NEW ZEALAND
OILED MARINE MAMMAL PROTOCOL

Photo: Kerri Morgan

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1. General Introduction

Over fifty different species of marine mammal have been recorded in New Zealand waters. The majority of these records are of cetaceans (whale and dolphins), with the remainder being pinnipeds (seals). All marine mammals are fully protected in New Zealand under the Marine Mammals Protection Act 1978. Baker et al. 2010 recently appraised the conservation status of all of New Zealand's marine mammal species according to the 2008 DOC Threat Classification Scheme (Townsend et al. 2008). Those with listings of Nationally Critical or Nationally Endangered are listed below:

'Nationally Critical'	'Nationally endangered'
• Bryde's whales	• Hector's dolphin
• Maui's dolphins	• southern right whales
• Southern Elephant seals	• bottlenose dolphins
• Orca	
• New Zealand sea lions	

During an oil spill in which multiple marine mammal species are affected, there is sound justification for these species to be afforded priority treatment over species with a lower conservation status.

Both cetaceans and pinnipeds are at risk of contamination during an oil spill; however oiled cetaceans are less of a concern as the thickness of the epidermis in these animals is thought to limit oil penetration in affected individuals (O'Hara & O'Shea 2001). As a result, cetaceans are not dealt with further in this guide which focuses on pinnipeds. In contrast to cetaceans, the pelage (fur) of pinnipeds is more readily affected by oil contamination. Contaminated pelage rapidly loses its insulation and waterproofing qualities, which is life threatening in many circumstances. For this reason the response protocol outlined below focuses on pinnipeds. The effects of oil on pinniped species will be largely external as most seal species do not have a significant oral component of their grooming behaviour, which reduces (but doesn't eliminate) internal toxic effects (Gales 1991). It is also possible that marine mammals may ingest or inhale oil, but there is little that can be done to eliminate or reduce this other than progressing cleanup operations as quickly and efficiently as possible.

For this protocol to be effective it is necessary for those using it to be able to quickly and accurately distinguish between pinniped species that may be encountered in New Zealand waters. The following species are seen around the mainland New Zealand coast:

Category	Species	Status
• Fur seals:	o New Zealand fur seals o Sub-Antarctic fur seals	o Resident/Breeding o Occasional visitor
• Sea lions:	o New Zealand sea lions (formerly called Hooker's sea lions)	o Resident/Breeding (Otago/Southland)
• True seals:	o Leopard seals o Elephant seals	o Frequent visitor o Occasional visitor

In addition, the following species are generally restricted to New Zealand subantarctic and Antarctic waters:

Category	Species
• Fur seals:	o Antarctic fur seal
• True seals:	o Crabeater seals o Ross seals o Weddell seals

The recommended publication to aid with species field identification is: A photographic guide to mammals of New Zealand, Carolyn M. King. 2008. New Holland Publishers. ISBN-13: 9781869662028.

Alternatively a useful online factsheet with species identification information can be downloaded at: http://www.doc.govt.nz/upload/documents/about-doc/concessions-and-permits/conservation-revealed/seals-lowres.pdf

For the purpose of this document the species above are divided into three categories: Fur seals, sea lions and true seals. These categories are based on comparative physiology and will be used hereafter to reflect the differences in oiled wildlife response (OWR) protocols and treatment criteria.

Effective contingency planning will rely on pre-spill knowledge of pinniped distribution. Regional Oil Spill Contingency Plans should contain information on local pinniped distribution, and further advice on this topic can be sought from the Regional Wildlife Advisor and/or Department of Conservation at the time of a spill.

Please note that these protocol have been developed primarily for a 'mainland' response, where 'mainland' describes the North Island, South Island, Stewart Island or Chatham Islands.

It is recognised that New Zealand's subantarctic islands may also be impacted by oil spills and that pinnipeds are likely casualties during such events. However, due to the remoteness and associated logistical constraints of a subantarctic response, we anticipate that these guidelines will provide a useful reference, but will need to be viewed in context of the MNZ oil spill plan for subantarctic response.

1.1. Relevant Legislation:

Any oiled wildlife response intentions should be formulated with input from local Department of Conservation representatives at the time of a marine oil spill. The relevant sections of the Marine Mammal Protection Act 1978 are provided below – please familiarise yourself with these sections before responding to oiled marine mammals:

MMPA 1978, Section 18: Treatment or disposal of sick or dead marine mammals

(1) Nothing in this Act shall affect—

a. Any person who gives any humane assistance, care, or medication to any stranded, sick, or injured marine mammal if (where known) details of the mammal's species, length, sex, and condition, or a general description of the mammal, and details of the treatment and any results of the treatment are forwarded to the Director-General or an officer* as soon as practicable: *[i.e., no permit is required, and there are no grounds for prosecution]*
b. The moving of any marine mammal by or under the direction of any officer* in the interests of public safety or the well-being of the mammal:
c. The destruction of any aged, sick, distressed, or troublesome marine mammal by or under the direction of an officer* or person authorised by the Minister.

(2) Dead marine mammals shall be disposed of in accordance with the advice of an officer* or person authorised by the Minister, which advice shall be given, where practicable, after consultation with the occupier of the place where the marine mammal is found.

** An 'officer' is defined as a DOC staff member who has been **warranted** under the Marine Mammal Protection Act (i.e. not just any DOC employee), a fisheries officer or a police constable*

MMPA 1978, Section 23: Offences and penalties

(2) Every person commits an offence against this Act who—

a. Except under the authority of any enactment, places or leaves any structure or trap or chemical or other substance in any place where a marine mammal is or is likely to be and which injures or harms, or is likely to injure or harm, any marine mammal:
b. Uses any vehicle, vessel, aircraft, or hovercraft to herd or harass any marine mammal.

A full copy of the legislation can be accessed via the following link:

http://www.legislation.govt.nz/act/public/1978/0080/latest/whole.html?search=ts_act_Marine+mammals+protection+act+1978_resel#DLM25332

1.2. Additional OWR documents of relevance:

This oiled marine mammal protocol is intended to be used in concert with the "Oiled Wildlife Response Standard Operating Procedure" in which general oil spill response protocol are outlined for all wildlife.

2. Fur Seals

2.1. Introduction:

All fur seals rely on their dense pelage for insulation. Their pelage functions in much the same way as feathers do on sea birds with regards to insulation – by trapping a layer of warm air next to the skin. Under normal circumstances the pelage and layer of warm air is impervious to water, however when oiled, the waterproofing properties of the pelage and the associated insulation properties are severely compromised leaving affected individuals susceptible to hypothermia, water-logging and reduced foraging success. It is for these reasons that this pinniped species is the most 'at risk' with regards to oil contamination.

No information is available on how long following oil contamination and cleaning it takes adult fur seals to regain their waterproofing, but adult sea otters with similar fur structure take 7 – 10 days to regain waterproofing (D. Jessup, pers. comm.), it is reasonable to assume that this would be similar for fur seals.

The treatment protocols and criteria outlined in this section apply to all fur seal species.

New Zealand fur seals (*Arctocephalus forsteri*):

NZ fur seals are the most abundant species of seal in New Zealand waters. Their populations are generally increasing and they have a near ubiquitous distribution around mainland New Zealand. Therefore this species is the most vulnerable to a mainland oiling event. Young NZ fur seal pups are at greatest risk of oiling as their distribution is nearly exclusively coastal for their first year during which they remain close to their natal/birth site (Gales 1991).

Subantarctic fur seals (*Arctocephalus tropicalis*):

The subantarctic fur seal is an infrequent visitor to mainland NZ. Subantarctic fur seals do not breed on the mainland or on any of New Zealand's subantarctic islands. This species is typically more aggressive on land than New Zealand fur seals (Pete McClelland pers. comm.). Responders should be made aware of this behavioural difference.

Antarctic fur seals (*Arctocephalus gazella*):

Antarctic fur seals are seldom seen around mainland New Zealand, but do occasionally visit the New Zealand subantarctic islands. Little is known about their winter distribution; it is possible that they forage in New Zealand's Antarctic territory during this time.

2.2. Responder Health & Safety:

Fur seals are unpredictable animals on land and take fright quickly when approached by humans. When threatened fur seals are quick to bite and can cause serious puncture and crush injuries which may be accompanied by severe, persistent *mycobacterial* infections. A full description of the

zoonotic diseases carried by marine mammals is given in Mackereth 2005 (included with the authors permission as Appendix 1), along with recommended precautions for responders. Risk analysis for marine mammal handlers etc is outlined in Hunt at al. 2008. Additional relevant information is presented in Mackereth et al. 2005 that reports on the prevalence of *brucella* and *leptospirosis* in NZ fur seal pups.

Fur seal operations during OWR should be supervised by an <u>experienced</u> handler and appropriate personal protection equipment (PPE – see Appendix 2) should be worn by all personnel involved with fur seals at all times

2.3. Response Options

Extreme care must be taken when entering a fur seal colony as adults commonly stampede for the ocean and may become injured or trample younger animals in the process.

Primary Response Options:	**PREVENTION**

- The primary response option for all pinnipeds is prompt habitat clean-up. Shore-line clean-up activities that minimise disruption to fur seal colonies and haul-out locations (following Mearns et al. 1999) should be given preference over more disruptive techniques.

- Pre-emptive capture and holding of fur seal pups may be suitable if predictions indicate that they can be released into clean habitat promptly (within the following timeframes as dictated by mean foraging trip duration of adult females: 4 days in summer; 8 days in Autumn and 12 days in winter. Harcourt et al 2002). Contact Dr. Laura Boren, DOC for further advice, see Appendix 3.

- Pre-emptive capture and translocation of adult fur seals may be suitable if predictions indicate that their habitat can be cleaned before their inevitable return.

Secondary Response Options:	**TREATMENT**

A. Minimum intervention option: Monitor impact, remove dead oiled seals, euthanase heavily oiled live seals (and their dependant pups*).

B. Moderate intervention option: Monitor impact, remove dead oiled seals, capture and conduct short-term treatment of live oiled fur seal pups in-situ before release.

C. Full intervention option: Monitor impact, remove dead oiled seals, capture and rehabilitate live oiled adults and pups ex-situ, release rehabilitated seals to the wild following habitat clean up operations.

Factors which may influence the appropriate level of intervention include:

- Cost/benefit analysis for individual animal
- Number and age-class of animals oiled & extent of oiling
- Weather, especially ambient temperature
- Seasonal life histories - breeding/lactating/moulting
- Whether or not other more threatened pinniped species are also oiled
- Advice provided from DOC
- Availability of suitable temporary rehabilitation facilities
- Availability of essential equipment and appropriate seal handling expertise
- Body condition of individual animals
- Predicted duration of shoreline cleanup and potential for recontamination

* *For the purpose of these protocol 'pups' are defined as animals still dependent on nutritional provisioning from their mothers; which is the case until they are weaned at 10 months of age (Reidman 1990).*

2.4 Response option feasibility analysis

	Pups	Juveniles	Adult females	Adult males	Mother/pup pairs
Response option A (Monitor etc)	Medium	High	High	High	High
Response option B (In-situ rehab)	High	Not Feasible	Not Feasible	Not Feasible	Not Feasible
Response option C (Ex-situ rehab)	Low*	Medium	Medium	Low	Medium

* This would entail hand-raising the pup and providing foraging training prior to release to wild.

2.5 Response Considerations

All Age-Classes:

- New Zealand fur seals have a non-threatened conservation status.
- The Department of Conservation has a policy of minimum intervention for NZ fur seals, however euthanasia is generally considered acceptable when animal welfare is at risk due to illness and/or injury.
- All age-classes will be candidates for euthanasia if an individual's survival is unlikely and/or undue suffering is occurring.
- Euthanasia decisions should be made by the attending veterinarian in consultation with DOC. Acceptable euthanasia techniques are outlined in Appendix 3.
- All contaminated carcasses should be removed as hazardous waste, and disposed of in consultation with DOC.
- Where possible necropsy of all dead seals should occur. Necropsy remains should be treated as per above. Necropsy protocol are outlined in Appendix 5.
- Moulting occurs between February and March for NZ fur seals (Mattlin et al. 1998).
- Post-release monitoring is recommended for all rehabilitated pinnipeds (see Appendix 6).
- Capture techniques are outlined in Appendix 7.
- Transport considerations are outlined in Appendix 8.
- Identifying oiled animals may be a challenge due to the naturally dark and glossy pelage of fur seals. See OWCN 2004 for techniques in assaying pelage swab samples in the field to ascertain oil exposure.
- Response planning should be undertaken in consultation with Laura Boren, NZ fur seal biologist where possible (Appendix 3).

Adult & Juvenile fur seals:

- The 'ex-situ' treatment and rehabilitation of adult and juvenile fur seals (response option C) is feasible with consideration of the following points:
- Individuals would require holding in captivity for 7 – 10 days following washing in order to regain waterproofing.
- Specific housing and husbandry requirements for captive pinnipeds would need to be met. These are outlined in Appendices 9 & 10 respectively.
- Supplementary feeding wild adult and juvenile fur seals in captivity may be challenging, however overseas examples indicate that it is indeed possible. Information on nutrition in captivity is provided in Appendix 11.

Fur seal pups:

- The treatment and rehabilitation of oiled fur seal pups is feasible under both 'in-situ' and 'ex-situ' (response options B and C) with consideration to the following points:
- All attempts to maintain the mother/pup bond should be made when considering response options. If it is confirmed that the mother of a dependent pup is dead, then the pup should be euthanized.
- Nutritional requirements for fur seal pups are discussed in Appendix 11.
- Advice regarding handling young pinnipeds is given in Appendix 12.
- NZ fur seal pups start spending significant portions of their days in rock pools and shallow coastal waters from 2 months of age onwards (L. Boren pers. comm.). At all ages, pups are reliant on a healthy pelage for insulation.
- NZ fur seal pups are born November – January (December represents the peak of pupping) (Bradshaw et al. 1999).
- NZ fur seal pups are weaned at 10 – 11 months of age (Reidman 1990).
- Even without oiling, NZ fur seal pup mortality is influenced by ambient temperature. Hence ambient temperature will be an important factor affecting mortality during a spill, with cold temperatures correlating with high pup mortality (Gales 1991).
- A case study of the 'in-situ' treatment of oiled NZ fur seal pups is provided in:

  Gales 1991. New Zealand fur seals and oil: An overview of assessment, treatment, toxic effects and survivorship. The 1991 Sanko Harvest Oil Spill. Report to the West Australian Department of Conservation and Land Management, August 1991. (a copy of this report is held in the NZWHC, OWR library and can be requested by email: oiledwildlife@massey.ac.nz)

Specific considerations for in-situ treatment of fur seal pups:

- Advice should be sought from Laura Boren, DOC on this option (Appendix 3).
- Temporary holding pens may need to be erected until the habitat is cleaned, it may be beneficial to construct these pens at a distance from the colony to reduce adult females being attracted by the audible calls of their pups (see Appendix 9)

- The time that pups are held must be minimised to ensure that they are returned to their mothers for feeding as soon as possible.
- If habitat clean-up can be achieved in less than four days then supplementary feeding of pups may not be necessary, provided fluid therapy is given.
- Overcrowding in pens must be avoided as it can lead to asphyxiation and crushing injuries.
- Once released, monitoring should be conducted to identify pups that are orphaned; obvious orphans are likely candidates for immediate euthanasia. Note that temporary abandonments of up to 10 days, followed by successful reunions, have been documented for NZ sea lions (Simon Childerhouse pers. comm.)
- Monitoring should also focus on identifying pups at risk of becoming re-contaminated through contact with oiled mothers. In these circumstances the following guidance may assist decision making:
  - If the mother is heavily oiled ex-situ treatment of mother and pup should be considered. If this is not possible, euthanasia of mother and pup may be required.
  - If the mother is lightly oiled and her chances of survival are moderate to high the following three options may warrant consideration: 1. no further intervention, 2. recapture pup following periods of maternal attendance (i.e. after the mother has fed the pup and then returned to sea) to de-contaminate as necessary or, 3. euthanase pup to decrease energy demands on the mother and increase her chance of survival

2.6. Treatment procedure:

A list of equipment which may be necessary to facilitate treatment is provided as Appendix 2.

If capture and cleaning is to occur, these must occur promptly to reduce the likelihood of organ toxicity and injury.

Intake:
As each oiled pinniped is captured it will proceed as follows:

Step 1: Initiation of an individual medical record
Step 2: Individual identification applied if necessary (see Appendix 13)
Step 3: Clinical assessment, triage and medical stabilisation actions (see Appendix 14)
Step 4: Enter dry holding enclosure to regain strength prior to cleaning

Pre-wash criteria:
On intake, oiled pinnipeds should be fully assessed by the attending veterinarian in accordance with Appendix 14 and stabilised before washing. Individual treatment records should also be initiated for each admitted animal in accordance with Appendix 15. It may take up to 48 hours to address thermoregulatory issues, hydration and nutrition, such that individuals are strong enough to undergo washing. Normal core body temperatures for pinnipeds are 36.6 – 39.0°C (OWCN 2004). No published packed cell volume (PCV) reference range is available for NZ fur seals, but proxy values (%) from other *Arctocephalus spp* are provided below:

Reference*	Species	Pups						Juveniles						Adults
		1 wk	2 wk	3 wk	1 mo	2mo	5mo	6mo	7mo	9mo	1yr	1.5yr	2yr	
1	**Australian fur seal**				38.9 +/- 0.6	34.7 +/- 1.6	46.5 +/- 0.8		45.5 +/- 0.8	49.0 +/- 0.6				51.4 +/- 1.0
2	**Juan Fernandez fur seal**	42 +/- 7.0	36 +/- 4.0	39 +/- 5.0					59 – 63					45.0 +/- 5.0
3	**Galapagos fur seal (males)**	35.88 +/- 4.82						41.37 +/- 3.01			46.68 +/-3.83	48.24 +/- 3.29	50.41 +/- 2.4	
3	**Galapagos fur seal (females)**	35.24 +/- 3.3						43.16 +/- 3.14			47.93 +/-3.24	49.29 +/- 2.96	48.75 +/- 1.82	48.53 +/-3.31

* References:
    1. Australian fur seal (*A. pusillus doriferus*); Spence-Bailey et al. 2007.
    2. Juan Fernandez fur seal (*A. philippii*); Sepulveda 1999
    3. Galapagos fur seal (*A. galapagoensis*); Horning & Trillmich 1997

Anaesthesia:
All fur seals, apart from lightly oiled pups (see Gales 1991) will need to be anaesthetised for washing. Appropriate anaesthesia techniques are to be determined by the attending veterinarian from Massey University in consultation with others as necessary. Acceptable anaesthesia techniques are outlined in Appendix 16.

Wash protocol (adapted from Oiled Wildlife Care Network 2004):
During the wash/rinse process pinnipeds should be monitored very closely for thermoregulatory distress and wash/rinse water temperature altered appropriately. Hyperthemia is common during the wash process for pinnipeds, so water temperature may need to be decreased if necessary.

Various pre-treatments may be required to shift weathered oil or tar patches. Commonly used pre-treatment agents include warmed (35°C) olive oil, canola oil or methyl oleate. Pre-treatments should be used sparingly and only on stubborn contaminated areas. Pre-treatments are massaged into the fur and should only be used for the minimum duration required to soften the contamination (no more than 10 - 15 minutes).

