THREATENED SPECIES RECOVERY PLAN SERIES NO.17

HOOKER'S SEA LION RECOVERY PLAN
(*Phocarctos hookeri*)

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A note on names: The sea lion discussed in this recovery plan, *Phocarctos hookeri* (Gray, 1844), has been called both 'Hooker's sea lion' and the 'New Zealand sea lion'. We are using this document as an opportunity to make people aware that both names refer to the same animal, and to express our preference for using 'New Zealand sea lion' as the common name. (See also p. 25 of this recovery plan.)

Cover photo: New Zealand sea lions, The Snares Islands, February 1995. (Photo: Janice Molloy)

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1. OBJECTIVE

The overall objective of this recovery plan is to maximise, to the best of our abilities, the potential for the population of *Phocarctos hookeri* - Hooker's sea lion, hereafter referred to as New Zealand sea lion - to reach an abundance and distribution determined by the natural carrying capacity of its ecosystem. The plan proposes a set of actions that will

- quantify and minimise any human-induced activities that may be limiting to New Zealand sea lion populations, and
- increase our understanding of the general biology and ecological significance of New Zealand sea lions.

It is anticipated that the outcomes arising from the implementation of these actions will enable managers to make informed policy decisions on sea lion/fisheries interactions and to a lesser degree the effects of tourism and any other anthropogenic issues that may arise in the future.

2. INTRODUCTION

The New Zealand sea lion is New Zealand's only endemic pinniped. It occurs primarily in New Zealand's subantarctic zone, with small numbers present in the southern parts of the South Island. Remains found in midden sites in the North, South and Chatham Islands suggest this species was more widespread prior to European settlement.

There is little published data on this species, and this paucity of knowledge is reflected and highlighted in this document. The accidental drowning of sea lions in a squid trawl fishery centred around the major sea lion populations on the Auckland Islands and the ensuing action by conservation groups and concerned parties has raised the profile of the species in the past decade.

This report attempts to reconcile the balance of information needs on New Zealand sea lions with resource availability. It is unrealistic to plan for a strategy of work that is well beyond the effective funding capacity of government and other potential funding agencies. By way of comparison the Final Recovery Plan for Steller Sea Lions (National Marine Fisheries Service 1992) recommends recovery actions and implementations that, despite being a desirable depth of knowledge for New Zealand sea lion, are far beyond resources available in New Zealand. Rather, this plan aims to be realistic in its aims, as well as take full advantage of all funding opportunities and collaborations with scientists and agencies worldwide. It is, however, likely that some additional resources will need to be allocated for this work.

The implementation of this recovery plan will be assisted by a recovery group made up of representatives from DoC (Science and Research, Protected Species Policy Divisions, Southland Conservancy, Otago Conservancy), MAF Fisheries, non-government conservation groups, the fishing industry and relevant scientists with appropriate expertise. One of the first tasks of this team should be to prioritise the key elements of work that is required to enable the actions in this plan to proceed and to recommend the appropriate allocation of resources to achieve this.

Proposed changes to the Wildlife Act and Marine Mammals Protection Act through the Fisheries Bill will enable the Minister of Conservation to prepare Population Management Plans (PMPs) for protected marine species incidentally caught in Fisheries. In the case of threatened species the PMP is to contain a calculation of an allowable level of take for all human induced activity, including commercial fisheries. It is not the intention that this Recovery Plan be used as a PMP. Rather, it is intended that the two documents will be closely linked and that data that is generated from the actions of this plan will be fed into the PMT to allow for population modelling to predict an acceptable level of take of sea lions from all human induced sources. Indeed, the requirements for data to produce a satisfactory PMT for this species will be a primary directive for the New Zealand sea lion Recovery Group in setting the research protocol. As such, this document has deliberately not discussed methods by which the levels of permitted bycatch will be set in the future; methods used to date are reviewed.

3. BACKGROUND INFORMATION

3.1 Legal and Conservation Status

Sea lions are protected in New Zealand under the Marine Mammals Protection Act 1978, and any regulations made under this act.

The lUCN Seal Specialist Group (Reijnders et al. 1993) classified New Zealand sea lion as "Vulnerable". Under their classification system Vulnerable denotes taxa believed likely to move into the "Endangered" category in the near future if the causal factors continue operating. Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still abundant but under threat from severe adverse factors through-out their range.

In the DoC report "Setting priorities for the conservation of NZ plants and animals" (Molloy and Davis, 1994), sea lions are classified as a Category B, Second Priority species. This ranking system is for threatened taxa endemic or indigenous to New Zealand which are classified as "Endangered", "Vulnerable", "Rare" or "Indeterminate" by IUCN. It is primarily a three category system (vis; A, B and C) and relies on a points score which are allotted according to taxonomic distinctiveness, status of the species, threats facing the species, vulnerability of the species and human values (Molloy and Davis, 1994).

The Convention for International Trade of Endangered Species (CITES) does not include New Zealand sea lions in its listings.

3.2 Natural History

3.2.1 Species Description

Sea lions are part of the Order Carnivora, Suborder Pinnipedia, Family Otariidae, and Subfamily Otariinae. Within the family Otariidae are the extant genera *Arctocephalus, Callorhinus, Eumetopias, Otaria, Phocarctos,* and *Zalophus.* The genus *Phocarctos* contains only one species, the New Zealand (Hooker's) sea lion, *P. hookeri.*

The New Zealand sea lion, *Phocarctos hookeri* (Gray, 1844) is commonly called Hooker's sea lion after Sir Joseph Hooker, who was the botanist with the British expedition to the antarctic 1839-43. (See comments on name in Objective 5.)

New Zealand sea lions, like all otariids, have marked sexual dimorphism. The males are much larger and more bulky than the females. Size and weight estimates of males lie within the range of 240-350 cm standard length and 318-410 kg (Gaskin 1972, Crawley and Cameron 1972). Cawthorn et al. (1985) measured males of up to 325cm and estimates their weight to be up to a maximum of 450 kg. Females are reported to be 180-200 cm long (standard length) and 136-230 kg (Gaskin 1972, Crawley and Cameron 1972). Cawthorn et al. (1985) noted maximum mass of females to be 160 kg.

Pups are between 70 cm and 100 cm long at birth with male pups being slightly heavier than females (mean = 7.9 kg for males, 7.2 kg for females). At 20 days post partum, male pups weigh 13 kg (range 10-22 kg) and females weigh 11 kg (range 9-20 kg) (Cawthorn et al. 1985). The natal pelage is a thick coat of dark brown hair (Walker and Ling 1981) which becomes dark grey with cream markings on the top of the head, the nose, tail and at the base of the flippers (Crawley and Cameron 1972). Cawthorn et al (1985) noted a difference between natal coats of males and females; about 57% of males have dark coats and about 85% of female pups have lighter brown coloured coats. Adult females coats vary from buff to creamy grey with darker pigmentation around the muzzle and the flippers. Adult males are blackish-brown with well-developed black manes reaching to the shoulders (Gaskin 1972).

