MANAGEMENT OF PINNIPEDS IN WESTERN AUSTRALIA 1998 - 2008

1. INTRODUCTION

The *Wildlife Conservation Act 1950* mandates a legislative requirement to "conserve and protect wildlife". Whilst the Act provides no legislative requirement for the production of specific Management Programs, such programs can provide a mechanism to set priorities for the conservation and protection of wildlife and guide CALM's and others' actions in relation to wildlife. This Western Australian Pinniped Management Program (henceforth to be referred to as the "Program") aims to provide such a mechanism in relation to the pinniped fauna (sea lions, fur seals and other seals) of Western Australia. The primary emphasis of the program is to deal with the native Australian sea lion (*Neophoca cinerea*) and New Zealand fur seal (*Arctocephalus forsteri*). Throughout the document these species will often be referred to simply as the "sea lion" and "fur seal".

The program is to be endorsed by the National Parks and Nature Conservation Authority (NPNCA), and approved by the Executive Director of CALM and the Minister for the Environment.

1.2 PERIOD OF OPERATION

The Western Australian Pinniped Management Program is to operate for 10 years (1998-2008) with the possibility of being adapted/reviewed in the light of changes in information, circumstances or resources.

2 OVERALL OBJECTIVES

Recognising that overall sea lion and fur seal populations are probably less abundant and possibly less widespread than their levels prior to exploitation, the overall objectives of the Program are to:

- maintain and enhance pinniped populations as widespread and abundant components of the WA coastal ecosystems in which they are found; and,

- manage interactions between existing and anticipated human demands on pinnipeds and the resources we share with them, on a sustainable and equitable basis.

2.1 MANAGEMENT AGENCIES:-

The Management Agencies and Stakeholders that are likely to have a principal responsibility or interest in this Program are:

- Western Australian Department of Conservation and Land Management (CALM)
- Western Australian Department of Fisheries
- Environment Australia (Federal waters)
- Australian Fisheries Management Authority (AFMA)
- Rottnest Island Authority
- Department of Defence
- Department of Transport
- South Australian Department of Environment and Natural Resources (SADENR)
- Western Australian Fishing Industry Council (WAFIC)
- Recreational Fishers organisations
- Non-Government Organisations

2.2 MEASURABLE AIMS

2.2.1 Species that breed in Western Australia (sea lion and fur seal)

- Determine the current distribution of breeding and haul-out sites.
- Determine foraging range and behaviour.
- Determine population abundance and trends.
- Determine population stock discreteness and the flow of animals between stocks.
- Identify, quantify and minimise any human-induced impacts that may be limiting to pinniped population abundance and/or distribution.
- Identify and quantify any pinniped-induced impacts that may be limiting to human enterprise and examine appropriate management strategies to minimise or mitigate these impacts.

2.2.2 Species that do not breed in Western Australia

- Determine temporal and spatial aspects of trends in sightings and beaching incidents of pinniped species that do not breed in Western Australia
- Develop better protocols for management of beaching incidents.

2.2.3 Positively influence public attitudes to Pinnipeds

- Develop protocols to ensure the production and appropriate distribution of high quality educational material and information on pinnipeds to commercial and non-commercial stakeholders with an interest in pinnipeds.

- To facilitate timely and open exchange between CALM and other stakeholders of information relevant to the management of pinnipeds

3. BACKGROUND TO PINNIPED MANAGEMENT IN WA

3.1 AUSTRALIAN SEA LION

3.1.1 *Taxonomic Relationships*

Sea lions are part of the Order Carnivora, Suborder Pinnipedia, Family Otariidae, and subfamily Otarinnae. Within the family Otariidae are the extant genera *Arctocephalus, Callorhinus, Eumatopias, Otaria, Phocarctos, Zalophus* and *Neophoca.* The genus *Neophoca* contains only one species, the Australian sea lion, *N. cinerea*. Some common names applied to this species are Australian sea lion (preferred): white-necked or white-caped hair seal, counsellor seal or hair seal. Australian sea lions could be confused with New Zealand sea lions (*Phocarctos hookeri*), but their ranges do not overlap. Sea lions and fur seals are markedly different in colour and morphology and should not be confused (see description below).

3.1.2 *Description*

The Australian sea lion displays a marked sexual dimorphism. Males can reach weights of up to 250 kg and standard lengths of up to about 200 cm. A creamy-white main and cap become prominent with age along with the development of a massive and obscure neck. The remainder of the body is brown. Females usually weigh 70-80 kg, but can reach more than 100 kg during pregnancy. They range in standard length from about 130-180 cm. Females and younger sea lions are silvery-grey dorsally and cream ventrally. Newborn pups are a chocolate-brown colour. All sea lions have a relatively short, rounded snout, small, tightly rolled external ears and relatively short flippers. By contrast the fur seals have long, pointed snouts, longer external ears and relatively longer flippers.
A full description of the external characteristics, colour and size of the various age-sex classes of the Australian sea lion is provided by Ling (1992). Diagnostic traits used to classify age-sex classes are also reported by Gales *et. al.* (1994).

3.1.3 *Reproduction*

The reproductive behaviour of the Australian sea lion is unique among pinnipeds. It has been shown

to have a non-annual, non-seasonal breeding cycle of 17-18 months (Ling and Walker 1978; Gales *et. al.* 1994; Higgins 1993), to be temporally asynchronous between breeding sites (Gales *et. al.* 1994), and to have a non-typical otariid mating strategy (Higgins 1990). Higgins (1993) determined the mean interbirth interval for sea lions at Kangaroo island, South Australia, to be 17.6 ± 0.3 months; this duration was also documented on islands of the west coast of Western Australia (Gales *et. al.* 1992a) and is believed to operate throughout the sea lions' breeding range (Gales *et. al.* 1994; Gales and Costa 1997). The consequence of the supra-annual duration of the breeding cycle is that a seasonal drift in pupping seasons occurs over time, with pupping eventually occurring at all times of year (and hence all seasons). Combined with the lack of temporal synchrony of pupping seasons at different sites, this species is particularly challenging to survey for estimates of pup production.

Females may produce their first pup at 4.5 years old (Higgins 1990); the duration of their reproductive life is unknown. The females are mated about 7 days after pupping (Higgins and Gass 1993) and the resulting blastocyst remains relatively dormant for the next 3.5-5 months before reactivation and the commencement of a prolonged post-implantation gestation of up to 14 months (Gales *et. al.* 1997). Pups are nursed for 15-18 months, weaning occurring about one month prior to the birth of the next pup (Higgins and Gass 1993). During lactation the females produce milk of lower energy (fat) content than most pinnipeds (30.8 ± 9.8% lipid) (Gales *et. al.* 1996). An estimated 71% of females produce pups in consecutive seasons (Higgins and Gass 1993).

The mating strategy of sea lions is not typical of the pattern seen in other polygynous colony breeding pinnipeds. Rather than procur and maintain dominance over a large number of females, sea lion bulls usually attend a single post-parturient female at a time, seeking another mate when that female has completed oestrus (Higgins 1990). This type of sequential polygyny may not be the only reproductive behaviour adopted by bull sea lions as Marlow (1975) reported males attending up to four females at one time on Dangerous Reef. A more detailed summary of this reproductive behaviour is given by Gales and Costa (1997).

The histology of the female sea lion reproductive tract has been described in detail by Tedman (1991).

3.1.4 *Mortality*

There are few survivorship data available for this species beyond the first six months of life. During this period 7% and 24% of pups had died on two consecutive breeding seasons on the islands off the west coast of Western Australia (Gales *et. al.* 1992a). Approximately 23% of pups died during the first six months on Kangaroo Island, South Australia. Mortality is likely to vary between sites and seasons. Some high mortality events of unknown cause among pups have been reported from the Pages Islands (56%) and Dangerous Reef (30%) in South Australia during 1996 (T. Dennis, personal communication). Higgins (1990) estimated mortality of Kangaroo Island sea lions was 40 to 50% after two years.

Longevity has not been determined for either sex of sea lions, but females marked at birth have been observed breeding at Seal Bay, Kangaroo Island 20 years later (T. Dennis, personal communication).

Causes of mortality for this species are likely to be wide-ranging and include natural events such as predation from sharks, parasitism, disease, starvation (particularly as a result of pups being separated from their mothers) (Mawson and Coughran, in preparation) and aggression of bulls to pups (Higgins and Tedman 1990). Anthropogenic causes recorded on an *ad hoc* basis include drowning of pups in lobster pots (Gales *et. al.* 1992a), bycatch in shark gill-nets (R. Johnstone, personal communication), entanglement in fishing and other debris (Shaughnessy *et. al.* 1997), deliberate killing and boat impact (Mawson and Coughran, in preparation). Mortality due to oil pollution has not been recorded for this species, but an oil spill from a tanker that sunk off the west coast of WA, the "Kirki", clearly demonstrated the potential of this threat. Historically, sealing was a significant cause of mortality. The full extent and potential impact of the anthropogenic causes of mortality are unknown.

3.1.5 *Diet & Feeding Habits*

Qualitative accounts of the diet of Australian sea lions have reported a wide variety of prey items ranging from teleost fish, elasmobranches, cephalopods, crustaceans, penguins and other sea birds, and turtles (Richardson and Gales 1987; Gales and Cheal 1992; Ling 1992). Many of the prey items identified are benthic and demersal organisms. The use of scats as a diagnostic tool to quantify diet in this species has been shown to be unreliable due to a low and highly variable rate of excretion of identifiable remains (Gales and Cheal 1992).