Prepare a 5% detergent solution using thermal neutral (37°C) softened fresh water and your detergent of choice (e.g. Tergo). Massage the detergent solution into the fur then rinse the pelage under moderate pressure (200 – 275 Kpa) in softened warm freshwater. Repeat this wash/rinse cycle until all oil has been lifted from the pelage and there is no oil visible in the rinse water and no remaining contaminant odour (Davis & Hunter et al 1995).

Perform a final rinse while still sedated. For fur seals this rinse should be extensive (30 – 40 minutes).

Fur seals should then be towel dried before anaesthesia reversal at which time they are placed in a dry enclosure with a blow dryer on room temperature setting for between 5 and 10 minutes. Animals should be carefully monitored for dehydration during this period.

Lightly oiled pinnipeds can be ‘spot washed’ using the above techniques only on discrete areas of pelage as necessary.

Washroom facility requirements are outlined in Appendix 17.

Post-wash conditioning:
Once the wash/dry process is complete, individuals should be held in warm and sturdy dry enclosure where they are able to be closely monitored until all signs of sedation have passed (minimum 1 hour).

Subsequently, and once stable, individuals should be provided access to pools of softened freshwater to encourage grooming which is fundamental to the restoration of waterproofing. During

the first few days individuals should be closely monitored to identify and assist animals which become waterlogged or are suffering from thermoregulatory distress. Warm water pools may be beneficial for particularly debilitated seals.

PIT tags with embedded temperature sensors may be useful throughout the wash/rehab process for early detection of thermoregulatory distress and to gauge when an individual has regained waterproofing (i.e. when subcutaneous temperature stabilises both in and out of pools). Jessup et al 2009 describes this technique during oiled wildlife response on sea otters.

Release:

All decisions on release will be taken in consultation with DOC and appropriate iwi representatives. The following release criteria should be met:

1. An individual maintains body temperature without assistance
2. No wet/cold spots are detectable on the pelage
3. Normal relaxed grooming behaviour is observed
4. The individual is capable of independent feeding (juveniles and adults) or is expected to be reunited with its mother for nursing (pups)
5. Good general health (normal blood values, good body condition etc)
6. Clean individuals will only be released into clean habitat.

Where possible individuals will be released as close as practicable to the location from which they were captured. However if shoreline clean-up operations are prolonged, consideration should be given to releasing individuals away from their capture site so as long as mother pup pairs are co-released and predictions indicate that the capture site will be clean before animals return.

Post – Release Monitoring:

Appendix 6 provides information on possible post release monitoring techniques. All post release monitoring by independent groups, in particular that which relies on tracking equipment to be attached, will be subject to the issuing of the relevant DOC marine mammal research permits. DOC can however deploy transmitters etc for management purposes without the need for a permit. It may be beneficial therefore that DOC lead this work if possible to avoid delays.

Once released, monitoring should be conducted to identify pups that are orphaned. Decisions on the fate of these pups must be made in conjunction with DOC. Note that temporary abandonments of up to 10 days, followed by successful reunions, have been documented for NZ sea lions (Simon Childerhouse pers. comm.).

Monitoring should also focus on identifying pups at risk of becoming re-contaminated through contact with oiled mothers. In these circumstances mothers should be captured and cleaned by one of the techniques outlined above.

3. Sea Lions

3.1 Introduction:

New Zealand sea lions are endemic to New Zealand and are listed by the IUCN as 'Vulnerable' based on both their restricted range and a recently documented population decline. They are also listed as 'nationally critical' according to the DOC Threat Classification System (Baker et al. 2010).

No other sea lion species have been recorded in New Zealand waters.

New Zealand sea lions have only recently begun to recolonise their former range around the New Zealand mainland after becoming locally extinct from the mainland during early human history (Childerhouse & Gales 1998). Their distribution around the New Zealand mainland is currently limited to Stewart Island, Otago and Southland, but individuals are seen as far north as Cook Strait on occasion. The vast majority of sea lions are based in the subantarctic, with more than 99% of all breeding for this species occurring on the Auckland Islands and Campbell Island (Childerhouse & gales 1998). An oil spill event in the subantarctic could have a catastrophic effect on this species depending on location and time of year.

Unlike fur seals, sea lions do not depend on their pelage for insulation, but rather they depend on a subcutaneous blubber layer for warmth. Neither does their fur have any waterproofing properties. These reasons mean that sea lions are likely to recover well from oil pollution, but **based on their conservation status, they should be given high priority when triage decisions are being made across a range of pinniped species during oiled wildlife response.**

Pups less than 3 months old rely on both their pelage and their developing blubber layer for insulation (Simon Childerhouse pers.comm.); hence pelage health is most important in this age group, as blubber depth is limited.

3.2. Responder Health & Safety:

Sea lions may bite humans when they feel threatened and can cause serious puncture and crush injuries which may be accompanied by severe, persistent *mycobacterial* infections. A full description of the zoonotic diseases carried by marine mammals is given in Mackereth 2005 (included with the authors permission as Appendix 1), along with recommended precautions for responders. Risk analysis for marine mammal handlers etc is outlined in Hunt at al 2008.

Sea lion operations during OWR should be supervised by an experienced handler and appropriate personal protection equipment (PPE – see Appendix 2) should be worn by all personnel involved with sea lions at all times.

3.3. Response options:

Primary Response Option:	**PREVENTION**

- The primary response option for all pinnipeds is prompt habitat clean-up.
- Pre-emptive capture may be a suitable response option for all age classes of sea lions, but the ease and practicality of this will vary by sex and size. See Appendix 9 for methods of temporarily restraining sea lions.

Secondary Response Options:	**TREATMENT**

All contaminated sea lions will be treated for oiling for the following reasons:

- They can be released immediately into clean habitat – no time needed to regain waterproofing.
- Threatened conservation status
- One of New Zealand's highest priority marine mammal species

The four recognised response options are:

A. Minimum intervention option: For individuals suffering only from discrete tar patches in non-critical locations, an appropriate action may be to simply allow the sea lion to moult the oiling off and to monitor the situation through time.

B. Moderate intervention option: Monitor impact, remove dead oiled sea lions, capture and conduct short-term treatment of live oiled sea lions in-situ.

C. Full intervention option 1: Monitor impact, remove dead oiled sea lions, capture and treat oiled sea lions, hold treated sea lions in-situ until habitat is clean and animals can be released to the wild.

D. Full intervention option 2: Monitor impact, remove dead oiled sea lions, capture and treat oiled sea lions and translocate to clean habitat (mother/pup pairs may be good candidates for translocation – see Gentry 1998).

Triage:

Priority for treatment should be given to individuals according to the following ranking:

1. Pups (especially females)
2. Breeding females
3. Juvenile females
4. Adult males
5. Juvenile males

3.4 Response option feasibility analysis

	Pups	Juveniles	Adult females	Adult males	Mother/pup pairs
Response option A (Moult/monitor)	Not Feasible	Low	High	High	Not Feasible
Response option B (In-situ & release)	High	High	High	Moderate	High
Response option C (In-situ & hold)	Moderate	Moderate	Moderate	Low	Moderate
Response option D (In-situ & translocate)	Not feasible	Moderate	Moderate	Low	High

3.5. Considerations for the treatment of oiled sea lions:

All Age-Classes:

- New Zealand sea lions have a conservation status of 'nationally critical' and are one of the top conservation priority species in New Zealand.
- All age-classes will be candidates for euthanasia if an individual's survival is unlikely and/or undue suffering is occurring.
- Euthanasia decisions should be made by the attending veterinarian in consultation with DOC.
- All contaminated carcasses should be removed as hazardous waste, and disposed of in consultation with DOC.
- Where possible necropsy of all dead sea lions should occur. Necropsy remains should be treated as per above. Necropsy protocol are outlined in Appendix 5.
- Moulting occurs between January and May for this species (McConkey et al. 2002).
- Once individuals have been cleaned, are in good body condition and are bright and responsive they can be released immediately into clean habitat.
- Response planning should be undertaken in consultation with Dr. Louise Chilvers, DOC sea lion biologist, where possible (Appendix 3)
- If there is a delay in habitat cleaning then animals may need to be confined temporarily until the habitat has been cleaned. Specific housing and husbandry requirements during any captive period would need to be met. These are outlined in Appendices 9 & 10 respectively.
- Or alternatively, consideration may be given to the translocation of clean individuals into clean habitat if shore-line clean-up operations are delaying release. Note that translocation may result in animals swimming back into the contaminated environment. However,

mother-pup pairs may be good candidates for translocation, as the presence of a pup at the translocation destination may minimise the likelihood of the mother returning to the contaminated site in the short-term (Gentry 1998).

- Post-release monitoring is recommended for all rehabilitated pinnipeds (see Appendix 6).
- Capture techniques are outlined in Appendix 7
- Transport considerations are outlined in Appendix 8.

Adult & Juvenile sea lions:

- Response option A is a feasible option for adult male and female sea lions, except for females with dependant pups. This is especially so if the oiling is relatively inaccessible to the grooming animal or if a solid tar patch is causing the animal minimal distress.
- The treatment and rehabilitation of oiled adult females and juvenile sea lions is feasible under response options B, C & D.
- Response options B, C & D are less feasible for adult males due to their size and strength. Decisions regarding the capture and handling of adult males should be made on a case by case basis during an event.
- Supplementary feeding adult sea lions in captivity should be unnecessary as all efforts should be made to minimise the captive period to a few days (adults will routinely go without feeding for 3 – 4 days in the wild. If adult sea lions need to be held for extended periods, information on supplementary feeding can be found in Appendix 11.

Sea lion pups (non-weaned)

- The treatment and rehabilitation of oiled sea lion pups is feasible under both response options B and C.
- Response option A is not considered a suitable response for pups as the toxic effects of any oiling on a pup may have negative developmental effects.
- Response option D is not feasible for pups alone, however may be a preferred option for mother/pup pairs.
- All attempts to maintain the mother/pup bond should be made when considering the treatment of oiled sea lion pups.
- All efforts should be made to ensure sea lion pups do not become orphaned due to human intervention during an oil spill.
- Pups are born in the months of December and January, and are weaned at 9 - 12 months of age (Cawthorn 1993).
- Advice regarding handling young pinnipeds is given in Appendix 12.

Considerations for in-situ treatment of pups:

- Temporary holding pens may need to be erected on-site until the habitat is cleaned. Housing and husbandry needs during captive periods are discussed in Appendices 9 & 10 respectively.
- Ideally mothers and pups would be captured and held together.

- However if pups are captured and held independently of their mothers; the duration of captivity must be minimised to ensure that they are returned to their mothers for feeding as soon as possible.
- Appendix 11 provides information on nutritional requirements if supplementary feeding during this period is required.
- If habitat clean-up can be achieved promptly then supplementary feeding of pups may not be necessary. However fluid therapy is likely to be required (Adult female foraging trips are typically up to four days in duration; hence pups are accustomed to fast during these periods).
- Overcrowding in pens must be avoided as it can lead to asphyxiation and crushing injuries. This is particularly important during warm weather.

3.6 Treatment procedure:

A list of equipment which may be necessary to facilitate treatment is provided as Appendix 2.

Intake:
As each oiled pinniped is captured it will proceed as follows:

Step 1: Initiation of an individual medical record
Step 2: Individual identification applied if necessary (see Appendix 13)
Step 3: Clinical assessment, triage and medical stabilisation actions (see Appendix 14)
Step 4: Enter dry holding enclosure to regain strength prior to cleaning

Cleaning methods**:**
Cleaning must occur promptly to reduce the likelihood of organ toxicity. There are two cleaning options for sea lions. The first is shaving small areas of affected pelage, and the second as washing (**preferred**), which is explained in depth below.

Shaving is deemed appropriate for juvenile and adult sea lions that are in good body condition and who have only discrete patches of oil. Shaving is not a suitable option for pups as they are reliant on an intact pelage for insulation. The time of year in relation to the moult may be a deciding factor in the suitability of this method. It is envisaged that adults will need to be anaesthetised for shaving; however juveniles may be able to be restrained physically for shaving depending on the extent and location of the oiling. See below for further notes on anaesthesia.

Pre-wash criteria:
On intake, oiled pinnipeds should be fully assessed by the attending veterinarian in accordance with Appendix 14 and stabilised before washing. Individual treatment records should also be initiated for each admitted animal in accordance with Appendix 15. It may take up to 48 hours to address thermoregulatory issues, hydration and nutrition, such that individuals are strong enough to undergo washing. Normal core body temperatures for pinnipeds range from 36.6 – 39.0°C (OWCN 2004), and normal packed cell volumes (PCVs) of 51% $\pm$ 2% for adult NZ sea lions and 52% $\pm$ 3% for juvenile NZ sea lions (Costa et al 1997).

Anaesthesia:
Sea lions of all age-classes will likely need to be anaesthetised for washing. Appropriate anaesthesia techniques are to be determined by the attending veterinarian from Massey University in consultation with others as necessary. Anaesthesia techniques are outlined in Appendix 16.

Wash protocol (adapted from Oiled Wildlife Care Network 2004):
During the wash/rinse process pinnipeds should be monitored very closely for thermoregulatory distress and wash/rinse water temperature altered appropriately. Hyperthemia is common in pinnipeds during the wash process, so water temperature may need to be decreased as necessary.

Various pre-treatments may be required to shift weathered oil or tar patches. Commonly used pre-treatment agents include warmed (35°C) olive oil, canola oil or methyl oleate. Pre-treatments should be used sparingly and only on stubborn contaminated areas. Pre-treatments are massaged into the

hair and should only be used for the minimum duration required to soften the contamination (no more than 10 – 15 minutes).

Prepare a 5% detergent solution using thermal neutral (37°C) softened fresh water and your detergent of choice (e.g. Tergo). Massage the detergent solution into the pelage then rinse under moderate pressure (200 – 275 Kpa) in softened warm freshwater. Repeat this wash/rinse cycle until all oil has been lifted from the pelage and there is no oil visible in the rinse water and no remaining contaminant odour (Davis & Hunter et al 1995).

Perform a final rinse while still sedated. For sea lions this can be relatively quick; the anaesthesia can then be reversed before the rinse process is finished in an outdoors pen with a pressure spray. Sea lions can then be left to air dry naturally. Animals should be carefully monitored for signs of dehydration during this period.

Lightly oiled pinnipeds can be 'spot washed' using the above techniques only on discrete areas of pelage as necessary.

Washroom facility requirements are provided in Appendix 17.

Post-wash conditioning:
Once the wash/dry process is complete, individuals should be held in warm and sturdy dry enclosures where they are able to be closely monitored until all signs of sedation have passed (minimum 1 hour).

Post-wash conditioning for waterproofing is unnecessary for sea lions; instead the primary post-wash objective is to release sea lions into clean habitat as soon as possible.

Release:
All decisions on release will be taken in consultation with DOC and appropriate iwi representatives. The following release criteria should be met:

1. An individual maintains body temperature without assistance
2. No oil is detectable on the pelage
3. Normal relaxed grooming behaviour is observed
4. Good general health (normal blood values etc)
5. Clean individuals will only be released into clean habitat.

Where possible individuals will be released as close as practicable to the location from which they were captured but individuals could potentially be released away from their capture site as long as mother pup pairs are co-released.

Post – Release Monitoring:
Potential post-release monitoring techniques are outlined in Appendix 6. All post release monitoring, in particular that which relies on tracking equipment to be attached, will be subject to the issuing of the relevant DOC marine mammal research permits. DOC can however deploy transmitters etc for management purposes without the need for a permit. It may be beneficial therefore that DOC lead this work if possible to avoid delays.

Once released, monitoring should be conducted to identify pups that are orphaned. Decisions on the fate of these pups must be made in conjunction with DOC. Note that temporary abandonments of up to 10 days, followed by successful reunions, have been previously documented for NZ sea lions (Simon Childerhouse pers. comm.).

Monitoring should also focus on identifying pups at risk of becoming re-contaminated through contact with oiled mothers. In these circumstances mothers should be captured and cleaned by one of the techniques outlined above.

The New Zealand Sea lion Trust conducts routine population monitoring on Otago beaches - they may be able to assist with individual identification of affected animals on the mainland (in particular mother/pup pairs)and post-release monitoring of oiled animals. The trust contacts are listed in Appendix 2.

4. True seals

Introduction:

Like sea lions, phocids or true seals, such as elephant seals and leopard seals, do not rely in their fur for insulation. Therefore treatment criteria and protocol as set out in section 3 for sea lions is relevant to these species and should be used accordingly.

Of the true seals, elephant seals and leopard seals are the most common species encountered in New Zealand waters. Elephant seals are occasional visitors to the NZ mainland, while leopard seal visits are somewhat more common. Both species are frequent visitors to all NZ subantarctic islands, with small breeding populations of elephant seals present on Campbell Island and the Antipodes (Baker et al. 2010).

Elephant seals have a conservation status of 'nationally critical', hence should be prioritised at triage during any oiled wildlife responses involving multiple species.

Crabeater, Ross and Weddell seals are all present in NZ Antarctic waters.

Responder Safety:

Due to their size, strength and potential aggression, specific safety protocols will need to be developed should an oil spill impacts these species. Contacts are listed in Appendix 18 for researchers who have worked with these species internationally and who may be able to provide prompt advice on this topic.

5. International Experience with Oiled Pinnipeds

5.1 Sanko Harvest Spill, Australia 1991:

During this event 211 New Zealand fur seals pups aged between 2 weeks and 2 months were contaminated with Heavy Fuel Oil. They were treated in-situ over the pursuing days. The response is detailed in the following unpublished paper:

Gales 1991. New Zealand fur seals and oil: An overview of assessment, treatment, toxic effects and survivorship. The 1991 Sanko Harvest Oil Spill. Report to the West Australian Department of Conservation and Land Management, August 1991.

A copy of this paper can be found in the NZWHC OWR library *and can be requested by email: oiledwildlife@massey.ac.nz*

5.2 San Jorge Spill, Uruguay 1997:

During this event nearly 5000 South American fur seals pups aged between 2 - 3 months were contaminated and died from crude oil contamination. The response to this remote event equated simply to an operational clean-up, with no seals being treated and rehabilitated. The response is detailed in the following paper:

Mearns, A.J., Levine, E. Yender, R., Helton, D. and T. Loughlin. 1999. Protecting fur seals during spill response: Lessons from the *San Jorge* (Uruguay) oil spill. Paper #32. International Oil Spill Conference March 8-11, 1999, Washington State Convention Centre, Seattle

A copy of this paper can be found in the NZWHC, OWR library *and can be requested by email: oiledwildlife@massey.ac.nz*

5.3 The Marine Mammal Centre (TMMC), Sausalito, California:

The Marine Mammal Centre has dealt with a number of oiled California sea lions over the years, However, as of October 2009 they had never dealt with adult fur seals (oiled or not) in a rehabilitation setting, but are prepared to do so should the need arise in the future (D. Wickham pers. comm.).

Case Study: Oiled California sea lion at TMMC –

Information presented by Scott Buhl during the OWCN Annual Rehabilitation Conference 'Oilapalooza 2009' San Diego, October 24 – 25 2009.