3.2.2 Life History

Distribution and Movements. New Zealand sea lions breed on the subantarctic islands of New Zealand, between latitudes 48'S and 53 ° S. The major breeding colonies are found at the Auckland Islands where about 95% of pups are born on Dundas Island, Enderby Island and Figure of Eight Island (Cawthorn 1993). A small breeding colony is found at North West Bay of Campbell Island, and several pups (usually fewer than 5) are born annually at Snares Island. The only post-European settlement records of breeding at locations other than the islands of the subantarctic are of a single female pup born in December 1993 at Otago and two pups born on Stewart Island in 1989 and 1991 respectively.

Haul-out sites are more wide-spread and extend to Macquarie Island in the south where a few males are seen each year, to Stewart Island, the islands of Foveaux Strait and the Otago Peninsula to the north where haul out sites of predominantly subadult males are present year round. Sightings of single animals (usually males) have been made at various other sites around the South Island of New Zealand, as well as at Plimmerton, on the south-west comer of the North Island.

Tagging studies conducted on pups from Enderby Island during 1980-1992 (Cawthorn, unpublished data) have resulted in sightings of these animals on the Otago Peninsula (about 360 nmi). The marine range of *P. hookeri* is unknown.

The present, limited, data suggest that *P. hookeri* do not migrate, and do not disperse widely from their breeding aggregations in the subantarctic.

The distribution of *P. hookeri* prior to European settlement of New Zealand was more extensive than the present recorded range. Maori used sea lions as an occasional food resource and skeletal remains have been found in middens from all around the North and South Island and Stewart Island (Smith 1989). The Rakiura Maori are known to have had a seasonal hunt for sea lions at Lord's River and Port Pegasus, Stewart Island (Starke 1986). Smith (1989) suggests that sea lions were breeding in the far north of the North Island, about Cook Strait and the South Otago area. Furthermore, Worthy (In press) describes the remains of a Late Holocene sea lion pup from Delaware Bay near Nelson and cites this as evidence of sea lions breeding in the area.

Sea lions are known to have occurred on Chatham Island as evidenced by remains of bones in Moriori middens (Smith 1977) and sand dunes (McFadgen 1994). The coincidence of human settlement and the disappearance of sea lions indicates that the animal may have been driven from Chatham Island by human predation (McFadgen 1994).

These subsistence takes of sea lions by Maori and Moriori are presumably the reason for the presently decreased range of *P. hookeri.* There are no data to suggest that the distribution of *P. hookeri* has altered since European settlement.

Habitat Use. New Zealand sea lion habitats include terrestrial and marine areas that are used for a variety of purposes. The terrestrial habitats are the most well-known and include rookeries (sites where sea lions pup and breed) and haul-outs (sites where sea lions congregate, but do not pup or breed). Rookery habitats are diverse and include sandy beaches (eg Sandy Bay, Enderby Island), reef flats with some beach area, some sward (primarily Poa tussock) and herb fields (predominantly megaherbs such as *Stilbocarpa* sp., and *Hebe elliptica* bushes; Dundas Island), and more dense bush such as rata, *Metrosideros umbellata, Coprosma,* ferns and grasses (Figure of Eight Island and Campbell Island), and solid bed rock (Snares). Females with pups often will move well inland on islands using vegetation such as rata for shelter. Generally the rookery sites are protected from large seas and have easy access from the sea. Haul-out sites at the subantarctic, Stewart Island and Otago region are similar to rookery sites in habitat type and include beaches and areas of rock and dense vegetation.

The marine habitat of *P. hookeri* is not described. Some preliminary data on lactating female sea lions have shown that they dive to depths in excess of 450 m, but concentrate their diving efforts at about 100-140m (Gentry et al in prep). The location of these dives in not known. Sea lions have been caught as an incidental bycatch in both squid and scampi fisheries that operate in shelf waters around the Auckland Islands and The Snares, as far away as 70 nmi from their natal sites, so these areas are clearly within the marine range of *P. hookeri.*

Reproduction. Observations of breeding of *P. hookeri* are restricted to those made on Enderby Island and are in many cases anecdotal (Falla 1965, Gaskin 1972, Best 1974, Marlow and King 1974, Marlow 1975, Cawthorn et al. 1985, Cawthorn 1993). There have been no thorough ethnological investigations of breeding in *P. hookeri* and the following account is a summary provided primarily by Cawthorn (1993).

Mature males are the first to occupy the beach at Sandy Bay in late November where they establish territories that they will defend aggressively. Pregnant females congregate at nearby haulouts prior to moving to Sandy Bay in early December, one to five days prior to giving birth. The females form into harems of up to 25 animals and are attended by a single dominant bull Challenger and bachelor bulls remain around the periphery of the harems and occasionally challenge the harem master. The tenure of harem bulls is unknown. Roger L. Gentry (unpublished data) noted that the mating system of the New Zealand sea lion was typical of otariids in most respects, but demonstrated some unusual characteristics such as absence ofmale and female site fidelity, continual movement of the female group past males on rigid, unmoving territories, male territoriality that is triggered by female presence, high male turnover rate, unusually brief territorial tenure, and virtual absence of female blocking by males.

Pupping begins in the first week of December and about half of the pups to be born that season will be born by December 24th. Pupping ceases by the third week in January at which time the remaining bulls disperse and the harems break-up.

After the post-partum oestrus (which probably occurs within two weeks of pupping) the cows make their first trip to sea and will alternate between foraging trips to sea and periods on land suckling their pups. Unattended pups form into pods, which are usually situated around the periphery of the harem.

The age of first reproduction for cows is unknown, but tagged cows of four years old have been seen with pups, presumed to be their first. Embryonic diapause has not been reported in *P. hookeri,* but is likely to occur as seems to be the case with all other pinnipeds. Pregnancy rates and pupping rates are unknown. Age of sexual maturity of males is unknown, but limited tag resight data have shown that 8-9 year olds are able to hold a territory. This is presumed to be the youngest of the territorial bulls (Cawthorn, personal communication). There are no estimates of longevity in this species, but maximum ages of 23 years for males and 18 years for females have been determined by counting growth layers in teeth from carcases (Cawthorn et al. 1985).

Natural Mortality. There are no published life tables for *P. hookeri* and no estimates of age or sex specific mortalities. It is likely that *P. hookeri* pups are subject to similar causes of mortalities as other otariids such as drowning, starvation, crushing and/or biting by larger animals, disease, parasitism, etc.

Predation by sharks, killer whales and leopard seals on *P. hookeri* is likely. Wounds consistent with shark attack are fairly common on sea lions, but this has not been quantified. Deep, evenly spaced puncture wounds have been seen and are assumed to be from killer whales. Leopard seals have been seen preying upon *P. hookeri* pups at Campbell Island (M. Cawthorn, personal communications).

Feeding. Studies of *P. hookeri* diet in the subantarctic are limited and unpublished. Preliminary data from collection of scats from sea lions on Enderby Island and stomach contents of sea lions drowned in fishing nets show that squid *(Nototodarus sloanii)* is an important component of sea lion diet, along with a wide range of less numerically important species such as benthic and demersal teleosts, elasmobranchs, octopus and various other invertebrates (Cawthorn et al. 1985). These collections were made during summer. Diet during autumn, winter and spring has not been investigated in the subantarctic, nor has age and sex specific diet been investigated.