Sea lions have been observed to feed from netted prey items (eg. eating the liver from netted sharks), which has bought them into conflict with fishermen. Sea lions, particularly males, living close to areas of human habitation can be easily trained to accept food directly from people.

The diving behaviour of lactating sea lions was studied at Kangaroo Island, South Australia. These animals spent 50-60% of their time at sea underwater and appeared to feed predominantly on, or close to, the sea bed. They showed no diurnal pattern in diving behaviour. The mean dive depth was 67m, most dives were less than 100m. Dive duration averaged 3.3 min., the longest dive recorded was 8.3 min. (Costa *et. al.* 1991; Gales and Costa 1997). Measurement of at-sea metabolism of lactating sea lions indicated that they expend more energy in foraging than similar sized California sea lions (*Zalophus californianus*). This could be interpreted to indicate that resources are more limited in coastal Australian waters than coastal north-west American waters. Indeed, the waters of Western Australia and South Australia are known to be among the most energy limited waters of the world (Rochford 1980), and this has been suggested to be a primary factor in determining the feeding behaviour and unusual life cycle of the Australian sea lion (Gales *et. al.* 1994; Gales and Costa 1997).

3.1.6 *Population structure and Movement Patterns*

Little is known of the population structure of Australian sea lions. No evaluation of genetic discreteness between breeding sites has been reported. Male sea lions sighted and marked on the islands off the metropolitan region of Perth have been found on the breeding islands in the Jurien Bay region, a distance of up to 280 km. (Gales *et. al.* 1992a). *Ad hoc* observations show reasonably wide dispersal from natal sites of juveniles & non-juvenile males. The movement of adult females is restricted by the dependence of their pups and they are likely to be fairly sedentary. **(Terry.....how far afield have sea lions tagged on KI been seen????)**

3.1.7 *Distribution & Haul Out Sites*

The Australian sea lion is distributed from Houtman Abrolhos in Western Australia to The Pages in South Australia. Gales *et. al.* (1994) reported that sea lions hauled out or bred on 69% of the 255 islands they surveyed within this range. Fifty islands, of with 27 are in Western Australia and 23 in South Australia were confirmed to support breeding populations of sea lions. These authors also reported six sites along the Great Australian Bight and west coast of the Eyre Peninsula where sea lions haul out and may breed. More recently Dennis and Shaughnessy (1996) reported on a systematic survey of potential sea lion haulout sites along a 206 km stretch of the Great Australian Bight. They found 10 breeding sites and 14 haulout sites. One breeding site was situated in Western Australia. Unpublished reports have also been subsequently made of one additional breeding location in the Recherche Archipelago at George island (Bernie Haberley, personal communication) and of a single pup being born at Steep Point at the southern entrance to Shark Bay. This increases the confirmed breeding locations of sea lions in Western Australia to 30. Gales *et.al.* (1994) also reported on a further six islands in Western Australia being possible, but unconfirmed breeding locations of sea lions. Breeding populations of New Zealand fur seals were sympatric with sea lions on seven islands in Western Australia and five in South Australia (Shaughnessy *et. al.* 1994). See Appendix 1 for a full list of all breeding sites.

Habitat selection for breeding sites by Australian sea lions is summarised by Gales *et. al.* (1994). Generally, sea lions prefer the sheltered aspect of islands with access to protected water for the pups. Substrate can vary from beach sand to limestone or granite rock. Vegetation such as *Nitraria schoberi* is used to shelter pups when available, but ledges under rocks may also be used. There are no reports of sea lions and fur seals using the same habitat for breeding sites. Habitat selection for haul-out sites is less specific and does overlap with that used by fur seals.

3.1.8 *Population estimates from past surveys*

The Australian Sea lion is a comparatively rare pinniped, being the least abundant of the world's five extant sea lion genera. Estimates of abundance suggest that the total population is of the order of

10,000 to 12,500 (Gales *et. al.* 1994; Dennis and Shaughnessy 1996), with perhaps 2,600 to 3400 in Western Australia (800-1,000 on the west coast and 1900-2400 on the south coast) (Gales *et. al.* 1994).

Estimates of pristine population abundance have not been reported. In Western Australia there are no data from which population trends can be determined, although from anecdotal accounts it appears that the population is not expanding in the way that fur seals appear to be. In South Australia the sea lion population on Kangaroo Island appears to have been stable for the past few decades (T. Dennis, personal communication).

3.1.9 *Status*

The Australian sea lion is listed as "specially protected" pursuant to section 14(2)(ba) of the Western Australian *Wildlife Conservation Act 1950.* This listing has been made in recognition of the view that the sea-lion is an uncommon animal that is likely to have declined significantly in abundance over recent centuries, that it can come into conflict with fishing activities and that the standard maximum penalty for taking such fauna may not provide an adequate deterrent to reduce the occurrence of illegal taking.

The 1994 IUCN (International Union for the Conservation of Nature) Red List of Threatened Animals (IUCN 1993) and the report of the Seal Specialist Group of the IUCN Species Survival Commission (Reijnders *et. al.* 1993) list the Australian sea lion as rare. The new categories of the IUCN published in November 1994 (IUCN 1994) no longer contain the category "rare" and interpretation of these criteria indicates the sea lion will be listed as Lower risk, near threatened (see detailed discussion in Shaughnessy, in preparation).

The sea lions are not listed with the Convention on International Trade of Endangered Species (CITES).

The draft Action Plan for Australian Seals (Shaughnessy, in preparation) lists the sea lion on the basis of the IUCN November 1994 criteria as Lower risk, Near threatened, Flagship taxon.

3.2 NEW ZEALAND FUR SEAL

3.2.1 *Taxonomic Relationships*

New Zealand fur seals are part of the Order Carnivora, Suborder Pinnipedia, Family Otariidae, and subfamily Otarinnae. Within the family Otariidae are the extant genera *Arctocephalus, Callorhinus, Eumatopias, Otaria, Phocarctos, Zalophus* and *Neophoca.* The genus *Arctocephalus* contains eight species, all but one of which live in the southern hemisphere. Only one species, *Arctocephalus*

pusillus has been divided into two sub-species (*A.p.pusillus*, the South African or Cape fur seal, and *A.p. doriferus*, the Australian fur seal). The New Zealand fur seal, *Arctocephalus forsteri* in monospecific, but recent work on genetic differences between stocks around Australia and New Zealand have suggested that some revision of the taxonomy of this species is required (Lento *et. al.* 1994, 1997). Analysis of skull morphology from disparate populations also supports this assertion (Brunner, in press).

Common names applied to this species are New Zealand fur seal (preferred) and South Australian fur seal.

New Zealand fur seals can be confused with other *Arctocephalus* species, particularly *A. pussilus doriferus, A. tropicalis, and A. gazella* that may be found within its range.

3.2.2 *Description*

The New Zealand fur seal displays sexual dimorphism. Adult males weigh 120-180 kg and measure 150-250 cm from nose to tail and adult females weigh 35-50 kg and measure 100-150 cm in length. The males are a dark grey to brown colour with a pale muzzle, long white vibrissae, and a long pointed snout. Females are metallic grey to brown on the dorsum and are paler ventrally. New born pups are dark brown to black, weigh 4-6 kg and are 60-70 cm from nose to tail (Goldsworthy and Crawley 1995).

3.2.3 *Reproduction*

New Zealand fur seals are synchronous, annual, polygynous breeders. Most pups are born during December and the first half of January throughout the range. On Kangaroo Island the median pupping date is 21 December and 90% of the pups are born between 3 December and 6 January (Goldsworthy and Shaughnessy 1994). Females are reported to produce their first pup at either four to five years of age (Goldsworthy and Crawley 1995) or six years of age (Shaughnessy in preparation). Approximately 67% of females produce pups in consecutive years at Cape Gantheaume, Kangaroo Island (Goldsworthy and Shaughnessy 1994). Gestation is likely to be partitioned into the typical otariid pattern of embryonic diapause for the first 3-4 months and an 8-9 month post-implantation period, but the reproductive physiology of this species has not been studied. Pups are usually weaned up to four months prior to the birth of the next pup (at 8-12 months). Male fur seals are socially mature at 8-9 years and are able to compete for territories.

A more detailed description of the reproductive behaviour of fur seals is provided by Goldsworthy and Crawley (1995).

3.2.4 *Mortality*

The mortality rate of pups on Kangaroo Island is reported to be 1% in the first 6 weeks, and 9% to 16 weeks of age (Shaughnessy *et. al.* 1995). These estimates have not been collected at other sites in Australia. In New Zealand.....(**Hugh Best data**). Mortality rates of pups have been shown to be density and resource dependant in other polygynous pinnipeds around the world and this is certain to be the case for fur seals in Australia.

Life history tables have not been determined for the New Zealand fur seal.

As is the case for the sea lions, causes of mortality of fur seals are likely to be wide-ranging and include natural events such as predation from sharks, parasitism, disease and starvation (Mawson and Coughran, in preparation). Anthropogenic causes recorded on an *ad hoc* basis include entanglement in fishing and other debris (N. Gales, unpublished data) and impact from oil (Gales 1991). Historically, sealing was a significant cause of mortality. The full extent and potential impact of the anthropogenic causes of mortality are unknown.