An adult female Californian sea lion suffering from domoic acid toxicity wandered into a waste oil pit at a mechanical shop and became 98% oiled. The following points outline the key elements of treatment:

- Admitted to TMMC where she was initially held in a dry pen. She was very stressed after transport, and was washed immediately.
- Anaesthetised with isoflurane (gas then ET tube)
- Pre-treatment: warmed canola oil
- Wash: washed for 1 hour in warm water with Dawn detergent
- Rinse duration: unknown
- Towel dried
- Washed two more times over a week total
- Held total of 2 months until stable and deemed releasable (rehab duration was confounded by domoic acid toxicity)
- When released she was 98% clear of oiling, the plan being that the remainder would be moulted off.
- Just prior to release she was satellite tagged to facilitate post-release monitoring.
- Lessons:
    - Wash should have been delayed for a few days until animal had stabilised
    - Would recommend an injectable anaesthetic during wash as difficulties were had maintaining the ET tube during the wash process and some soapy water was inhaled.
    - Need very large wash tub for sea lion
    - For further information contact: *Frances Gulland, Scott Buhl & Erin Brodie, TMMC*

5.4 SeaWorld San Diego (SWSD), San Diego, California:

SeaWorld San Diego dealt with numerous oiled sea otters during the Exxon Valdez spill, and assisted during the development of the mobile otter rehabilitation housing system (as described in Williams & Davies 1995). As of October 2009, SWSD had never dealt with oiled fur seals, but were well equipped to do so if necessary, having rehabilitated adult fur seals for other reasons (entanglement etc. M. Bressler pers. comm.). SWSD personnel are of the strong opinion that access to salt water is essential for regaining water proofing in both otters and fur seals (M. Bressler pers. comm. Note this is contrary to Dave Jessup's recent work as outlined below).

5.5 Marine Wildlife Veterinary Care and Research Centre, DFG, Santa Cruz, California:

The Marine Wildlife Veterinary Care & Research Centre (MWVCRC) is the primary sea otter rehabilitation facility in California. This is the only fur bearing marine mammal that they deal with.

Case Study: Olive the sea otter:

- *This case study was presented by Dave Jessup at the OWCN Annual Rehabilitation Conference 'Oilapalooza 2009' San Diego, October 24 – 25 2009.*
- Pre-treatment: warmed olive oil massaged into fur for 30 min
- Wash process: 45 minute wash in 2.5% Dawn solution at 29.5°C

- Rinse process: 40 minute rinse in soft fresh water at 35°C. When subcutaneous temperature dropped the rinse water temperature was increased to 38°C until subcutaneous temperature had normalised.
- Post-wash period: Immediate access to softened fresh water. 24 hours inside, then transferred to outdoor enclosure. During early stages of rehab, pool temperature was increased then gradually decreased to normal sea water temperature.
- Cost: $USD5000 for 2.5 weeks of care (this cost does not include facility construction as the facility was already in existence.
- For further information contact Dave Jessup and see Jessup et al 2009 in the proceedings of the Effects of Oil on Wildlife Conference. This study scientifically quantified the benefits of using softened fresh water during the waterproofing phase as opposed to sea water via the use of PIT tags which measured subcutaneous temperature to objectively assess waterproofing status on a number of experimentally oiled otters. The abstract can be downloaded from the following link: http://www.eowconference09.org/wp-content/uploads/15-4-jessup.pdf

5.6 Comparison between California marine mammal rehabilitation facilities:

	SWSD	**TMMC**	**MWVCRC**
Access to sea water during early rehab	Preferential	Preferential	Avoid
Access to fresh water during early rehab	Avoid	Avoid	Preferential *
Manual grooming	Preferential	Unnecessary	Unknown
Detergent choice	Dawn	Dawn	Dawn
Pre-treatment choice	Unknown	Canola oil	Olive oil
Opinion regarding shaving tar patches on sea lions	Prefer to wash or leave to moult	Prefer to wash or leave to moult	Not applicable

***** Jessup et al 2009 showed a clear scientific benefit of using softened fresh water in conditioning pools for sea otters during OWR. This is likely to also be the case for NZ fur seals.

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APPENDICES

Marine mammal zoonoses and zooanthroponoses: a New Zealand context ***Appendix 1***

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[This report is included with the authors expressed permission]

Introduction

Surveillance in marine mammals and new technology is revealing novel evidence of agents such as brucellosis, in New Zealand marine mammals, giving rise to concern about their zoonotic potential. This report compiles monographs on agents of marine mammals that may cause zoonoses.

Each agent is discussed in terms of its general worldwide status and then its status in New Zealand. Details of the actual zoonosis and means of infection are given and the infectious hazards implicit in working with marine mammals identified. In addition to consideration of human infections derived from marine mammals the possibility of reverse zoonosis or zooanthroponoses, is considered for each agent. Precautions are suggested for each agent to prevent human and marine mammal infections.

Advice concerning zoonoses and zooanthroponoses and suitable for employees directed to work with marine mammals, is summarised (Table 1) with reference to specific infectious agents.

An effort has been made to place the risk of infection by a particular agent in context. Many of the agents are more commonly found in the environment, on food, in domestic animals or in other people, than in marine mammals. It is important that when communicating such risks that the overview is given and unnecessary anxiety is avoided.

The following agents were considered zoonoses or zooanthroponoses worthy of discussion:

1. *Brucella* spp
2. *Camphylobacter*
3. *Erysipelothrix rhusiopathiae*
4. Influenza A virus
5. *Klebsiella pneumoniae*
6. Leptospirosis
7. *Mycoplasma*
8. Poxvirus
9. *Salmonella*
10. *Tuberculosis*

In compiling the monographs I have relied on the Handbook of Zoonoses, second edition by George Berin and Infectious disease of Wild mammals, third edition, by Williams and Barker. Essential to this work were the various publications and reports of Padraig Duignan.

Monographs

1 *Brucella* species

General status
Brucella spp were first recovered from sea mammals in 1994, and since then have been isolated or detected serologically in a wide range of marine mammals. *Brucella* spp in marine mammals appear to be well host-adapted and cause relatively little pathology in the primary host (Foster et al 2002). Reproductive disease characteristic of smooth *Brucella* spp has been observed in dolphins. Two bottlenose dolphins (*Tursiops truncatus*) aborted fetuses that died as a result of *Brucella* infection. Placentitis occurred in both cases (Miller et al 1999). Two species of marine *Brucella* spp have been proposed, *B. pinnipediae* found in pinnipeds (seals, sea lions and walruses) and *B. cetaceae* from cetaceans (Cloeckaert et al 2003).

NZ status
Evidence of brucellosis in marine mammals in New Zealand is limited due to a lack of surveillance. Opportunistic testing of serum and tissues from Hector's dolphin have tested positive to ELISA and PCR tests for smooth *Brucella* and marine *Brucella* spp respectively (McDonald et al. 2006).

Zoonosis
In 1999 the Veterinary Record reported that a researcher in the United Kingdom, working with strains of *Brucella* isolated from marine mammals, reported suffering from continuing headaches, lassitude and severe sinusitis (Brew et al 1999). A rising titre to *Brucella* antibodies was observed and marine *Brucella* was isolated from blood samples.
There have been no reported cases of marine *Brucella* infection in people working with marine mammals (so far as I am aware). Two cases in Peruvian males have been reported in the literature and one case in a South Auckland man is in press. Contact with marine mammals has been excluded in all three cases. All patients did consume raw fish. Domestic animals have been shown to be susceptible to Marine *Brucella* strains. As *Brucella* has yet to be demonstrated in fish it is more likely the patients were infected from contact with raw milk from domestic cattle or goats (Peruvian cases) or from slaughter and dressing of pigs (South Auckland case).

Means of infection
People become infected from contact with blood or aborted materials of clinically affected animals. Infection gains entry through abraded skin or mucous membranes or by inhalation. Typically, abattoir workers and veterinarians are at risk from infection in countries where smooth *Brucella* spp are endemic in livestock.

Hazard identification
- Blood from unhealthy marine mammals.
- Aborted materials

Zooanthroponoses
- Infection of marine mammals from humans is unlikely

Precautions
Do not handle aborted materials or open carcasses without gloves, nose and mouth mask, and eye protection (hereon referred to as protective clothing). Do not handle unhealthy marine mammals or open carcasses if there are cuts or abrasions to the hands or arms. Wear a waterproof apron when opening carcasses. Cleaning and disinfection of hands and exposed skin should be carried out prior to consuming food and drink.

2 *Campylobacter*

General status
The genus *Campylobacter* contains 13 species and is wide spread among humans, mammals and birds. Enteric *Campylobacter*, such as *C. jejuni* and *C. coli* occur naturally in birds and mammals and are sometimes pathogenic.

Campylobacter fetus subsp. jejuni colonizes the intestine of chickens, turkeys, and waterfowl but is generally non-pathogenic in mature poultry. It is estimated that over half of all commercial broiler and turkey flocks harbour *C jejuni* . The organism has been isolated from numerous birds, including *Columbae* and domestic and free-living *Galliformes* and *Anseriformes*.

For decades, wild birds have been considered natural vertebrate reservoirs of *Campylobacter* spp. and are frequently mentioned as possible vectors for transmission to poultry, cattle, and humans (Merck Veterinary Manual).

New Zealand status
Campylobacter spp, with only minor sequence difference in 16sRNA from *C jejuni* and *C lari*, were isolated from marine birds including apparently healthy gentoo and macaroni penguins sampled on Bird Island, South Georgia (Duignan, 2001).
Campylobacter sp infection is suspected as the cause of an outbreak of acute septicaemia and necrotising vasculitis in New Zealand sea lions in 1998. There is no evidence that this species is zoonotic.

Zoonosis
Campylobacteriosis is a significant enterocolitis of man acquired through consumption of undercooked poultry meat contaminated with *Campylobacter jejuni*. *Campylobacter jejuni* is the predominant species associated with food-borne infection derived from poultry. *Campylobacter coli* and *C lari* are occasionally recovered from the intestinal tract of poultry, and both have been implicated in food-borne infection.
C. jejuni frequently contaminates raw chicken. Surveys show that 20 to 100% of retail chickens are contaminated. Raw milk is also a source of infections. The bacteria are often carried by healthy cattle and by flies on farms. Non-chlorinated water may also be a source of infections. However, properly cooking chicken, pasteurizing milk, and chlorinating drinking water will kill the bacteria.

Zooanthroponoses
Unknown

Means of infection
Consumption of contaminated chicken, water or milk.

Hazard identification
People with enteritis or diarrhoea are a potential hazard to marine mammals.

Precautions
People with enteritis or diarrhoea should not handle marine mammals. Cleaning and disinfection of hands and exposed skin should be carried out prior to and after handling marine mammals, especially before consuming food or drink.

Rookeries should be protected from livestock, effluent and sewage.

3 *Erysipelothrix rhusiopathiae*

General status
Erysipelothrix rhusiopathiae is found throughout the world. Swine are an important reservoir of infection, however the organism is a saprophyte (found in the environment) and affects a wide range of vertebrates and invertebrates: including birds, fish, dolphins, seals and sea lions, and has been isolated from the slime layer of marine and freshwater fish and from crocodiles.

The bacteria are transmitted through ingestion, or entry of the organism through cuts and abrasions. The disease takes on two forms: a skin form and a septicaemic form, the latter can be fatal. Cetaceans seem more susceptible than pinnipeds.

New Zealand status
Outbreaks of economic significance are uncommon except in turkeys. In 1979 an out break occurred on a large duck farm, involving 10-30% of the young birds (Anonymous, 1980). In 1996 a 5-month-old captive little spotted kiwi died suddenly having been treated 6 weeks earlier previously for a respiratory illness. One of the findings was a moderate growth of *Erysipelothrix rhusiopathiae* isolated from the lung (Black, 1996).

An outbreak of *E. rhusiopathiae* occurred in juvenile Kakapo translocated from Codfish Island to Chalky Island during July 2004 (McInnes, 2005).

Zoonosis
Sealing and whaling are among many occupations associated with infection of people. The most common infection is erysipeloid, caused by contamination of cuts or wounds, and resulting 2 to 7 days later in a localised skin infection of the fingers or hands with reddened edges, and swelling. The non-pathological term speck finger may have been used for this infection.

A serious septicaemic form is known, but is rare in non-immunosuppressed people. Human cases have been fatal when the disease progressed to an infection of the blood and spreads throughout the body, however infection is readily treated with antibiotics.

Zooanthroponoses
Unknown

Means of infection
Most human cases involve localized infections resulting from entry through a cut or abrasion in the skin.

Hazard identification
Healthy marine mammals may have skin lesions and the clinically ill could have septicaemia.

Precautions
Protective clothing should be used when handling marine mammals. When opening a carcass use an apron and a chain mesh glove on the non-knife hand. People with cuts or abrasions on the hands and arms should not handle diseased marine mammals. Dis-infect hands and exposed skin before and after handling marine mammals.

4 Influenza A virus

Humans can become infected with Influenza types A, B and C. Influenza B viruses appear to only infect man (and laboratory rodents) and will not be discussed further here; they cause flu outbreaks every few years. Influenza C also only affects humans and causes only mild illness.

Influenza A viruses naturally infect man, several other mammalian species and a wide variety of birds. Interspecies transmission may occur. Epidemics of respiratory disease in man have been caused by influenza a subtypes H1N1 (1918-19, "Spanish flu,"), H2N2 (1957-58, "Asian flu,"), and H3N2 (1968-69, " Hong Kong flu,"), and possibly H3N8. Subtypes H1N1 and H3N2 are frequently isolated from swine and are still in circulation in humans. In horses outbreaks of respiratory disease have been caused by H7N7 and H3N8. Respiratory disease in seals has been associated with subtypes H7N7 and H4N5 and subtypes H1N1 and H10N4 have been isolated from whales.

The World Health Organisation guards against epidemics or respiratory disease by monitoring influenza subtypes and preparing vaccines.

There are 16 H subtypes and 9 N subtypes of influenza A viruses and these, in many different combinations, have been found in birds. Most infections in birds are inapparent infections sustained by faecal oral infection cycle with replication in the intestine. Virulence, associated with H5 and H7 subtypes, is associated with the ability to spread to other tissues. Invasion and spread to tissues occurs due to a number of factors associated with the HA protein, and two strains of the same subtype can vary in virulence for domestic birds.

Traditionally concerns about pandemic viruses have been associated with the transmission of pathogenic strains to people from an intermediate mammalian host such as pigs. In contrast, the outbreaks in poultry of H5N1 in Asia and H7N7 in the Netherlands are examples of outbreaks that directly cause human infections and deaths. More recently direct infections from birds or avian virus contaminated environments to humans have occurred.

Authorities respond to H5 and H7 in poultry by stamping out or phasing out poultry infected with low pathogenic subtypes and stamping out highly pathogenic subtypes.

General status of marine mammals

In 1979 seals in New England were found with signs of respiratory distress and frothy blood nasal discharge. Infection with H7N7 influenza A was confirmed in association with haemorrhagic pneumonia. In 1982 a H4N5 virus was isolated from harbour seals with bronchopneumonia. The findings gave rise to speculation that earlier outbreaks of pneumonia in harbour seals, Crabeater seals, and grey seals may have been caused by influenza virus.

Although no illness has been attributed to influenza A among marine mammals of the Pacific, (H1N3) was isolated from a minke whale caught in the South Pacific during the 1975/76 whaling season. A close antigenic, genetic and biological relationship was demonstrated between isolates of influenza A from a tern and the whale. Close associations have also been demonstrated between isolates from ducks and seals in the Atlantic.

New Zealand status

Five avian influenza virus subtypes (H1N3; H4N6; H5N2-low pathogenicity; H6N4; H11N3) have been isolated from birds in New Zealand. All isolates have been made from apparently clinically healthy, free-living mallard ducks (Stanislawek 2001). In 1996 a survey of pigs detected H3N2 of likely human

origin in 89% of pigs tested. The predominant subtype may vary. In 1992 H3N2 dominated, where as H1N1 predominated in 1992. in found in humans. H3N2 viruses have often been associated with more severe disease manifest as excess pneumonia and increased influenza mortality.

Although no investigation of influenza infection has occurred among New Zealand's marine mammals, the potential for transmission from birds to marine mammals exists. Overseas, introduction of avian viruses into sea mammals has occurred on several recent and independent occasions (Duignan 2000). *Anseriformes* (ducks, geese, swans) and *Charadriiformes* (gulls, terns, surfbirds and sandpipers) are believed to be the main reservoirs.

Zoonosis
In 1979 self-limiting conjunctivitis was reported in workers handling seals infected with H7N7 virus (Swayne 2003). As H7N7 has been reported in seals the signs and symptoms of the subtype associated with an outbreak in poultry in the Netherlands are of interest. The Netherlands reported that 83 confirmed cases of human H7N7 influenza virus infections had occurred among poultry workers and their families since the H7N7 outbreak began. The vast majority (79) of these people had conjunctivitis, and 6 of those with conjunctivitis also reported influenza-like illness (ILI) symptoms (e.g., fever, cough, muscle aches). One person had ILI only (no conjunctivitis) and 2 persons had mild illness that could not be classified as ILI or conjunctivitis. In addition, one individual, a 57-year-old veterinarian who visited one of the affected farms in early April, died on April 17 of acute respiratory distress syndrome (ARDS) and related complications from H7N7 infection.

Means of infection
In such situations where animals have clinical signs of respiratory illness, people should avoid contact with the animals or contaminated surfaces. Infected animals exhale the virus and shed it in their saliva, nasal secretions, and faeces. It is believed that most cases of bird flu infection in humans have resulted from contact with infected poultry or contaminated surfaces.

Hazard identification
- Sick marine mammals (especially those with pneumonia)
- Areas contaminated with sick marine mammals

Zooanthroponoses
Marine mammals are likely to be susceptible influenza A virus from people.

Precautions
First responders (incursion investigators MAF Biosecurity) to possible influenza infections in animals and birds in New Zealand are vaccinated for influenza (to prevent dual infections and possible reassortment of virus) and have prophylactic access to the antiviral Tamiflu. Close fitting face masks are on hand to prevent conjunctival infection.

Marine mammals showing signs of pneumonia (respiratory distress or discharges from the blow hole or nose) should not be handled without protective clothing. Cleaning and disinfection of hands and exposed skin should be carried out prior to consuming food and drink.

People coming down with the flu and those with the flu must not work with marine mammals.

5 Klebsiella pneumoniae

General status
Klebsiella pneumoniae is known as a resident of the intestinal tract in about 40% of man and animals. It is considered to be an opportunistic human pathogen meaning that under certain conditions it may cause disease. *Klebsiella pneumoniae* is also well known in the environment and can be cultured from soil, water and vegetables. In fact, it is likely that we have *K. pneumoniae* in our intestine from eating raw foods such as salads. *Klebsiella pneumoniae* in humans forms part of the normal flora of the gastrointestinal tract, oropharynx, and respiratory tract. It is a pathogen following invasion of the lungs or wounds, particularly burns, and is a common cause of hospital acquired urinary tract infections. Septicaemia is one outcome of infection. New manifestations of disease humans have been reported in Asia, in the form of liver abscesses and meningitis (Ko et al 2002).

The virulence of *Klebsiella* is not well understood, but its antiphagocytic capsule plays a role in lung infections by preventing phagocytosis. It is thought that aerobactin, an iron-binding protein, also contributes to virulence. *K. pneumoniae* is now among the most common gram-negative bacteria encountered by physicians worldwide. This is probably due to the bacterium's antibiotic resistance properties. In one study multidrug-resistant *K. pneumoniae* were frequently detected in test samples collected from animal farms and retail meat products. They were resistant to ampicillin, tetracycline, streptomycin, gentamycin, and kanamycin (Kim et al 2005).

Klebsiella pneumoniae has been isolated from the respiratory system of Belunga whales, California sea lion, common dolphin and pacific white sided dolphin (Higgins, 2000) and associated with septicaemia in a pilot whale.