Sea lions have been reported to occasionally prey upon fur seals, elephant seals, penguins, and various sea birds (M. Cawthorn and P. Dilks, personal communication)

Diet of male *P. hookeri* in the Otago region has been studied using diagnostic remains in scats and regurgitations (Lalas 1992). He noted that during winter and spring the sea lion diet consisted of inshore reef fishes, especially greenbone (*Odax pullus*), and shallow benthic species such as righteye flatfish (Pleuronectidae) and swimming crabs (*Ovalipes catharus*). During summer and autumn the sea lions targeted near-shore pelagic fish, especially jack mackerel (*Trachurus* sp.) and near-shore benthic species, especially octopus (*Octopus maorum*). Barracouta (*Thyrsites atun*) were taken throughout the year. Nototodarus sloanii was not an important component of the diet of the sea lions from Otago Peninsula.

3.2.3 Population Status and Trend

The total population of *P. hookeri* was estimated to be 14,083 immediately before the pupping season of 1992/3 (Cawthorn 1993). This estimate was calculated from an estimated pup production in 1992/3 of 408 for Sandy Bay, Enderby Island, 25 for South East Point, Enderby Island, 2,000 for Dundas Island, 67 for Figure of Eight Island, 150 for Campbell Island, and 10 for the Snares Islands. The total population estimate assumed a constant female survival rate to age 3 of 0. 81, a constant male survival rate to age 3 of 0.9, a female reproductive rate of 0.65, a constant sex ratio of 1:1 (no differential mortality) and no density dependent factors operating between sites (Cawthorn 1993). There are no data to support the above estimates, and thus the total estimate must be regarded as having wide, unquantifiable error margins. In addition it should be noted that the estimate was based on an assumption of differential mortality in juveniles, and then erroneously assumed a constant sex ratio of 1:l through all age groups. If pup survival rates in the range of 0.5-0.95 are used for the first three years of life, and pupping rates of 0.65-0.85 are used in the total population estimate then the range ofnumbers of *P. hookeri* immediately prior to the 1992/3 pupping season is 8,587 to 15,393. This range estimate also makes the assumptions of a constant sex ratio and absence of density dependant mortality factors.

The status of the *P. hookeri* population is unknown. The only breeding colony for which reasonable time series data on pup production are available are for Sandy Bay, Enderby Island. At this site approximately 400 pups have been born each year for the previous 20 years, and perhaps for as long as the previous 50 years (Marlow 1975, Best 1974, Taylor 1971, Falla 1965). The apparent stability of this portion of the population does not infer stability at other sites. The largest breeding group at Dundas Island has been counted too infrequently and over too short a time frame, and with insufficient accuracy to measure change.

Sea lions were exploited for their pelts for a period of 24 years following the discovery of the Auckland Islands in 1806 (Cumpston 1968). The kill was largest in the latter period of the sealing industry when the more valuable fur seals became less numerous. The number of sea lions taken by the sealers is unknown as the records of cargoes are poor or nonexistent, but it is clear that many animals were killed during that time. For example in 1825 two vessels recorded a take of 3480 sea lion skins from the Auckland Islands (Cumpston 1968). Further sea lions were killed for food by castaways following this period (Cumpston 1968). In the late 1880's sea lions were protected by law and significant kills ceased. The impact of these commercial and subsistence kills is unknown and it is therefore not possible to predict the pre-exploitation population size of *P. hookeri.*

The impact of the use of sea lions as an occasional food resource by Maori in pre-European times is not able to be quantified. Whilst there is evidence that this subsistence take led to the extinction ofthe species on the New Zealand mainland and Stewart Island, we have no quantifiable data to indicate a change in overall numbers.

3.2.4 Natural Factors Influencing the Population

Predation. It seems unlikely that major changes in sea lion predator numbers or behaviour would have occurred. None of the major predators (large sharks, killer whales and leopard seals) have been subjected to exploitation in this region, which could have led to a change in predator-prey balance. As *P. hookeri* would probably represent only a small portion of the diet of these predators it seems likely that variations in predation rate would not be detectable and would be unlikely to cause major changes in sea lion mortality.

Parasitism and Disease. There are few accounts of parasites found in or on *P. hookeri.* The louse *Antarctophthirus microchir,* the nematode *Porrocaecum decipiens* and the cysticeri of an unidentified cestode are the only parasites recorded to date (Enderlein 1906, Johnston and Mawson 1943, King 1964, Marlow 1975). It is likely that there are many more parasites commonly using *P. hookeri* as a primary host. The mortality or morbidity of parasite infection in this species has not been investigated.

Whilst disease leading to reproductive failure and neonate, juvenile and adult mortality almost certainly occur to some degree in *P. hookeri,* there have been no investigations into the disease types or prevalence.

Clearly the highly localised distribution of this species makes them extremely vulnerable to an epizootic disease, such as phocine distemper virus.

Environmental Change. All populations of animals can be influenced to varying degrees by changes in their environment such as shifts in food availability, loss of shelter or habitat, thermal challenge etc. Among the pinnipeds, relationships between sea surface temperature and Pribilof fur seal pup survival have been demonstrated (York, in press), as well as major changes in productivity and survival caused by El Nino events (Trillmich and Ono, 1991). Costa et al. (1989) demonstrated a relationship between availability of krill and the growth and nutrition of Antarctic fur seals.

New Zealand sea lions are clearly vulnerable to the same types of environmental changes, but no data exist to give us an impression of the relative stability or otherwise of their biotope. As with vulnerability to disease, the highly localised distribution of this species makes the consequences of major environmental change potentially more serious.

4 KNOWN AND POTENTIAL HUMAN IMPACTS

4.1 Incidental Take in Fishing Operations

Subantarctic Squid Fishery. Much of the information in this section has been taken from the 1994 report of the MAF Fisheries Fishery Assessment Working Group on Nonfish Species and Fisheries Interactions (compiled by S. J. Baird). This group is convened by MAF Fisheries and individuals from many organisations including MAF, DoC, the fishing industry, Museum of New Zealand, and non-government conservation groups are represented.

Prior to the establishment of the 200 nmi New Zealand Exclusive Economic Zone (EEZ) in 1978, Soviet trawlers and Japanese trawlers and jiggers fished for squid around the coast of the South Island of New Zealand and around the Auckland Islands shelf.

Since that time the southern trawl fishery for squid (SQU6T) has operated on the southern and eastern edge of the Snares Shelf and on the Auckland Islands shelf, in depths of about 150-250 m. Fishing effort in the two areas can vary considerably between years due to fluctuations in squid abundance, squid market value, and competition with other international squid fisheries. Fishing effort for squid will also change with the value and return from other finfish fisheries the trawlers engage in before and after the squid season.

The Total Allowable Commercial Catch (TACC) has been about 30,000 t, and since 1978 the reported catch has been between 9,500 and 34,355 t (MAF Fisheries Statistics Unit data). Effort and catches for the first few seasons in the 1990s have been the lowest since the fishery began. In 1992/93 only 1500 t of squid were caught (MAF Fisheries Statistics Unit data). An average of about 33 trawlers (up to a maximum of 50) from Japan, Korea, New Zealand, Norway, and CIS has operated in the fishery with effort concentrated between January and April.