3.2.5 *Diet & Feeding Habits*

Little is known of the diet of this species. The only work conducted to date has occurred at Kangaroo island where prey items consisted principally of fish and cephalopods. Cephalopods represented a greater proportion of the diet in summer, fish were more common in winter. Birds (mainly the little penguin) were also represented in the diet (Goldsworthy and Crawley 1995). The biases associated with attempts to quantify prey components in diet from scat or regurgitate analysis are likely to as significant a problem with fur seals as for any other pinniped. Consequently, the data should be interpreted cautiously.

Studies of the foraging behaviour of lactating fur seals conducted at Kangaroo Island show that, in contrast to the sea lion, female fur seals dive almost exclusively during the night and rest during the day. Dives are usually made to the sea bed in the near-by shallow shelf waters (70-80m) during early lactation (summer-autumn) and then to more variable depths of 20-200m in waters further from the breeding grounds around the edge of the continental shelf (Goldsworthy and Crawley 1995). This seasonal and diurnal pattern of diving behaviour is also recorded for this species in New Zealand (Harcourt *et. al.* 1996; Mattlin *et. al.* in press). Studies of the diving behaviour of other age and sex classes have not be undertaken.

In contrast to the sea lions, fur seals tend not to frequent inshore areas with human populations. Consequently, conflict with inshore fishers appear to be infrequent. Fur seals are commonly seen from commercial fishing vessels operating further offshore.

3.2.6 *Population structure and Movement Patterns*

Little in known of the population structure of the New Zealand fur seal. The work of Lento *et. al.*

(1994; 1997) and Brunner (in press) suggest that the population is not panmictic and movements of animals between these, as yet undefined, sub-populations may be infrequent. Furthermore, Lento *et. al.* (1994; 1997) argue that the differences seen at a molecular level between New Zealand fur seals from differnt locations are of the magnitude reported for full species differences in other mammals. Some mixing between the New Zealand and Australian stocks of New Zealand fur seals may occur as one animal tagged as a pup on an island off the west coast of the South Island of New Zealand was found drowned in a fishing net at Lakes Entrance, Victoria (H. Best, personal communication). Similarly, there are occasional reports of New Zealand fur seals in parts of Australia that are beyond the normal range (see below). Most of these sightings are of fur seals tagged as pups on Kangaroo Island. Several thousand fur seals have been tagged at this site. The significance of these extra-limital animals is unknown as these movements may or may not represent a migration from, and back to, their natal site, in which case the mixing of the genetic material will be limited.

Juvenile, non-reproductive female and male fur seals are likely to disperse widely from natal sites during the non-breeding season. The degree of dispersal of lactating females are constrained in their dependant offspring.

3.2.7 *Distribution & Haul Out Sites*

New Zealand fur seals breed around the southern half of New Zealand and the islands to the south; and in Australia along the south coast of Western Australia, coastal South Australia and Maatsuyker Island in Tasmania and Macquarie Island (Goldsworthy and Crawley 1995; Shaughnessy *et. al.* 1994; Brothers and Pemberton 1990; S. Goldsworthy, personal communication). The western most breeding site is Flinders Island, near Augusta, WA (P. Lambert, personal communication); a further 16 islands support breeding population of fur seals in Western Australia and 13 in South Australia (Shaughnessy *et. al.* 1994) (See Appendix 2 for full list of islands).

Breeding habitat is typically jumbled, rocky terrain on fairly exposed aspects of islands. Pups and juveniles secrete themselves among the rocks and can be very hard to see; this behaviour makes census work a challenge. Peak numbers of animals occur on the breeding colonies during the breeding season, but animals are present year round. Haul-out habitats are more widespread and diverse in character.

3.2.8 *Population estimates from past surveys*

The only comprehensive survey of New Zealand fur seals conducted over most of their range was conducted by Shaughnessy et. al. (1994). They estimated the abundance of new-born pups from the survey data and extrapolated to an estimate of overall population abundance. This technique resulted in estimates of 7,000 fur seals in WA, with a further 27,000 or so in South Australia. A further several hundred or so New Zealand fur seals live around Maatsuyker Island and the population size from Macquarie Island has not been estimated. Comprehensive surveys of fur seals

in New Zealand have not been conducted over the entire range in recent times. Based on surveys of some locations (using different techniques and at different times) the population is thought to number well in excess of 50,000, with perhaps as many as two hundred thousand animals (N. Gales, personal communication).

Rates of annual increase in pup production have been reported for several fur seal breeding sites in South Australia and vary from 0 to 19% (Shaughnessy *et. al.* 1995). Anecdotal information suggests that fur seal populations have also been expanding in both range and magnitude in Western Australia. This has also been the case in New Zealand where some colonies are expanding at rates in excess of 20% per annum. These relatively recent observations of population expansion in this species are likely to represent a degree of recovery after previously indiscriminate harvesting of animals for fur. It is unlikely that current populations are equal to or greater than they were historically.

3.2.9 *Status*

The New Zealand fur seal is listed as "Specially Protected" pursuant to section 14(2)(ba) of the Western Australian *Wildlife Conservation Act 1950.* This listing has been made in recognition of the view that the sea-lion is an uncommon animal that is likely to have declined significantly in abundance over recent centuries, that it can come into conflict with fishing activities and that the standard maximum penalty for taking such fauna may not provide an adequate deterrent to reduce the occurrence of illegal taking.

The currently published IUCN lists do not include this species (IUCN 1993; Reijnders *et. al.* 1993). The more recent IUCN criteria (IUCN 1994) indicate the fur seal is Lower risk and Conservation dependant. New Zealand fur seals are listed according to these IUCN (1994) categories in the draft Action Plan for Australian Seals (Shaughnessy, in preparation).

Fur Seals are listed as an Appendix II species with CITES. This listing precludes any international trade with fur seals or fur seals parts without a CITES permit.

3.3 OTHER PINNIPEDS ENCOUNTERED

Other pinnipeds that are not native to Western Australia are occasionally encountered along the coast. For many of these animals their presence on the coast is regarded as being at the extreme of, or beyond, their normal range. Commonly, they are in poor condition and often require some management intervention.

3.3.1 *Other fur seal species.*

The most commonly encountered species is the Subantarctic (also known as Amsterdam) fur seal *Arctocephalus tropicalis.* This fur seal breeds on Subantarctic islands in the southern Indian and Atlantic oceans and have been reported to be increasing their population range and abundance

(Bester 1987; Kerley 1987; Roux 1987; Goldsworthy and Shaughnessy 1989). Within the Australian region, Subantarctic fur seals breed on Macquarie Island (Shaughnessy *et. al.* 1988) and one pup has been born at the haul-out site at Heard Island (Goldsworthy and Shaughnessy 1989). On the basis of this Shaughnessy (1992) has recommended that they be considered part of the Australian fauna.

Records of Subantarctic fur seals on the Australian coast have been summarised up to 1991 by Gales *et. al.* (1992b). Of the 37 sightings reported, 17 occurred in WA. Since them, many more sightings of this species have been reported (Mawson and Coughran, in preparation). Diagnosis of fur seal species is difficult, particularly among juvenile age classes. Consequently, it is likely that many Subantarctic fur seal sightings are not reported, as they are confused with the native New Zealand fur seals. Similarly, if an Antarctic fur seal (*Arctocephalus gazella*) was to appear on the WA coast its presence may well be undetected. Sighting of these non-native *Arctocephalus* species are important as interbreeding between these congenerics has been reported (Shaughnessy *et. al.* 1988).

3.3.2 *Leopard seal*

Leopard seals (*Hydrurga leptonyx*) breed on the Antarctic pack ice all around Antarctica. Each year they are recorded on the Australian coast, often in a malnourished state. Mawson and Coughran (in preparation) summarise the recent records in WA. This species can be particularly difficult and dangerous to handle.

3.3.3 *Southern elephant seal*

Southern elephant seals (*Mirounga leonina*) breed on Subantarctic islands throughout the Southern Ocean, including Macquarie and Heard Islands. Prior to exploitation by humans, elephant seals bred on King Island in Bass Strait. Sightings in WA were rare until recently when reports from North West Cape and the south coast have become more common. The animals sighted appeared to be in good health and include records of a birth (Mawson and Coughran, in preparation).

3.3.4 *Crabeater seal*

Crabeater seals (*Lobondon carcinophagus*) breed in the Antarctic pack-ice and are believed to be the most abundant of the worlds' pinnipeds. Despite this, reports of their occurrence in Australia are rare. There are two records of Crabeater seals in WA (Mawson and Coughran, in preparation).

3.4 Past Harvesting Of Pinnipeds And Impacts On Populations

3.4.1 Aboriginal Harvests

The degree to which fur seals and sea lions were utilised by indigenous Australians in not reported. Pinniped bones have been recovered from Aboriginal middens on Kangaroo Island (N. Draper, SADENR, unpublished report), and Tasmania (Wood Jones 1925) and it is likely that their use as a

food resource was more widespread. There are no records of pinniped bones found in Aboriginal middens in WA, but the nature of coastal terrain is that the sites weather rapidly (C. Dorch, peronal communication). Early European explores in WA did record instances of Aborigines clubbing pinnipeds and it seems highly likely that if pinnipeds were easily available to coastal hunters, they would have been utilised, particularly for their high value in fat reservers (S. Marghar, personal communication). Coastal islands may have offered Australian pinnipeds a safe haven from human predation. Currently, a few sea lions breed on isolated and inaccessible mainland sites (Dennis and Shaughnessy 1996); such practice may have been more widespread for sea lions and fur seals prior to human occupation of Australia. In New Zealand, Maori use of sea lions appears to have resulted in at least a reduction in range, and potentially a reduction in absolute abundance (Childerhouse and Gales, in press). It is unlikely that the level and impact of aboriginal harvesting of pinnipeds in WA was large, given their limited use of off-shore marine resources, but such hypotheses are unlikely to be elucidated.