New Zealand status
An unusual disease presentation in New Zealand sea lions at Sandy Bay rookery, Auckland Islands was seen for the first time in 2002. The presentation was characterised by systemic bacterial infection that caused suppurative polyarthritis, severe necrotising fasciitis, myositis and osteomyelitis, suppurative peritonitis, pleuritis, or meningitis. For 41 pups, this syndrome was the primary cause of death and for an additional 16 it was a contributing factor along with hookworm infection or trauma. A consistent isolate was *Klebsiella pneumoniae,* with frequent isolations of *Salmonella* spp (Duignan 2003).

Zoonosis
Unknown

Means of infection
Normally resent in the respiratory and gastrointestinal tract. The organism can invade the lungs or cause septicaemia following wounds or order disease events in the host.
Hazard identification
Marine mammals with abscesses or septicaemia are a potential hazard.

Zooanthroponoses
Marine mammals are at risk of the introduction of new strains when handled by humans.

Precautions
Disinfect hands prior to handling marine mammals and disinfect equipment prior to use with marine mammals. Wear protective clothing when handling marine mammals.

6 Leptospirosis

General status
Leptospirosis in marine mammals can cause fever, petechial haemorrhages, hepatic and renal failure, abortion and death. The disease is common in California sea lions (*Zalophus californianus*) and northern fur seals (*Callorhinus ursinus*). Four epidemics in California sea lions were reported between 1981 and 1994. Of 2,338 stranded sea lions, 33% had clinical signs of leptospirosis, including depression, anorexia, polydypsia, dehydration, and reluctance to use their hind flippers (Gulland et al 1996). Leptospirosis in northern fur seals has been reported with interstitial nephritis in adults and multiple haemorrhages in neonates (Smith et al 1977). Serology has implicated serovars Pomona, Hardjo, and Grippotyphosa as causes of leptospirosis in pinnipeds, while serovar Pomona has been isolated on a number of occasions from diseased California sea lions (Gulland et al 1996).

New Zealand status
Eight serovars of *Leptospira* within two pathogenic species have been isolated and confirmed as being present in New Zealand. These are serovars Australis, Canicola, Copenhageni and Pomona within the species *L. interrogans*, and serovars Balcanica, Hardjobovis, Tarrasovi and Ballum within the species *L. borgpetersenii.* Serovars Canicola and Australis have only been isolated from human patients in this country.

In 2001 101 pre-weaned New Zealand fur seal pups were serologically tested for leptospirosis. Thirteen of the seals were suspicious or positive to serovars Canicola, Hardjo, or Pomona. One seal of 98 tested for *L. interrogans* serovar Canicola was positive, 3/101 (3.0%) tested for *L. interrogans* serovar Hardjo were positive, and 3/103 (2.9%) tested for *L. interrogans* serovar Pomona were positive. The highest titres (12,800) were found to serovar Pomona (In press).

While the serological profiles provide evidence of exposure to a *Leptospira* sp, further studies are required to confirm the presence of *Leptospira* sp, by isolation or demonstration of the bacterium in association with interstitial nephritis.

L. interrogans Pomona and *L. borgpetersenii* Hardjobovis (serovar Hardjo) are maintained in New Zealand pigs and cattle respectively. Opportunities for transmission from domestic cattle or pigs to New Zealand fur seals may occur on mainland rookeries. To sustain infection in seals the *Leptospira* sp would have to be maintained in the adult New Zealand fur seal.

If *Leptospira* spp are maintained in adult New Zealand fur seals, then the suckling pups could become infected by direct contact with the females, their urine, or effluent. The common natural routes of infection are believed to be via the conjunctiva, oral or nasal mucosa, or damaged skin (Marshall et al 2002).
Care should be exercised when handling New Zealand fur seals to prevent human infection or inadvertent transfer of infection to another species of marine mammal.

Zoonosis
Leptospirosis in humans is an acute febrile generalised disease arising from a bacteraemia and generalised vasculitis, with many possible non-specific clinical presentations and course. Subclinical and inapparent infections are common. Most patients present with sudden onset of headache, muscle pains and tenderness, and fever, sometimes with rigours, accompanied by nausea with or without vomiting, conjunctival suffusion, a transient skin and mucosal rash and by photophobia and

other signs of meningism. In the mild form the patient may feel better at the end of the septicaemic phase (4-7days) and organ function may recover 3-6 weeks after onset.

Means of infection
Urine is a common source of human infection as *Leptospira* spp are carried in the kidneys of other wise healthy animals. Leptospira survive well in water. Contact or ingestion of contaminated water or soil can also result in human infection. In addition to urine, the blood and tissues of animals with acute leptospirosis could be infectious, and care should be taken when opening such a carcass.

Hazard identification
- Contaminated areas of a rookery
- Urine of healthy animals
- Aborted materials
- Blood, urine and tissues of unhealthy animals

Zooanthroponoses
- Infection of marine mammals from humans is unlikely

Precautions
Prevent contact with urine or contaminated water by use of waterproof gloves. If opening a carcass prevent wet contact by using protective clothing. People with cuts or abrasions on the hands and arms should not open carcasses. Cleaning and disinfection of hands and exposed skin should be carried out prior to consuming food and drink.

Rookeries should be protected from livestock, effluent and sewage.

6 *Mycoplasma*

General status
Mycoplasma are a diverse group of small bacteria that lack a cell wall. They can be isolated from the mucous membranes of healthy animals, and occasionally cause or are involved in disease. They are difficult to isolate and probably occur in all mammals even where infection is un-described. Signs of infection include septicaemia, polyarthritis, or keratoconjunctivitis.

Invasion with Mycoplasma may be secondary to other primary diseases. *M phocidae* was isolated from the respiratory tract of harbour seals during an epidemic of Influenza A pneumonia on the New England Coast (Madoff et al, 1982). *M phocarhinis* and *M phocacrerbrale* were isolated from the internal organs of moribund or dead harbour seals during a morbillivirus epidemic (Kirchoff et al, 1989).

Mycoplasma spp are considered host specific with a few exceptions, and are not usually implicated as zoonotic infections. Madoff et al (1991) isolated *M. phocacrebrale* from a lesion (seal finger) on a human handler bitten by a seal and also from the teeth of the same seal.

Due to the absence of a cell wall many antibiotics are ineffective. *Mycoplasma* spp are sensitive to tetracyclines. Cases of seal finger that respond to tetracycline and not penicillin may be caused by *Mycoplasma*, the reverse may be true for *Erysipleothrix*.

New Zealand status
Unknown. *Mycoplasma* spp probably occur in all mammals even where infection is un-described.

Zoonosis
In 1994 a DOC staff member was bitten on the hand by a New Zealand fur seal. Three days after the bite the hand was swollen and tender. Over the next 20 days the hand swelled slowly and was painful. The infection did not respond to Augmentin, Noroxin or erythromycin. On day 23, tetracycline was prescribed and the swelling and pain reduced very quickly to full recovery (Cawthorn, 1994).

Zooanthroponoses
Unknown

Means of infection
Cuts to the hands, pre-exisiting or sustained when opening carcasses, or bites may lead to localised infection with bacteria and *Mycoplasma*.

Hazard identification
- Animals that may bite.
- Needles or knives that may cut or prick the user or assistant.
- Previously sustained cuts or abrasions of the skin.

Precautions
Using protective clothing should be used when handling marine mammals. Correct restrain of animals to prevent bites. When opening a carcass use an apron and a chain mesh glove on the non-knife hand. People with cuts or abrasions on the hands and arms should not handle diseased marine mammals. Dis-infect hands and exposed skin before and after handling marine mammals.

7 Parapoxvirus

General status
Human infections with animal parapoxviruses are normally due to occupational exposure. Most animal poxviruses are not zoonotic, however four parapoxviruses occasionally cause infections in humans: pseudocowpox, bovine popular stomatitis, orf (sheep scabby mouth) and seal parapoxvirus.

Seal parapoxvirus caused nodulous proliferative skin lesions about the mouth, neck flippers and thoroax of captive grey seals. Individuals handling the seals also developed these nodules.

New Zealand status
Unknown

Zoonosis
Firm (proliferative) painful nodules appear at the site of infection and there may be a low fever and swelling of the draining lymph node.

Means of infection
Human infection occurs due to direct contact with lesions or mechanical transfer to cuts or abrasions.

Hazard identification
Seals with nodules in the skin are a hazard.

Zooanthroponoses
- Unknown

Precautions
People with cuts or abrasions should not handle seals. Gloves should be routinely worn.

8 *Salmonella*

General status
Salmonella spp are pathogens of people, livestock, wild mammals, birds, reptiles and even insects. While some serotypes have a narrow host range, most have a broad host range. Although primarily intestinal parasites of humans and animals, salmonellae are widespread in the environment and commonly found in farm effluents, and human sewage. *Salmonellae* survive well in the environment, multiplying in water. Carriage of *Salmonella* is common in healthy animals.

Salmonella spp can become established in animal production systems through cycles involving a wide range of hosts and faecal contamination of grains and feed. Clinical disease may involve enteritis, colitis or septicaemia.

Production processes that minimise contamination of food combined with the correct food preparation and basic hygiene such as washing hands are necessary to prevent human infections. Animals with salmonellosis should be handled with care; however infection normally occurs due to ingestion of contaminated water or food.

New Zealand status
The *Salmonella* serotypes *S.* Cerro and *S.* Newport were isolated from New Zealand sea lions and feral pigs on the Auckland Islands, and *S.* Newport has been isolated from a New Zealand fur seal. The source of infection is likely to be human waste in the marine environment (Fenwick et al, 2004).

Zoonosis
People are susceptible to infection, either by direct contact with infected animals or through their products, as occurs in food born salmonellosis. In general, salmonellosis is more of a problem in young or old people. Infection during pregnancy should be avoided due to high-fever related complications.

A person in Otago became severely ill after contracting salmonellosis from a stranded fur seal in 2001.

Zooanthroponoses
Marine mammals are susceptible to *Salmonella* associated with human and agricultural waste. People with enteritis or diarrhoea should not handle marine mammals.

Means of infection
Oral infection associated with poor hygiene or ingestion of faecal contaminated water or food.

Hazard identification
Faeces or contaminated areas of a rookery are a hazard.

Precautions
The aged, young or the pregnant should take extra care when handling sick marine mammals. Protective clothing should be worn. Cleaning and disinfection of hands and exposed skin should be carried out prior to and after handling marine mammals, especially before consuming food or drink.

People with enteritis or diarrhoea should not handle marine mammals.

Rookeries should be protected from livestock, effluent and sewage.

9 Tuberculosis

General status
Tuberculosis refers to the disease of people and other mammals caused by tubercle bacilli of the tuberculosis complex: *Mycobacterium tuberculosis*, *M. bovis*, *M africanum and M microti*. These species of *Mycobacterium,* termed 'tuberculosis complex', are distinguished from 'tuberculoid bacilli', such as *M avium* complex and *M marinum,* and saprophytic bacilli such as *M pheli* or *M asiaticum,* as they are contagious (transmitted person to person) rather than non-contagious infections. They do not grow in the environment (soil and water) as do the tuberculoid and saprophytic bacteria. All of these *Mycobacterium* spp are cultured on artificial media, and this distinguishes them from the cause of leprosy *M leprae* and from *M paratuberculosis*, a cause of chronic enteritis in animals that requires special culture media.

Humans and animals vary in their susceptibility to *M bovis* and *M tuberculosis*, however prevalence in a species reflects their level of exposure, and the disease may be indistinguishable. Lesions can be extra-pulmonary or pulmonary. Pulmonary exudates are infectious and transmission may occur with droplets in the air or contact with faeces that contain tubercle bacilli due to the swallowing of pulmonary exudates. Tubercle lesions in the mammary lymph nodes or glands can lead to infection by drinking unpasteurised milk, and pose a risk when draining externally of when they are incised post-mortem.

Tuberculoid bacilli such as the *M avium* complex are readily recovered from soil and water and may also cause pulmonary disease indistinguishable from *M bovis* and *M tuberculosis.* Tuberculoid infections are most frequently extrapulmonary (often unilateral infection of the high cervical lymph nodes). The saprophytic bacilli are not pathogenic except in immuno-suppressed humans.

The name *Mycobacterium pinnipedii* sp. nov. is proposed for a novel member of the M. tuberculosis complex found in seals in Australia, Argentina, Uruguay, Great Britain and New Zealand (Cousins et al 2003). The seal isolates could be distinguished from other members of the M. tuberculosis complex on the basis of host preference and phenotypic and genetic tests. Pinnipeds appear to be the natural host for this 'seal bacillus', although the organism is also pathogenic in guinea pigs, rabbits, humans, Brazilian tapir, and, possibly, cattle. Infection caused by the seal bacillus is predominantly associated with granulomatous lesions in the peripheral lymph nodes, lungs, pleura, spleen and peritoneum. Cases of disseminated disease have been found. As with other members of the *M. tuberculosis* complex, aerosols are the most likely route of transmission.

New Zealand status
Mycobacterium pinnipedii sp. nov has been detected in free living New Zealand fur seals (Hunter et al 1998) and *M bovis* has been detected in captive New Zealand fur seals but not yet in wild New Zealand fur seals.

M. bovis has not been detected in New Zealand marine mammals. *M bovis* in New Zealand occurs in humans, cattle, deer, pigs, sheep, possums, rabbits, hedgehogs, dogs, cats, and other animals including kiwi. *M bovis* survives well in the environment, up to 4 weeks dry conditions and 5 months cold damp conditions. Given its distribution and survival in the environment, exposure of fur seals in mainland colonies may have occurred or could occur at any time.

Zoonosis
The proposed *M pinnipedii* sp nov has an unknown zoonotic potential, however it should be assumed to be as zoonotic as other members of the complex.

Pulmonary tuberculosis due to *M bovis* occurred in a seal trainer in 1988 at a marine park in Western Australia at the same time it was isolated from Australian sea lions and New Zealand fur seals in the park. It should be noted that the trainer would be as infectious for the seals, as seals with pulmonary tuberculosis would be to him!

Tuberculoidosis (discharging abscesses) occurred in a scientist working on the Snares in 1972 after sustaining a cut during the necropsy of a New Zealand sea lion that had white pulmonary lesions (Cawthorn1994).

Means of infection
Pulmonary exudates are infectious and transmission may occur with droplets in the air or contact with faeces that contain tubercle bacilli due to the swallowing of pulmonary exudates. Tubercle lesions in the mammary lymph nodes or glands can lead to infection by drinking unpasteurised milk, and pose a risk when draining externally of when they are incised post-mortem.

Hazard identification
- Sick marine mammals (especially those with pneumonia)
- Areas contaminated with sick marine mammals
- Cuts sustained while working with carcasses
- Tuberculous lesions in the lymph nodes and thorax.

Zooanthroponoses
Marine mammals are susceptible to tuberculosis from people. People with chronic coughs or open sores should not work with marine mammals.

Precautions
Prevent contact with faeces or contaminated areas by use of waterproof gloves. If opening a carcass, prevent wet contact by using protective clothing and an apron. A chain mesh glove should be used on the non-knife hand when opening carcasses. People with cuts or abrasions on the hands and arms should not open carcasses.

Cleaning and disinfection

Disinfection may be ineffective if the wrong disinfectant, or the wrong dilution is used, or where disinfectant is applied to soil or organic matter. The best practice is to establish a cleaning and disinfection station and a clear sense of a clean zone and a dirty zone. Items should not pass from the clean to the dirty zone unless they are clean, and items should not pass from the dirty to the clean zone unless they are disinfected.

The cleaning and disinfection station should be established **before** marine animals are handled, as any attempt to set equipment up afterwards will only contaminate the equipment, vehicles etc. Containers with water and disinfectant at the specified dilution should be prepared, and all equipment (boots) disinfected prior to use. Disinfectants do not work when things are dirty. Any item that is difficult to clean, should be clean prior to use. Removal or of engrained dirt will be necessary before subsequent disinfection.

Special containers and sealable plastic bags should be used for 'sharps' or items that are to be discarded.

As a rule, disinfect hands, equipment, boots before and after contact. It is ill-advised to investigate the problem and then find out that precautions should have been taken.

A variety of disinfectants are available for use, however some do not kill all the agents discussed here and some are toxic or corrosive. Soap or detergent and water will not be effective against all the zoonotic agents. Vircon S used at 2% dilution (routinely used at 1%) will kill all the above agents. Care is required when using it to prevent eye splashing and items should be rinsed off after use to prevent corrosion, however it is gentler than most other disinfectants.

Summary

Table 1 summarises the precautions required for each the zoonoses and zooanthroponoses with reference to each agent. In general terms people working with marine mammals should:

1 Disinfect with 2% Vircon S before handling marine mammals
2 Disinfect with 2% Vircon S after handling marine mammals
3 Wear protective clothing (gloves, nose and mouth mask, eye protection) with marine mammals
4 If opening a marine mammal carcass wear a plastic apron and chain mesh gloves
5 Wear a close fitting face mask when working with sick animals
6 Not handle marine mammals with cuts or abrasions on the hands or arms
7 Not handle marine mammals if (the person) has diarrhoea.
8 Not handle marine mammals if (the person) is coming down with the flu or have the flu.
9 Have current influenza vaccination and prophylactic Tamiflu if working with influenza cases.
10 Restrain animals that may bite appropriately, consider thick welders gloves for holding the animal.
11 Be tested for TB before working with marine mammals if the people have a chronic cough.

Rookeries should be protected from livestock, livestock effluent and sewage

Table 1: Risks and precautions associated with zoonoses or zooanthroponoses.

Agent	Zoonosis	Zooanthroponoses	Agents may occur in		Precautions
			healthy animals	un-healthy animals	
Brucella spp	Possible	Unknown	Yes	Yes	2, 3, 4, 6
Camphylobacter	Unknown	Possible	Yes	Yes	1, 2, 7
Erysipelothrix	Yes	No	Yes	Yes	2, 3, 4, 6, 10
Influenza A virus	Yes	Yes	Yes	Yes	1, 2, 3, 4, 5, 8, 9
Klebsiella pneumoniae	Possible	Possible	Yes	Yes	1, 2, 3, 4, 6,
Leptospirosis	Yes	No	Yes	Yes	2, 3, 4, 6, 12
Mycoplasma	Yes	No	Yes	Yes	2, 3, 4, 6, 10
Poxvirus	Yes	No	Yes	Yes	2, 3, 4, 6
Salmonella	Yes	Yes	Yes	Yes	1, 2, 3, 7, 12
Tuberculosis	Yes	Yes	Yes	Yes	2, 3, 4, 5, 6, 11, 12

Key	Precautions
1	Disinfect before handling marine mammals
2	Disinfect after handling marine mammals
3	Wear protective clothing (gloves, nose and mouth mask, eye protection) with marine mammals
4	If opening a marine mammal carcass wear a plastic apron and chain mesh gloves
5	Wear a close fitting face mask
6	Do not work with marine mammals with cuts or abrasions on the hands or arms
7	People with diarrhoea should not handle marine mammals.
8	People coming down with the flu or that have the flu should not work with marine mammals
9	Current influenza vaccination is recommended as is prophylactic Tamiflu.
10	Restrain animals that may bite appropriately, consider thick wielders gloves for holding the animal.
11	People with a chronic cough should be tested for TB before working with marine mammals.
12	Rookeries should be protected from livestock, livestock effluent and sewage

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Equipment for pinniped OWR: *Appendix 2*

The following equipment is likely to be necessary during OWR involving pinnipeds.

