operations Act 1997*
- *Marine Parks Act 1997* (NSW)

National Parks and Wildlife Act 1974

The objects of the *National Parks and Wildlife Act 1974* (NPW Act) include the conservation of nature, which encompasses, the conservation of habitat, ecosystems, ecosystem processes, and biological diversity at the community, species and genetic levels. They also provide for the establishment and management of reserves, although marine reserves are established under the *Marine Parks Act 1997* and managed jointly by National Parks and Fisheries agencies (more detail below).

The NPW Act also establishes the National Parks and Wildlife Service (NPWS), which has management responsibility for implementation of the *Threatened Species Conservation Act 1995*, including listings of threatened species and implementation of recovery plans (see below).

Threatened Species Conservation Act 1995

The objects of this Act are defined in section 3, but are similar to most threatened species legislation throughout the country; they include provisions to protect species, populations and communities at risk, as well as to management of processes that may be putting these groups at risk. Unlike threatened species legislation in other jurisdictions, the NSW Act links in closely with fisheries legislation (see section 220BA of the NSW *Fisheries Management Act 1994*) and the fisheries and National Parks agencies take a joint management approach to marine conservation issues.

NSW Fisheries looks after threatened freshwater and saltwater fish, invertebrates and saltwater plants. Other types of animals (including whales, dolphins, seals and waterbirds) and plants (including freshwater plants) are the responsibility of NPWS.

Protection of Environment Operations Act 1997

The *Protection of Environment Operations Act 1997* is one of the overarching pieces of environmental protection legislation in NSW that provide a framework for establishing environmental policy and licensing arrangements, particularly as they relate to pollution of the environment. The Act is limited in its specific relevance to the management of seals, however it does create specific offences and penalties with relation to pollution of waters (under the Act, waters are taken to include tidal areas and the sea).

Marine Parks Act 1997 (NSW)

The primary objective of the *Marine Parks Act 1997* (NSW) is to conserve marine biodiversity and marine habitats through the declaration and management of marine parks. Tourism, fisheries, aquaculture and other human activities that interact with seals can be managed within marine parks under the Act. Sanctuary zones, which exclude fishing, collecting and aquaculture, can be established in particular seal habitat areas, for example around haul-out sites, feeding areas and rafting sites. Regulation of activities can also apply across whole marine parks, for different zones and in particular areas to regulate activities such as aquaculture. For example, only 'extensive aquaculture' (no supplementary feeding) is permitted in the habitat protection zones of Jervis Bay Marine Park under the zoning plan for the park as contained in the Marine Parks Regulation 1999. This excludes finfish aquaculture from nearly all the marine park, and from all areas within the bay itself. Lastly, permits are required for such activities as commercial tour operations (seal watching and diving) and charter fishing operations in marine parks and can carry conditions for managing interactions of people with seals (Rodney James, pers. comm.).

7.2.2 Victoria

- *Wildlife Act 1975*
- *National Parks Act 1975*
- *Flora and Fauna Guarantee Act 1988*
- *The Fisheries Act 1998*

Wildlife Act 1975

In Victoria, the Australian fur seal is protected under section 42 (hunting, taking or destroying notable wildlife) subsection (1) of the *Wildlife Act 1975*. Subsection (1) states that a person must not hunt, take or destroy notable wildlife. The penalty is 120 penalty units or 12 months' imprisonment, or both, and an additional 10 penalty units for every head of wildlife in respect of which an offence has been committed.

The Australian fur seal was declared to be 'notable wildlife' under section 47b(2) of the *Wildlife Act 1975* as from 21 March 1998 (*Victorian Government Gazette, 19 March 1998*).

The New Zealand fur seal and Australian sea lion are protected under section 43 (hunting, taking or destroying protected wildlife), subsection (1) and (2) of the *Wildlife Act 1975*. Subsection (1) states a person must not hunt, take or destroy protected wildlife. The penalty is 50 penalty units or 6 months' imprisonment or, both, and an additional penalty of five penalty units for every head of wildlife in respect of which an offence has been committed. Part (2) states that subsection (1) does not apply to a person: who is: (a) the holder of a licence or authorisation which authorises the hunting, taking or destroying of other protected wildlife; and (b) acting in accordance with licence or authorisation.

National Parks Act 1975

The establishment of a system of Marine National Parks (and sanctuaries), representing about 5 percent of Victorian coastal waters in which commercial fishing is prohibited, contributes to the protections of seals in those areas (George Grossek, pers. comm.).

Flora and Fauna Guarantee Act 1988 (FFG Act)

The FFG Act is Victoria's legislative response on biodiversity conservation and sustainable use of native flora and fauna (including marine mammals). It is administered by the Department of Sustainability and Environment. The FFG Act provides a systematic administrative and management framework for the

recovery of threatened species, and ensures that the harvesting and other uses of flora and fauna are safe and sustainable. The Act provides for the development of action statements (s 19) and management plans (s 21) to guide future management towards the recovery of populations of threatened species.

The Fisheries Act 1998

The Fisheries Act represents Victoria's legislative response on the management, protection and sustainable use of Victoria's fisheries resources and is administered by the Department of Primary Industries. The objectives of the *Fisheries Act 1995* include 'to protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity' (s.3b). The Act also establishes the regulatory framework for managing and administering commercial and recreational fishing and aquaculture in Victoria, including the development of management plans, the content of which is based on specifically stated guidelines. For example, section 28 states that a management plan must 'as far as is known, identify critical components of the ecosystem relevant to the plan and current or potential threats to those components and existing or proposed preventative measures' (s 28 (6) (e)).

7.2.3 Western Australia

- *Wildlife Conservation Act 1950*
- *Policy formulation under Fish Resources Management Act 1994, Wildlife Conservation (Close Season for Marine Mammals) Notice 1998*
- *Fish Resources Management Act 1994*
- *Conservation and Land Management Act 1984*

Wildlife Conservation Act 1950

All fauna in Western Australia is protected under section 14 of the *Wildlife Conservation Act 1950* (and the definition is taken to include marine mammals). The Act establishes licensing frameworks for the taking and possession of protected fauna and also establishes offences and penalties for interactions with fauna. This will implemented as part of the Pinniped Management Programme.

Fish Resource Management Act 1994

The primary objective of the *Fish Resource Management Act 1995* is 'to conserve, develop and share the fish resources of the State for the benefit of present and future generations' (s 3). The Act establishes the regulatory framework for managing commercial fishing in WA, including the development of management plans that may include provisions relating to interactions between pinnipeds and fishing gear, or specifications that particular gears be used in fisheries where interactions with wildlife may occur (s 62).

The Act also includes similar provisions relating to aquaculture operations (s 95), as well as provisions for establishing fish habitat protection areas (s 115), which are separate to marine parks and marine nature reserves (which would be established under the *Conservation and Land Management Act 1984*).

Policy is formulated under the *State Fisheries Resource Management Act 1995*. [Note: There is no policy formulation under the Wildlife Conservation (Closed Season for Marine Mammals) Notice 1998]

The Wildlife Conservation (Closed Season for Marine Mammals) Notice 1998 sets guidelines to minimise the disturbance to marine mammals from interactions with humans, and also to protect people from inadvertent harm when interacting with marine mammals.

Conservation and Land Management Act 1984

The *Conservation and Land Management Act 1984* provides the legislative framework for establishing of the Department of Conservation and Land Management. It also establishes the framework for the creation and management of marine parks, reserves and management areas in Western Australia (s 6(6), 13). Each class of marine protected area has a different level of protection, the strictest being marine reserves (s13A) (total conservation), marine parks (s13B) (limited commercial and recreational activity), and management areas (s13B) (essentially reservation for recreational, commercial or scientific purposes). The Act also establishes the Marine Parks and Reserves Authority (s 26A). Areas included in marine parks and marine nature reserves are vested in the Authority to manage, which is responsible for developing and implementing management plans for these marine reserves (s 26B). Offences are also created for the taking of flora and fauna without a permit in marine parks, reserves and management areas (s 101A, B, C). 'Flora and fauna' is taken to have the same meaning as in the *Wildlife Conservation Act 1950*.

7.2.4 South Australia

- *Aquaculture Act 2001*
- *Fisheries Act 1982*
- *National Parks and Wildlife Act 1972* (SA)

Aquaculture Act 2001

The primary objective of the *Aquaculture Act 2001* is 'to promote ecologically sustainable development of marine and inland aquaculture' (s 8). The Act allows for conditions to be included on licences, which are 'considered necessary by the Minister in order to prevent or mitigate significant environmental harm or the risk of significant environmental harm' (s 52). Given that all marine mammals are protected in SA waters, this provides the potential for aquaculture licensees in areas where seal interactions are likely to be required to incorporate sensitive mitigation measures in their operations. Further, these conditions may also be incorporated into Aquaculture Policies for particular areas; thereby ensuring any aquaculture development in the whole area of concern is consistent with the objectives.

Fisheries Act 1982

The *Fisheries Act 1982* aims to provide for the conservation, enhancement and management of fisheries; the regulation of fishing and the protection of certain fish; the protection of marine mammals and the aquatic habitat; the control of exotic fish and disease in fish; and the regulation of fish processing. The Act creates offences and penalties for killing, injuring, molesting or possessing marine mammals. The only defence to these offences is a lack of intention to cause harm and the demonstration of all reasonable care to avoid the interaction (s 41A).