The vessels are usually large stern trawlers that operate bottom or pelagic trawls with 60 or 100 mm diamond mesh nets. Mean tow time is about 3.5 hours at 5.6-8.5 km per hour (Gibson, in press). Tow paths are not usually in a straight line and can be U-shaped. Tows can be repeatedly trawled over the same path without the gear being retrieved.

The first reported incidental catch of sea lions in trawlers was in 1978 when 10 sea lions were killed in 58 trawls from one research vessel. In 1982 the Minister of Fisheries established a 12-nmi fishing exclusion zone around the Auckland Islands in an effort to protect the sea lion breeding populations. In 1987 MAF observers were placed on some fishing vessels and the incidental mortality of sea lions estimated. The level of observer coverage has varied annually. Between 1988 and 1993 14.8% of squid tows in area 6T were observed (range: in 1991 the observer coverage was 10%, in 1993 it was 29%). From these data, the sea lion kill for the observed portion of the fleet was extrapolated over the unobserved portion of the fleet. Between 1987-1993 MAF observers have reported 76 sea lion kills, two of which were on the southern Snares Shelf, and 74 on the Aucklands shelf. More female sea lions are killed than males; estimates vary from 54.5 - 65.2% females. Estimates of kill for the period 1988-1993 are presented in Table 1. Published estimates of sea lion kill vary between reports; the report of the seals/fisheries interactions technical working group on the Hooker's sea lion-Aucklands shelf trawl squid fishery interaction (24 April 1991) estimated sea lion kills for the summers of 1987,'88,'89, and '90 to be 143, 43, 108, and 148 respectively. The variation in the number of sea lions caught is a reflection of variations in fishing effort and location. The incident rate of a capture of a single sea lion every 2-2.5% of tows is reasonably constant. The assumption that this encounter rate applied for the years prior to 1988 would yield estimated catches greater than for the years reported in Table 1. It must be recognised that the data in Table 1 do not correct for catch per unit effort, nor do the figures subdivide the effort of fishing into the zones within are 6T; Snares Shelf, north of Auckland Islands, east of Auckland Islands.

Table 1: Estimated number of New Zealand sea lions caught in area 6T, 1988-93.

Year	No. sea lions caught
1988	33
1989	140
1990	116
1991	21
1992	82
1993	17

The impact of the bycatch on *P. hookeri* population size is unknown as there are no reliable data of total population size taken over the duration of the operation of the southern trawl fishery for squid. Furthermore, it is difficult to model for potential effects as there are no survivorship curves for this species, nor data on other necessary life history parameters. Woodley and Lavigne (1993) used life history tables for northern fur seals *(Callorhinus ursinus)* and Himalayan thar *(Hemitragus jemlahicus)* to model the impact of the bycatch on *P. hookeri* population size. They concluded that both models would result in *P. hookeri* having a limited capacity for population increase. If data from *C. ursinus* are used, a bycatch of over 1 % of mature females would result in a population decline; in the case of modelling using *H. jemlahicus* as a type animal, *P. hookeri* populations would decrease with any level of bycatch. A report presented to the seals/fisheries interactions technical working group (Anon 1991) used some life history parameters from Steller sea lions *(Eumetopias jubatus)* to predict that an incidental take of 80 females per season represented a removal of less than 2.5 % of females of all ages from the population. Based on draft guidelines from the U.S. National Marine Fisheries Service to govern incidental take in marine mammal populations, and the assumption that the New Zealand sea lion population is not less than 20 % of its pre-exploitation size, the authors claimed that a bycatch of up to 80 females each year is probably insufficient to cause a decline in the population.

Debate on mechanisms to ameliorate the sea lion/fisheries conflict has been active on a national and international level. The IUCN, in a resolution adopted at the 1993 meeting recommended to the New Zealand Government that a sanctuary should be established around the Auckland Islands in a bid to protect this endemic species. In 1993 the Minister for Conservation officially sanctioned the previously established 12-nmi non-fishing zone around the Auckland Islands as a marine mammal sanctuary. Suggestions to better monitor or mitigate the bycatch have covered such options as closing down the trawl fishery and switching to jigger based operations, increasing observer coverage to as high as 100%, the use of acoustic seal deterrent and mechanical escape devices and increasing the non-fishing zone.

The current management measures rely primarily on the setting of a maximum allowable catch limit of sea lions, the exceeding of which results in the closure of the fishery. In February 1992 the Ministers of Fisheries and Conservation set an allowable take of 32 sea lions (16 females) for the 1991/92 fishing season. The approximate doubling of population size estimates soon after this led to an increase of the allowable take to 63 sea lions (32 females) for the 1993 season. This limit was also used for the 1994 fishing season and was not exceeded in those years.

The catch limit of 63 sea lions was determined by the Department of Conservation based on draft guidelines from the United States National Marine Fisheries Service (NMFS). In its draft guidelines NMFS proposed several formulas for calculating Potential Biological Removal (PBR) for populations that were within their Optimum Sustainable Population (OSP) range, for those below OSP and for those where data were unavailable to calculate OSP. New Zealand sea lions were placed in the last of these categories. PBR was then calculated by multiplying the best estimate of minimum stock abundance (N_{min}), times the default value for the per capita rate of increase at Maximum Net Productivity Level (MNPL) for the stock (R_{mnpl}), times a stock recovery factor (F_r):

$$(PBR_{est}) = (N_{min})\ (R_{mnpl})\ (F_r)$$

Based on work conducted by Cawthorn (1993), N_{min} was estimated to be 10,500. The estimate for R_{mnpl} was based on theoretical average maximum per capita rates of increase for pinnipeds, 0.06. The estimate for F_r was 0.1, which is the suggested recovery factor to use for endangered stocks. MAF agreed to the figure of 63 as they stated they had calculated a similar number using a rationale broader than that provided by NMFS. A description of the MAF calculation is not available.

The fishing industry also instigated measures aimed at managing the conflict. During the 1990-91 fishing season they adopted a voluntary Code of Practice, which was originally designed to decrease the catch rates of New Zealand fur seals in the west coast South Island hoki fishery. Further to this the fishing industry agreed that any vessel that caught four or more sea lions would voluntarily withdraw from the squid fishery. Full details of the Code of Practice are available from fishing industry representatives. The requirements of the code of practice can be summarised as follows:

1. Shooting and hauling of fishing gear must be completed as quickly as possible
2. If problems occur when shooting gear all efforts should be made to keep the net mouth closed until the problem is resolved.
3. If sea lions are sighted around the boat the shooting of gear should, if possible, be postponed.

4. If possible no turns should be made when trawling, however if turns are necessary they should be at, or below, 150 m.

5. The practice of collapsing the net opening by making a 45 degree turn prior to retrieval should be encouraged.

6. Gear testing and fixing should if possible occur in waters outside the normal fishing areas where sea lions are found.

7. During night fishing operations one crew shall be assigned to keep watch for sea lions and aft gantry lights shall be illuminated for the shortest possible duration.