Equipment	Use category
Leather welding gloves	PPE
Tyvex suits	PPE
Nitrile gloves (disposable)	PPE
Safety sunglasses	PPE
High visibility Safety Vests (as necessary, i.e., not capture!)	PPE
Whistles	PPE
Hibitane/Hibiclens disinfectant - 500ml	PPE
Wash PPE – aprons, gum boots, long gloves, face sheilds	PPE
GPS	Field assessment
binoculars	Field assessment
Field note books and pencils	Field assessment
Plastic bags & Cable ties, 200mm	Field assessment
Nets - large throw nets & ring nets, various small nets	Capture
sea lion nets	Capture
Noose pole	Capture
Matasorb (sorbent mats)	Capture
Wildlife Collection tags	Capture
Sturdy transport cages (ideally with divisions)	Transport
Stretchers – canvas, soft mesh, or sturdy board	Capture & Transport
Herding boards	Capture & Rehab
Flipper tags and applicator gun, PIT tags	ID
50ml syringes, without catheter	Stabilisation
Roll of silicone tubing	Stabilisation
Cotton buds	Stabilisation
0.9% NaCl (500ml bottle)	Stabilisation
Squeeze bottles	Stabilisation
Digital thermometer	Stabilisation
Electrolytes, powder	Stabilisation
Anaesthesia machine (or darts for large males)	Veterinary
Tergo detergent	Wash
Sturdy pools with appropriate haul out decking (not PVC fabric)	Rehab
Commercial fish grinder	Rehab
Electric heat pads	Rehab
Necropsy equipment	Necropsy
Note for items that come into physical contact with animals, two sets should be available – one for use on clean seals and one for use on oiled seals.	

Key National Contacts: ***Appendix 3***

Name, Title	Organisation	Contacts
Dr. Louise Chilvers, Sea lion Biologist	Aquatic & Threats Unit Department of Conservation, Wellington	Phone: 04 4713073 Email: lchilvers@doc.govt.nz
Dr. Laura Boren, Fur Seal Biologist & DOC Marine Mammal Advisor	Aquatic & Threats Unit Department of Conservation, Wellington	Mobile: 0274 455 413 Phone: 04 471 3062 Email:lboren@doc.govt.nz
Katja Geschke, Zoo Animal Vet (marine mammal experience)	Wellington Zoo Wellington	Mobile: 021 227 8304 Office: 04 381 6757 Email: katja.geschke@wellingtonzoo.com
Shaun McConkey, Sea lion biologist & President of Trust	NZ Sea Lion Trust, Dunedin	Mobile: 021 2983697 Home: 03 4667037 Email: sealiontrust@clear.net.nz
Dr. Liz Slooten, Hectors dolphin biologist	University of Otago, Dunedin	Mobile: 027 447 4418 Office: 03 479 7980 Email: liz.slooten@stonebow.otago.ac.nz
Dr. Steve Dawson, Hectors dolphin biologist	University of Otago, Dunedin	Office: 03 479 7468 Email: steve.dawson@otago.ac.nz
Dr. Chris Lalas Marine Biologist	Dunedin, Otago	Office: 03 478 1149 Email: ithaki@xtra.co.nz
Jim Fyfe, Marine Ranger with sea lion handling experience	Department of Conservation, Dunedin	Office: 03 474 6946 Email: jfyfe@doc.govt.nz
Pete McClelland Senior Conservation Officer with sea lion handling experience	Department of Conservation, Invercargill	Office: 03 211 2400 Email: pmcclelland@doc.govt.nz
Don Neale, Marine Technical Support with fur seal handling experience	Department of Conservation, West Coast	Office: 03 756 9118 Email: dneale@doc.govt.nz

Department of Conservation Emergency Hotline

0800 DOC HOT (0800 362 468)

Euthanasia of pinnipeds during OWR *Appendix 4*

Decisions regarding euthanasia should be made by the attending veterinarian in conjunction with DOC during OWR. Considerations for animal welfare will be paramount in the decision process. During all oiled wildlife response under the management of MNZ, no individual is to be euthanized without the explicit direction of the attending veterinarian.

Situations when euthanasia may be appropriate include:

- Pups that are confirmed orphans
- Moribund/diseased individuals
- Individuals with serious injury which would prohibit survival in the wild
- Non-threatened species (when resources are stretched already to care for threatened species)
- Individuals with symptoms of underlying disease

A humane death is defined as one that obtains rapid unconsciousness (in a relatively pain free manner) followed by cardiac or respiratory arrest (Andrews et al. 1993).

The following euthanasia techniques are deemed to be humane during OWR and are described in greater detail in Greer et al 2001 – Chapter 32, CRC Handbook of Marine Mammal Medicine:

Intravenous administration of barbiturate:
This is the most common method of euthanasia employed by marine mammal veterinarians worldwide. Pentobarbital dose rate is 60 – 200mg/kg for most species (Greer et al 2001). Intraperitoneal administration is an option when vasculature is difficult to locate.

Inhalant anaesthetic agents:
This technique is also commonly used for small pinnipeds, however time to death is often prolonged in diving mammals with breath-holding abilities. Suitable agents are halothane, isoflurane, methoxyflurane and enflurane.

Gunshot to the head:
A firearm of appropriate calibre must be selected for the task and an experienced firearm license holder must be responsible for the discharge. The target organ for pinnipeds is the brain. The Department of Conservation routinely use this technique for fur seals and may be available to assist in this capacity.

Regardless of the technique, death should be verified* by noted absence of a heartbeat.

* Verification may be difficult in elephant seals. In such cases the following techniques (used to verify death in stranded cetaceans) and described by the Department of Conservation 2007 may be helpful.

"Simultaneous observation of the following provides a good indication of death:

- complete dilation of the pupils;
- absence of palpebral and corneal reflexes;
- slack lower jaw."

Key reference:
Andrews, E.J., Bennett, B.T. and J.D. Clark. 1993. Report of the AVMA panel on euthanasia. Journal of the American Veterinary Medical Association 202: 230 - 247

Greer, L.L., Whaley, J and T.K. Rowles. 2001. Marine Mammal Anaesthesia. *In*, Dierauf & Gulland (eds) CRC Handbook of Marine Mammal Medicine, Second Edition. Chapter 32

Department of Conservation, 2007. Marine Mammal Stranding Standard Operating Procedure. Unpublished Report. Department of Conservation, Wellington, NZ.

Pinniped Necropsy Protocol: ***Appendix 5***

Excerpt from:
Roe, W. D. 2008. Identification of Marine Mammals Captured in New Zealand Fisheries: Methods Used. Unpublished report. New Zealand Wildlife Health Centre, Massey University.

Note that this protocol was developed for fisheries by-catch circumstances. Some aspects of the protocol may be adapted by the attending pathologist during oil spill response as necessary. The standard data sheet for pinniped necropsies is provided at the end of this appendix.

Prior to necropsy specimens are removed from the freezer and thawed at room temperature. The species and sex are determined based on external morphology and expertise of the examiner.

Pathological examination and sampling is conducted according to a standard protocol. The procedure includes recording the body weight (kg), external measurements (cm), and examination of the carcass for external lesions indicative of trauma, for example lacerations, scars, fractures etc. Significant lesions are documented on a body map diagram. The body is opened along the ventral midline and the blubber depth (mm) is recorded over the mid-sternum. A small skin sample is collected from the pectoral or pelvic flipper and stored in 70% ethanol for genetic analysis. The skin and hair are removed, and any bruising is noted on a body map diagram, with an assessment of the amount of the body involved, location, and depth of the bruising. Blubber samples may be taken from the dorsal aspect of the left pelvis for fatty acid analysis (used in diet determination), and stored at –80°C for further research. In females the mammary gland is sliced at 5-10mm intervals along its length to evaluate the presence of milk, and samples collected into 10% buffered formalin for microscopic analysis.

The body cavity is then opened. Abdominal fluid is removed and measured. Samples are collected from lung, liver, spleen and kidneys and frozen at -20^{o}C. These tissues can be used for virology, bacteriology and toxicology at a later date. The tongue, trachea and oesophagus are dissected out and removed along with the lungs. The trachea and lower airways are opened and examined, and multiple incisions made into the lung tissue. The heart is opened and all chambers and walls examined. The stomach is removed, tied off, and either examined immediately or frozen at –20°C until the contents can be examined at a later date. The liver is assessed for tears or ruptures, and for evidence of disease. The hepatic sinus and gall bladder are examined, as are the spleen, pancreas and adrenals. Samples of each of these tissues are saved in formalin. In females the reproductive tract is dissected out and the uterine horns are opened and examined for signs of pregnancy. A sample of uterus is collected into formalin The length, width and depth of the ovaries are measured (mm) using Vernier calipers, and the ovaries weighed (g) using a Mettler PM 4800 Delta Range balance. The ovaries are examined grossly for the presence of corpora lutea (CL) and corpora albicantia (CA). Both ovaries are saved in formalin. In males the testes are removed, weighed, measured and a sample saved in formalin. Kidney capsules are removed and the kidney examined for evidence of trauma or disease.

The head is carefully skinned and examined for bruising and fractures. The mandible is dissected out, tagged, and frozen at -20^{o}C for future ageing by cementum and or dentine analysis of teeth. The brain is then removed by sectioning the head with a band-saw and carefully breaking down attachments between the skull and brain tissue. The surface of the brain is examined grossly and the brain is then fixed in 10% buffered formalin for at least two weeks. Once adequately fixed, the brain is removed and again examined grossly for detection of bruising (contusions).

Pathology

Traumatic lesions are assessed in three categories: body wall subcutaneous/skeletal, cranial, and abdominal cavity. The severity of trauma in each category is then assessed as follows.

- subcutaneous/skeletal trauma is classified as mild, moderate, or severe based on the amount of tissue involved, the depth of bruising, and the presence or absence of ante-mortem skeletal fractures
- cranial trauma is assessed as mild, moderate, or severe based on extent of tissue involved and depth of bruising. If haemorrhage within the skull or in the brain tissue is present, trauma is classified as severe.
- body cavity haemorrhage is classified as moderate or severe based on the volume of blood present in these cavities and the specific organs involved (e.g. liver, spleen, large vessels).

An assessment of the **overall severity** of trauma (mild, moderate or severe) is then given based on the assumed combined effect of trauma in each category.

Stomach content analysis

The stomachs are weighed (kg), opened using scissors and all material washed into a 1 mm sieve. The stomach is then re-weighed to allow the weight of the stomach contents to be determined. Large, relatively undigested material is removed at this stage. Smaller, more digested material is gradually sorted using a black-bottomed tray. Otoliths are clearly visible against this background, and as they are denser than most of the other material, they sink to the bottom of the tray. Squid beaks, eye lenses, fish bones, and other relevant food material are also collected. Lesions in the gastric mucosa are described and quantified. Otoliths, bones, and squid beaks are stored in 70% alcohol for more detailed analysis of diet at or immediately before the time of death.

Histological (microscopic) analysis

Tissues are fixed in 10% buffered formalin before preparation for microscopic analysis. Briefly, this involves trimming tissues into 2mm blocks, then embedding them in paraffin for routine histochemical processing. Processed tissues are sectioned at 5µm intervals using a microtome, mounted on glass slides and stained with haematoxylin and eosin. Slides are examined microscopically at 40 to 100x magnification.

Testes are examined microscopically to assess the maturity of the seminiferous tubule epithelium and evaluate the presence of spermatozoa. The microscopic characteristics of the testicular and epididymal tissue, in conjunction with the combined weight of the testes (summed testicular mass) of an individual male enable its classification as sexually mature (with active or inactive spermatozoa production as appropriate), immature, or pubertal.

Ovaries are examined to confirm the presence of corpora lutea or albicantia as assessed grossly. The uterine horns are also examined to assess the maturity of the reproductive tract, and mammary tissue is assessed for the presence of milk and for evidence of any inflammatory response (mastitis) or disease.

Sections of lung are examined to determine the presence or absence of pulmonary congestion and oedema (excessive blood in vessels and excessive fluid in the airways) as these are indicators of drowning.

Sections of trachea, oesophagus, spleen, adrenal, liver, heart, diaphragm and kidney, as well as the whole brain, are saved for histological analysis as indicated. It should be noted that in frozen tissues accurate histological interpretation of lesions can be markedly compromised.

NON BYCATCH PINNIPED DATA SHEET

MUCIC # _____

Lab Case ID (PM #) _____ Tag # _____

Date found: _____ Necropsy Date: _____

Location: _____

DOC Contact: _____

Species: _____

Sex: _____ Age: Juv., SubAd., Ad.

Weight: _____kg Std. Length: _____m Girth: _____m Blubber: ____mm

Carcass state: fresh / mild / moderate / severe decomposition

Fresh: chilled / frozen

HISTORY

ARRIVAL DETAILS

GROSS PATHOLOGY

External Examination (see diagram and eyes, ears, flippers)

Internal Examination (Blubber, subcutis, mammary gland, fascia, muscle, skeleton)

Alimentary system (mouth, teeth, oesophagus, stomach, small intestine, large intest., liver, gall bladder, pancreas, peritoneum, lymph nodes).

Respiratory system (nose, larynx, trachea, bronchi, lungs, pleura, lymph nodes)

Cardiovascular (Heart, pericardium, great vessels)

Urogenital system (kidneys, bladder, ureters, urethra, gonads, vagina/penis/prepuce)

Lymphatic (thymus, spleen, lymph nodes)

Endocrine (thyroids, adrenals)

Nervous system (only if head trauma).

REPRODUCTIVE SYSTEM

Female:

Ovaries: Weight Dimensions (LxWxD) CA(#, Size) CL (size) Uterine Horn Diameter

Right:

Left:

Pregnant: Yes / No Milk: Yes / No

Foetus: Length (crown-rump, mm):_____ Weight: _____kg. Sex: M / F

Male:

Testes: Weight + epidid (kg) Weight – epidid (kg) Length x diameter (mm).

Left.

Right

STOMACH

Weight with contents:_____kg

Weight empty: _____kg

Contents: _____kg

Composition: fish, squid, other inverts, squid beaks, otoliths, rocks.

Parasites collected: Yes / No

Ulcers: Number _____ Size range: _____

Other lesions: _____

IMAGES: Yes / No

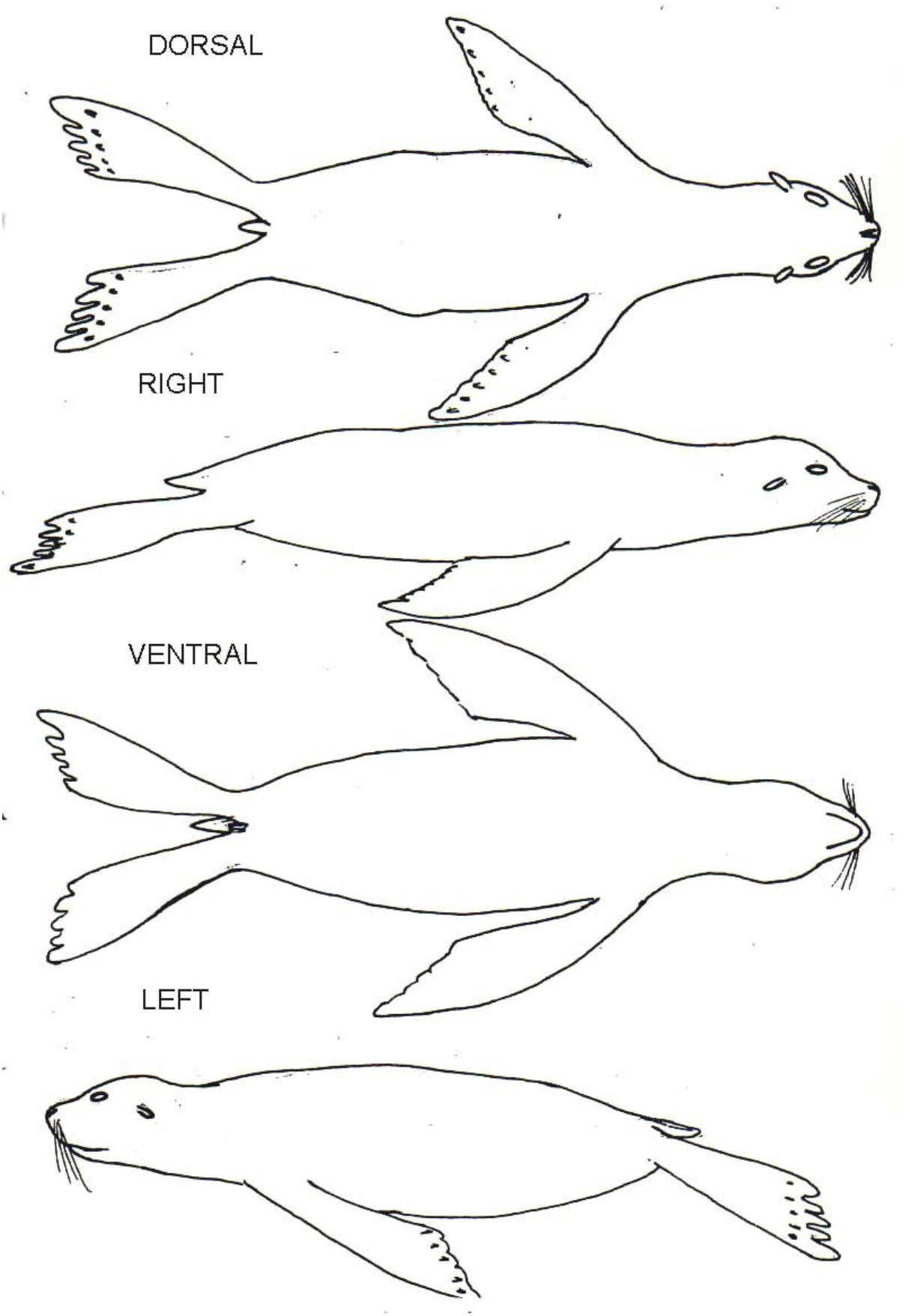
SAMPLE CHECKLIST

Discipline	**Tissue**	**Storage**	**Check**
Histopathology	Lung, Heart, Liver, Spleen, Thyroid, Trachea, Kidney, Diaphragm, Adrenals, CNS, Any lesion, Gonads, Mammary gland, foetus.	Formalin	
Toxicology/Diet	Blubber	Freezer (300g whirlpack)	
Age determination	Jaw	Label - bucket	
Museum	Skull	Big freezer	
Brucella	Lung, Liver, Spleen, Lymph Nodes, Uterus, Testis, Mammary Gland, Foetus, Kidney	Brucella culture medium	
		PBS for PCR testing	
Parasitology	Intestine / stomach / lung	Frozen -80/ alcohol	
Bacteriology	Abdo pool/thoracic pool	pottle	
Diet	Gut contents / blubber	Fish bin / -80 freezer	
Other studies/samples:			

DISPOSAL/STORAGE DETAILS

DIAGNOSIS

Examiner(s): (Please sign)