The Act also provides for the declaration of Aquatic Reserves (s 47) and Marine Parks (s 48). Management and administration of marine parks is vested in the Minister for Fisheries (s 48A) and there is a requirement to prepare plans of management for marine parks within two years of their declaration (s 48B).

National Parks and Wildlife Act 1972 (SA)

The *National Parks and Wildlife Act 1972* provides for offences and penalties for taking, killing or possessing protected species (s 51, 51A, 60); all marine mammals are protected species in South Australia. There are provisions under the Act for permits to take protected species (s 53). National Parks and reserves declared under this Act are primarily terrestrial reserves, as marine parks are declared under the provisions of the *Fisheries Act 1982*.

7.2.5 Tasmania

- *Living Marine Resources Management Act 1995*
- *Threatened Species Protection Act 1995*
- *Marine Farming Planning Act 1995*
- *National Parks and Reserves Management Act 2002*
- *Nature Conservation Act 2002*

Living Marine Resources Management Act 1995

The *Living Marine Resources Management Act 1995* is described as an Act 'to promote the sustainable management of living marine resources, to provide for management plans relating to fish resources, and to protect marine habitats'. It includes provision for the creation of Marine Resources Protected Areas (s 105) and habitat protection areas for fish (the definition of fish does not include marine mammals) (s 118). There is also the capacity under the Act to create codes of practice for the fishing and marine farming industries (s 28–29), and while wildlife interactions are not specifically listed as matters to be considered (s 29), there is provision to include issues relating to the conduct of persons involved in commercial and recreational fishing or marine farming.

Threatened Species Protection Act 1995

The *Threatened Species Protection Act 1995* provides for the protection and management of threatened native flora and fauna (including marine species) to enable and promote the conservation of native flora and fauna. The Act includes provision for identification and protection of threatened species (s 13) and critical habitats (s 23), identification of threatening processes and establishment of recovery plans (s 25), and threat-abatement plans (s 27). The Act also creates offences relating to listed flora and fauna (s 51) as well as capacity to require offenders to undertake restoration work for any damage to habitat or listed species (s 54).

Marine Farming Planning Act 1995

The *Marine Farming Planning Act 1995* largely deals with planning for marine farming, but includes requirements for plans to have environmental impact assessments. Possible negative interactions with seals could be highlighted when developing proposals.

National Parks and Reserves Management Act 2002

The *National Parks and Reserves Management Act 2002* provides for the management of national parks and other reserved land (land is taken to include the sea bed and the sea above) (s 3). There are no specific references to pinnipeds in the Act, and the definition of wildlife is taken to be the same as that in the *Nature Conservation Act 2002*.

Nature Conservation Act 2002

The *Nature Conservation Act 2002* provides for the conservation and protection of the fauna, flora and geological diversity of the State, and for the declaration of national parks and other reserved land and for related purposes. As for the *National Parks and Reserves Management Act 2002*, land is taken to include seabed and the sea above. The Act makes provisions for making regulations to conserve wildlife, including marine life (but excluding fish) (s 26). Section 21 (3(c)) states that regulations may be made under the Act: 'for the purposes of protecting fish farming and other fishing activity, provisions prohibiting or controlling the use of devices designed to deter seals from interfering with fish farming and other fishing activities'.

Key issues arising from Assessment

Key issues arising from this assessment are summarised below:

(i) General

- Limited quantitative and independent data on the nature and extent of human–seal interactions across all sectors.
- Feeding of seals, changing seal behaviour due to habituation to a predictable food (seals associating food with humans).
- Illegal shooting of seals (injury and/or fatalities).
- Limited information on seal ecology, notably seal abundance, diet and foraging range.

(ii) Wild fisheries

- Loss of income due to interactions with seals that may result in damage/loss of gear, damage/loss of catch, and disturbance of fishing operations.
- Injury and fatal entanglement of seals in fishing gear.
- Limited available data suggests that fisheries–seal interactions are most evident in the gillnet fisheries, the southeast trawl fishery, and pot and trap fisheries.
- Entanglement in fisheries-related debris such as discarded and derelict nets, bait box straps, monofilament nets and nylon ropes.

(iii) Marine finfish aquaculture

- Loss of income due to interactions with seals that may result in loss of valuable stock, and increased costs through the need to protect stock from seals and possibly to make expensive repairs.
- Injury and fatal entanglement of seals in fish farm nets.
- Limited available data suggests that aquaculture–seal interactions are most evident in the salmonids in Tasmania and southern bluefin tuna in South Australia.

(iv) Seal-focused tourism

- Disturbance to seals by tourists (particularly during the breeding season) potentially causing behavioural changes and reducing pupping success rates.
- Safety of tourists interacting with seals.

Next steps

This report provides background information for future consultation with the general public and stakeholder groups to formulate a national strategy to mitigate adverse impacts on Australian seal populations and the fisheries, aquaculture and tourism sectors. The next phase of this process is to engage the general public and stakeholder groups in the development of the National Seal Strategy.

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Appendices

Appendix A Distribution of the Australian sea lion

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
WA		Great Australian Bight	2 km West of Twilight Cove, Great Australian Bight	-32.279	126.012	Breeding	
WA		Abrolhos	Alexander Island, Abrolhos	-28.667	113.817	Breeding	
WA	Nature Reserve	Recherche Archipelago	Anvil Island, Recherche Archipelago	-33.737	124.096	Haul-out	
WA	Nature Reserve	Bald Island Nature Reserve	Bald Island, E of Mt Manypeaks	-34.917	118.463	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Barrier Island, Recherche Archipelago	-33.979	123.139	Haul-out	
WA	Nature Reserve		Beagle Island	-29.808	114.877	Breeding	
WA	Nature Reserve	Recherche Archipelago	Beaumont Island, Recherche Archipelago	-34.090	122.539	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Bellinger Island, Recherche Archipelago	-33.887	123.639	Possible breeding	
WA			Bird Rock (off Bald Island)	-34.917	118.483	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Boxer Island	-33.998	121.678	Haul-out	
WA	Nature Reserve		Buller Island	-30.656	115.115	Breeding	
WA			Burns Rocks	-31.717	115.700	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Capps Island	-33.988	121.682	Haul-out	
WA	Nature Reserve	Carnac Island Nature Reserve	Carnac Island	-32.121	115.662	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Cloud Rock	-34.044	122.090	Haul-out	
WA	Nature Reserve	Two Peoples Bay Nature Reserve	Coffin Island	-35.000	118.217	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Cooper Island, Recherche Archipelago	-34.231	123.607	Breeding	
WA	Nature Reserve	Recherche Archipelago	Corbett Island	-34.117	121.983	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Cranny Island, Recherche Archipelago	-33.731	124.078	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Daw Island, Recherche Archipelago	-33.846	124.134	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Draper Island, Recherche Archipelago	-34.196	122.496	Haul-out	
WA			Dyer Island (off Rottnest Island)	-32.019	115.551	Haul-out	
WA	Nature Reserve	Doubtful Islands Nature Reserve	East Doubtful Island	-34.380	119.616	Possible breeding	
WA	Nature Reserve	Eclipse Island Nature Reserve	Eclipse Island	-35.179	117.885	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Figure of Eight Island, Recherche Archipelago	-34.027	121.607	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Finger Island, Recherche Archipelago	-34.105	122.344	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Foam Rocks	-34.130	122.847	Haul-out	
WA		Abrolhos	Gilbert Island, Abrolhos	-28.667	113.817	Breeding	
WA	Nature Reserve	Recherche Archipelago	Glennie Island, Recherche Archipelago	-34.096	123.105	Breeding	