8. Offal dumping shall be avoided whilst shooting or hauling a net.

It is not known if the implementation of the Code of Practice has decreased the level of bycatch as it has been voluntarily adopted by all fishing vessels and no controlled experiments have been conducted.

Subantarctic scampi trawl fishery. In 1990/91 the subantarctic scampi trawl fishery began operating in area 6T on the Auckland Islands shelf. This fishery has not had an observer programme, and thus there are no observed catches of sea lions. In 1993 one fishing vessel reported the catch of 3 sea lions during one day. It is not known if this is an unusual single incident, or if there is a more widespread, unreported bycatch in this fishery.

Other potential fisheries. There are currently no other fisheries operating on the Auckland Island shelf area. Clearly any fishery that may be opened in the future, particularly trawl fisheries, must be assessed carefully for their potential to take a sea lion bycatch. Similarly, it is possible that sea lions' foraging range extends well beyond the Auckland Island shelf area and fisheries for species such as the Southern blue whiting *(Micromesistius australis)* on the Bounty Shelf and north of Campbell Island may have a sea lion bycatch potential.

4.2 Competition for Food

There are no published data on the diet of *P. hookeri* on which to make an assessment of the potential for competition with commercial fisheries. Cawthorn (1993) believes that the arrow squid *(Nototodarus sloanii)* is an important seasonal component of sea lion diet, but there are no quantitative data on which to analyse this.

It is not known if sea lions prey on scampi *(Metanephrops challengeri),* which are also fished commercially on the Auckland Islands shelf.

Diet of the small population of sea lions in the Otago region includes a significant number of prey species that are important to recreational and commercial fisheries of that region (Lalas in prep.). An expansion of this population and the potential for the establishment of a breeding rookery could lead to a perceived or real level of competition in the future.

4.3 Disturbance

Tourism. New Zealand sea lions are subject to interactions with tourists at three main sites: Enderby Island, Otago Peninsula and The Catlins. Tourism to the subantarctic has increased dramatically in the past few years and is managed by the Department of Conservation, Southland Conservancy via the issuing of concessions. Enderby Island is the principal landing site for tourists at the Auckland Islands. All commercial tour operators are obliged to take a DoC representative with them who, among other things, oversees the interactions between tourists and sea lions. The DoC representative for these groups briefs the group prior to landing on the island and informs them of a set of interaction guidelines aimed at minimising the impact of the tourists on the sea lions. These guidelines are extensive, those of particular relevance to the sea lion specify that:

- A minimum guide to tourist ratio of 1:20
- A maximum of 600 people will be permitted to land at any one site in one year
- A minimum distance of 5 metres from all wildlife to be maintained, and 7 metres from marine mammals (eg sea lions)
- Animals have right-of-way
- All people are to keep off Sandy Bay Beach during the sea lion breeding season (December and January) except for entry to and exit from the island.
- A system of marker flags will be used at Enderby Island to route passengers around low impact sensitive sites.
- At Enderby Island the DoC representative will restrict party size and movements according to the location of breeding sea lions.

Many other more general conditions also apply. Copies of permit requirements and regulations can be obtained from DoC, Southland Conservancy.

Private expeditions to the Auckland Islands in small yachts have been increasing over the past few years. Although a representative, or person accredited by DoC is required to accompany these vessels, some vessels visit the islands without a permit and representative. The increase in visits from licensed vessels and the presence of DoC research staff on the islands should ensure that major problems do not arise from these vessels.

Subantarctic tourism occurs from December through to February of each summer. This period coincides with pupping and the early nursing period, during which time the consequences of disturbance are potentially most severe. This is also the period during which the bull sea lions are territorial and aggressive, thus maximising their potential threat to the tourists. There are currently no data on which to analyse the interactions between tourists and sea lions, in terms of impact on sea lions, or the quality of the experience for the tourists. The anecdotal accounts of tour operators and DoC representatives are not sufficient for the future management of this increasing interaction; a study of this interaction is required.

The tourism/sea lion interaction that occurs on the Otago Peninsula and The Catlins is less regulated and occurs year round. It is likely that the number of tourists visiting these sites will exceed that of the more remote subantarctic sites. This population of sea lions consists primarily of subadult males. One birth has been recorded in this area in 1993. DoC, Otago Conservancy, have expressed concern that the tourism causes harassment of the sea lions and have suggested a series of guidelines under which the interaction can be managed. It is important that these guidelines be developed and that the current sea lion population monitoring programme currently under way be continued.

Harassment and shooting. Deliberate harassment and, on occasions, shooting of sea lions has been reported from the Catlins where at least seven sea lions have been killed in the past two years. Considering the small number of resident sea lions that live at The Catlins and the Otago Peninsula (circa 50; Lalas and McConkey 1994) is possible that this level of impact could jeopardise this local population. This type of event is clearly in contravention of the Marine Mammals Protection Act and is, where possible enforced by DoC. There are no data to indicate if shooting of sea lions is more widespread.

Research. It is recognised that scientific research into *P. hookeri*, or terrestrial areas they utilise, has the potential to cause disturbance. Such research should be carefully scrutinised to ensure that adequate efforts are made to minimise impact on individual animals and/or populations. Similar scrutiny should be applied to reserve management activities and research other than on sea lions. The current system of requiring permits from DoC and from approved ethics committees should be adequate for this control.

4.4 Entanglement in Debris

Entanglement in debris has been identified as being a potentially major problem in pinnipeds (Fowler 1988, Wallace 1985). There are no published data on entanglement rates in *P. hookeri*, but anecdotal information suggests the incident rate is likely to be low. During the summers of 1990/91, 91/92, and 1992/3 only three sea lions were seen with debris ligatures around their necks (M. Cawthorn, personal communication).

Fishing debris in the form of pieces of trawl net, plastic strapping bands and monofilament line are the most common encountered in other pinnipeds. Accurate records of incident rate, age/sex of those impacted, degree of injury caused and causative agent should be maintained at a centralised data base in order to more accurately quantify the potential impact of debris on sea lions.

4.5 Feral Animals

Since the discovery of the Auckland Islands there have been several introductions of non-native animals. These include sheep, cattle, pigs, goats, rabbits, mice and cats. The sheep were unable to sustain a viable population, but all other species inhabited various parts of the Auckland Islands until recently. The Auckland Islands Management Plan was produced in 1987 and recommended the removal from the islands of all feral species. Since then, cattle, goats and rabbits have been removed, and plans are currently being prepared to eradicate pigs. On Enderby Island rabbits caused some pup mortality associated with entrapment in burrows and subsequent starvation (Cawthorn, personal communication). The removal of the rabbits and the gradual deterioration and disappearance of the burrows will remove this source of incidental mortality. It is also possible that mice may have been removed from Enderby Island as an incidental effect of the rabbit poisoning programme. This will leave no introduced animal species on Enderby. There are no known introductions on Dundas Island and Figure of Eight Island.

Of the introduced species on Campbell Island, none are known to impact sea lions.

4.6 Toxic Substances and Introduced Disease

There have been no analyses of *P. hookeri* tissues for contaminants. Their remote location in relation to heavy industry or agricultural run-off make it unlikely that they accumulate significant toxic substances.