DORSAL
RIGHT
VENTRAL
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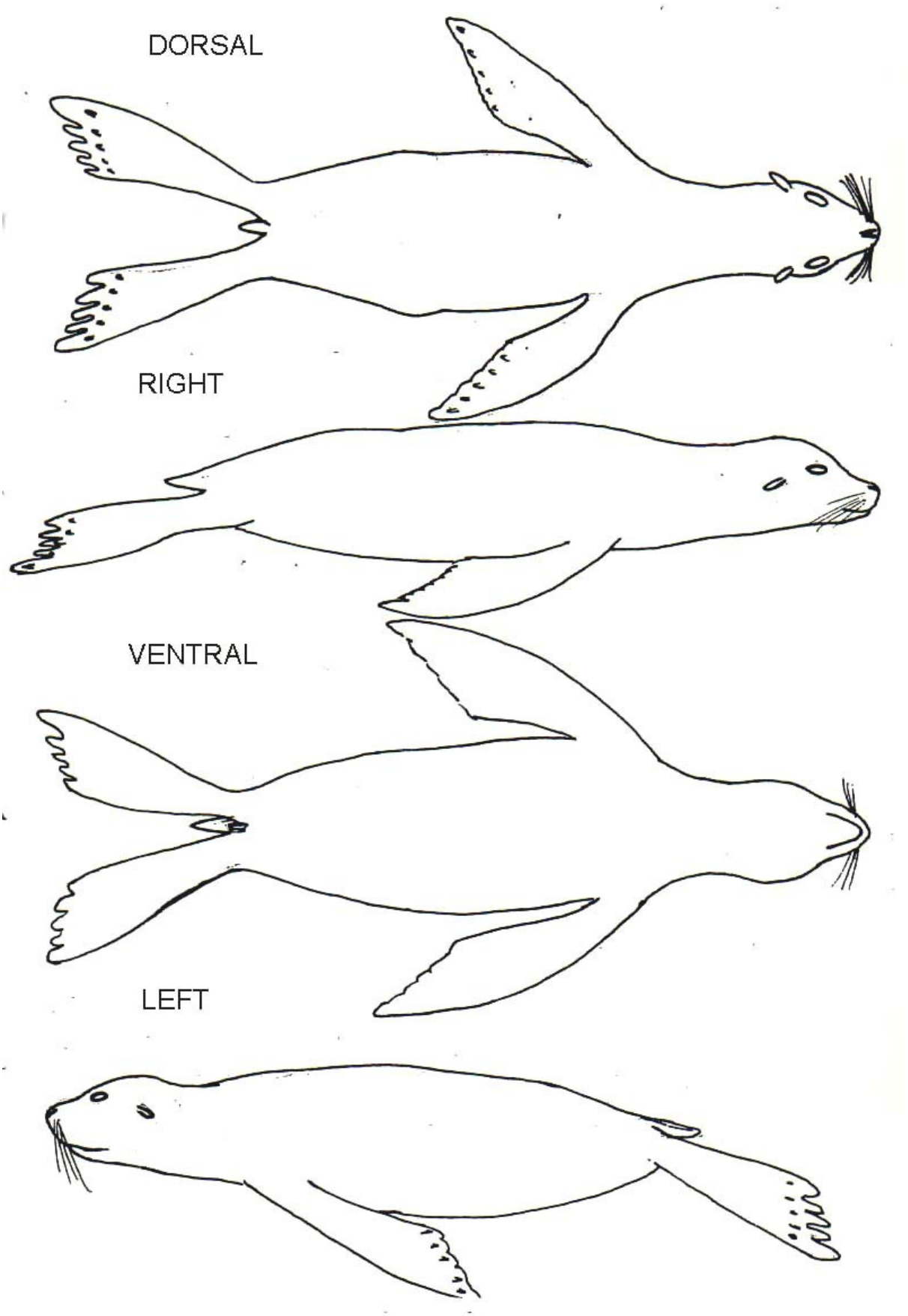
DORSAL
RIGHT
VENTRAL
LEFT

Post-release monitoring techniques: ***Appendix 6***

Post release monitoring is highly recommended for pinnipeds following oiled wildlife response. Such monitoring allows managers and researchers alike to gauge how successful their rehabilitation efforts were, and may help to justify decisions regarding rehabilitation in the future. Note that in New Zealand it is debateable as to whether post-release monitoring costs are considered "reasonable" costs as far as the spillers' legal obligation for cleaning-up the spill. This means that these costs are unlikely to be recoverable from the spiller, hence external funding should be obtained for this monitoring.

There are few published post-release studies on oiled pinnipeds, however Lander et al 2002 found that harbour seal pups that had been rehabilitated for a number of reasons unrelated to oiling demonstrated similar behaviour, movement, and survival rates as wild pups. As it may take some time for rehabilitated individuals to adapt to the wild, Harvey (1991) recommended that post-release monitoring of seals should extend for at least 3 – 4 months after their release.

A structured post-release monitoring programme should include sufficient treated and non treated individuals to allow the investigation of potential statistical differences. Ideally such a programme would include representative individuals of both sexes, ages and reproductive states. Although the monitoring method may vary, it is important to carefully consider the amount of monitoring that will be required to achieve the target outcomes. Biological criteria that could be monitored vary considerably depending on what you are interested in but could include short- and long-term survival, reproductive rates, growth rates, foraging activity and area, home range, and attendance patterns. All could be excellent proxies for post-release monitoring but the range and nature of these will need to be determined by species, situation, and funding availability.

Historically flipper tags have been a main-stay for identification and subsequent monitoring of pinnipeds in New Zealand. Flipper tags rely on re-sight data to be collected after tag application.

At the very minimum we recommend that flipper tags and Passive Integrated Transponder (PIT) tags be applied to rehabilitated oiled seals and sea lions to facilitate future monitoring (see Appendix 12). The collection of a small genetic sample via 'toe clipping' is also recommended for addition to the national marine mammal tissue bank which is managed by DOC.

Remote monitoring technologies are rapidly evolving, leading to ever increasing sophistication as to data that can potentially be collected from wildlife (see Lander et al 2001 for more detail). Potential remote techniques that are available for post release monitoring are summarised below. Costs may dictate that transmitting tags are applied to only a subset of individuals:

- Radio tagging:
  - typically VHF
  - some transmitters incorporate mortality, temperature and activity sensors
  - useful to also tag a wild control group
  - reasonably inexpensive

- Time depth recorders:
  - These can be archival - tag must be recovered to collect data or satellite-linked
  - In addition to time and depth they can be programmed to collect numerous other parameters (water temp, position, heart rate, body temperature etc)
- Satellite tagging:
  - Relatively expensive
  - Data transmitted via satellite to the user, hence no tag recovery needed
  - Battery size affects tag size and duration of transmission
  - May not be available at short notice - usually require a reasonable set-up time, application approval from Argos, custom built tags etc
  - Location information accuracy varies, hence best suited to research where spatial accuracy is not critical to the nearest metre. GPS linked are now available but are more expensive.
  - Louise Chilvers at DOC routinely uses these on NZ sea lions; she may be able to help with making these tags available at short notice.
- GPS tagging (transmitting and archival tags):
  - Facilitates more accurate location data than satellite tagging.

Local suppliers of wildlife tracking equipment:

Sirtrack – Wildlife Tracking Solutions:

Private Bag 1403, Goddard Lane
Havelock North 4157, New Zealand
Phone +64 6 877 7736
Fax +64 6 877 5422
Freephone within New Zealand - 0800 SIRTRACK (0800 747 872)
Website: http://www.sirtrack.com/

The consideration of animal welfare is crucial before deployment of tracking instruments on pinnipeds. Any device attached to the body of a seal or sea lion will undoubtedly affect the hydrodynamics of an individual, hence will have the potential to reduce foraging success. Animal welfare considerations are particularly important for rehabilitated animals which may have reduced fitness in the wild immediately after release.

A DOC permit will also be required to mark any individual or attach any tracking equipment. DOC can however undertake such tasks without a permit for management purposes. It may therefore be beneficial for DOC to lead the post-release monitoring programme.

References:

Lander, M.E., Westgate, A.J., Bonde, R.K. and M.J. Murray. 2001. Tagging and Tracking. *In*: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Pp. 851 – 880.

Lander, M.E., Harvey, J.T., Hanni, K.D. and L.E. Morgan. 2002. Behaviour, movements, and apparent survival of rehabilitated and free-ranging harbour seal pups. Journal of Wildlife Management 66 (1): 19 – 28

Harvey, J.T. 1991. Survival and behaviour of previously captive harbour seals after release into the wild. *In* J.E. Reynolds and D.K Odell (eds.); Marine Mammal Strandings in the United States. NMFS Technical Report 98.

Pinniped capture techniques: ***Appendix 7***

Capture should occur under the direction of an experienced handler whenever possible. The people listed below may be able to assist with the capture itself or provide advice on aspects such as: best technique, appropriate capture gear for different scenarios, capture logistics, etc.

The following people are familiar with standard research capture techniques for **fur seals** (key contact is underlined):

- Dr. Laura Boren, DOC National Office
- Don Neale, DOC West Coast
- Mike Morrissey, DOC Kaikoura
-

The following people are familiar with standard research capture techniques for **sea lions** (key contact is underlined):

- Dr. Louise Chilvers, DOC National Office
- Jacinda Amey, Southland NZ
- Kerri Morgan, Massey University
- Nathan McNally, University of Otago
- Dr. Chris Lalas, Dunedin NZ
- Jim Fyfe, DOC Dunedin
- Amelie Auge, University of Otago
- Shaun McConkey, NZ Sea Lion Trust
- Helen McConnell, Massey University
- Dr. Simon Childerhouse, AAD, Tasmania

Capture techniques are not described here, as capture attempts by inexperienced teams can be dangerous for both the field team and the animal. We therefore strongly recommend that advice be taken directly from the personnel listed above regarding capture techniques and equipment.

General points to consider when planning the capture of pinnipeds:

Before you leave the car park:

- Good preparation is essential
- Human safety must be prioritised, followed closely by animal welfare
- Ensure trained/experienced personnel are used whenever possible
- Appoint a team leader
- Prepare a communication strategy and undertake a thorough briefing with your fellow capture personnel
- Be aware of both tide and weather conditions
- Seek local advice (access points, coastal geography etc) when working in unfamiliar locations
- Ensure appropriate personal protection equipment (PPE) is provided to all personnel
- Ensure appropriate equipment is available, and that users are familiar with it.
- Be familiar with the species that you are likely to encounter and know their natural history

Once you have identified a target animal:

- Assess each target animal on a case by case basis > assess the situation from a distance > develop a game plan > also develop a back-up plan in the event that the first plan is not successful.
- Have pre-defined roles within the capture team
- Inform bystanders of your intentions if necessary
- Identify possible escape routes of the target animal
- Avoid all potential stressors to the animal both before and after capture: noise, excessive movement, smell

Useful Tactics:

- Move slowly as you approach
- Avoid eye contact as you approach.
- Once you have decided to 'strike' DO NOT HESITATE.
- If possible have two nets ready (one each amongst two 'catchers', the second can be used if the first one misses.
- Use camouflage PPE if appropriate to increase the success of capture
- Use 'single image' technique – one person 'hides' in the silhouette of the other
- Zigzag search technique for a single person
- Keep net low until you intend to 'strike'
- Identify and aim to block possible escape routes of the animal
- Use the wind to mask noise – approach on the leeward side of an animal

Transport of pinnipeds during OWR: ***Appendix 8***

The capture and transport process will be very stressful for the animal, and all practical steps should be taken to ensure transport is as efficient as possible to minimise the increased stress associated with close confinement.

Basic principles:

- The safety of both of the animal and the handlers needs to be ensured at all times.
- Adequate ventilation must be provided to all oiled wildlife during transportation
- Adequate shelter from wind/rain must be provided as necessary
- Mothers and pups kept together but consider putting the pup in a separate animal carrier so the mother doesn't squash the pup.

Important Safety Note:
The vehicle driver and the oiled animal/s must not share the same airspace during transport to ensure that the driver is not subject to dangerous volatile fumes.

Transport vehicles: Appropriate vehicles will need to be selected by the Wildlife Operations Manager at the time of a spill. The following vehicles **may** be suitable for the transport of oiled pinnipeds (the suitability of each option below will vary depending on the circumstances):

- Utes with cages*
- Utes with canopies
- Caged Stock trailers* and suitable towing vehicles
- Small trucks with canopies
- Small trucks with caged enclosure*
- Horse floats/trucks
- Appropriately sized boats
- Helicopters (from remote sites)

***Note**, if unrestrained pinnipeds are to be transported in caged vehicles/trailers the cage must be covered and solidly lined to prevent pinnipeds from climbing out of the cage during transport.

Transport enclosures: Appropriate enclosure sizes will vary with the species, age and number of animals requiring transport.

- In some instances the vehicle or trailer structure and the transport enclosure will be one and the same. For example a horse float (single or double) may be suitable for transporting a single large unrestrained pinniped.
- In other instances the animal/s will need to be restrained in an enclosure before being placed in the vehicle. For example a number of juvenile fur seals could be transported together in the back of a well ventilated canopied ute if they are placed in individual plastic animal carriers before being loaded into the vehicle.

Transport times: Transport times should be minimised. If animals need to be transported for more than 2 hours they may require a stabilisation stop en-route during which fluid therapy can be administered. Ideally the time between capture and arrival at the treatment facility should be minimised to negate the need for field stabilisation or stabilisation stops during transport.

Housing for pinnipeds in captivity during OWR: ***Appendix 9***

General housing considerations (adapted from OWCN 2004):

- Ventilation (10 – 15 air exchanges per hour)
- Temperature control
- Water filtration (separate systems for each enclosure)
- Safe and escape proof
- Minimise visual stressors

The following enclosures may be needed depending on the response strategy chosen and the species in question:

Fur seals –

A. Temporary in-situ holding pens for pups
B. Dry holding enclosures for oiled seals during pre-wash stabilisation
C. Dry holding enclosures for clean seals during post-wash stabilisation
D. Conditioning enclosures with pools and haul-out space for waterproofing

Sea lions –

E. Temporary in-situ holding pens for pups and/or adults
F. Dry holding enclosures for oiled sea lions during pre-wash stabilisation
G. Dry holding enclosures for clean sea lions during post-wash stabilisation

These enclosure types can be categorised as 'Dry holding pens' (A, B, C, E, F, G) or 'Conditioning pens with pools' (C) and are discussed further below.

Dry holding pens –

- These are intended for short-term use only (maximum 5 days).
- They may be used for 1) pre-emptive capture, 2) the holding of oiled animals prior to washing, and 3) the holding of clean animals during post-wash stabilisation.
- The construction of all dry pens need to be sturdy to ensure animals will not injure themselves, however in-situ pens for pups will not need to be as substantial as those required for adults.
- Care must be taken to select a fencing option that minimises likelihood of injury – for instance regarding temporary fencing supplies - diamond mesh is preferable over vertical metal bars which may trap and injure flippers.
- Various construction materials, as identified below, may be suitable for dry holding pens. Some of these products can be routinely supplied by temporary fence hire businesses (see below for contacts):
    - Water filled plastic barriers (good for pups: typically used during road construction)
    - Temporary wire fencing (diamond mesh), may need additional supports for strengthening if they are to be used for adult pinnipeds. Alternatively lighter gauge plastic coated wire mesh may be acceptable for the restraint of pups.

    - Wood is not advisable for construction of pinniped enclosures due to hygiene concerns (inability to disinfect it thoroughly).
- It would be beneficial if all pens can be sub-divided into halves for cleaning purposes. This would allow handlers to force animals into one end of an enclosure while the other half can be safely cleaned and vice versa.
- There are two options for managing oily waste in pens set up on natural substrate (grass, sand, gravel etc):
    1) A ground cover can be provided which will prevent the substrate from becoming contaminated. A tarpaulin over which sorbent pads and then tube matting has been laid is likely to be sufficient for this purpose, or
    2) Alternatively enclosures can be repositioned frequently after which the natural substrate is removed as hazardous waste.
    - Note that even clean animals may still be excreting oily waste as they metabolise and eliminate hydrocarbons from their systems; hence consideration of this waste needs to be given for both oiled and recently cleaned animals.
- A ground covering may not be necessary on a concrete substrate if the area is well drained and can be hosed frequently to remove faeces etc into a waste water oil interceptor system. However, tube matting may be necessary in some instances to prevent abrasions on the ventral surface of the flippers if the concrete is not smoothly finished.

<u>Conditioning enclosures for waterproofing (juvenile and adult fur seals only) –</u>

- These are intended for medium-term use only (7 - 10 days).
- They are used for housing fur seals after they have been washed while they regain their waterproofing.
- Pools are required during this period both for the restoration of waterproofing (through encouraged grooming) and the stimulation of feeding behaviours in captivity.
- Construction must be sturdy and secure to ensure animals will not injure themselves.
- A concrete base will be ideal for these enclosures. As these enclosures will be 'wet' zones, grassed areas will <u>not</u> provide a suitable substrate.
- Moulded fibreglass pools with slatted haul out decking surrounding them and a secure exterior fence are perhaps the most ideal temporary arrangements.
- Alternatively, and possibly more appropriate for young pups, would be the use of plastic pallets to provide raised haul-out platforms in a small enclosure with a small adjoining pool (fish bin of water). A series of such enclosures could be erected from a bare concrete pad using holes drilled into the concrete into which metal pipes could be set to mark the corners of each enclosure (c. 1 x 2 m). Plastic coated wire mesh could then be strung between the poles and tied down to the concrete at the base.
- In an ideal setting, gates in the exterior fence would be half doors (i.e. the top half can be operated separately from the bottom half), and would swing in both directions.
- The large plastic bins used to transport live fish (approx. dimensions = 1.3 x 1.3 x 1.3m) can be successfully adapted for small pinnipeds, e.g. young fur seals. Haul out decking needs to be constructed around the pool. These bins were used successfully for otters during the Exxon Valdez spill.

- PVC fabric/vinyl pools are unsuitable for all marine mammals due to lack of strength.
- Controlling bacteria in pools is often a challenge. Chlorine can be used for this, but it will damage pelage if left un-neutralised. SeaWorld San Diego use chlorine followed by 'drip neutralisation' for their fur seal enclosures.
- Lander et al 2002, who conducted a post-release monitoring study on rehabilitated animals from The Marine Mammal Centre, Sausalito, California noted "During tagging procedures, we noticed rehabilitated pups had brittle pelage compared with that of wild pups, which might have been a result of their exposure to bleach, chlorine, ozone, or the freshwater system at TMMC".
- Softened freshwater in pools is ideal and will allow waterproofing to be regained in the shortest period (D. Jessup). In otters, Jessup 2009 found that salt water pools during conditioning elicited a marked metabolic response leading to physiological stress on the animal and requiring increased food intake (D. Jessup 2009)
- For information on water quality issues see:
  Arkush, K.D. 2001. Water Quality. *In: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Pp. 779 - 790*
- Bright/reflective pool colours should be avoided

General considerations:

- Shade should always be available to captive pinnipeds.
- Sharp corners etc should be avoided during all enclosure construction as pinnipeds are prone to eye injuries when care is not taken in this respect.
- When making decisions on captive housing of pinnipeds, attention should be given to the natural habitat that the animal is accustomed to and the behavioural traits of the species. For instance:
  - Fur seals and sea lions are highly mobile on land over varying terrain; hence raised pools with ramps should cause few problems for this species. True seals on the other hand, such as elephant seals and leopard seals, are less mobile ashore and benefit from sunken pools with graduated entry/exit points.
  - Fur seals and sea lions will sometimes attempt to climb out of mesh enclosures (especially where two mesh walls meet in a corner). Corner covers may be necessary to prevent escapes.

Examples of conditioning enclosures – TMMC, Sausalito, California

- Total enclosure dimension = approx. 8 x 6m
- Centrally placed graduated concrete pool. Deep portion of pool is 2 x 2m large and 1.2m deep, with a shallow periphery measuring c. 5 x 5m and c. 0.5m deep).
- This enclosure easily houses 3 x adult female California sea lions.
- Salted fresh water was used in pools (our preference would be for softened freshwater).
- Inner corridors between enclosures act as traps and can be used to isolate individuals away from water if necessary.
- All surfaces concrete

- Exterior fence for each enclosure consists of 1m high concrete wall with diamond wire mesh fencing above (total height = approx. 3 m).