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
WA	Nature Reserve	Recherche Archipelago	Halfway Island (local name = Ford Island), Recherche Archipelago	-33.770	124.040	Breeding	
WA	Nature Reserve	Recherche Archipelago	Hasler Island	-34.117	123.067	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Hastings Island	-34.100	122.117	Haul-out	
WA	Vacant Crown Land		Haul Off Rock	-34.702	118.661	Breeding	
WA	Nature Reserve	Recherche Archipelago	Hector Island	-34.000	121.717	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Helby Island	-34.117	123.067	Haul-out	
WA	Nature Reserve	Recherche Archipelago	High North Island (local name)	-33.717	124.100	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Hood Island	-34.142	122.050	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Hope Island	-34.079	122.163	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Hugo Island	-34.145	122.317	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Kermadec Island (= Wedge Island), Recherche Archipelago	-34.088	122.834	Breeding	
WA			Little Island, N of Perth	-31.800	115.700	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Little Island, Recherche Archipelago	-34.457	121.990	Breeding	
WA	Nature Reserve	Recherche Archipelago	MacKenzie Island, Recherche Archipelago	-34.200	122.112	Breeding	
WA	Nature Reserve	Recherche Archipelago	Manicom Island	-34.117	123.033	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Marts Group	-33.993	122.651	Haul-out	
WA	Nature Reserve	Recherche Archipelago	McKenzie Rocks	-34.217	122.067	Haul-out	
WA	Nature Reserve	Doubtful Islands Nature Reserve	Middle Doubtful Island	-34.375	119.607	Breeding	
WA	Nature Reserve	Recherche Archipelago	Middle Rock	-34.317	121.850	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Murray Rocks	-34.000	122.083	Haul-out	
WA	Nature Reserve	Recherche Archipelago	N/E York Island	-34.017	122.583	Haul-out	
WA	Nature Reserve	Recherche Archipelago	N/W York Island	-34.017	122.583	Haul-out	
WA	Nature Reserve	Great Australian Bight	Near Toolina Cove, Great Australian Bight	-32.829	124.900	Haul-out	
WA	Nature Reserve	Recherche Archipelago	New Year Island, Recherche Archipelago	-33.856	124.127	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Nook Island, Recherche Archipelago	-33.733	124.100	Breeding	
WA	Nature Reserve	Recherche Archipelago	Pasley Island (or Paisley Island), Recherche Archipelago	-34.011	123.532	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Passage Island, Recherche Archipelago	-33.983	122.433	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Pearson Island	-34.217	122.350	Haul-out	
WA			Poison Creek Island	-33.917	123.330	Breeding	
WA	Nature Reserve	Recherche Archipelago	Red Island, Recherche Archipelago	-33.871	121.350	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Red Islet	-34.033	119.783	Breeding	
WA	Nature Reserve	Recherche Archipelago	Rocky Island, Recherche Archipelago	-34.083	120.867	Breeding	
WA	Nature Reserve	Recherche Archipelago	Rodonia Island	-33.833	123.917	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Round Island, Recherche Archipelago	-34.105	123.888	Breeding	
WA	Nature Reserve	Recherche Archipelago	Salisbury Island, Recherche Archipelago	-34.360	123.552	Breeding	
WA	Nature Reserve	Shoalwater Islands Nature Reserve	Seal Island	-32.293	115.691	Haul-out	

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
WA			Seal Rock (NW of Doubtful Islands group)	-34.350	119.567	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Seal Rock	-34.020	121.656	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Slipper Island, Recherche Archipelago	-34.046	122.753	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Spindle Island, Recherche Archipelago	-33.763	124.161	Breeding	
WA	Nature Reserve	Recherche Archipelago	Stanley Island (= Wickham Island), Recherche Archipelago	-34.020	123.291	Breeding	
WA		Abrolhos	Suomi Island, Abrolhos	-28.700	113.833	Breeding	
WA			SW Rock (Twin Peaks Island)	-33.983	122.900	Breeding	
WA	Nature Reserve	Recherche Archipelago	Tadpole Island (local name)	-33.733	124.033	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Taylor Island, Recherche Archipelago	-33.920	122.873	Breeding	
WA	Nature Reserve	Recherche Archipelago	Termination Island, Recherche Archipelago	-34.471	121.992	Possible breeding	
WA	Nature Reserve	Recherche Archipelago	Tizard Island	-34.017	122.683	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Wee Rock (local name)	-34.083	123.900	Haul-out	
WA	Nature Reserve	Doubtful Islands Nature Reserve	West Doubtful Island	-34.374	119.580	Haul-out	
WA			West Island, NW point of the island	-34.082	120.485	Breeding	
WA	Nature Reserve	Recherche Archipelago	Westall Island, Recherche Archipelago	-34.079	122.967	Possible breeding	
WA		Abrolhos Is	Square Is	-28.902	113.944	Breeding	
SA	National Park	Lincoln National Park	Albatross Island	-35.069	136.181	Haul-out	c
SA	Conservation Park	Althorpe Islands Conservation Park	Althorpe Island	-35.369	136.861	Haul-out	l
SA	Conservation Park	Baudin Rocks Conservation Park	Baudin Rocks	-37.089	139.722	Haul-out	l
SA			Bird Rock	-32.183	133.617		
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Black Point - KI	-36.038	137.406	Haul-out	m
SA			Blythe Island	-34.568	136.292		
SA	Conservation Park	Nuyts Reef Conservation Park	Breakwater Island	-32.322	133.561	Haul-out	e
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Buffalo Reef	-34.759	136.421	Haul-out	l
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B1	-31.517	131.061	Breeding	a
SA			Bunda Cliffs B10	-31.685	129.011	Breeding	
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B2	-31.586	130.581	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B3	-31.582	130.126	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B4	-31.586	130.061	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B5	-31.585	130.031	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B6	-31.609	129.762	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B7	-31.625	129.511	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B8	-31.640	129.381	Breeding	a

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs B9	-31.647	129.311	Breeding	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H1	-31.529	131.041	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H10	-31.620	129.542	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H11	-31.623	129.521	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H12	-31.636	129.421	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H13	-31.642	129.353	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H14	-31.646	129.322	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H2	-31.604	130.801	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H3	-31.585	130.553	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H4	-31.586	130.072	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H5	-31.587	129.992	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H6	-31.607	129.781	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H7	-31.615	129.692	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H8	-31.615	129.651	Haul-out	a
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H9	-31.619	129.571	Haul-out	a
SA	Crown Land	Vacant crown land	Cannan Reef	-32.639	133.246	Haul-out	l
SA	Conservation Park	Cap Island Conservation Park	Cap Island	-33.947	135.113	Haul-out	l
SA	National Park	Flinders Chase National Park	Cape Borda - KI	-35.749	136.591	Haul-out	l
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cape Bouguer - KI	-36.042	136.909	Haul-out	e
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cape Bouguer (East of) - KI	-36.036	136.900	Haul-out with occasional pupping	k
SA	National Park	Flinders Chase National Park, Prohibited Area	Cape DuCouedic - KI	-36.058	136.708	Haul-out	l
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Cape Gantheaume - KI	-36.074	137.461	Haul-out	l
SA			Cape Linois - KI	-36.019	137.586	Haul-out	
SA	Crown Land	Vacant crown land	Cape Rocks	-34.913	135.534	Haul-out	l
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cave Point - KI	-36.026	136.957	Haul-out	
SA	National Park	Lincoln National Park	Curta Rocks	-34.948	135.870	Haul-out	l
SA			Daly Head Islet	-35.029	136.925	Haul-out	
SA			Dangerous Reef (East)	-34.814	136.226	Breeding	
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Dangerous Reef (West)	-34.814	136.217	Breeding	f
SA	Crown	none	D'Entrecasteaux Reef	-31.981	131.930	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	Dog Island	-32.489	133.331	Haul-out	l

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
SA			Donington Island	-34.721	135.999	Haul-out	
SA	Conservation Park	Investigator Group Conservation Park	Dorothee Island	-33.997	134.249	Haul-out	b
SA	Conservation Park	Isles of St Francis Conservation Park	Egg Island	-32.473	133.315	Haul-out	l
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	English Island	-34.638	136.196	Breeding	b, e
SA	Crown	Lighthouse Reserve	Evans Island	-32.369	133.482	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	Fenelon Island	-32.581	133.282	Breeding	d
SA	Conservation Park	Whidbey Isles Conservation Park	Four Hummocks Island (Central)	-34.769	135.031	Haul-out	l
SA	Conservation Park	Whidbey Isles Conservation Park	Four Hummocks Island (NE)	-34.751	135.082	Haul-out	l
SA	Conservation Park	Whidbey Isles Conservation Park	Four Hummocks Island (North)	-34.758	135.042	Breeding	b
SA	Conservation Park	Whidbey Isles Conservation Park	Four Hummocks Island (South)	-34.778	135.032	Haul-out	l
SA	Conservation Park	Nuyts Archipelago Conservation Park	Franklin Island (north-east)	-32.449	133.669	Breeding	c
SA	Conservation Park	Nuyts Archipelago Conservation Park	Franklin Island (south)	-32.462	133.639	Breeding	c
SA	Conservation Park	Isles of St Francis Conservation Park	Freeling Island	-32.480	133.344	Haul-out	l
SA	Conservation Park	Nuyts Archipelago Conservation Park	Goat Island	-32.309	133.521	Haul-out	l
SA	Conservation Park	Whidbey Isles Conservation Park	Golden Island	-34.700	135.332	Haul-out	l
SA	Conservation Park	Goose Island Conservation Park	Goose Island	-34.457	137.364	Haul-out	l
SA	Conservation Park	Greenly Island Conservation Park	Greenly Island	-34.639	134.791	Haul-out	b
SA			Hareby Island	-34.582	136.296	Haul-out	
SA	Conservation Park	Isles of St Francis Conservation Park	Hart Island	-32.642	133.151	Haul-out	l
SA	Conservation Park	Althorpe Islands Conservation Park	Haystack Island	-35.322	136.908	Haul-out	l
SA	National Park	Lincoln National Park	Hopkins Island	-34.968	136.061	Haul-out	l
SA	Conservation Park	Baird Bay Islands Conservation Park	Jones Island	-33.185	134.367	Breeding	b
SA	Conservation Park	Nuyts Archipelago Conservation Park	Lacy Island	-32.399	133.371	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	Lacy Island (Rocks NW of)	-32.367	133.349	Haul-out	l
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Langton Island	-34.597	136.252	Haul-out	i
SA	National Park	Lincoln National Park	Lewis Island	-34.957	136.032	Haul-out	l
SA	National Park	Lincoln National Park	Liguanea Island	-34.998	135.620	Breeding	b, c
SA	Conservation Park	Althorpe Islands Conservation Park	Little Althorpe Islands	-35.373	136.845	Haul-out	l
SA	National Park	Lincoln National Park	Little Islet	-34.950	136.025	Haul-out	l
SA	Conservation Park	Nuyts Archipelago Conservation Park	Lounds Island	-32.273	133.366	Breeding	b, c
SA	Conservation Park	Isles of St Francis Conservation Park	Masillon Island	-32.559	133.281	Breeding	d
SA	Conservation Park	Nicolas Baudin Island Conservation Park, Prohibited Area	Nicolas Baudin Island	-33.016	134.133	Breeding	b, e