3.4.2 Past Hunting for the Skin and Oil Trades

The hunting of Australia's three native pinnipeds (Australian sea lions, New Zealand fur seals and Australian fur seals) occurred primarily between 1798 and 1825. During this period it is clear that most populations were effectively driven to commercial extinction. Remnant populations continued to be harvested on an occasional basis until the 1920s. Fur seals were the primary target of this industry as the pelt was highly valued; sea lions were often taken as a secondary target when fur seals were less abundant. Estimates of numbers taken, or pristine population abundance are largely unavailable, making comparisons with present abundance difficult. It is clear that sea lions and fur seals suffered a range reduction from the east, and in case of sea lions from the west. In WA, records of early explorers show that sea lions were once relatively abundant in the Albany region (Vancouver 1801; Flinders 1814) and were also relatively abundant at Houtman Abrolhos (Gilbert 1843). Only remnant populations are currently found in there regions. Similarly, records indicate that sea lions once bred and were relatively abundant on Rottnest and Garden Islands (Freycinet 1807); they are now uncommon visitors to these islands.

Southern fur seal populations appear to be experiencing a period of recovery throughout their circumpolar range and the New Zealand fur seal is no exception. Despite this population increase it is unlikely that current population levels are approaching those prior to exploitation. Sea lions do not appear to be experiencing a similar recovery. The causes for this may be the lower reproductive potential of an animal with a supra-annual gestation or may reflect a competitive limit for its idiosyncratic ecology.

3.4.3 Collecting for Pinniped Displays

Four permits have been issued for the collection of pinnipeds for public display in WA. They were all issued to Atlantis Marine Park, an oceanarium that operated in Two Rocks from 1981 to 1989. The

first permit was issued in 1981 for the collection of six sea lions and six fur seals. The animals were collected from Daw Island in the Rechereche Archipelago. Further collections were made from the Recherche Archipelago of one sea lion (from Wickham Island), and two fur seals (from Rocky Island) in 1984. In 1987 a further license was issued for the collection of 6 sea lions from Daw Island (**are these figures correct?**).

Permits were also granted to Atlantis during the 1980's on an *ad hoc* basis for the display of animals found injured or malnourished along the WA coast. These animals comprised Subantarctic fur seals and Leopard seals.

3.5 Other Human Impacts On Pinniped Populations

3.5.1 Incidental Take in Fisheries

Interactions between marine mammals and commercial fisheries are a common and growing global problem. A summary of pinniped interactions with fisheries in Australian waters is provided by Shaughnessy (in preparation). Interactions with pinnipeds are particularly common in areas where major trawl fisheries operate and in areas where aquaculture and pinniped foraging grounds overlap. In WA the only commercial trawl fishery is for benthic crustaceans in waters north of Shark Bay. The nets are relatively small and the area is north of the range of fur seals and has minimal overlap with sea lions. No interactions have been reported. A seine fishery, primarily targeting pilchard, operates in the south-western and southern coastal waters of WA. There have been no negative interactions with pinnipeds reported in this fishery. A gill net fishery for shark operates is the same waters as the seine fishery. This fishery has reported problems of pinnipeds eating and damaging netted shark (particularly of sea lions eating shark livers). There are also reports of sea lions becoming entangled in the fishing nets and drowning (R. Johnstone, personal communication). The magnitude of this interaction has not been assessed. Similar interactions are also reported in South Australia.

Sea lions are known to interact with recreational gill nets on the west coast of Western Australia although no drownings have been reported. Tags, applied to sea lion pups on the west coast breeding islands, have been found tangled in the nets (N. Gales, unpublished data). As tags have not been applied to sea lions elsewhere in Western Australia it is unknown if this interaction is more widespread. Recreational gill netting occurs through most of the range of the sea lions (**is this correct?**).

Details of trap nets for herring required. Also entanglements in any other fishing gear in WA and SA.

In WA, juvenile sea lions are reported to occasionally become caught and drowned in lobster pots in the mid-west coast region (Gales *et. al.* 1992a). The magnitude of this interaction has not been quantified, but the problem has also been identified with sea lions in South Australia and fur seals in

Victoria and Tasmania. In these States steps to modify fishing equipment have been undertaken in an attempt to mitigate the problem.

3.5.2 Damage Reduction Taking Associated with Fisheries

(a) Estuarine gill net & some seine netting

Along the south coast of WA individual animals, particularly older male sea lions, are believed to have become habituated to feeding from gill nets. Given that the fishery overlaps with the foraging range of the small number of sea lions around the Albany region and the ease of feeding on netted fish, such an interaction is not unexpected. During the feeding episodes the sea lions have commonly damaged the nets as well as depriving the fisherman of their catch. In an effort to solve the problem CALM have issued a number of damage reduction permits. In the past few years these permits have allowed the fishermen to scare the sea lion by shooting in the vicinity of the animal. Thirty two such licences were issued by CALM between 1990 and 1996; all were for sea lions in the south coast region. Prior to this several permits were granted which allowed the animal to be destroyed. The practice of shooting troublesome pinnipeds has previously been used in Tasmania for fur seals around fish farms. This practice was only of a short-term benefit to the fish farmer and proved to be offer no long term solution (Pemberton and Shaughnessy 1993).

(b) Aquaculture

Interactions between pinnipeds and fish farms are common where farming is conducted in areas where pinnipeds are found. Indeed, Pemberton and Shaughnessy (1993) demonstrated a direct relationship between the magnitude of the problem and the proximity to fur seal colonies in the Tasmanian region. Aquaculture is not a major industry in Western Australia, and consequently the problems of interactions with pinnipeds have been minimal. Sea lions do interact with sea pens holding Bluefin Tuna in South Australia (**any more details Terry?**).

Attempts to mitigate this problem have been made wherever this type of interaction occur and have involved methods including visual deterrents (such as model killer whales swimming around the pens), acoustic deterrents (ranging from killer whale vocalisations to sounds designed to scare or hurt the animal), aversive stimuli such as feeding the seals fish filled with emetics, shooting animals and exclusion barriers. Some of the sophisticated high-energy sound transmitting devices have been reported to be successful, but have not been subject to rigorous testing. Exclusion nets work well, but require a high level of investment from the farmers to operate. The remaining techniques do not appear to offer long term solutions to the interactions.

3.5.3 Illegal Taking

Sea lions and fur seals have been illegally killed in Western Australia. Incidents such as shooting,

spearing and clubbing have been identified from examination of injured and dead pinnipeds seen along the coast (Mawson and Coughran, in preparation). The magnitude of this problem is unknown and difficult to determine given the isolated nature of the West Australian coastal environment. No prosecutions have been made.

3.5.4 Fishing Impacts on Pinniped Food Resources/Populations

The potential dynamics of any competition between pinnipeds and human fishers in Western Australia for a common resource is not well understood. The diet of WA's pinnipeds is poorly described and difficult to quantify, and the dynamics of the marine food chain from which humans acquire their resource are equally poorly understood. Consequently, we can only speculate on the likelihood of direct competition and impact. Given that what little we know of the diet of sea lions indicates a wide range of prey types, and the relatively small scale and diverse nature of this states' commercial fisheries, it seems unlikely that sea lion food resources are impacted by humans. Fur seals appear to be slightly more specific in prey selection and feeding behaviour and may therefore be more vulnerable to impact. However, given the apparent increase in population range and abundance that fur seals are currently experiencing, the degree of any potential impact on food resources does not appear to be limiting.

3.5.5 Oil Spill Impacts

The potential for impact from oil spills on pinniped populations in Western Australia exists throughout the range of both native species as coastal shipping and ports are a feature of the coastline. The only significant oil spill to impact pinnipeds in Western Australia was the sinking of the bulk ore carrier "Sanko Harvest" in February 1991 (Gales 1991). During this event 700 tonnes of heavy fuel oil contaminated over 200 fur seal pups at two colonies in the Recherche Archipelago. Other age classes of fur seal appeared to escape contamination. Mortality of pups was estimated to be between 13% and 33% on one island and to be at least 6.4% on the other island. It was not possible to separate mortality from the oil spill from other unrelated factors (Gales 1991).

The sinking of the tanker "Kirki" off the mid-west coast region of Western Australia in 1993 represented a significant threat to populations of breeding sea lions in the region. Fortunately weather and oceanographic conditions at the time prevented the oil from reaching these locations.

In general terms sea lions are believed to be less vulnerable to the deleterious effects of oil contamination than fur seals, mainly due to the simple hair type of the sea lion pelage and the fact that it has no major role in thermoregulation. By contrast, fur seals have a dense under-fur beneath the coarser guard hairs which acts as an essential insulating layer. A summary of effects of oil on pinnipeds is provided by Gales and St. Aubin (1995).