The highly localised breeding distribution of *P. hookeri* makes it more vulnerable to impact from oil than many pinnipeds. Fortunately sea lions appear to be reasonably resistant to impact from oil (Gales and St. Aubin, In press) and there is little major shipping (and thus risk of oil spill) in the region of the New Zealand subantarctic. Nevertheless, the increase in the number of visits of large tourist ships to these islands, and the ensuing use of exposed anchorages represents a real risk that needs to be considered in future management plans. On a smaller scale anchorage by large fishing vessels also represents a risk.

Human visitation to sea lion colonies presents the possible opportunities for introduction of disease. Routine procedures such as ensuring that visitors do not go ashore with soiled boots and clothing (particularly from farms) should minimise this potential. Such practices are essential for ensuring that there are no introductions of flora to the islands. Some plant introductions could result in reduction of available terrestrial habitat due to overgrowth by plants that sea lions cannot travel over or through.

5 CONSERVATION STRATEGY: OBJECTIVES

OBJECTIVE 1: DETERMINE POPULATION SIZE AND STATUS

1. MEASURE CURRENT POPULATION SIZE

Explanation

There is no one time during which the entire population of New Zealand sea lions can be counted. As such, measurement of population size will rely on using the most reliable methods available. The measurement of pup production is the most appropriate tool for this purpose. During the pupping season the pups of the year remain onshore for the first few weeks of their lives and are localised enough to enable an estimate of total pup numbers using direct counts and/or standard mark recapture methodologies. The specific techniques used will vary between sites as factors such as animal density, terrain, and access will determine the efficacy of each technique. In most cases mark-recapture techniques will be used. Multiple recaptures will be conducted to enable calculation of variance and confidence intervals to be made. Where direct counts are made multiple counts will be conducted for the same reasons.

Once an estimate of seasonal pup production has been achieved it is possible to construct simple life-history models to estimate total population size. Such estimates are compromised by poor quality data on life history and are therefore best presented in the form of an estimated range within which total population size is thought to lie (eg Gales et al., in press). Even so, such estimates should be regarded as being of secondary importance to the more easily measured and more reliable estimates of pup production.

Work Plan

1. Develop a technique of direct counting or mark-recapture methodologies for assessing pup production at each of the breeding rookeries of *P. hookeri.* Multiple counts during the season are required to construct a pupping curve to enable us to predict the best time to measure pup production in ensuing seasons. Such data already exist for the Enderby Island population (Cawthorn, 1993).

2. Evaluate pup production using the standard technique at all known rookery sites during the summer pupping seasons.

3. Transfer responsibility of undertaking monitoring from DoC Science and Research to the relevant conservancy.

4. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Outcome

A reliable estimate of pup production at the primary rookery sites. A scientific publication of the data.

Key Personnel

* Science and Research Division, DoC
* Southland Conservancy, DoC
* Otago Conservancy, DoC

2. MEASURE POPULATION STATUS

Explanation

In order to measure the status of the sea lion population, estimates of pup production for each site are required over a number of seasons. The accuracy of our estimates of pup production will determine the likelihood of detecting changes in pup production. As such, it is necessary to utilise tools such as power analysis to construct an experimental design that will have a satisfactory chance of measuring a change of perhaps 5 % in pup production between seasons. These analyses should be conducted prior to the initiation of a long term monitoring programme and will determine the frequency with which it is necessary to measure pup production at each site.

Monitoring of sea lion numbers and occasional births at sites around the mainland of New Zealand and Stewart Island is required to monitor the possible expansion of sea lion distribution. The birth of a pup on the Otago Peninsula in 1993 raises the possibility that this species may expand its current pupping range. An extension of the pupping ranges to the New Zealand mainland is regarded as a positive step in the recovery of the species and should be encouraged through protection and management.

Work Plan

1. Conduct analysis based on data from initial pup production estimates in the 1994/95 season to determine the power of these estimates for predicting actual changes in pup production over time.

2. Produce a long term monitoring programme based on the above analysis.

3. Science and Research Division, DoC, to analyse each season's pup production estimates for evidence of trends.

4. Monitoring to continue at non-subantarctic sites where sea lions congregate (Otago Peninsula, The Catlins and Stewart Island).

5. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Outcome

A reliable estimate of sea lion population status and distribution. A scientific publication of the data.

Key Personnel

* Science and Research Division, DoC
* Southland Conservancy, DoC

* Otago Conservancy, DoC
* Relevant collaborative scientists

OBJECTIVE 2: ASSESS THE POTENTIAL THREATS TO NEW ZEALAND SEA LIONS

1. FISHERIES INTERACTIONS

Explanation

Observer data has been used to estimate the total number, capture rate and sex ratio of New Zealand sea lions incidentally killed in the Auckland Island squid fishery. These data have been collected since 1987, but analysis is often a year or more behind collection time. Scientists from the New Zealand fishing industry also collect data from industry supported observers and conduct their own independent analyses. A joint DoC/MAF Fisheries relational data base needs to be established which would contain all past data and all new data relevant to bycatch of sea lions.

Some carcase retrieval has occurred on an ad hoc basis in the past. The carcases has been used to determine sex, age, reproductive status, nutritional status, and stomach contents. All future sea lions brought on board should be kept for such analysis.

Work Plan

1. Assess the percentage observer coverage needed for each fishery to provide reliable estimates of sea lion mortality in trawl fisheries.

2. Investigate the types of information which can be collected by observers which will assist in determining the magnitude and characteristics of sea lion capture. As a minimum this information should include primary age/sex classes taken, the areas in which they are caught, the seasonality of the catch during the fishing season, and trawl operational information. These data must be in a form that can be cross-referenced to a tag on bycatch animals.

3. Ensure that the current observer data recording sheets are adequate for documenting the data.

4. Ensure that all sea lions killed as incidental take in trawl fisheries are marked with a tag that can be cross-referenced to the relevant data sheet (see 2, above), stored in a legally suitable body bag, frozen and returned to shore for analysis.

5. Develop a protocol and funding for the retrieval of sea lions carcases from fishing vessels and transport to a suitable storage facility.

6. Develop a protocol and funding for the autopsy and full analysis of the carcases and the imputing of data onto a data base.

7. Create a joint DoC/MAF Fisheries relational data base, and input all past bycatch data, and new data annually.

8. Undertake analysis of all data on an annual basis.

9. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Outcome

A reliable estimate of the extent and characteristics of fisheries interactions.

Key Personnel

* Science and Research Division, DoC
* MAF Fisheries
* Fishing industry

2. TOURISM

Explanation

The growth of ecotourism in the Auckland Island region and the use of Enderby Island as a landing site necessitates careful control to ensure that impact is minimised. As Southland Conservancy manage and licence the operators in this area it would be advantageous to initiate a study of overall human impact to provide relevant advice to the managers. Such studies are ideally suited for defined post-graduate research degrees. Similarly, assessment of the impact of tourism on the sea lions of the Otago region should be quantified to ensure that adequate protective guidelines are developed.