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
SA	National Park	Flinders Chase National Park	North Casuarina Island - KI	-36.068	136.702	Haul-out with occasional pupping	h
SA	Conservation Park	Gambier Islands Conservation Park	North Island	-35.121	136.476	Breeding	c
SA	Conservation Park	Neptune Islands Conservation Park, Prohibited Area	North Neptune Island	-35.230	136.068	Haul-out	b, c
SA	Conservation Park	The Pages Conservation Park, Prohibited Area	North Page Island	-35.759	138.301	Breeding	e, g
SA	Conservation Park	Nuyts Reef Conservation Park	Nuyts Reef (east)	-32.048	132.179	Haul-out	l
SA	Conservation Park	Nuyts Reef Conservation Park	Nuyts Reef (middle)	-32.139	132.141	Haul-out	b, c
SA	Conservation Park	Nuyts Reef Conservation Park	Nuyts Reef (southern rocks)	-32.139	132.131	Haul-out	l
SA	Conservation Park	Nuyts Reef Conservation Park	Nuyts Reef (west)	-32.119	132.131	Haul-out	b, c
SA	Conservation Park	Olive Island Conservation Park	Olive Island	-32.719	133.970	Breeding	b, e
SA	National Park	Flinders Chase National Park	Paisley Island (West Bay) - KI	-35.900	136.538	Haul-out	l
SA	Conservation Park	Gambier Islands Conservation Park	Peaked Rocks	-35.187	136.483	Breeding	c
SA	Conservation Park	Investigator Group Conservation Park	Pearson Island	-33.949	134.261	Breeding	b
SA			Perforated Island	-34.727	135.158	Haul-out	
SA	Crown Land	Vacant Crown Land	Point Bell (Rocks SW of)	-32.221	133.113	Haul-out	l
SA	Conservation Park	Fowlers Bay Conservation Reserve	Point Fowler	-32.030	132.473	Haul-out	a, b
SA	Crown Land	none	Point Gibbon	-33.829	136.779	Haul-out	l
SA	Conservation Park	Point Labatt Conservation Park	Point Labatt	-33.152	134.261	Haul-out with occasional pupping	b
SA	Conservation Park	Whidbey Isles Conservation Park	Price Island	-34.708	135.290	Breeding	b
SA	Conservation Park	Nuyts Archipelago Conservation Park	Purdie Island	-32.270	133.228	Breeding	b, c
SA			Rabbit Island (Louth Bay)	-34.605	135.986	Haul-out	
SA			Reevesby Island	-34.523	136.280	Haul-out	
SA	Conservation Park	Rocky Island (north) Conservation Park	Rocky Island (North)	-34.259	135.260	Breeding	b
SA	Conservation Park	Rocky Island Conservation Park	Rocky Island (South)	-34.810	134.718	Haul-out	b, c
SA			Rosemary Shoal	-34.693	136.366	Haul-out	
SA	Conservation Park	Seal Bay Conservation Park, Prohibited Area	Seal Bay - KI	-35.996	137.327	Breeding	g
SA	Conservation Park	Althorpe Islands Conservation Park	Seal Island (Toe of Yorke Pen)	-35.339	136.921	Haul-out	l
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Seal Slide - KI	-36.026	137.536	Breeding	h
SA	Conservation Park	Sinclair Island Conservation Park	Sinclair Island	-32.143	132.991	Haul-out	l
SA			Slade Point (Pt Searcy)	-33.055	134.168	Haul-out	
SA	National Park	Lincoln National Park	Smith Island	-34.986	136.029	Haul-out with occasional pupping	j

State	Tenure	Status of Area	Site/Locality	Lat (S)	Long (E)	Colony/ Haul-out site[1]	Pup count data
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Smith Rock	-34.586	136.265	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	Smooth Island	-32.485	133.309	Haul-out	l
SA	National Park	Flinders Chase National Park	South Casuarina Island - KI	-36.086	136.694	Haul-out	l
SA	Conservation Park	Neptune Islands Conservation Park, Prohibited Area	South Neptune Island	-35.330	136.112	Breeding	b
SA	Conservation Park	Neptune Islands Conservation Park	South Neptune Island (Lthouse)	-35.336	136.111	Haul-out	l
SA	Conservation Park	The Pages Conservation Park, Prohibited Area	South Page Island	-35.779	138.291	Breeding	e, g
SA	Conservation Park	Gambier Islands Conservation Park	South-west Rock	-35.187	136.483	Haul-out	l
SA	Conservation Park	The Pages Conservation Park	SSW Reef	-35.784	138.288	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	St Francis Island	-32.506	133.286	Haul-out	d
SA	Freehold	none	Thistle Island	-35.009	136.181	Haul-out	l
SA	Conservation Park	Investigator Group Conservation Park	Topgallant Island	-33.717	134.612	Haul-out	l
SA	Conservation Park	Investigator Group Conservation Park	Veteran Isles (North Islet)	-33.968	134.265	Haul-out	l
SA			Veteran Isles (South Islet)	-33.975	134.263	Haul-out	
SA	Conservation Park	Investigator Group Conservation Park	Ward Island	-33.741	134.285	Breeding	b, c
SA	Conservation Park	Investigator Group Conservation Park	Ward Island (South East)	-33.757	134.306	Haul-out	l
SA	Conservation Park	Isles of St Francis Conservation Park	West Island	-32.511	133.251	Breeding	b
SA	Conservation Park	Waldegrave Islands Conservation Park	West Waldegrave Island	-33.596	134.761	Breeding	e
SA	Conservation Park	Goose Island Conservation Park	White Rocks	-34.452	137.362	Haul-out	l
SA	National Park	Lincoln National Park	Williams Island	-35.029	135.971	Haul-out	l

[1] Definitions:
Breeding: has at least 15 pups recorded during at least one survey over the past 20 years **Haul-out (OP)**: haul-out with occasional pupping–has 1–4 pups recorded during at least one survey over the past 20 years **Haul-out:** sites that are frequented by seals

(a) Dennis and Shaughnessy (1996); (b) Shaughnessy, pers. comm.; (c) Gales *et al.* (1994); (d) Robinson *et al.* (2003); (e) Shaughnessy and Dennis (2003); (f) Shaughnessy *et al.*, (2004); (g) Shaughnessy pers. comm.; (h) Shaughnessy (2002); (i) T. Dennis, pers. comm.; (j) Shaughnessy *et al.* (1997); (k) Shaughnessy and Dennis (2002); (l) South Australian Offshore Island Biological Database, DEH; (m) J.McKenzie, La Trobe University, pers. comm.

Appendix B Distribution of the Australian fur seal

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
NSW			Montague Island	-36.251	150.225	Haul-out (OP)	a
NSW		Ben Boyd National Park	Green Cape	-37.261	150.047	Haul-out	
NSW		Near Steamers Beach (Jervis Bay)		-35.176	150.726	Haul-out	
Vic.	Fauna Reserve	nil	Lady Julia Percy Island	-38.418	142.000	Breeding	b
Vic.	Fauna Reserve	nil	Seal Rocks, adjacent to Phillip Island	-38.526	145.099	Breeding	b
Vic.	?	Marine Park	Kanowna Island (including Ansor Islets), adjacent to Wilsons Promontory	-39.154	146.310	Breeding	b
Vic.	?	nil	Rag Island, in the Cliffy Group	-38.955	146.679	Breeding	b
Vic.	?	nil	The Skerries, off Croajingalong National Park	-37.755	149.518	Breeding	b
Vic.	?	?	Cape Bridgewater	-38.380	141.400	Haul-out (OP)	b
Vic.	?	?	Marango Reef, Apollo Bay	-38.670	143.830	Haul-out	
Vic.	?	?	Port Phillip Bay, seal platform and channel markers	-38.330	144.830	Haul-out	
Vic.	?	Marine Park	Norman Island, adjacent to Wilsons Promontory	-39.025	146.241	Haul-out	
Vic.	?	?	Notch Island, in the Cliffy Group	-38.941	146.674	Haul-out	
Vic.	?	?	White Rock, in the Cliffy Group	-38.907	146.645	Haul-out	
SA	Wilderness Area	Cape Bouguer Wilderness Area	KI - Cape Bouguer	-36.030	136.910	Haul-out	e
SA	National Park	Flinders Chase National Park	KI - Cape du Couedic (Admirals Arch)	-36.060	136.700	Haul-out	c
SA	National Park	Flinders Chase National Park	KI - Cape du Couedic (Ladders North)	-36.060	136.700	Haul-out	
SA	National Park	Flinders Chase National Park	KI - Cape du Couedic (Nautilus Rock)	-36.060	136.700	Haul-out	c
SA	Wilderness Area	Cape Gantheaume Wilderness Area	KI - Cape Gantheaume	-36.074	137.461	Haul-out	c
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Casurina Islets (North)	-36.068	136.702	Haul-out	f
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Casurina Islets (South)	-36.060	136.700	Haul-out	f
SA	Conservation Park	The Pages Conservation Park, Prohibited Area	North Page Island	-35.759	138.301	Haul-out	e, e
SA	Crown Land	Vacant Crown Land	Young Rocks	-36.380	137.200	Haul-out	f
Tas.	Nature Reserve		Judgement Rocks	-39.507	147.129	Breeding	g
Tas.	Nature Reserve		Judgement Rocks	-39.507	147.129	Breeding	b
Tas.	Nature Reserve		West Moncoeur	-39.233	146.504	Breeding	g