References:

Arkush, K.D. 2001. Water Quality. *In: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Pp. 779 -790*

Oiled Wildlife Care Network. 2004. Protocols for the care of oil affected mammals. M. Haulena, S. Johnson, J. Mazet, P.Yochem & M. Ziccardi eds. Davis, CA: University of California, Wildlife Health Center.

USEFUL LOGISTICAL CONTACTS

Temporary Fencing Hire:

- Fahey Fence Hire, Christchurch
  Phone: 03 343 9960, Mobile: 021 334 766
  http://www.faheyfencehire.co.nz/
- Hampden Fence hire, Auckland
  Phone: 0800 426 002 Phone: 09 274 7557
  http://www.hampden.co.nz/,
- 0508 TEMP FENCE, Auckland
  Phone: 0508 836 733, Fax: 09 426 5849, Email: info@0508tempfence.co.nzv,
  http://www.0508tempfence.co.nz/home/
- AdFence, Auckland
  Phone: 0800 89 49 29, email: james@adfence.co.nz,
- Temporary Fence, Tauranga
  Phone: 0274 945 788, Fax: 07 552 4934,

Moulded Fibreglass Swimming Pools:

- Bluewater pools, Auckland
  Phone 09 441 6281
  http://www.bluewaterpools.co.nz/
- Splashtime pools, Nelson
  Phone 03 547 3411, 0274 446 188
  www.splashtimepools.co.nz
- Laguna pools, Tauranga
  Phone 0800 524 862, 07 850 6216, 021 222 5451,
  www.lagunapools.co.nz
- Barrier Reef Pools, agents all over NZ (see website)
  www.barrierreefpools.co.nz

Pinniped husbandry in captive facilities: ***Appendix 10***

Quarantine protocols (adapted from OWCN 2004):

- Always handle the healthiest animals first during treatment rounds
- Disinfectant foot baths should be placed outside each enclosure
- Disinfecting or changing PPE between individual animals
- Separate cleaning/feeding equipment should be designated for different enclosures/areas
- Movement of animals (& personnel as practicable) should be minimised between enclosures

Captive Complications:

- Minor ventral surface flipper abrasions are sometimes seen in captive pinnipeds. However, these are generally not serious. Most species are well adapted to firm surfaces in the wild; hence clean smooth concrete surfaces should pose few problems for pinnipeds in captivity.
- Eye problems tend to be symptomatic of water quality issues. Bright/reflective pool colours and a lack of shade are also contributing factors. Residual chlorine and ozone have been linked to eye lesions which are then readily exacerbated by opportunistic bacterial infections (conjunctivitis, keratitis – see Thornton et al 1998). Saline washes are recommended to mitigate eye problems in pinnipeds (Gulland et al. 2001 – Chapter 41).
- The shorter the duration of captivity, the lower the chances of individuals developing secondary captive complications. Hence, following OWR treatment, individuals should be released to the wild as quickly as possible.

Species requirements:

- When making decisions on captive husbandry of pinnipeds, attention should be given to the natural habitat that the animal is accustomed to and the behavioural traits of the species. For instance:
    - Due to their agility on land and inquisitive nature captive fur seals and sea lions may benefit from environmental enrichment, e.g. music, climbing platforms & novel objects.

Social grouping in captivity:

- During OWR only individuals of the same species should be housed together, and even then the following factors should be considered:
- Mother pup bonds should be maintained as a matter of priority
- Similar age-classes should be housed together
- During the breeding season adult males will probably need to be housed separately to avoid aggression associated with sexual competition.

References

Gulland, F.M.D., Haulena, M. and L.A. Dierauf. 2001. Seals and sea lions. *In* L.A. Dierauf and F.M.D. Gulland (eds): CRC Handbook of Marine Mammal Medicine, Second Edition, CRC Press LLC, Boca Raton, Florida. Chapter 41.

Oiled Wildlife Care Network. 2004. Protocols for the care of oil affected mammals. M. Haulena, S. Johnson, J. Mazet, P.Yochem & M. Ziccardi eds. Davis, CA: University of California, Wildlife Health Center.

Thornton, S.M., Nolan, S. and Gulland, F.M.D. 1998. Bacterial isolates from California sea lions (*Zalophus californianus*), harbour seals (*Phoca vitulina*) and northern elephant seals (*Mirounga angustirostris*) admitted to a rehabilitation center along the central California coast, 1994 – 1995. Journal of Zoo and Wildlife Medicine 29: 171 - 176

Nutrition of Captive Pinnipeds ***Appendix 11***

Excellent general information on nutrition and nutritional disorders can be located in:

Worthy, G.A. 2001. Nutition and energetics. *In: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Pp. 791 – 827.*

PUP NUTRITION

Hand rearing of orphan pups should never be the intention of oiled wildlife response. However it makes sense to include some basic information on pup nutrition in this SOP in the event that we are faced with orphaned pinniped pups. This information may be beneficial in the interests of animal welfare while decisions are being made by all interested parties (On-Scene-Commander, DOC, Iwi, Massey University) with regards to the appropriate course of action.

Note – that 'imprinting' of pups onto humans during periods of captive care is possible but appears rare (e.g. Lynn et al 2009). This appears to be more of a problem with sea lions as opposed to fur seals (M. Bressler pers. comm.).

The appropriate nutrition of pups is paramount to their development and survival. The most comprehensive information on suitable maternal milk substitutes for pinnipeds is:

Townsend, F.I. and L.J. Gage. 2001. Hand rearing and artificial milk formulas. In: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Pp. 829 – 850.
Note that recipes from this chapter have been largely reproduced in Appendix 12 of OWCN 2004.

It is important to remember that these formulas were not developed specifically for NZ species; hence they may need revision to some extent. The majority of these formula's rely on a product called 'Zoologic Milk Matrix 30/55 (Pet Ag Inc., Hampshire, IL)', a similar product available through Michele Thompson, IVABS is 'Wombaroo sea lion milk replacer'. During a spill an urgent delivery could be facilitated for this product through Michele (phone: 06 356 9099 extn 7440)

<u>New Zealand sea lions:</u>

Of most relevance to NZ sea lion pup nutrition is the following diet information which is summarised from an unpublished report by Monica Bando entitled "Hand-rearing of an orphaned New Zealand sea lion pup, January – April 2005". This report was prepared in relation to an orphaned sea lion pup which was cared for successfully by Massey University and Wellington Zoo from age 18 to 73 days of age. A full copy of this report is help in the NZWHC, OWR library *and can be requested by email: oiledwildlife@massey.ac.nz*

INITIAL DIET:
The feed formula described in table 1 was derived by modifying a California sea lion (Zalophus californianus) neonate diet recipe from Marineland, Napier as well as a California sea lion diet from

the CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation (Dierauf and Gulland 2001).

These quantities yielded approximately one day's intake. The pup was tube-fed 300mL of warm (30-35℃) fish formula three times a day. Weight gain on this feeding regime averaged ~150g/day.

Ingredients	***Fat (g)***	***Prot (g)***	***Fat (kcal)***	***Prot (kcal)***	***Total kcal***	***Fat % ME***	***Prot % ME***
300 g salmon	*24*	*60*	*204*	*210*	*414*	*49*	*51*
30 mL canola oil	*30*	*0*	*255*	*0*	*255*	*100*	*0*
30 mL cream	*11.5*	*0.6*	*98*	*2*	*100*	*98*	*2*
375 mL lactose- free milk	*15*	*12*	*128*	*4*	*132*	*97*	*3*
2 mazuri vitamin tablets							
5 mL calcium sandoz syrup							
~150 mL electrolyte solution							
Total	***80.5***	***72.6***	***685***	***216***	***901***	***76***	***24***

Table 1. Estimation of macro-nutrient composition of formula fed to pup.

REPLACEMENT DIET:
For convenience, the pups diet was gradually switched to "Wombaroo Sea Lion Milk Replacer." The Wombaroo diet requires mixing the powder in cream, a 300 g powder : 700 ml cream ratio. 1.5L of this formula was fed per day.

Further analysis suggested that the fish formula diet better approximated the milk composition of New Zealand sea lions than the Wombaroo formula.

New Zealand fur seals:

Marineland NZ has successfully raised NZ fur seal pups in the past. If fur seal pups are oiled during a spill they should be contacted early on in the response for their milk formula recipe.

Foraging training strategies

Foraging training strategies may need to be considered in that unlikely case that pups are help long-term. There is no published information on how fur seals learn to forage. However pups reared at TMMC and at SeaWorld San Diego are provided sequential nutrition after they have been admitted to captivity as follows:

- Electrolytes > formula > fish mash > whole dead fish in pool (they often play with it first then once they start chewing on it realise that it is food and will swallow whole dead fish from this point on) > live fish in pool if necessary (note this is illegal in NZ, without an ethics exemption). At TMMC pups are fed 10% of their body weight over each 24 hour period in captivity.

ADULT NUTRITION:

Access to pools of a reasonable depth (see Appendix 8) is needed to stimulate foraging of captive adult pinnipeds. Internationally, captive adults are typically fed good quality small – medium sized dead fish (e.g. herring 10 – 20 cm length), which is thrown into the pool. Overseas examples suggest that most adults will feed using this technique, and for those that won't, live fish are fed to stimulate feeding (note this is illegal in NZ, without an ethics exemption).

If multiple animals share an enclosure, it is recommended that during feeding someone is appointed to the role of simply monitoring individual intake to make sure all animals get enough food. In general, captive rehabilitating pinnipeds should be fed frequent, small, calorie rich meals.

If adult fur seals only have access to freshwater pools they should be provided with an oral salt supplement following Gulland et al 2001:

- Sodium chloride, 3g/kg fish
- Thiamine, 25–35mg/kg fish
- Vitamin E, 100 IU/kg fish

References:

Lynn, B. L., C. Reichmuth, R. J. Schusterman, and F. M. D. Gulland. 2010. Filial imprinting in a Steller sea lion (*Eumetopias jubatus*). Aquatic Mammals 36(1):79-83.

L.A. Dierauf and F.M.D. Gulland (eds): 2001. CRC Handbook of Marine Mammal Medicine, Second Edition, CRC Press LLC, Boca Raton, Florida.

- *Townsend, F.I. and L.J. Gage. Chapter 37. Hand rearing and artificial milk formulas.*
- *Worthy, G.A.J. Chapter 36. Nutrition and energetics.*
- *Gulland, F.M.D., Haulena, M. and L.A. Dierauf. Chapter 41. Seals and sea lions*

Oiled Wildlife Care Network. 2004. Protocols for the care of oil affected mammals. M. Haulena, S. Johnson, J. Mazet, P. Yochem & M. Ziccardi eds. Davis, CA: University of California, Wildlife Health Center.

Pinniped handling techniques for young animals *Appendix 12*

These guidelines are intended for the following age-classes:

- New Zealand fur seal 0 – 2 years
- New Zealand sea lion 0 – 1 year

Key messages:

- ❖ Maintain control of the jaw at all times when handling seal pups
- ❖ Allow flexibility in your approach to handling seals to suit individual needs and different scenarios
- ❖ Don't turn your back on any captive seal while inside it's enclosure
- ❖ Only trained people to handle pinnipeds during OWR
- ❖ All those handling pinnipeds should be supervised by someone with experience in this field.

<u>General points –</u>

- Pinniped pups will readily bite when stressed in both the wild and captive settings – care must be taken to ensure handler safety
- It is important that a degree of flexibility in is maintained with regard to these guidelines - the success of techniques described here will vary between individuals and through time. If a technique is clearly not working it is important to change tact and try something different.
- Pinniped pups are extremely mobile – especially in water
- Because of their agility in water, no captures of pinnipeds in rehabilitation pools should be attempted, capture attempts should occur only in dry areas of the enclosure to reduce stress to the animal during the capture process and increase capture success.
- Herding boards/shields are useful to allow handlers to safely approach captive pinnipeds. A solid wooden board with a handle on the back or a small wire mesh 'gate' can be used for this purpose.
- Avoid startling sleeping pinnipeds as they often are aggressive if they are not given a few minutes to wake-up.
- If as a handler you are confronted by an aggressive captive pinniped, you should back away from the individual and adopt a 'neutral' attitude and stance which may help to diffuse aggression.
- Control pectoral and hind flippers during pinniped restraint as the animal can gain leverage to escape from both front and hind flippers.
- Pinnipeds can be moved over short distances within their enclosures using a 'wheelbarrow' style of approach, whereby the handlers holds the hind flippers and directs the head to the intended location to which the animal walks on its pectoral flippers.
- During the captive period animals will become more familiar with handling procedures, feeding systems etc through time, allowing handlers to modify their approach as appropriate.
- During tube feeding the handler is recommended to use one hand to hold the lower jaw and other hand to hold the upper jaw from behind the canines. A second person will be necessary to insert the feeding tube and administer food/fluids.

Capture techniques:

1. Herding boards can be used to restrict individual seals into a corner of their enclosure
2. A towel can then be thrown over the head of the animal
3. The primary handler can then approach and catch the seal by either:
   - Pinning it behind the head with a hand or a 'squash pole' before straddling the animal and restraining it's flippers against its body with their knees (a second person may be needed to hold the body securely in some circumstances), or
   - Allowing the animal to bite down on the padded thumb of a glove (sheepskin works well as padding) while they firmly hold the bottom jaw. The handler can then lift the body with the other hand to where it can be pinned with flippers restrained under the handlers arm
4. Once restrained animal's can be wrapped firmly in a towel to help control the pectoral flippers if necessary.

Fur seals:

- Typically only one person will be needed to capture, hold and manipulate young (0 – 12 months) fur seal pups during rehab.
- Two people are recommended for tube-feeding; one person is designated the role of 'holder' while the other is the 'feeder'.
- Fur seal behaviour is reasonably predictable if handlers are familiar with recognising behavioural cues.

Sea lions:

- Typically two people will be needed to capture, hold and manipulate young (0 – 12 months) sea lion pups during rehab.
- Three people are recommended for tube-feeding; one person holds, another feeds and the third is present to assist as required.
- A gag made of PVC piping may be useful to keep a sea lions mouth open while a feeding tube can be passed into the stomach.
- Sea lions can be restrained on the ground for a period with two straddling people – the front person sitting over the shoulders pinning the head firmly to the ground; the other person straddling behind restraining the pectoral flippers with their knees.
- Behaviour is difficult to predict.

Table 1. Average weights of NZ fur seals and NZ sea lions:

FUR SEALS			**SEA LIONS**		
Age	**Weight (kg)**	**Reference**	**Age**	**Weight (kg)**	**Reference**
Birth	3.0 – 5.5	Boren 2005	Birth	10	Chilvers et al 2007
2 months	6 - 11	Boren 2005	3 months	23 - 35	Inferred from: Chilvers et al 2007 & Childerhouse et al 2005
4 months	9 - 14	Boren 2005	1-2 years	45 - 80	Childerhouse et al 2010

References:

Boren, L.J. 2005. New Zealand fur seals in the Kaikoura region: colony dynamics, maternal investment and health. Unpublished PhD thesis. University of Canterbury, Christchurch, NZ

Childerhouse, S.J., Dawson, S.M., Fletcher, D.J., Slooten, E. & B.L. Chilvers. 2010. Growth and reproduction of female New Zealand sea lions. Journal of Mammalogy 91(1): 165 – 176

Childerhouse, S., Gibbs, N., McAlister, G., McConkey, S., McConnell, H., McNally, N. & Sutherland, D. 2005. Distribution, abundance and growth of New Zealand sea lion *Phocarctos hookeri* pups on Campbell Island. New Zealand Journal of Marine and Freshwater Research 39: 889 – 898

Chilvers, B.L., Robertson, B.C., Wilkinson, I.S. & P.J. Duignan. 2007. Growth and survival of New Zealand sea lions, *Phocarctos hookeri:* birth to 3 months. Polar Biology 30: 459 - 469

Individual identification of pinnipeds during OWR *Appendix 13*

A DOC permit is required for all 'tagging' of marine mammals in New Zealand. All methods described below (temporary and semi-permanent) are considered tagging in this context.

Temporary identification methods (not recommended)
Researchers have used the following temporary marking methods successfully to track individual pinnipeds over days/weeks.

- Bleaching patches of pelage
- Spray painting patches of pelage
- Clipping areas of pelage

However, all these techniques rely on a potential disturbance to the pelage integrity, which is considered counter-productive to the aims of oiled wildlife response. Hence we recommend that these techniques be avoided and that the flipper tag method outlined below be utilised instead.

Flipper tags (recommended):
Both New Zealand sea lion and New Zealand fur seal pups have been subject to ongoing tagging studies, whereby plastic 'livestock' tags are punched through the trailing edge of the proximal fore-flipper. This technique is widely accepted and has been approved through various ethics committees in the past for both species. Personnel undertaking tag application should be trained by someone who is an experienced tagger, regarding the details of tag placement and application technique. For both species, pups should be tagged in both flippers. For a general description of tag application and placement for different species see:

- Erickson, A. W., M. N. Bester and R. M. Laws. 1993. Marking techniques. Pages 89–118 *in* R. M. Laws, ed. Antarctic seals: Research methods and techniques. University Press, Cambridge, U.K. (available from: Massey University Library. Turitea Books (Level 2) - 599.745 Ant)

Fur seals: Recommended tags for NZ fur seal use are numbered Allflex® (NZ) sheep ear tags (Dowell et al. 2008). Tag colour and number system should be discussed with Dr. Laura Boren to ensure consistency with any DOC tagging studies. Tag placement is in the trailing edge of the proximal fore-flipper, and should be overseen by someone familiar with tagging this species. Flipper tags are highly recommended for fur seal pups. For all other age-classes their application should be assessed on a case by case basis. Application of flipper tags to sub-adults and adults may be best achieved under general anaesthetic concurrent with the wash process.

Sea lions: Recommended tags for NZ sea lions are uniquely numbered 'coffin' shaped 'Dalton DAL 008 Jumbotags' (Dalton Supplies Ltd., Henley-on-Thames, United Kingdom: Chilvers and Mackenzie 2010). Tag colour and number system should be discussed with Dr. Louise Chilvers to ensure consistency with any DOC tagging studies. Tag placement is in the trailing edge of the proximal fore-flipper, and should be overseen by someone familiar with tagging this species. Flipper tags are highly recommended for sea lion pups. For all other age-classes their application should be assessed on a case by case basis. Application of flipper tags to animals older then pups may be best achieved under general anaesthetic concurrent with the wash process.

True seals: Recommended tags for all true seal species are uniquely numbered 'Dalton DAL 008 Jumbotags' (Dalton Supplies Ltd., Henley-on-Thames, United Kingdom: Pistorius et al. 2000). Tag

placement is in inter-digit webbing of the hind flipper, and should be overseen by someone familiar with tagging this species. All age classes are good candidates for hind flipper tagging.

Passive Integrated Transponder (PIT) Tags (recommended):
PIT tags are tiny identification chips which are injected subcutaneously for permanent identification. A 'reader' is needed to read the unique code that each chip has. The preferred supplier is Trovan, Ltd., Douglas, United Kingdom. PIT tags are highly recommended for all seal species and all age classes. Note that PIT tags are not detectable visually, but require a microchip reader for detection.