Work Plan

1. Assess current regulations for sea lion/human interactions at sites where interaction occurs and amend as necessary.

2. Review potential for impact at each major interaction site and instigate research programmes to monitor the impact as necessary.

3. Develop guidelines for minimising the impact of tourism on sea lions at mainland sites.

Outcome

Appropriate regulations to manage human/sea lion interactions. A monitoring protocol for assessing potential impact.

Key Personnel

* Science and Research Division, DoC
* Southland Conservancy, DoC
* Otago Conservancy, DoC

OBJECTIVE 3: OBTAIN ECOLOGICAL AND DEMOGRAPHIC INFORMATION NECESSARY FOR THE MANAGEMENT OF THE SPECIES.

One of the primary objectives of this recovery plan is to direct research to increase our understanding of the general biology and ecological significance of the New Zealand sea lion.

1. FORAGING ECOLOGY

Priority: **High**

Explanation

An investigation of the at sea range and behaviour of *P. hookeri* is central to our endeavour to better understand and hence preserve this species. A description of horizontal foraging range, diving and feeding behaviour and target prey can provide managers with a powerful tool when this is analysed with data from the fishing fleet. The current 12-nmi marine mammal sanctuary around the Auckland islands is set at an arbitrary distance with no reference to the foraging range of the species. Data from a study of foraging ecology will provide a meaningful measure of the degree of protection this sanctuary offers. Furthermore, knowledge of where and how sea lions feed may offer opportunities to partition the squid resource between commercial fishers and sea lions, should this become necessary.

The advent of sophisticated satellite based tracking and data logging technologies has allowed us to access this previously unknown portion of the life cycle of sea lions. These technologies are expensive (although the costs are reducing with time) and will require a broad based and imaginative approach to attract funds from a variety of agencies. Foraging ecology can be divided into three major categories; diving behaviour, diet and energetics.

Effort in this study should focus on animals that would cause the greatest population impact if removed by the squid fishery, as well as the selection of animals that will allow retrieval of equipment. The study should therefore focus on reproductive females in the first instance and perhaps broaden to include juveniles at a later date when the technologies have been more fully developed for this species. Lactating females return to their pupping grounds to feed their offspring and thus represent a reliable study animal with a high probability of recapture.

Our current understanding of the feeding areas of New Zealand sea lions is limited to location of capture of sea lions by fishing vessels. These qualitative and *ad hoc* data indicate that sea lions forage over the entire extent of the fishery on the Auckland Islands shelf. In order to better define the foraging range and behaviour of this species a combination of remote sensing and data logging technologies is required.

Radio tracking of at-sea movements of marine mammals has been successfully undertaken with a variety of species over the past few years. Particular success has been achieved with the phocid seals, such as elephant seals, where the study animal will rest at the water surface for a sufficient period of time, and in an appropriate position, to allow the satellite tag to achieve an uplink with the satellite (system Argos). Data transferred includes information on position, and in some cases summaries of behavioural data such as diving depths and durations. Efforts to track otariids (eared seals) have not met with quite the success of the phocids, most likely due to different behaviour at the water surface that decreases the opportunities for successful uplinks to occur. This is particularly true for fur seals of various species (I. Boyd, personal communication; R. Harcourt, personal communication). Sea lions are probably less active at the sea surface and satellite tracking of Steller's sea lions and South American sea lions has been successfully achieved (T. Loughlan, personal communication; D. Thompson, personal communication).

Satellite linked radio tags are able to provide data on position at the sea surface, but not on diving behaviour. Whilst satellite linked dive recorders are available for seals, they require uplinks with satellites to download the dive data. If problems with satellite up-links are encountered much of the dive data would be lost. Separate satellite linked radio tags and data loggers which record diving behaviour against time should therefore be used. As the effort for this work will focus (at least initially) on lactating females, it will be possible to retrieve the tags when the animal returns to feed its pup and combine the diving data with position data.

In order to achieve data of sufficient quality for management of the species, as many tags as possible should be deployed to collect data throughout the annual reproductive cycle.

Work Plan

1. Develop techniques for satellite tracking and logging dive data on adult female sea lions at Enderby Island during the summer of 1994/95. Testing of the efficacy of two available satellite systems (ARGOS and SAFIR) will occur during this technique development with up to seven transmitter being used. A variety of time depth recorders (up to nine) will be tested. These will all monitor depth, time and water temperature. Some will monitor swim velocity and some will monitor stomach temperature. A crude geolocation capability will also be tested against satellite determined position fixes.

2. Develop a strategy for the deployment protocol of satellite tags and TDRs on various age/sex classes of sea lions at different locations, and different parts of the season. Priority will initially be given to sexually mature females from the Auckland Islands during the squid trawl fishery. It is likely that the foraging work will be at least a 3-5 year project.

3. Undertake analysis of all sea lion foraging data in relation to effort of squid trawl fisheries and major oceanographic and bathometric features.

4. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Outcome

An understanding of the foraging range and diving behaviour of sea lions.

Key Personnel

* Science and Research Division, DoC

* MAF Fisheries
* Collaborating scientists

2. DIET

Priority: High

Explanation

An understanding of the diet of sea lions at the Auckland Islands will enable us to understand more clearly the relationship between fishing effort of sea lions and commercial vessels. The dearth of any quantitative data on diet of sea lions at the Auckland Islands make this action a high priority. Investigations of diet of marine homeotherms have been characterised by problems of biases in the various sampling regimes used. These biases will vary between species, diet types, and sampling time. They are thus very difficult to quantify. In order to overcome these biases to as great an extent as possible, a multiple sampling regime should be incorporated. Diet should be sampled directly from stomach contents of bycatch animals, from scats and regurgitations of free-ranging animals, and from stomach lavage of particular study animals. Stomach lavage animals should be selected from animals that have been used for diving studies, so that stomach contents can be correlated to actual diving behaviour.

Diet studies should be conducted throughout the year, and not merely represent the early lactation period each summer. Spatial variations in diet should be incorporated with studies focused at all major sea lion population aggregations.

Work Plan

1. Collect and analyse scats and vomit samples from known age/sex sea lions on the Auckland Islands during the summer of 1994/95. Studies should initially focus on mature females.
2. Develop a safe means of gastric lavage for diet analysis in sea lions.
3. Collect and analyse stomach samples from sea lions killed incidentally in trawl fisheries and any other source.
4. Encourage, support and develop diet analysis at sites other than the Auckland Islands, and throughout the annual life cycle.

Outcome

An understanding of the diet of various age/sex classes of the New Zealand sea lion and its temporal and spatial variations.

Key Personnel

* Science and Research Division, DoC
* Collaborating scientists

3. LIFE HISTORY PARAMETERS

Priority: High

Explanation

The acquisition of life table data requires a major commitment to long term and high effort studies at specific sites. Such studies require long-lasting, easily read individual identification that is not lost over time. As such, standard tagging practices usually are not sufficient. Hot branding or freeze branding represent the only currently reliable methods and should be considered and investigated in this species. Such markings can be used to estimate such vital parameters as age of first reproduction, age specific pup production, site fidelity, ontogeny of male territory acquisition, cohort survivorship, non-breeding range of individuals, and others (National Marine Fisheries Service, 1992). It is possible that in the future subcutaneous implants of inert, coded, glass chips may provide a suitable permanent marking system. Currently this technology is limited by the low range of reading the chip with remote equipment. Developments of this technology should be followed closely.