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
Tas.	Nature Reserve		West Moncoeur	-39.233	146.504	Breeding	b
Tas.	Nature Reserve		Moriarty Rocks	-40.590	148.278	Breeding	h
Tas.	Nature Reserve		Moriarty Rocks	-40.590	148.278	Breeding	b
Tas.	Nature Reserve		Tenth Island	-40.944	146.984	Breeding	b
Tas.	Nature Reserve		Tenth Island	-40.944	146.984	Breeding	g
Tas.	Nature Reserve		Reid Rocks	-40.172	143.924	Breeding	h
Tas.	Nature Reserve		Reid Rocks	-40.172	143.924	Breeding	b
Tas.	Nature Reserve		Albatross Island	-40.377	144.655	Haul-out (OP)	h
Tas.	Nature Reserve		Bull Rocks	-40.738	145.297	Haul-out (OP)	g
Tas.	Nature Reserve		Wright Rock	-39.593	147.550	Haul-out (OP)	g
Tas.	Non-allocated crown land		Hogan Group	-39.204	146.984	Haul-out (OP)	g
Tas.	Nature Reserve		Ile de Phoque	-42.415	148.162	Haul-out (OP)	
Tas.	National Park		The Friars	-43.526	147.292	Haul-out (OP)	g
Tas.	National Park		Hippolyte Rock	-43.123	148.051	Haul-out	
Tas.	National Park		Cape Pillar	-43.223	148.008	Haul-out	
Tas.	National Park		Cape Raoul	-43.244	147.798	Haul-out	
Tas.	National Park		Cape Huay	-43.138	148.006	Haul-out	
Tas.	National Park		Tasman Island	-43.240	148.002	Haul-out	
Tas.	National Park		Maatsuyker Island	-43.645	146.278	Haul-out	
Tas.	National Park		Needle Rocks	-43.663	146.255	Haul-out	
Tas.	National Park		Walker Island	-43.632	146.273	Haul-out	
Tas.	National Park		Flat Witch Island	-43.619	146.287	Haul-out	
Tas.	National Park		Pedra Branca	-43.861	146.973	Haul-out	
Tas.	National Park		Mewstone	-43.741	146.373	Haul-out	
Tas.	National Park		East Pyramid	-43.418	145.919	Haul-out	
Tas.	National Park		Flat Top Island	-43.641	146.381	Haul-out	
Tas.	Conservation Area		Sandy Cape	-41.422	144.744	Haul-out	
Tas.	Conservation Area		Point Hibbs	-42.617	145.264	Haul-out	
Tas.	Nature Reserve		Bass Pyramid	-39.810	147.244	Haul-out	
Tas.	non-allocated crown land		North East Islet	-39.445	147.376	Haul-out	
Tas.			Double Rock	-40.366	147.886	Haul-out	
Tas.	Nature Reserve		Devils Tower	-39.377	146.744	Haul-out	
Tas.			Forty Foot Rocks	-39.202	146.421	Haul-out	
Tas.			Black Reef	-40.836	148.245	Haul-out	
Tas.	National Park		Visscher Island	-42.857	147.974	Haul-out	

[1] Definitions:
Breeding: has at least 15 pups 'recorded during at least one survey over the past 20 years' **Haul-out (OP)**: haul-out with occasional pupping–has 1–14 pups 'recorded during at least one survey over the past 20 years' **Haul-out**: sites that are frequented by seals

(a) Irvine *et al.* (1997); (b) Kirkwood *et al.* (2005); (c) Shaughnessy and Dennis (2003); (d) Shaughnessy and Dennis (2000); (e) Shaughnessy and Dennis (1999); (f) Shaughnessy *et al.* (1994); (g) UD; (h) Pemberton and Gales (2004).

Appendix C Distribution of the New Zealand fur seal

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
NSW			Montague Island	-36.255	150.225	Haul-out (OP)	a
Vic.	?	Marine Park	Kanowna Island (including Anderson Islets), adjacent to Wilsons Promontory	-39.155	146.310	Breeding	b
Vic.	?	nil	The Skerries, off Croajingalong National Park	-37.750	149.520	Breeding	b
Vic.	Fauna Reserve	nil	Lady Julia Percy Island	-38.414	142.011	Haul-out (OP)	b
Vic.	?	?	Cape Bridgewater	-38.380	141.400	Haul-out	b
WA	Nature Reserve	Bald Island Nature Reserve	Bald Island	-34.933	118.467	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Beaumont Island, NW point of the island. Recherche Archipelago	-34.090	122.534	Breeding	
WA			Bird Rock (Off Bald Island)	-34.917	118.483	Haul-out	
WA	National Park	D'Entrecasteaux National Park	Black Point, SE tip.	-34.426	115.544	Occasional haul-out	
WA			Bunker Bay	-33.543	115.035	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Capps Island	-33.988	121.682	Occasional haul-out	
WA	Nature Reserve	Chatham Island Nature Reserve	Chatham Island	-35.033	116.500	Occasional haul-out	
WA	Nature Reserve	Two Peoples Bay Nature Reserve	Coffin Island	-35.000	118.217	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Cooper Island, SW end. Recherche Archipelago	-34.231	123.607	Breeding	
WA	Nature Reserve	Recherche Archipelago	Corbett Island	-34.117	121.983	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Cranny Island, adjacent to low lying isthmus. Recherche Archipelago	-33.731	124.078	Breeding	
WA	Nature Reserve	Recherche Archipelago	Daw Island, NW point of the island. Recherche Archipelago	-33.847	124.136	Breeding	
WA	Nature Reserve	Recherche Archipelago	Draper Island, NE corner of the island. Recherche Archipelago	-34.196	122.496	Breeding	
WA	Nature Reserve	Doubtful Islands Nature Reserve	East Doubtful Island	-34.380	119.616	Breeding	
WA	Nature Reserve	Eclipse Island Nature Reserve	Eclipse Island, E end of the N side.	-35.182	117.884	Breeding	
WA	Nature Reserve	Recherche Archipelago	Figure of Eight Island	-34.027	121.608	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Finger Island, Recherche Archipelago	-34.103	122.345	Occasional haul-out	
WA	Nature Reserve	Fliners Island Nature Reserve	Flinders Islet	-34.413	115.207	Breeding	
WA	Nature Reserve	Recherche Archipelago	Fur Rock	-34.017	121.650	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Gunton Island	-33.987	121.995	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Hastings Island	-34.100	122.117	Occasional haul-out	
WA	Vacant Crown Land		Haul Off Rock, W end of the N coast.	-34.702	118.661	Breeding	
WA	Nature Reserve	Recherche Archipelago	Hood Island, N end of bay on the NE side of the island. Recherche Archipelago	-34.142	122.050	Breeding	

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
WA	Nature Reserve	Recherche Archipelago	Kermadec Island	-34.088	122.834	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Libke Island, E and SE sides of the island. Recherche Archipelago	-34.215	122.084	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Little Island	-34.200	122.112	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	McKenzie Island	-34.200	122.117	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	McKenzie Rocks	-34.217	122.067	Occasional haul-out	
WA	Nature Reserve	Doubtful Islands Nature Reserve	Middle Doubtful Island	-34.375	119.607	Breeding	
WA	Nature Reserve	Recherche Archipelago	New Year Island, NE shore. Recherche Archipelago	-33.856	124.127	Breeding	
WA	Nature Reserve	Recherche Archipelago	Pasley Island	-34.011	123.532	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Pointer Island	-33.717	124.083	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Rocky Island, Recherche Archipelago	-34.083	120.917	Breeding	
WA	Nature Reserve	Recherche Archipelago	Round Island	-34.105	123.888	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Rug Rock	-34.017	121.650	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Salisbury Island, in middle of the island on the W side. Recherche Archipelago	-34.360	123.552	Breeding	
WA			Seal Rock	-34.350	119.567	Haul-out	
WA	Nature Reserve	Recherche Archipelago	Seal Rock, W, N and E coasts. Recherche Archipelago	-34.019	121.656	Breeding	
WA	Nature Reserve	Recherche Archipelago	Square Rock	-34.017	121.650	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Termination Island	-34.471	121.992	Occasional haul-out	
WA	Nature Reserve	Doubtful Islands Nature Reserve	West Doubtful Island	-34.374	119.580	Haul-out	
WA			West Island, NE point of island	-34.082	120.485	Breeding	
WA	Nature Reserve	Recherche Archipelago	Westall Island	-34.083	122.967	Occasional haul-out	
WA	Nature Reserve	Recherche Archipelago	Wickham Island	-34.020	123.291	Occasional haul-out	
WA	Nature Reserve	Saint Alouarn Nature Reserve	St. Alouarn Island	-34.400	115.183	Haul-out	
WA	Nature Reserve	Seal Island Nature Reserve	Seal Island	-34.383	115.150	Haul-out	
WA			Hamelin Bay	-34.230	115.010	Haul-out	
WA			Cape Naturaliste	-33.530	115.010	Haul-out	
SA	National Park	Lincoln National Park	Albatross Island	-35.069	136.181	Haul-out	c
SA	Conservation Park	Althorpe Island Conservatin Park	Althorpe Island	-35.369	136.861	Haul-out	c
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Berris Point - KI	-36.065	137.482	Breeding\ Haul-out	n
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Black Point - KI	-36.038	137.407	Haul-out	h