3.5.6 Chemical and Disease Impacts

A wide range of pinniped diseases have been diagnosed from post-mortems of sea lions and fur seals in Western Australia (Mawson and Coughran, in preparation). The incidence and effects of these diseases on a population level are not known. The only disease reported to date of significant public health and agricultural health importance is tuberculosis. The causative organism is genetically similar to the bacteria which causes tuberculosis in cattle and has been shown to be transmissible to humans. It is not clear if this disease has always been endemic in sea lion and fur seal populations in Western Australia, of if the disease was introduced from cattle (Cousins *et. al.* 1993).

There are no records of any mass mortality events of pinnipeds in Western Australia such as those seen in the northern hemisphere as a result of infection with seal Morbillivirus. No tests for the occurrence of antibodies to this virus have been undertaken in this region. The cause of some unusually high mortality rates of sea lion pups at the Pages and Dangerous Reef in South Australia has not been determined (T. Dennis, personal communication), but disease must be regarded as a possible cause.

There are no data on the rate of uptake of anthropogenic chemicals by pinnipeds in Western Australia, nor of any measurable effects. Data are available on contaminant loads in some Western Australian cetaceans (Mell, in preparation), the amounts recorded to date being low compared to levels from more industrialised northern hemisphere locations. It is likely that contaminant levels in pinnipeds will also be low.

3.5.7 Recreational Use of Islands Inhabited by Pinnipeds

Pinnipeds are vulnerable to disturbance at locations where they haul out to rest or breed. All regular pinniped haul out and breeding habitats in Western Australia are off shore and are hence only accessible via sea or air. Clearly the potential for disturbance is associated with proximity to human populations. The lack of any breeding populations of sea lions around the Perth metropolitan area and the relative lack of pinniped breeding populations in the Albany region are both testimony to the impact of human pressure. Perhaps the islands in the mid-west coast region of Western Australia that support breeding populations of sea lions represent the areas under greatest potential impact from human recreational activities. Similarly the islands in the Perth metropolitan region are the most highly utilised for recreation and this may well impact the recolonisation potential of this previous sea lion breeding habitat. Impact of this type will be most influential on breeding locations, but chronic disturbance at haul-out sites is also likely to influence pinniped distribution.

It is possible for sea lions to habituate to the presence of humans in controlled circumstances. At Seal Bay, Kangaroo Island, people have been viewing sea lions at very close proximity for over two decades without any reported impact. The sea lions use this beach primarily as a resting site. The breeding locations in the two bays adjacent to Seal Bay are off limits to the tourists. In Western Australia the adult and juvenile male sea lions that haul-out on the islands of the Perth metropolitan region have acclimatised to reasonable recreational use the islands. It is likely that female or juvenile

sea lions that occasionally use these habitats will be less tolerant of human pressure.

Fur seals are easily disturbed from haul-out sites and breeding sites and are extremely vulnerable to human pressures. Fortunately the habitats they select are not favoured by humans for recreation.

Other types of disturbance that result from human use of island habitat are the removal of vegetation cover from deliberately lit fires (eg. loss of critical breeding habitat for sea lions at some locations), removal of vegetation from introduction of exotic animals such as goats (eg. Gull Island in Esperance), introduction of exotic vegetation that inhibits the movement of pinnipeds (eg. box-thorn on the Beagle Islands) harassment of pinnipeds by dogs, perturbations in pinniped behaviour as a result of being fed, and disturbance caused by people swimming in close proximity to the islands.

Currently there are no specific standard control mechanisms in place to manage or limit non-commercial human recreational use of any sea lion or fur seal breeding or haul-out habitat in Western Australia.

3.5.8 Nature-based Tourism Interaction Impacts

Nature-based tourism or eco-tourism is currently a boom industry in Western Australia. The native sea lions and fur seals are a natural target for coastal operators and CALM is receiving an increasing number of applications for permits to interact with these species. Currently four licensed operators are conducting boat-based tours to see pinnipeds at Carnac Island, the islands of Shoalwater Bay, Augusta and Bremer Bay. An increasing number of applications are expected. There are no licences issued allowing people to land on the islands, nor to swim with the seals. Licensing of commercial operators is required for those wishing to visit islands vested as A Class nature reserves or lying within marine parks. Islands vested as C class nature reserves are for general non-conservation related purposes and permits are not required to conduct commercial operations on them. The status of the sea lion and fur seal breeding locations is listed in Appendix I.

3.5.9 Debris/Refuse/Other

Sea lions and fur seals have been observed in Western and South Australia with bait-bands and fishing net (usually monfilament, gill-net type) wrapped around their necks (Shaughnessy *et. al.* 1997; Robinson and Dennis 1988; N. Gales, unpublished data). Other debris reported around the necks of sea lions and fur seals include polypropylene packing straps, nylon ropes, rubber bands, rubber rings, plastic bags, polythylene cordage, six-pack yokes, loops of cotton cord, binder twine and portions of garments (see summary in Shaughnessy, in preparation). Entanglement often leads to the eventual death of the animal. Entanglement rates are difficult to estimate as survey methods vary and are usually restricted to animals ashore. Gales (1990) recorded a rate of 0.2% of entanglement of sea lions throughout their range. Around Kangaroo Island the rate is about 0.3% (South Australian Department of Environment and Natural Resources records). Shaughnessy (1995) recorded an incidence rate of 0.07% for fur seals around Kangaroo island. These rates are regarded

as indicative only. Further data summarising age/sex class proportions of affected animals are required to further elucidate the problem.

Occasionally boats collide with sea lions and result in injury from impact with the hull and/or the propeller (Mawson and Coughran, in preparation). Such incidents are particularly likely in areas where sea lions have become habituated to feeding from boats. There are no records of boat impacts with fur seals in Western Australia.

3.6 PINNIPED IMPACTS ON HUMAN ACTIVITIES

3.6.1 Pinniped Impacts on Fish Stocks or damage to nets and gear

Just as there is a potential for commercial fisheries to impact pinniped populations, the converse potential exists for pinnipeds to impact upon resources available for commercial or amateur fisheries. As noted previously, analysis of the likelihood of such an impact is limited by our lack of understanding of pinniped diet, of fish stock levels and of the dynamics of the marine food chain. Given that pinniped populations are likely to be at low levels compared to historical abundance, and if we assume that current utilisation of the marine resources used by humans and other marine predators is at equilibrium and at a sustainable level, then it is possible to extrapolate that the likely increase in abundance of fur seals may impact resources currently available to fisheries. Alternative hypotheses to this are that the current levels of human take will limit any growth in pinniped populations or, that the relationship between human and pinniped utilisation of resources is so indirect as to show no measurable impact upon each other. More data are required to better understand this complex relationship.

South Australian example of relationship between fur seals/abalone/wrasse (Terry can you expand on this)

More direct impact of pinnipeds on fisheries are in the form of:

- direct take from nets resulting in loss of fish and damage to gear (most commonly by sea lions)
- impact at fish farms in the form of direct kills of fish, effects of stress on fish growth and health, and damage to gear
- direct take of fish from fish trap nets
- removal of baits from lobster pots

3.6.2 Pinniped impact on access to, and utilisation of, offshore islands, beaches and nearby waters

During the breeding season pinnipeds become territorial and aggressive. They may also be aggressive to humans at other times, particularly if they have lost their natural wariness of humans, through conditioning brought about by feeding or regular interactions. Whilst pinnipeds are highly

vulnerable to disturbance, they are also potentially dangerous to people who enter their habitats. Serious injuries have been sustained by people on several occasions during visits to the islands along the mid-west coast of Western Australia. People have also been attacked by pinnipeds expecting to be fed. These attacks have occurred on the beach and in the surrounding water. Such behaviour places significant limits on responsible management of human access to pinnipeds. Similarly the presence of sea lions on the beaches of the few islands of metropolitan Perth is likely to displace humans who might otherwise have used the beach for recreation.

Pinnipeds are also food for large sharks and so diving and other 'in water' based activities in the vicinity of known seal breeding and haul-out areas have the potential to be particularly dangerous to humans.

4. IMPLEMENTATION OF PINNIPED MANAGEMENT IN WA

4.1 INTRODUCTION

The purpose of this section is to relate the measurable aims outlined in section 2.3 with some proposed actions and/or targeted outcomes.

4.2 TERRESTRIAL AND MARINE CONSERVATION RESERVE SYSTEM

Within the framework of the Terrestrial and Marine Conservation Reserve System the Pinniped Management Program will aim to protect pinnipeds as components of the overall marine ecosystems. In particular, the protection will centre on key breeding, haul-out and foraging areas and may take the form of spatial and temporal restrictions of human access to some key sites (particularly breeding locations) or the implementation of marine buffer zones around breeding or haul-out sites limiting commercial and recreational activity in response to the nature and extent of the interaction with people.

Action

- Review all existing Regional Management Plans and other plans (eg. the Wilson Report) to determine their relevance to pinnipeds and the Pinniped Management Program.

4.3 PINNIPED POPULATION AND DISTRIBUTION TARGETS AND ACTIONS

This section relates to the Australian Sea-lion and New Zealand fur seal only. Consideration of non-native or extralimital species is provided in section 4.5.