Recognition of natural markings (recommended):
A high proportion of adult sea lions and fur seals sustain wear and tear injuries which render the individual recognisable from its peers. In circumstances where only a few individual adults are admitted to care for oiling, it may be possible to rely on such markings to distinguish individuals without applying alternative tags or marks. Features such as those listed below are useful for individual recognition:

- Damage to the trailing edge of the fore flippers (including tag loss scars)
- Damage to the toes and webbing on the hind flippers
- Body scars
- Tooth damage
- Body size etc

Note – the NZ Sea lion trust holds a catalogue of over 100 sea lions in Otago that are identifiable by such features (McConkey 1999). Animals accumulate natural markings of this nature over time; hence natural markings may be especially appropriate for adult animals which are not ideal candidates for flipper tags.

Genetic Material:
Genetic finger printing techniques can also be employed to identify individuals. A small amount of skin can be snipped off the end of a hind digit and stored in 70% ethanol for future genetic matching.

Reference:

Chilvers, B. L. & D. I. Mackenzie. 2010. Age- and sex-specific survival estimates incorporating tag loss for New Zealand sea lions, *Phocarctos hookeri*. Journal of Mammalogy 91(3): 758-767

Dowell, S.A., Boren, L.J., Negro, S.S., Muller, C.G., Caudron, A.K. and N.J. Gemmell. 2008. Rearing two New Zealand fur seal (*Arctocephalus forsteri*) pups to weaning. Australian Journal of Zoology 56: 33-39

Mcconkey, S. 1999. Photographic identification of the New Zealand sea lion: a new technique. *New Zealand Journal of Marine and Freshwater Research*, *33*(1): 63-66

Pistorius, P.A., Bester, M.N., Kirkman, S.P. and P.L. Boveng. 2000. Evaluation of age- and sex-dependent rates of tag loss in southern elephant seals. *Journal of Wildlife Management*, *64*(2): 373-380

Intake Examination, Triage and Veterinary Stabilisation of oiled pinnipeds *Appendix 14*

Veterinary examination:
On intake a full veterinary examination should be performed if practicable using the template provided in Appendix 15.

Triage:
Two levels of triage need to be considered at this time:

- Triage based on presenting medical needs, whereby treatment of those individuals with the greatest chance of survival is prioritised. The attending veterinarian will oversee this triage.
- Triage by conservation status needs also to be considered.

Triage by conservation:
The following priority ranking should be observed for a spill affecting numerous pinniped species:

1. New Zealand sea lions
2. Southern elephant seals
3. Leopard seals
4. New Zealand fur seals

Within an individual species group prioritisation should occur as follows:

a) Pups (especially females)
b) Breeding females
c) Juvenile females
d) Adult males
e) Juvenile males

Blood sampling:
A blood sample should be taken to facilitate basic diagnostics (PCV, TP). The caudal gluteal vein is the most convenient blood collection site for both fur seals and sea lions. Other options are the inter-digital vein in the hind flipper and the jugular vein.

Hydration therapy:
Most oiled pinnipeds will present in a state of dehydration. Blood values should be determined where possible to guide fluid therapy. In lieu of blood results - dehydration should be presumed at 5 - 10%. Hydration therapy can be administered via the following routes:

- Oral
- Subcutaneous
- Intravenous
- Intraosseous
- intraperitoneal

Data Collection:
The absolute minimum of data to be collected during intake (following Gulland et al 2001) is:

- Sex
- Age-class
- Standard length
- Body condition score

However, attempts should be made to complete as many fields of the examination template as possible, whilst remaining realistic about the constraints of handling conscious wild pinnipeds.

Body temperature correction:
Attention should be given to each individual's thermoregulatory state and holding pen temperature should be modified to normalise body temperature if necessary. Individual heating pads or hot water bottles can be provided for animals that require warming. Sprinklers can be used to cool animals as can ice packs if necessary. Shade should be available at all times to captive pinnipeds.

Underlying injuries and disease:
Individuals with serious injury or disease symptoms at intake may be immediate candidates for euthanasia depending on the scale of the event and the resources available. The attending veterinarian will be responsible for decisions relating to the treatment of all underlying injury or illness during OWR.

Common medical conditions of oiled pininpeds:
For a summary of the following important medical conditions common to oiled pinnipeds see OWCN 2004:

- Stress
- Hypoglycaemia
- Shock
- Vomiting
- CNS Disorders
- Respiratory distress

References:

Gulland, F.M.D., Haulena, M. and L.A. Dierauf. 2001. Seals and sea lions. *In* L.A. Dierauf and F.M.D. Gulland (eds): CRC Handbook of Marine Mammal Medicine, Second Edition, CRC Press LLC, Boca Raton, Florida. Chapter 41.

Oiled Wildlife Care Network. 2004. Protocols for the care of oil affected mammals. M. Haulena, S. Johnson, J. Mazet, P.Yochem & M. Ziccardi eds. Davis, CA: University of California, Wildlife Health Center.

Pinniped Admission and Summary Record ***Appendix 15***

Incident Name:_____ Admission #: _____

Admission date: _____ Admission time: _____

Species: _____ Pup /Juv. / Adult Male / Female / ?

Tag number: _____ Chip number: _____

History - from collection tag:

Capture date: _____ Capture time:_____ Capture method:_____

Capture location: _____

Collected by (name): _____

Status at time of collection (circle one): Alive Dead

Degree of oiling at time of collection (%): _____

Date & time of departure to treatment facility: _____

Pre-transport treatment Details: Treatment given at staging site: YES / NO

Mouth/Nose Cleared YES / NO Warmed YES / NO

Excess oil removed YES / NO Eyes Irrigated YES / NO

Oral Hydration YES / NO Volume:_____ Fluid:_____

Other comments: _____

_____

_____

Admission Physical Examination:

Fur: _____ Pulse: _____

Mouth: _____ Weight: _____

Nose: _____ Body condition: _____

Eyes: _____ Digestive tract:_____

Ears: _____ Lymph nodes: _____

Skin: _____ Dehydration: _____%

Body: _____ Temperature: _____°C

Fore-flippers: _____ PCV: _____

Hind-flippers: _____ Buffy Coat: _____

Posture: _____ Total Protein: _____

Strength: _____ Blood Glucose: _____

Demeanour _____ Faecal (Direct):_____

Respiration _____ Faecal (Float): _____

Faecal – Blood: Yes / No

Comments: _____

_____

_____

_____

_____

_____

Triage Ranking: ☐ Low priority ☐ Medium priority ☐ High priority

Type of Oil: _____

Degree of Oiling: 25% 50% 75% 100%

Area Oiled:

NB: Guard hairs only = 'Sheen' or 'Light' : Guard hairs to under-fur = 'Medium' **:** Guard hairs to skin = 'Heavy'

Head:	☐ Sheen	☐ Light	☐ Medium	☐ Heavy
Chest:	☐ Sheen	☐ Light	☐ Medium	☐ Heavy
Fore-Flippers	☐ Sheen	☐ Light	☐ Medium	☐ Heavy
Back:	☐ Sheen	☐ Light	☐ Medium	☐ Heavy
Belly:	☐ Sheen	☐ Light	☐ Medium	☐ Heavy
Hind-flippers:	☐ Sheen	☐ Light	☐ Medium	☐ Heavy

Initial rehydration therapy:

Fluid type:_____ Volume: _____

Medical Treatment Summary: _____

_____

_____

_____

_____

_____

_____

Samples collected: _____

Euthanased - Date: _____ Method: _____

Reason: _____

Date washed	Product used	Wash duration	Patient condition
1.			
2.			
3.			

Pre-release Physical Examination:

Fur: _____
Mouth: _____
Nose: _____
Eyes: _____
Ears: _____
Skin: _____
Body: _____
Fore-flippers: _____
Hind-flippers: _____
Posture: _____
Strength: _____
Demeanour _____
Respiration _____

Pulse: _____
Weight: _____
Body condition: _____
Digestive tract:_____
Lymph nodes: _____
Dehydration: _____%
Temperature: _____°C
PCV: _____
Buffy Coat: _____
Total Protein: _____
Blood Glucose: _____
Faecal (Direct):_____
Faecal (Float): _____
Faecal – Blood: Yes / No

Comments: _____

_____

_____

_____

Release Location: _____

Date Released: _____ Time Released _____

Pinniped Anaesthesia during OWR: ***Appendix 16***

Small to medium sized New Zealand sea lions and New Zealand fur seals

Isoflurane inhalation is the safest trialled technique for anaesthesia in small to medium sized New Zealand sea lions and New Zealand fur seals (Gales and Mattlin 1998). A portable anaesthesia machine has been developed to facilitate this technique. The Department of Conservation has one of these machines that may be available for use during OWR; contact Dr. Louise Chilvers Sea lion Biologist for further information.

This technique requires animals to be physically restrained before being masked for delivery of the anaesthetic agent. This physical restraint aspect means that large adults may need to be sedated (e.g. intramuscular midazolam) via remotely administered intramuscular injection (blowpipe or dart gun) before they can be masked, this can lead to a prolonged recovery times and complications associated with the use of injectable agents during anaesthesia maintenance (Gales & Mattlin 1998).

Dosage rates for anaesthesia by isoflurane inhalation following Gales & Mattlin 1998 are provided below:

Species	**Dosage**
NZ fur seal	1.2 – 4.0%
NZ sea lion	0.8 – 4.0%

The recommended dose rate of midazolam for sedation in Otariids is 0.1 – 0.2 mg/kg for (McBain 2001).

Haulena & Heath 2001, strongly recommend intubation for all pinniped anaesthesias and comment that great care should be taken in positioning the head and neck to ensure tracheal stricture. It is prudent to note however that many NZ sea lions have been anesthetised without intubation in ongoing studies by the Department of Conservation on the Auckland Islands.

Adult male sea lions:

Anaesthesia of adult male sea lions has been performed on only a limited number of males to date. The technique for this age-class differs in that Zoletil 100® is initially administered remotely at a dosage of 1.7mg/kg before the animal (once unconscious) is masked and maintained via a portable anaesthesia machine (Geschke & Chilvers 2009).

The main concern for seals when under anaesthesia is the risk of vomiting.
Anaesthetised individuals lack a gag reflex, meaning that any material that is regurgitated is easily aspirated and may obstruct the airway and/or cause aspirate pneumonia.

The following guidelines are used by the Department of Conservation Sea Lion Research Team during sea lion anaesthesia and may help to mitigate complications (L. Chilvers pers. comm.)

1. Ensure animal has been ashore (i.e. not foraging and has an empty stomach) for at least 3 hours prior to anaesthesia (This maybe assumed if need be i.e. dry fur, relaxed asleep on shore, nursing pup, long way from shore etc) .
2. Whilst anaesthetised, position animal with head slightly higher than the body to reduce risk of stomach content leakage.
3. For the duration of the anaesthesia process have one person with the sole responsibility of observing the animals breathing. This person should also hold a hand on the animals throat to feel for movement or vomiting.
4. If vomiting does occur - reverse anaesthesia immediately by administering pure oxygen. Clear mouth and take immediate action to ensure the animal's body is higher than its head. This can be achieved either by lifting the body or by excavating a depression in the ground under the head and shoulder area.
5. If severe i.e. liquid and food actually came out of mouth - consider giving animal an injectable long lasting antibiotic to help prevent aspirate pneumonia (Antibiotics should be keep on hand in all cases)

The following information sheet (prepared by Larry Vogelnest, Taronga Zoo, Sydney) on leopard seal resuscitation during anaesthesia may be useful for other pinniped species during anaesthesia emergencies.

References:

Chilvers, L. Department of Conservation, Wellington, New Zealand.

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Haulena, M. and R.B. Heath. 2001. Marine mammal anaesthesia. *In*: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Chapter 29

McBain, J.F. 2001. Cetacean medicine. *In*: CRC Handbook of Marine Mammal Medicine, Second Edition, L.A. Dierauf and F.M.D. Gulland (eds.), CRC Press LLC, Boca Raton, Florida. Chapter 40

Leopard seal resuscitation procedure

Prepared by Larry Vogelnest, Senior Veterinarian, Taronga Zoo
January 2009

Recognising cardiopulmonary difficulties

- Increased respiration rate and effort (up to 14 bpm) – indicates possible airway obstruction and hypoventilation
- Apnoea for 30 seconds or longer
- Loss of visible or audible heart beat
- Change in mucous membrane colour from pink to any other colour
- Capillary refill time > 3 seconds

Assessment of CPA should be extremely rapid – if in doubt start CPR

Basic life support

Aim: to supply the heart and brain with oxygenated blood – every intervention should be aimed at improving myocardial oxygenation, cerebral oxygenation or both

- Provision of oxygen and ventilation
    - Check for airway obstruction and rectify – change position of animal, stimulate by rolling, punch chest, open mouth. If no improvement intubate and ventilate using 30L/min demand valve or re-breathing bag. If still breathing and moving air but having difficulty give O_2 via face mask while trying to improve respiration. Give 2-4 bpm
- Provision of circulation
    - External chest compressions – in large animals the thoracic pump mechanism rather than direct cardiac compression is used. The thoracic pump mechanism relies on compression of the chest wall causing significant increase in intra-thoracic pressure, forcing blood out of the chest away from the heart, then when the chest wall is allowed to relax, blood will flow into the chest toward the heart again. The arrangement of valves in the heart and great vessels ensure a one way flow of blood. For this mechanism to be effective it is important to allow full relaxation between compressions to allow cardiac filling. Compressions should be at a rate of 80-100/min and should continue for at least 3 min before taking a break to check for heart beat and spontaneous respiration. Ventilation must continue during the compressions. To prevent fatigue of the person doing the compressions the ventilator and compressor should swap every 3 min.
- Check ET CO_2 – if CO_2 is present this will indicate effective ventilation. No CO_2 means inadequate perfusion. A sudden increase in CO_2 indicates return of spontaneous circulation
- Check mucous membrane colour as an indicator of effective ventilation and perfusion
- Check heart beat
- Check pupil size – fixed and dilated is not a good sign

Drug therapy

Only a small number of drugs are actually effective during CPR and some may do harm

- Adrenaline – 0.1ml/kg of 1:10 000 (= 0.01mg/kg) – intracardiac, IV (extradural, jugular, lingual veins), IM in the tongue or endotracheally (if this route is used double the dose and flush with sterile water or saline followed by several large breaths)
- Atropine – if bradyarrhythmia is present give 0.04mg/kg IV, IM in the tongue or endotracheally (if this route is used double the dose and flush with sterile water or saline followed by several large breaths)

Wash room facility requirements: *Appendix 17*

Many features that are considered important for the design of oiled wildlife response facilities for the treatment of birds are relevant also to oiled marine mammals; hence Appendix 10 of the avian SOP should be consulted in addition to the marine mammal specific features listed below.

NOTE:
For marine mammals it is anticipated that the wash station and the rinse station will be one and the same for all individuals except for pups, which are possibly small enough to transfer to separate wash stations should this be deemed advantageous.

Water Supply

- Temperature: Provide washing and rinsing water temperatures which can be easily controlled between 10 and 40°C
- Pressure: Provide water pressure at 200 - 275 kPa in wash/rinse area, while maintaining sufficient water pressure in other areas as necessary.
- Quantity: Provide supply line(s) large enough to cater for all areas requiring water simultaneously. The quantity should be sufficient to provide a continuous flow of 15 L/minute to all indoor outlets and an additional supply for pools if necessary.
- Quality: Maintain a water softness of 30-50 mg calcium carbonate per litre for wash/rinse stations and pools.
- Wash/rinse stations require an unlimited supply of temperature controlled softened water over 60 – 90 minutes.

Wash/rinse work station

- A metal bench at 1050 mm height, with a worktop approximately 1000 mm long by 500 mm wide is ideal for personnel comfort during the wash process. A drain in the bench centre may also be beneficial.
- The use of tubs for the wash process may or may not be appropriate depending on the size of the animal:
  - If tubs are to be used extreme care must be taken to keep the animals mouth and nostrils above water at all times.
  - For pups/juveniles shallow tubs may be useful to retain the wash solution around the animal during the wash process.
  - For large animals it may be difficult to find a tub that is long enough, in these circumstances a continuous supply of wash solution in buckets may be a better option, with the animal lying directly on the work bench.
  - If no tub is used during the wash process, due attention must be given to the safe drainage of waste water around the work station in order to ensure responder safety.
- Strong task lighting will be required.

Key International Contacts: ***Appendix 18***

Name, Title	Organisation	Contacts
Pam Yochem, Senior Research Scientist (experienced in all facets of MM OWR)	Hubbs SeaWorld Research Institute, San Diego, California	Phone: 619 226 3870 Fax: 619 226 3944 Email: PYochem@hswri.org
Brent Stewart, Senior Research Scientist (vast experience in post release monitoring)	Hubbs SeaWorld Research Institute, San Diego, California	Phone: 619 226 3875 Fax: 619 226 3944 Email:bstewart@hswri.org
Frances Gulland, Director (experienced in all facets of MM OWR)	The Marine Mammal Centre Sausalito, California	Phone: 415 289 7325 Fax: 415 289 7333 Email: Gullandf@TMMC.org
Bill van Bonn, Marine Mammal Veterinarian	The Marine Mammal Centre, Sausalito, California	Phone: 415 289 7325 Fax: 415 754 4031 Email: vanbonnb@tmmc.org
Deb Wickham, Operations Manager (experienced in all facets of MM OWR)	The Marine Mammal Centre, Sausalito, California	Phone: 415 289 7331 Fax: 415 754 4031 Email: wickhamd@tmmc.org
Dave Jessup, Senior Wildlife Veterinarian (experienced in all facets of MM OWR)	Marine Wildlife Veterinary Care & Research Centre, Department of Fish & Game, Santa Cruz, California	Phone: 831 469 1726 Fax: 831 469 1723 Email: djessup@ospr.dfg.ca.gov
Mark Bressler, Senior Animal Care Specialist (experienced in all facets of MM OWR)	SeaWorld, San Diego, California	Phone: 619 226 3893 Fax: 619 226 3951 Email: mark.bressler@seaworld.com
Hendrik Nollens, Marine Mammal Veterinarian	SeaWorld, San Diego, California & University of Florida	Email: NollensH@vetmed.ufl.edu Email: Hendrik.Nollens@SeaWorld.com
Martin Haulena, Marine Mammal Veterinarian (experienced in marine mammal rehabilitation)	Vancouver Aquarium	Phone: 604-659-3468 Email: Martin.Haulena@vanaqua.org
Larry Vogelnest, Senior Veterinarian (experienced with leopard seal handling and all facets of MM OWR)	Taronga Zoo Bradleys Head Road Mosman, NSW 2088	Email: LVogelnest@zoo.nsw.gov.au T 61 2 9978 4618 F 61 2 9978 4516 M 0419 413311
Nick Gales, Director of AMMC, Marine Mammal biologist (experienced in all facets of MM OWR, NZ sea lions, elephant seal experience)	Australian Marine Mammal Centre, Australian Antarctic Division, Kingston, Tasmania	Phone: 03 6232 3209 Fax: 03 6232 3288 Email: ammccoordinator@aad.gov.au
Simon Childerhouse, Marine Mammal Scientist (NZ sea lions, NZ humpback whales)	Australian Marine Mammal Centre, Australian Antarctic Division, Kingston, Tasmania	Phone: +61-439-317-605 Fax: 03 6232 3288 Email: simon.childerhouse@aad.gov.au
Padraig Duignan, Marine Mammal Pathologist (sea lion rehab experience)	Melbourne University, Australia	Phone: 61 3973 12016 Mobile: 61 406596776 Email: pduignan@unimelb.edu.au

NB. MM OWR = marine mammal oiled wildlife response