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H1	-31.529	131.041	Haul-out	d
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H2	-31.604	130.801	Haul-out	d
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H3	-31.603	130.721	Haul-out	d
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H4	-31.612	129.684	Haul-out	d
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H5	-31.639	129.421	Haul-out	d
SA	Marine Park	Great Australian Bight Marine Park	Bunda Cliffs H6	-31.649	129.301	Haul-out	d
SA	Crown Land	Vacant Crown Land	Cape Adieu (Rocks SSE of)	-32.048	132.179	Haul-out	c
SA	Wilderness Area	Ravine des Casoars Wilderness Area	Cape Borda - KI	-35.766	136.575	Haul-out	c
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cape Bouger - KI	-36.042	136.909	Haul-out (OP)	n
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cape Bouguer (East of) - KI	-36.036	136.900	Haul-out	j
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 4 (Nautilus North)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 6 (Spooks Bay, north)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic (10 sites)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 1 (Ladders North)	-36.058	136.708	Breeding\ Haul-out	o
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 10 (Spooks Bay north)	-36.058	136.708	Haul-out (OP)	g, j, p,
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 2 (Ladders South)	-36.058	136.708	Breeding\ Haul-out	o
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 3 (Libke)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 5 (Nautilus Rock)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 7 (Weirs Cove North)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Cape du Couedic 8 (Weirs Cove South)	-36.058	136.708	Breeding\ Haul-out	n
SA	National Park	Flinders Chase National Park	KI - Cape du Couedic 9 (Admirals Arch)	-36.058	136.708	Haul-out (OP)	n
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Cape Gantheaume - KI	-36.074	137.461	Breeding\ Haul-out	n
SA	Conservation Park	Cape Hart Conservation Park	Cape Hart - KI	-35.891	138.057	Haul-out (OP)	g, j, n
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Cape Linois - KI	-36.019	137.587	Haul-out (OP)	s

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
SA	Crown Land	Vacant Crown Land	Cape Rocks	-34.913	135.534	Haul-out	c
SA	Wilderness Area	Cape Bouguer Wilderness Area	Cave Point - KI	-36.026	136.957	Breeding\ Haul-out	n
SA	National Park	Lincoln National Park	Curta Rocks	-34.948	135.870	Haul-out	c
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Dangerous Reef (East)	-34.817	136.216	Haul-out	e
SA	Conservation Park	Sir Joseph Banks Group Conservation Park	Dangerous Reef (West Reef)	-34.817	136.216	Haul-out	e
SA	Conservation Park	Investigator Group Conservation Park	Dorothee Island	-33.997	134.249	Haul-out (OP)	f
SA	Conservation Park	Isles of St Francis Conservation Park	Fenelon Island	-32.581	133.282	Haul-out	f
SA	Conservation Park	Whidby Isles Conservation Park	Four Hummocks Island (Central)	-34.769	135.031	Breeding\ Haul-out	f
SA	Conservation Park	Whidby Isles Conservation Park	Four Hummocks Island (North)	-34.758	135.042	Haul-out	c
SA	Conservation Park	Whidby Isles Conservation Park	Four Hummocks Island (South)	-34.778	135.032	Breeding\ Haul-out	f
SA	Conservation Park	Greenly Island Conservation Park	Greenly Island	-34.639	134.791	Haul-out (OP)	f
SA	Conservation Park	Isles of St Francis Conservation Park	Hart Island	-32.642	133.151	Haul-out	c
SA	Conservation Park	Baird Bay Islands Conservation Park	Jones Island (Baird Bay)	-33.185	134.366	Haul-out	g
SA	Conservation Park	Nuyts Reef Conservatin Park	Lacy Island	-32.399	133.371	Haul-out	c
SA	National Park	Lincoln National Park	Liguanea Island	-34.998	135.620	Breeding\ Haul-out	c
SA	Conservation Park	Althorpe Island Conservatin Park	Little Althorpe Islands	-35.373	136.845	Haul-out	c
SA	Conservation Park	Whidby Isles Conservation Park	Little Hummock Island	-34.751	135.082	Haul-out (OP)	c
SA	Conservation Park	Nicolas Baudin Island Conservation Park, Prohibited Area	Nicolas Baudin Island	-33.016	134.133	Haul-out (OP)	g
SA	Conservation Park	Nicolas Baudin Island Conservation Park	Nicolas Baudin Island (Cape Blanche Is)	-33.016	134.133	Haul-out (OP)	j
SA	National Park	Flinders Chase National Park, Prohibited Area	North Casuarina Island - KI	-36.068	136.702	Breeding\ Haul-out	q
SA	Conservation Park	Gambier Islands Conservation Park	North Island	-35.121	136.476	Haul-out	c
SA	Conservation Park	Neptune Islands Conservation Park, Prohibited Area	North Neptune Island	-35.230	136.068	Breeding\ Haul-out	j, r
SA	Conservation Park	The Pages Conservation Park, Prohibited Area	North Page Island	-35.759	138.301	Haul-out	g
SA	Conservation Park	Investigator Group Conservation Park	North Veteran Island	-33.975	134.264	Haul-out	c
SA	Conservation Park	Nuyts Reef Conservatin Park	Nuyts Reef (southern rocks)	-32.139	132.131	Haul-out	k
SA	Conservation Park	Nuyts Reef Conservatin Park	Nuyts Reef (west)	-32.119	132.131	Haul-out	k
SA	Conservation Park	Olive Island Conservation Park	Olive Island	-32.721	133.969	Haul-out	j
SA	National Park	Flinders Chase National Park, Prohibited Area	Paisley Is (West Bay) - KI	-35.900	136.538	Haul-out	k

State	Tenure	Status of Area	Site/Locality	Lat	Long	Colony/ Haul-out site[1]	Pup count data
SA	Conservation Park	Gambier Islands Conservation Park	Peaked Rocks	-35.187	136.483	Haul-out	c
SA	Conservation Park	Investigator Group Conservation Park	Pearson Island	-33.949	134.261	Haul-out (OP)	f
SA	Wilderness Area	Cape Gantheaume Wilderness Area	Pelorus Islet - KI	-36.129	137.544	Haul-out	m
SA	Conservation Park	Point Labatt Conservation Park	Point Labatt	-33.153	134.261	Haul-out	j
SA			Rabbit Island (Coffin Bay)	-34.620	135.433	Haul-out	
SA			Rabbit Island (Louth Bay)	-34.605	135.986	Haul-out	
SA	Crown Land	Vacant Crown Land	Rapid Head	-35.519	138.167	Haul-out	l
SA	Conservation Park	Rocky Island North Conservation Park	Rocky Island (North)	-34.259	135.260	Haul-out	c
SA	Conservation Park	Rocky Island South Conservation Park	Rocky Island (South)	-34.810	134.718	Breeding\ Haul-out	f
SA	Conservation Park	West Island Conservation Park	Seal Island (Encounter Bay)	-35.577	138.644	Haul-out	l
SA	Conservation Park	Althorpe Island Conservatin Park	Seal Island (Toe of Yorke Pen)	-35.339	136.921	Breeding\ Haul-out	c
SA	National Park	Flinders Chase National Park, Prohibited Area	South Casuarina Island - KI	-36.086	136.694	Haul-out	c
SA	Conservation Park	Neptune Islands Conservation Park, Prohibited Area	South Neptune Island	-35.320	136.112	Breeding\ Haul-out	j, r
SA	Conservation Park	Neptune Islands Conservation Park	South Neptune Island (Lthouse)	-35.336	136.111	Haul-out (OP)	j
SA	Conservation Park	Gambier Islands Conservation Park	South-west Rock	-35.187	136.483	Haul-out	c
SA	Wilderness Area	Cape Gantheaume Wilderness Area	The Verandah - KI	-36.008	137.603	Haul-out	i, g
SA	National Park	Flinders Chase National Park, Prohibited Area	Vennachar Point - KI	-35.886	136.535	Haul-out	c
SA	Conservation Park	Investigator Group Conservation Park	Ward Island	-33.741	134.285	Breeding\ Haul-out	c
SA	Freehold	None	Wedge Island	-35.159	136.489	Haul-out	c
SA	Conservation Park	West Island Conservation Park	West Island	-35.606	138.592	Haul-out	l
SA	Conservation Park	Waldegrave Island Conservation Park	West Waldergrave Is (Little Waldergrave Is. Outer Waldergrave Is. Seal Is.)	-33.596	134.779	Haul-out (OP)	f
SA	National Park	Lincoln National Park	Williams Island	-35.029	135.971	Haul-out	c
SA	Crown Land	Vacant Crown Land	Young Rocks (Young Rock)	-36.363	137.263	Haul-out	
SA	National Park	Flinders Chase National Park, Prohibited Area	KI - Knife and Steel Beach	-36.050	136.710	Haul-out (OP)	n
Tas.	National Park		Maatsuyker Island	-43.649	146.283	Breeding	t
Tas.	National Park		Maatsuyker Island	-43.649	146.283	Breeding	t
Tas.	National Park		Flat Witch Island	-43.619	146.287	Breeding	t
Tas.	National Park		Flat Witch Island	-43.619	146.287	Breeding	t