Targets

- Avoid changes in population abundance, trends and distribution that could lead to the species being listed as threatened according to the 1994 IUCN criteria
- At least maintain current abundance and distribution of the breeding population, with potential for increase in some areas throughout its former range
- Re-establish breeding in former areas of Western Australia, in particular the Perth Metropolitan region and the Albany region (Sea lions only)
- Facilitate regional management of the species if appropriate, once aspects of population discreteness have been elucidated

Actions

- Identify breeding, foraging and haul-out habitats
- Define the stock structure via genetic tools
- Determine trends in overall and sub-population abundance
- Determine competing uses for breeding, foraging and haul-out sites (including competition with fur seals)
- Rank significant breeding, foraging and haul-out sites in order of importance based on consideration of above
- Protect important habitats with reference to the above ranking system
- Develop criteria for management intervention in human interactions.
- Provide for damage mitigation on a case by case assessment of potential for avoiding by: better planning of activities
  gear modification
  deterrents, acoustics/other technology
  removal of individual if no other resolution.

4.4 MANAGEMENT OF SEALS IN FISHERIES (LIMITING DESTRUCTIVE INTERACTIONS)

4.4.1 *Oceanic & Estuarine*

Fishermen from the south coast region regard pinniped interactions as a significant problem in their business and require assistance from CALM for the management of the interaction.

Targets

- Determine the extent of pinniped/fisheries interactions on a regional and fishery-type basis
- Determine the degree of prey overlap between pinnipeds and fisheries (commercial and recreational) on a regional basis.
- Develop strategies to minimise conflicts.
- Enhance the education of fishermen on aspects of pinniped ecology, demography and their needs.

Actions

- Gather data on impacts from pinnipeds in terms of frequency and nature of interaction, gear damage, catch reduction and actions taken.
- CALM to liaise with commercial and recreational fishing organisations to determine the most appropriate method to collect the above data. Methods may involve collection of data from fishing log books if they are modified to include a pinniped interaction report and if CALM can have access to them. Or alternatively, CALM could either provide its own pinniped interaction form to fisherman or conduct its own independent survey.
- Implement and monitor effects of changes in gear design or fishing practice that

might result from the analysis of the nature of pinniped/fisheries interactions.

- Quantify diet of sea lions and fur seals from the suite of techniques available including scat and vomitus analysis and fatty acid analysis.
- Develop education and information material on pinnipeds to provide to fishermen, including prohibitions on feeding pinnipeds or on waste fish disposal in the vicinity of pinnipeds.
- Consider the implementation of 'special case' licensed scaring and removal (destruction) of problem pinnipeds in designated fisheries.

4.4.2 Aquaculture

Although the aquaculture industry is still relatively small in Western Australia there is clearly a real potential for interactions with pinnipeds to become an issue as the industry expands.

Targets

- CALM to be aware of developments in the aquaculture industry insofar as they are likely to represent a potential for unwanted pinniped interactions.
- Minimise interactions between pinnipeds and aquaculture industry by appropriate facility design and location.
- CALM to be familiar with international developments in the management of interactions between pinnipeds and aquaculture

Actions

- CALM to provide guidance on potential site locations or gear design at an early stage in development of the aquaculture industry.

4.5 MANAGEMENT OF EXTRALIMITAL OR INJURED, INCAPACITATED OR DEAD PINNIPEDS

The basis for management of extralimital, injured and incapacitated pinnipeds encountered at current rates is not one of species conservation, but rather is based on public protection, animal welfare, advocacy and staff/specialist training.

Targets

- Protect extralimital, injured and/or incapacitated pinnipeds from harassment by people or dogs and ensure that the welfare of the animal is considered when determining the management action.
- Protect people from extralimital, injured and/or incapacitated pinnipeds and ensure that public health and risk are considered when determining the management action.
- Determine the rate of encounter with these pinnipeds on a species and regional basis and where possible determine the cause of the event.
- Maximise the opportunity for public education and advocacy that arise from such

events.

- Ensure that a mechanism is in place to provide early warning and an appropriate response in the event of a mass mortality event

Actions

- Develop strategies to protect seals from humans and *vice versa*.
- Develop a protocol to determine the management of these pinnipeds on a case by case basis with options including:
  - leave alone and take no action
  - provide care on site and monitor
  - provide care at another facility (eg. a rehabilitation facility)
  - translocation and release
  - translocation and keep in captivity for education/research/display
  - destruction.
- Develop protocol for scientific data collection (including post-mortems) and data storage and analysis.
- Develop a definition and protocol to facilitate the detection and appropriate response in the event of a mass mortality event.
- Explain management action to the public.

4.6 MANAGEMENT OF NATURE BASED TOURISM

Nature based tourism in the marine environment has grown rapidly in Western Australia in the past few years. The initial focus has been whale-watching, but an increasing number of operators are now applying for permits to interact with pinnipeds at locations throughout their range.

As outlined in section 3.6.2, above, there is a definite need for management of such interactions to consider human safety aspects of proposed actions, as well as pinniped conservation requirements.

Targets

- To minimise the potential impact of nature based tourism on pinnipeds, whilst facilitating maximum public awareness, enjoyment and education from the experience.
- To ensure the vesting of key breeding and haul out locations of sea lions and fur seals is such that CALM is able to legally manage the interactions that occur there.
- To ensure that only those actions with pinnipeds that are considered to be reasonably safe for the human participants are permitted to operate.

Actions

- Develop protocols and standards on which to manage and licence the interactions between pinnipeds and nature based tourism. The protocols are to prohibit feeding

of pinnipeds, prohibit interactions in the water (on the basis of public safety), promote boat based interactions and determine key locations on land where the impact of the interaction will not be significant (eg. breeding habitats and critical haul-out habitats may be excluded).

- List the vesting of all key breeding and haul out locations for sea lions and fur seals and, where necessary, make recommendations for upgrading of vesting to ensure CALM maintains the power to license operators using that site.

4.7 PUBLIC EDUCATION AND AWARENESS PROGRAMS ON PINNIPEDS

Targets

- Raise public awareness to the needs of pinnipeds to reduce human conflicts with seals. eg. No feeding of wild seals.
- Provide information on background to seal management.
- Encourage the public to contribute reports on seal populations and to become involved in, and supportive of, moves to maintain and possibly re-establish pinniped breeding and haul-out sites.

Actions

- Identify target audience and provide information via direct contact (at schools, zoos, Underwater World, Universities etc), interpretive signage, popular articles, press releases, internet.
- Verify/set standards for accuracy of licensed nature based tourism and hand-outs and verbal information.
- Involve nature based tourism operators in data collection and education.
- Improve information transfer and cooperation with the fishing industry.
- Monitor and respond to the effectiveness of public education mechanisms such as surveys of awareness, records of public responses (eg. direct thanks), records of public reporting.

4.8 SEAL HARVESTING

Since the cessation of commercial sealing last century there have been no demands to recommence an industry to exploit the fur or oil and leather of Western Australia's pinnipeds. The special legal protection of all pinnipeds in Western Australia over-rides their being taken for food by aboriginals or other members of society. The utilisation of pinniped carcases is limited to scientific purposes, with no other demands for material being made in recent years. There are occasional informal demands for a cull of fur seals or sea lions made by fishing groups, based on their perception of their loss of livelihood from competition with pinnipeds.

While pinniped carcases can provide supplies of certain oils and skins, as was evidenced with the

early sealing industries, there is no current demand for such products. Recognising that it would be possible to manage a sustainable harvest of pinnipeds, in keeping with national and international strategies for sustainable resource use, the lack of current demands for seal products, the costs involved in harvest regulation and monitoring, and the desire to allow for continued population recovery combine to suggest that no such harvests should operate for the life of this program.

5.0 POPULATION MONITORING AND ASSESSMENT

The following section relates to Australian sea lions and New Zealand fur seals only. Rates of occurrence of other species of pinnipeds are to be monitored through records of sighting and beaching events.

5.1 CONSIDERATION OF AVAILABLE TECHNIQUES

A variety of survey techniques are available to estimate abundance of pinniped populations. The techniques vary enormously in such things as cost, ease of operation and efficacy, and need to be selected on the basis of the aims of the survey. Pinnipeds disperse widely when at sea and spend a large proportion of their time diving. Consequently, most census techniques are conducted at sites where animals accumulate on land at breeding or haul-out locations.

5.1.1 Direct Counts

Direct counts can be conducted from a boat or from the ground and can be targeted at specific age or sex classes or include all classes. Similarly, they can be conducted at breeding sites, haul-out sites or both. The accuracy and precision of this technique can vary with many factors including the behaviour of the animals (eg. activity level, aggression towards counters etc), density of animal distribution (eg. tightly clumped or sparse), terrain (rocky, vegetation cover, sandy beach etc), time of day (ie. movement of animals in and out of the water), counter (some people consistently over or under count) and actual number of animals (eg. the comparison of counting less than 10 animals versus counting several thousand). It is very difficult to quantify the bias of all these variables and consequently, correction factors may not be able to be satisfactorily incorporated.

Because pinnipeds spend their lives in water and on land it is very difficult to determine the absolute abundance of a population from direct counts of all age and sex classes on land as it is not possible to determine the proportion of the population that is at sea at the time of the survey. Fortunately, new born pups spend all their time on shore and it is possible to estimate pup abundance from direct counts. These counts can then be used as an index of absolute population abundance, and some estimates of absolute abundance can be made by incorporating simple population models. Furthermore, trends in absolute abundance can be estimated based on changes in pup production over time. During direct counts of pinniped pups all pup carcases should also be recorded as they represent a proportion of the pup production for that year.

Direct counting of pinnipeds is the most straightforward survey technique available. If counts are targeted at pups it is possible to compare the resulting estimate with the estimate derived from a mark-recapture technique (see 5.1.2). Correction factors can be determined from the comparison. These correction factors may be site, species and density specific and should therefore be used with caution.

When should direct count surveys be conducted?

- Every breeding season if resources permit. This will greatly increase the power of the estimates to detect trends in changes of abundance.
- High frequency while determining relationship between growth rates and correction factors.
- Fur seal surveys should be conducted from mid January to mid February. Virtually all pups should have been born by this time, but will still remain at the natal site. Estimates of mortality need to be incorporated to account for surveys conducted at different times.
- Sea lion surveys are far more difficult to plan as breeding is asynchronous across the range, pupping seasons last for 4 - 5 months and the breeding cycle is almost 18 months (section 3.1.3). Consequently, data needs to be maintained on the timing of the breeding season for each island population. As some pups may leave the natal colony with their mothers before they are 5 months old it is possible to miss some pups in surveys conducted at the very end of the breeding season. Similarly, surveys conducted too early in the pupping season will miss the pups born late in the season. Two visits to breeding colonies during the pupping season helps to improve the accuracy of the estimate.

Cost

- Relatively high due to cost of boats, isolated location of many sites and the need for a minimum of 2-3 staff. Landing on the islands from the boat can often only be achieved by swimming ashore making the operation potentially hazardous.

5.1.2 Mark/Recapture

Mark-recapture techniques of abundance estimation are a powerful and widely used tool. In its most simple form the technique involves capturing a proportion of a population, marking the captured individuals, releasing them back into the population and then surveying some portion of the population to measure the proportion of marked versus unmarked individuals. As the absolute number of marked animals is known, it is then possible to estimate the overall abundance of that population. This simple model makes the assumptions that the population is closed during the mark-recapture experiment (no births, deaths, immigrations or emigrations), that the marked and unmarked animals are equally visible to the counter, and that the marked population mix evenly through the unmarked population. The precision of this technique is greatly increased by conducting multiple recapture counts and an estimate of variance can also be calculated.

This technique can be used with any age or sex class of animal, but it is most directly applicable to estimate pup abundance as this population satisfies the requirements for the experiment. The types of marks that have been used are flipper tags, hair clipping of the crown (visible in fur seals only), and small highly-coloured caps for sea lion pups. The flipper tags are not an ideal mark as the tag location is often not visible during recapture, limiting the proportion of the population being surveyed. Hair clipping is an excellent tool for fur seals, the mark lasting until the moult in April and having no apparent negative impact on the animal. The problem with using the coloured caps on sea lion pups is that they are eventually shed and pollute the area.

When should mark-recapture surveys be conducted?

- Same timing as for direct counting

Cost

- More expensive than direct counting as more time is required at site (about 2 days compared to a few hours). Other logistic and personnel costs are the same.

5.1.3 Aerial Survey (Photography)

Aerial surveys are a useful tool for determining aspects of pinniped distribution. Islands can be checked quickly for the presence or absence of significant numbers of animals (particularly if good quality photographs are taken) and some idea of the spatial distribution of animals on the island can be acquired. It is usually not possible to accurately estimate numbers of animals ashore from this technique as many animals (particularly pups) are secreted by rocks and vegetation. It is also difficult to determine age and sex classes of animals from aerial photographs.

This may be a useful tool for regular checks of islands for evidence of sea lion breeding behaviour in order to plan appropriate timing for a boat survey. In such circumstances the presence of adult males attending females may be detectable.

The timing of surveys will depend upon their purpose.

Cost

- Relatively cheaper than other techniques, but data is not comparable.

5.2 KEY SITES CRITERIA

Conducting surveys at all breeding sites for fur seals and sea lions in Western Australia during every breeding season would be an enormous and expensive undertaking. From a management perspective an estimate of absolute abundance of pinnipeds is of less relevance than an estimate of the trend in abundance. A robust and logistically more reasonable technique to predict population trends is to monitor pup production of fur seals and sea lions at specific Key Sites. The criteria for

selection of a Key Site for the purposes of the Program are:

- breeding colony
- reasonable access via boat from a nearby town
- a geographic spread of Key Sites
- a reasonable range of pup productivity across Key Sites
- simpatric sea lions and fur seals
- a reasonable spread of human impacts across Key Sites (eg. proximity to fisheries)
- proximity to a variety of foraging habitats (eg. colonies close to the continental shelf edge and colonies near shore)
- a reasonable spread of breeding seasons (for sea lions only)

Note that not all of the above criteria must be satisfied for the selection of a Key Site.

5.3 FUR SEAL MONITORING

Aims

- Determine gross changes in abundance/trends.
- Determine gross changes in distribution/trends.

Abundance Monitoring Program

- Replicate previous survey conducted in 1989/90 in order to compare a current estimate of abundance with the previous estimate.
- Extend the survey in order to get a more complete coverage of breeding sites to estimate overall abundance (8 colonies were surveyed too early in the pupping season to provide meaningful estimates of pup production during the 1989/90 survey: Eclipse, Hauloff, Doubtful, Daw, New Year, Cranny, Cooper and Salisbury Islands)
- Establish ongoing monitoring strategy focusing on surveys at Key Sites only (Section 5.2). These data will be used to measure trends in overall population abundance.
- Conduct a mark-recapture estimate of pup production at all Key Sites during the same breeding season every three years (minimum of 3 personnel required).
- Formal survey of distribution with pup production estimates of all islands once every 10 years, as for 1989/90 survey.
- CALM staff and/or consultants are to be used to conduct the surveys.

Key Sites (west to east)

1. Flinders Island
   - most westerly fur seal breeding location of reasonable size.
   - possible growth as has just re-established .
   - fisheries operate in the vicinity of the island.
   - nature based tourism operates in the area.

2. Haul Off Rock
   - reasonably accessible.
   - sea lion colony present.
   - fisheries operate in vicinity of the island.
   - near shore colony.

3. Middle Doubtful Island
   - reasonable access.
   - minor public use of island.
   - fisheries operate in vicinity of the island.
   - near shore colony.

4. Rocky (Investigator) Island
   - isolated location.
   - small colony with room to expand.
   - good harbour.
   - sea lion colony present.

5. Seal Rock
   - large colony.
   - reasonable access.
   - long term data set on pup production estimates.

6. Hood Island
   - reasonable access.
   - long term data set on pup production estimates.
   - small colony.

7. Salisbury Island
   - largest breeding colony with limited room to expand.
   - isolated.
   - sea lion colony present.
   - reasonable landing for small boats.
   - close to continental shelf edge.

8. Daw Island and New Year Island
   - good anchorage.
   - isolated location
   - eastern end of Western Australian island range.

<u>Distribution Monitoring Program</u>

- Formal survey of distribution with pup production estimates of all islands once every 10 years, as for 1989/90 survey.
- Acquire data on fur seal distribution from other island surveys (eg. sea lions, Cape Barren Geese etc) on a serindipedous basis.
- Acquire data from broader network (field officers, fishing industry, tourists etc).

Budget and Funding

Funding to support the survey work will be sought from a wide range of sources including:

- CALM.
- Nature based tourism fees.
- Fisheries Research and Development Council (FRDC).
- Australian Fisheries Management Authority (AFMA).
- Environment Australia: Research and Surveys Program.
- Department of Environment Sport and Training: Oceans policy (DEST).
- CSIRO: biodiversity sector.
- Private Industry.

5.4 AUSTRALIAN SEA LION

Aims

- Determine gross changes in abundance/trends.
- Determine gross changes in distribution/trends.
- Determine temporal aspects of pupping seasons at sites across the range

Abundance Monitoring Program

Because sea lions do not breed at one time at all sites it is not possible to conduct a single survey to estimate pup production across the range. The population estimate published by Gales *et. al.* (1994) was the result of surveys conducted over a four year period with multiple visits to islands to determine if sea lions bred there and during what timeframe. Such an undertaking is enormously expensive. Consequently, the following approach is recommended as a method to estimate current sea lion pup production:

- Produce a database listing all currently known breeding locations and what is known of the pupping season at each of these sites.
- Continuously update the database using information from any verifiable source.
- Select Key Sites and monitor pup production during two breeding seasons (every 1.5 years), then monitor every second breeding season (3 years). The more vulnerable colonies on the west coast to be surveyed every breeding season.
- During surveys of Key Sites visit known breeding colonies in vicinity and survey for pup production when appropriate.

- Survey to be either direct counts (this is accurate for small colonies on reasonably open terrain) or mark-recapture.
- Surveys require a minimum of two or three personnel.

Key Sites (number in brackets refers to the number of months the pupping season is before "-" or after "+" the one at North Fisherman Island).