[1] Definitions:
Breeding: has at least 15 pups 'recorded during at least one survey over the past 20 years' **Haul-out (OP)**: haul-out with occasional pupping–has 1–14 pups 'recorded during at least one survey over the past 20 years' **Haul-out**: sites that are frequented by seals

a) Shaughnessy *et al.* (2001); (b) Kirkwood *et al.* (2005); (c) Shaughnessy *et al.* (1994); (d) Dennis and Shaughnessy (1996); (e) Shaughnessy and Dennis (1999); (f) Shaughnessy pers comm.; (g) Shaughnessy and Dennis (2002); (h) Jane McKenzie, La Trobe University pers. comm.; (i) Juvenile haul-out, B. Page (2001); (j) Shaughnessy and Dennis (2003); (k) Biological Survey Database, South Australia; (l) Entered by Alison Wright, from local knowledge of Chris Halstead, Nov 2004; (m) Robinson *et al.* (1996); (n) Shaughnessy and Dennis (2004); (o) Shaughnessy and Dennis (1998); (p) Shaughnessy and Dennis (2001); (q) Shaughnessy (1997); (r) Shaughnessy and McKeown (2002); (s) Brad Page, La Trobe University, pers. comm.; (t) UD.

Appendix D Relevant standards from the draft policy specifically associated with recreational and commercial tourism interactions with marine mammals in South Australia.

Operating standards.

Minimum standards:

Standard 1. Do not touch or attempt to touch a marine mammal.

Standard 2. Do not feed or attempt to feed a marine mammal.

Standard 3. Do not discard any food, debris or waste within the caution zone (**150 m of a seal or sea lion—see Table below**) of a marine mammal.

Standard 4. Do not make any loud or sudden noises, or play underwater sound recordings, within the caution zone of a marine mammal.

Standard 5. Do not enter or remain within the caution zone of a marine mammal that is within a special interest area (during the period stated), except in accordance with a Department of the Environment and Heritage permit, licence or other agreement, or in the presence of a warden.

Standard 6. Immediately withdraw from the caution zone of a marine mammal that appears to be distressed, sick, injured, stranded, entangled or dead.

Standard 7. Observe the following approach limits within the caution zone of a marine mammal: no closer than 15 m to a seal or sea lion [Note: Allowing oneself to drift within a specified approach limit due to wind, currents or forward momentum constitutes an approach and should not occur].

Additional standards when using aircraft

Standard 8. Do not enter or remain with the caution zone of a marine mammal when using an aircraft below an altitude of 1000 feet.

Standard 9. Do not hover, circle or make any sudden or repeated changes in direction or speed when using an aircraft within the caution zone of a marine mammal.

Additional standards when using motorised vessels

Standard 10. Do not enter or remain with the caution zone of a marine mammal when using the following motorised vessels:

a hovercraft; or·

a wing in ground-effect craft [WIG]; or·

a personal motorised watercraft (e.g. jetski, seadoo); or·

a vessel engaged in motorised water sports (e.g. waterskiing, parasailing).

Standard 11. Observe a 'no wake' speed limit when using a motorised vessel within the caution zone of a marine mammal.

Standard 12. Do not make any sudden or repeated changes in direction or speed when using a motorised vessel within the caution zone of a marine mammal.

Standard 13. Do not enter or remain with the caution zone of a marine mammal if another motorised vessel is already present.[Note: The vessel closest to the marine mammal has priority at all times.]

Standard 14. Observe a one-hour time limit when using a motorised vessel within the caution zone of a marine mammal.

Standard 15. Post a dedicated lookout when using a motorised vessel within the caution zone of a marine mammal, to monitor marine mammal activity.

Standard 16. Observe the following approach limits when using a motorised vessel within the caution zone of a marine mammal:·no closer than 50 m to a seal or sea lion. [Note: Allowing the vessel to drift within a specified approach limit due to wind, currents or forward momentum constitutes an approach and should not occur.]

Standard 17. Do not use a motorised vessel in the following ways:·

to follow a marine mammal; or·

to approach a marine mammal from head-on or from directly behind; or·

to approach a marine mammal from an angle of less than 30 degrees to its observed direction of travel.

Standard 18. Do not position a motorised vessel in the following ways:·

to be directly upwind of a marine mammal; or·

to intercept the travel path of a marine mammal; or·

to come between a marine mammal and its likely escape route.

Standard 19. Ensure that any motorised vessel used is in good condition and has the following features:· main engines fitted or designed so that they can be readily shut down or idled for long periods; and

good access for passenger viewing to minimise the need to constantly reposition the vessel for viewing; and·

manoeuvrability at low speeds to minimise the need for increased revolutions to position the vessel; and·

low windage in relation to draught to minimise effects of wind on position.

Additional standards when conducting in-water interactions

Standard 20. Do not conduct an in-water interaction with a group of more than 20 persons.

Standard 21. Do not conduct an in-water interaction for more than 30 minutes.

Standard 22. Do not conduct more than two in-water interactions per day with a particular marine mammal or group of marine mammals.

Standard 23. Ensure that any person who participates in an in-water interaction:·

is wearing a suitable flotation device; and·

does not wear sunscreen; and·

enters the water in a quiet and orderly fashion; and·

avoids sudden movements; and·

does not approach or attempt to approach a marine mammal.

Standard 24. Do not conduct an in-water interaction with the following equipment:·
artificial lighting (e.g. torches, flash photography); or·
underwater breathing apparatus (e.g. scuba, hookah); or·
motorised diving aids (e.g. personal water propeller, sea-scooter).

Standard 25. Do not conduct an in-water interaction from a moving vessel unless:·
the vessel is moved in a direction parallel to (or away from) that of a marine mammal; and·
each person in the water is holding onto a mermaid line (or equivalent).

Standard 26. Immediately discontinue an in-water interaction if a shark or a newborn marine mammal (fully dependent upon its mother) is observed.

Species (caution zone)	Type of marine mammal	Persons on land or in the water	PERSONS IN CONTROL OF CERTAIN CRAFT			
			Non-motorised vessel	Motorised vessel ('no wake' speed)	Hovercraft, WIG, PWC, water sports	Aircraft (min. 1000 ft)
Seal or Sea lion (150 m)	Distressed, sick, injured, stranded, entangled, dead	150 m	150m	150 m	150 m	150 m
	Within a special interest area[1] (during period stated)	with permit or warden–15 m otherwise–150 m		150 m	150 m	150 m
	Other	15 m	15 m	50 m	150 m	150 m

[1] No permits are available for seal/sea lion interactions using a motorised vessel in the Seal Bay special interest area

Appendix E Western Australian *Wildlife Conservation Act 1950, Wildlife Conservation (close season for marine mammals) Notice 1998,* made by the Minister under section 14(2)(a).

5. (2) A contact vessel (any vessel—including powered boats, sailing boats, inflatable boats, hovercraft, kayaks, surf skis, and jet skis—and any tender vessel accompanying the vessel, within a contact zone, which for seals is the area within a water surface radius of 100 m of the animal) or aircraft must not, without reasonable excuse, disperse or separate a group of marine mammals

5. (6) A contact vessel must not, without reasonable excuse, block
b) any passage of escape available to a marine mammal from an area where escape is otherwise prevented by a barrier, shallow water, vessel or some other obstacle to the marine mammal's free passage

5. (7) A contact vessel must abandon interaction with a marine mammal at any sign of a marine mammal becoming disturbed or alarmed except in the case of a remedial interaction.

6. (1) Aircraft are not, without reasonable excuse, to flu within a distance of 300 m of a marine mammal

7. (1) A person must not feed a marine mammal

7. (2) A person must not, without reasonable excuse, block the direction of travel of a marine mammal any passage of escape available to a marine mammal from an area where escape is otherwise prevented by a barrier, shallow water, vessel, vehicle or some their obstacle to the marine mammal's free passage.

7. (4) If a person is in the water and a fur seal, seal or sea lion is within a distance of 10 m that person must not attempt to pursue or touch the fur seal, seal or sea lion and must avoid allowing a fur seal, seal or sea lion to touch them. (Note, fur seals, seals and sea lions can be dangerous and can cause serious injury if approached.)

7. (5) A person in a contact vessel must not attempt to touch a marine mammal or allow a marine mammal to touch them.