1. Abrolhos Islands (Eastern group) (-1)
   - Northern extreme of breeding range
   - Small colony in area where sea lions were historically abundant
   - High levels of human activity
   - Breeding season at similar time to Red, Six Mile and Rocky islands

2. Mid-west coast islands (Beagles, Nth Fisherman and Buller) (0)
   - Main centre for species on west coast
   - Relatively long term records of pupping seasons and surveys
   - Accessible
   - High levels of human activity

3. Haul-off rock (-6)
   - Western limit of breeding on south coast
   - Fur seal Key Site
   - Near shore environment
   - Relatively accessible
   - Similar breeding season to Kimberley Island

4. Red Islet off Fitzgerald River National Park (-1)
   - Medium sized colony
   - Isolated location with low levels of human activity
   - reasonable access
   - Similar breeding season to Rocky and Six Mile Island

5. Rocky Island (-1)
   - Key Site for fur seals
   - Isolated location with low levels of human activity
   - Similar breeding season to Red Island and Six Mile Island

6. Kimberley Island (-6)
   - Medium sized colony
   - Good access from Esperance
   - Similar breeding season to Haul-off Rock

7. Salisbury Island (+8.5)
   - Small colony with room to expand
   - Close to continental shelf
   - Key Site for fur seals

8. Six Mile Island (-1)
   - Eastern range of island breeding habitat in WA
   - Near shore habitat
   - Isolated location
   - Reasonable access

9. Colonies of Great Australian Bight
   - Recently surveyed by Dennis and Haberely
   - Key habitats for potential mixing of populations between WA and SA

Distribution Monitoring Program

- Acquire data on sea lion distribution from other island surveys (eg. fur seals, Cape Barren Geese etc) on a serindipedous basis.
- Acquire data from broader network (field officers, fishing industry, tourists etc).
- Conduct broad education program to alert the public to the need to report sightings of sea lion pups.

6. RESEARCH

This sections summarises and prioritises the key research issues that need to be addressed for pinniped research in Western Australia. The Program should be used as a catalyst to initiate these projects and secure funding for them.

Gaps in Knowledge/Research issues

Indicative Priority	**Details**
High	**Population identification** (genetics) - collect skin or blood (for DNA) during surveys - Define sub-population boundaries to set management units - Determine level of genetic flow between populations Cost and duration: 3 - 5 years x 1 person per species + assistance.

High Determine the average **duration of the pupping season** and variation around this for sea lions and fur seals.

Cost and duration:

One season for fur seals should be sufficient, involving 2 people at 2 sites.

2 - 3 years for sea lion, involving 2 people at all Key Sites.

High **Diet and foraging ecology studies** of both species.

Special interest in any links/impacts to fishing.

Also the relationships between seal species and with other marine predators.

Cost and duration:

Diet studies to be undertaken by PhD student using fatty acid analysis as well as more traditional techniques. 3-5 yrs, 1 person per species plus assistance.

Foraging ecology studies on both species require expensive remote logging and transmitting equipment (5-6 thousand dollars per animal) and should be conducted over several seasons. 5 yrs, 1 person with extensive collaboration and assistance.

High Social research on human requirements/expectations in relation to pinnipeds and people.

Cost and duration:

Masters project for 1 person with survey and follow up.

High Research of damage prevention measures in fisheries eg. spikes in lobster pots to prevent seal pups being caught.

Cost and duration:

Costs are technology dependant.

High Document rates of entanglement, bycatch and damage/take in WA fisheries.

Cost and duration:

1 person, 2 years to conduct extensive surveys and co-ordinate volunteer observer program if possible.

High Construct stochastic models to assess the viability and survival prospects of WA's pinnipeds (Population Viability Analysis)

Cost and duration:

1 person provided with results of surveys and research. 1 month.

High Investigate the role of the Leeuwin current as a determinant of the demography and reproductive behaviour of WA's pinnipeds.

Cost and duration:
Significant amounts of this work should result from a critical analysis of the results of most of the above studies.

High Identification of important land and ocean habitat for protection action, including vegetation cover management.
Cost and duration:
Significant amounts of this work should result from critical analysis of the results of most of the above studies.

Medium Investigation of the mechanisms that determine range expansion in fur seals and sea lions. (eg. compare ages of reproductive females at different sites)
Cost and duration:
1 person with extensive assistance. 5 yrs

Medium Determine historic population levels via libraries/manifests/oral histories/museums.
Cost and duration:
1 person (perhaps masters student) 1yr.

Low Full life history data.
Cost and duration:
20+ years to research with several people.

Low Disease investigations and bio-sample banks/requirements, [e.g. teeth] and skulls.
Cost and duration:
1 person to co-ordinate and maintain collection.

Low Blood parameters
Cost and duration:
1 person with assistance, 1 year.

7. REPORTING ON THE MANAGEMENT PROGRAM

Annual reports to the Executive Director of CALM shall be compiled by CALM personnel summarising the progress made in accomplishing the aims of this Program. All program leaders for components of this program will be required to report annually to CALM on progress in their particular areas of responsibility.

8. REVIEW OF THE MANAGEMENT PROGRAM

8.1 ESTABLISHMENT OF A PINNIPED MANAGEMENT TEAM

A Pinniped Management Team will be appointed at the time of approval of this Program. The team should comprise representatives from CALM, the Fisheries Department, and also persons with expertise in professional and recreational fishing, scientific (including veterinary research), commercial interaction tour operations and other aspects of wildlife conservation.

8.2 REVIEW TIMETABLE FOR THE PINNIPED MANAGEMENT PROGRAM

It is intended that the completed program will operate for a ten year period from the date of approval by the State Minister for the Environment. If no replacement program is available for approval at the ten year anniversary of approval of this program, it will remain in operation until such a replacement program is approved.

This management program will be continually reviewed during its period of operation by the management team and CALM supervisory personnel. Where detail changes of a minor nature are required these will be made to operational copies of the program. However, if major significant changes are warranted, the program will be replaced with a suitably modified program.

8.3 PREPARATION OF REVISED MANAGEMENT PROGRAMS AND/OR REVISIONS DURING THE APPROVED LIFE OF THIS PROGRAM

Gordon can you fill this in

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APPENDIX 1. LOCATIONS AND STATUS OF PINNIPED COLONIES IN WESTERN AUSTRALIA

Table 1. Breeding colonies of the Australian sea lion in Western Australia, the position and conservation status of the island (Key site colonies are in bold).

COLONY	Latitude °S	Longitude °E	Estimated pup production*	Conservation Status
Suomi Is. (Abrolhos)	28 00	114 00		Class A reserve
Alexander Is. (Abrolhos)	28 00	114 00		Class A reserve
Gilbert Is. (Abrolhos)	28 00	114 00	20	Class A reserve
Serventy Is. (Abrolhos)	28 00	114 00		Class A reserve
Beagle Is	29 48	114 52	79	Class A reserve
North Fisherman Is.	30 08	114 56	63	Class A reserve
Buller Is.	30 39	115 06	39	Class A reserve
Hauloff Rock	34 42	118 40	35	Vacant crown land
Middle Doubtful Is	34 22	119 35	20	Class A reserve
Red Islet	34 02	119 47	40	Class A reserve
West Is.	34 06	120 29	25	Class A reserve
Rocky (Investigator) Is.	34 05	120 55	25	Class A reserve
Little Is.	34 28	122 00	5	Class A reserve
Mackenzie Is.	34 12	122 06	38	Class A reserve
Kimberley Is.	33 57	122 28	50	Class A reserve
Kermadec (Wedge) Is.	34 05	122 50	6	Class A reserve
Taylor Is.	33 55	122 52	7	Class A reserve
SW Rk., (Twin Peaks Is.)	33 59	122 54	1	Class A reserve
Glennie Is.	34 06	123 06	30	Class A reserve
George Is.	34 03	123 15.5	>2	Class A reserve
Wickham (Stanley) Is.	34 01	123 17	20	Class A reserve
Poison Creek Is.	33 55	123 20	5	Class A reserve
Salisbury Is.	34 22	123 33	25	Class A reserve
Cooper Is.	34 14	123 37	4	Class A reserve
Round Is.	34 06	123 53	25	Class A reserve
Six Mile Is.	33 39	123 59	50	Class A reserve
Ford (Halfway) Is.	33 46	124 02	30	Class A reserve
Spindle Is.	33 44	124 10	60	Class A reserve
Great Australian Bight	31 00	126 01	?	Nature reserve

* Estimated pup production from Gales *et. al.* (1994)

Table 2. Breeding colonies of the New Zealand fur seal in Western Australia, the position and conservation status of the island (Key site colonies are in bold).

COLONY	Latitude °S	Longitude °E	Approximate pup production*	Conservation Status
Flinders Is.	34 25	115 12	2**	Class A reserve
Eclipse Is.	35 11	117 53	30	Lighthouse reserve
Hauloff Rk.	34 42	118 40	50	Vacant crown land
Doubtful Is. (2)	34 22	119 35	50	Class A reserve
West Is.	34 06	120 29	45	Class A reserve
Rocky (Investigator) Is.	34 05	120 55	30	Class A reserve
Seal Rock	34 01	121 40	190	Class A reserve
Hood Is.	34 09	122 03	40	Class A reserve
Libke Is.	34 13	122 04	170	Class A reserve
Finger Is.	34 07	122 21	4	Class A reserve
Draper Is.	34 12	122 30	20	Class A reserve
Beaumont Is.	34 06	122 33	75	Class A reserve
Salisbury Is.	34 22	123 33	450	Class A reserve
Cooper Is.	34 14	123 37	120	Class A reserve
Cranny Is.	33 43	124 05	60	Class A reserve
New Year Is.	33 52	124 06	30	Class A reserve
Daw (Christmas) Is.	33 51	124 06	70	Class A reserve

* Approximate pup production figures are rounded off from figures reported by Shaughnessy *et. al.* 1994.
** P. Lambert (personal communication)