8. Commercial interaction with marine mammals is unlawful in all state waters (and land) unless a licence to carry out this activity has been granted under the *Wildlife Conservation Act 1950* and, similarly, commercial interaction is unlawful in any reserve to which the *Conservation and Land Management Act 1984* applies unless the relevant licence is also held under the *Conservation and Land Management Act 1984*.

9. Clauses 5, 6 and 7 do not apply to a person who is authorized under the Act to interact with marine mammals, if the interaction occurs in accordance with the authorisation. *For example:* a licence issued under Regulation 17 of the *Wildlife Conservation Regulations 1970* or remedial interactions undertaken at a whale stranding.

10. (1) It is an offence for a person to capture, kill, injure, hunt, hit, strike, ride, disturb, molest or take in any other way, a marine mammal unless that person does so in accordance with this notice and the *Wildlife Conservation Act 1950*, or unless it is lawful for that person to do so under the *Conservation and Land Management Act 1984*. It is also an offence for a person to have in his/her possession any carcass or any part of any carcass of any dead marine mammal unless authorised in writing by the Executive Director of CALM.

10. (2) To the extent that this notice and the Wildlife Conservation (Close Season for Bottlenose Dolphins in Shark Bay Marine Park) Notice 1995 are inconsistent, the Wildlife Conservation (Close Season for Bottlenose Dolphins in Shark Bay Marine Park) Notice 1995 prevails.

Further conditions for marine mammal (seal and sea lion) interaction licences issued pursuant to Wildlife Conservation Regulation 15 and the *Wildlife Conservation Act 1950*, applying to commercial wildlife interaction tour operations.

1. General

This licence applies to interactions from the platform of the vessel (i.e. the vessel specified in the purpose of this licence) and does not authorise any swimming with seals/sea lions or any other 'in water' interactions with seals and sea lions.

The Licensee shall not feed marine mammals or throw any object in the water in the vicinity of marine mammals, nor shall he/she permit any passengers or crew to do so.

The Licensee shall dedicate a crew member as a marine mammal lookout.

The Licensee shall ensure that persons under their control or involved in their tour shall NOT touch, or attempt to touch, a seal/sea lion.

The Licensee shall ensure that persons under their control or involved in their tour shall NOT enter the water from the tour vessel in situations where seals/sea lions are closer than 10 m distant from the vessel.

The Licensee shall ensure that at all times persons under their control or involved in their tour shall maintain AT LEAST 5 to 10 m distance away from any sea lions 'hauled out' on land (or rocks or navigation markers etc.)

2. Use of Vessels Covered by this Licence

The Licensee shall NOT permit the vessel to:

restrict the normal behaviour of marine mammals; or, effectively herd or chase marine mammals; or 'box-in' seals/sea lions in or cut off their path; or approach closer than 50 m to island inhabited by breeding seal populations.

3. Area of Operations

3.1. This licence covers marine mammal interactions only within that area of Western Australia identified in the 'purpose' section of this licence.

4. Operations near Research Vessels

4.1. The Licensee shall not, in circumstances where an identified (signposted and licensed) marine mammal research vessel is interacting with a seal, encroach upon that research interaction unless such an approach is agreed to by the skipper of the research vessel. (Note that similarly, in situations where marine mammals are being interacted with by Wildlife Conservation Regulation 15 licensees, the researchers must not approach those mammals closer than public limits unless a closer approach is agreed to by the interacting licensees).

5. Aircraft and Marine Mammals

5.2 The Licensee shall not, under any circumstances, use helicopters to spot marine mammals for vessel based interaction purposes.

6. Reports and Provision of Information

6.1. The licensee shall co-operate with the Department of Conservation and Land Management in gathering and providing any reasonable data as may be required for research and management purposes.

7. Cautions and Insurance

7.1. The Licensee is to exercise due care in the vicinity of marine mammals in recognition that they are wild animals and, while normally not aggressive to vessels or people, are capable of inflicting damage or injury, particularly if harassed or distressed.

The Licensee shall only undertake marine mammal interactions as provided for under this licence during periods when the licence is both:

fully covered by comprehensive insurance for the full value of the vessel (or aircraft, as appropriate) and all equipment for all licensed marine mammal interaction operations; and

holds a valid public liability insurance policy providing no less than A$5 million cover for all licensed marine mammal interaction operations.

7.3 This Licence is an authority to operate marine mammal interactions only within the scope of the *Wildlife Conservation Act 1950* and associated regulations as they apply to the conservation and protection of wildlife and related matters. The Licensee has the responsibility to ensure that he/she has all other necessary legal authorities and approvals to undertake all activities associated with the interactions with marine mammals authorised under this licence.

Further conditions for marine mammal (sea lion) interaction licences issued pursuant to Wildlife Conservation Regulation 15 and the *Wildlife Conservation Act 1950*, applying to commercial wildlife interaction tour operations.

1. General

This licence applies to boat-based interactions from the vessel (i.e. the vessel specified in the purpose of this licence).

The Licensee is authorised by this licence to conduct both viewing of sea lions from the vessel and 'in water' tour interactions with sea lions to the approach limits specified in the *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998* (i.e. persons involved in the tour in any capacity may approach sea lions in the water no closer than 10 m and must carefully move away from any sea lions that approach closer than this distance).

The Licensee shall NOT feed marine mammals or throw any object in the water in the vicinity of marine mammals, nor shall he/she permit any passengers or crew to do so.

The Licensee shall dedicate a crew member as a marine mammal lookout.

The Licensee shall ensure that persons under their control or involved in their tour shall NOT touch, or attempt to touch, a sea lion.

The Licensee shall ensure that persons under their control or involved in their tour shall NOT enter the water from the tour vessel in situations where sea lions are closer than 10 m distant from the vessel.

The Licensee shall ensure that at all times persons under their control or involved in their tour shall maintain AT LEAST 5 to 10 m distance away from any sea lions 'hauled out' on land (or rocks or navigation markers etc.)

2. Use of Vessels Covered by this Licence

The Licensee shall NOT permit the vessel to:

restrict the normal behaviour of marine mammals; or, effectively herd or chase marine mammals; or 'box-in' sea lions in or cut off their path; or approach closer than 50 m to island inhabited by breeding seal populations.

3. Area of Operations

This licence covers marine mammal interactions only within that area of Western Australia identified in the 'purpose' section of this licence.

4. Operations near Research Vessels

4.1 The Licensee shall not, in circumstances where an identified (signposted and licensed) marine mammal research vessel is interacting with a sea lion, encroach upon that research interaction unless such and approach is agreed to by the skipper of the research vessel. (Note that similarly, in situations where marine mammals are being interacted with by Wildlife Conservation Regulation 15 licensees, the researchers must not approach those mammals closer than public limits unless a closer approach is agreed to by the interacting licensees).

5. Aircraft and Marine Mammals

5.2 The Licensee shall not, under any circumstances, use helicopters to spot marine mammals for vessel based interaction purposes.

6. Reports and Provision of Information

6.1. The licensee shall co-operate with the Department of Conservation and Land Management in gathering and providing any reasonable data as may be required for research and management purposes.

7. Cautions and Insurance

7.1 The Licensee is to exercise due care in the vicinity of marine mammals in recognition that they are wild animals and, while normally not aggressive to vessels or people, are capable of inflicting damage or injury, particularly if harassed or distressed.
The Licensee shall only undertake marine mammal interactions as provided for under this licence during periods when the licence is both:
fully covered by comprehensive insurance for the full value of the vessel (or aircraft, as appropriate) and all equipment for all licensed marine mammal interaction operations; and
holds a valid public liability insurance policy providing no less than A$5 million cover for all licensed marine mammal interaction operations.

7.3. This Licence is an authority to operate marine mammal interactions only within the scope of the *Wildlife Conservation Act 1950* and associated regulations as they apply to the conservation and protection of wildlife and related matters. The Licensee has the responsibility to ensure that he/she has all other necessary legal authorities and approvals to undertake all activities associated with the interactions with marine mammals authorised under this licence.

Appendix F Abbreviations

AFMA	Australian Fisheries Management Authority
BAP	Bycatch Action Plan
BRS	Bureau of Rural Sciences
CALM	Department of Conservation and Land Management
CITES	*International Trade in Endangered Species*
CTS	Commonwealth Trawl Sector
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DEH	Australian Government Department of the Environment and Heritage
EMS	Environmental Management Strategy
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFG Act	Flora and Fauna Guarantee Act 1988
GHATF	Gillnet, Hook and Trap Fishery
ISMP	Integrated Scientific Monitoring Programme
IUCN	International Union for the Conservation of Nature and Natural Resources
MACC	Marine and Coastal Committee
MSC	The Marine Stewardship Council
NHT	Natural Heritage Trust
NSSG	National Seal Strategy Group
PIRSA	Primary Industries and Resources, South Australia
SA	South Australia
SARDI	South Australian Research and Development Institute
SESSF	Southern and Eastern Scalefish and Shark Fishery
SETF	South East Trawl Fishery
SETFIA	South East Trawl Fishery Industry Association
SED	Seal Exclusion Device
SLED	Sea lion excluder device
SMP	Scientific Monitoring Programme
SRG	Scientific Reference Group
SSJF	Southern Squid Jig Fishery
WA	Western Australia
WCRLF	West Coast Rock Lobster Fishery

DAFF job no. 950531