The desirability of such data and the investment required should be considered by the sea lion recovery group and actioned if required.

Work Plan

1. To review appropriate models that could be used to model sea lion populations and outline research requirements for determining relevant parameters (eg, age at first reproduction, annual survivorship etc)

2. Review methodologies available for long term marking of sea lions to enable collection of appropriate data for the population model.

3. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Outcome

Construct life history tables for New Zealand sea lions.

Key Personnel

* Science and Research Division, DoC
* Collaborating scientists

4. ENERGETICS

Priority: Low

Explanation

Like the diet studies, investigations of energy intake and output by marine predators have been characterised with various biases. Metabolic rate investigations utilising radioactively labelled molecules are expensive and have been biased by salt water intake during feeding, and enormous variations in metabolic rate that were not predicted. They do, however, provide an index of energy expended during foraging and rest, as well as energy intake. More recently heart rate has been shown to be an index of activity (and thus energy expenditure), and may well have application in this species. Further investigations of energy budgets can be accomplished by measuring the caloric value of ingested prey (especially if diet is able to be quantified), as well as the lipid content and volume of sea lion milk. Energetics research in this species should be directed towards determining the significance of sea lions as a resource consumer in its marine ecosystem.

Work Plan

To be developed upon advice from the recovery group.

5. HEALTH, CONDITION AND VITAL PARAMETERS

Priority: Low

Explanation

As an adjunct to existing, on going studies every effort should be made to monitor health, condition and vital parameters. These data are likely to prove valuable in the long term for interpreting anthropogenic and non-anthropogenic influences upon sea lion survivorship. As stated earlier the highly localised distribution of this species makes it more vulnerable than many other populations to disease pandemics. If such an event were to occur, long-term data sets of disease status, parasite burdens, condition indices and overall health would prove invaluable.

Work Plan

Data to be collected on serendipitous basis as an adjunct to other studies. Further work plans can be developed if directed by the recovery group.

OBJECTIVE 4: DEVELOP AND USE MEASURES TO MINIMISE INCIDENTAL CAPTURE DURING FISHING OPERATIONS

Explanation

An ideal amelioration of the sea lion/fisheries conflict would be the development of methodologies that prevented sea lions approaching vessels and ultimately entering the nets. In the past, techniques such as playing recordings of sea lion predators (eg killer whales), producing loud and painful acoustic stimuli from bombs or loud speakers and altering standard fishing practices (eg code of practice) have been developed and tested in New Zealand and internationally. In most cases the results have been equivocal. In recent years Norway has developed an escape device for use in their prawn fishery (similar to a turtle exclusion device used in the Pacific) that effectively removes fish bycatch without an economically significant loss of prawns. This may be able to be modified and used to exclude seals.

Further research is needed urgently in this area, and close liaison with other countries developing and testing alternative measures.

Work Plan

1. Undertake trials of a prototype seal escape device based on the design of the Norwegian fish exclusion device.

2. Trial other techniques as they become available for their effectiveness in excluding sea lions.

3. Undertake boat based studies of the behaviour of sea lions around trawlers, in an attempt to seek ways to minimise their capture.

4. Review the effectiveness of the fishing industry Code of Practice, and promote its use if it is shown to reduce capture.

5. Once new measures have been shown to minimise capture of sea lions, adopt these measures throughout the fishery(s) immediately.

6. Ensure that relevant data are provided to the development and updating of the New Zealand sea lion Population Management Plan.

Key Personnel

* Science and Research Division, DoC
* MAF Fisheries
* Fishing Industry

OBJECTIVE 5: RAISE AWARENESS OF NEW ZEALAND SEA LION

1. PUBLIC AWARENESS

Explanation

The New Zealand sea lion is New Zealand's only endemic pinniped and yet its public profile is not high. Much of the reason for this is the almost complete lack of printed material on this species within the popular and scientific literature. Schools and other interested groups are poorly provisioned with information. This situation requires urgent attention. Information brochures, popular articles in natural history magazines, scientific publications and general educational material should be produced as a matter of priority. All opportunities to disseminate information via the media should also be taken.

Advocacy should be targeted to improve the often negative way in which these animals are regarded. Around the Catlins shooting incidents have led to concern of the viability of that small population; such problems are best approached through advocacy.

Key Personnel

* Information services, DoC
* Science and Research, DoC
* PSPD, DoC

2. `NEW ZEALAND SEA LION' TO BE THE OFFICIAL COMMON NAME FOR *P. HOOKERI*

Explanation

As a component of the advocacy and of raising the profile of the New Zealand sea lion in the public mind it may be advantageous to desist from using the name `Hooker's sea lion' and, as a matter of policy use `New Zealand sea lion'. This name is already used as a synonym in the scientific literature. As stated earlier, the name Hooker is after Sir Joseph Hooker, who was the botanist with the British Expedition to the Antarctic in 1839-43. Apart from the association the name has with the sea lion, it has no significance to the New Zealand public. By changing the common name to `New Zealand sea lion' the species becomes linked directly to this country and advocacy opportunities should be improved. Naturally, the scientific name *Phocarctos hookeri* would remain unchanged.

In this recovery plan, the name `New Zealand sea lion' has been used. Other organisations such as universities, museums, crown research institutes, conservation organisations, fisheries management groups etc should all be encouraged to adopt the standard name.

Key Personnel

* Information services, DoC
* Science and Research, DoC
* PSPD, DoC

6 POLICY

The actions listed above will facilitate far more substantial advice being provided to policy makers. This is particularly true in the area of management of the sea lion/fisheries interaction. This management can take many forms including alterations in maximum allowable catch limits, alterations in boundaries of non-fishing zones and sanctuaries and alterations in fishing practices and gear types.

Input into these management decisions will come from actions from the Recovery Plan process as well as from the Population Management Plan. Each of these forms of regulation require agreement and co-operation between several agencies in order to succeed. At this time there is a general agreement that the intention of all parties is to decrease the bycatch of sea lions over time.

Where proven practices for mitigating sea lion bycatch are introduced it is hoped that the sea lion bycatch will gradually decrease. It is not the scope of this recovery plan to set a range of options, nor to set an agenda for such changes, but rather to note the shared intention of decreasing bycatch of sea lions over time and to provide a mechanism to help achieve this end.

7 CONCLUSIONS AND SUMMARY

When reviewing the literature on this species one of the most notable impressions gained is the almost total lack of published scientific material. It is without doubt the least studied of the five extant sea lion species and one of the least studied pinnipeds. It is essential to redress this imbalance in the near future, and it is hoped that this document will provide a mechanism by which this endeavour can be carefully steered.

It is sobering to consider that the only published estimate of impact of bycatch on this species predicts a likely decrease in population size. Whilst this estimate was based on the few data available for this species and life tables from other species, it nevertheless sets a clear agenda for the focusing and intensification of our research and advocacy needs.

To achieve the actions identified in this plan will require a marked increase in resource allocation. The scale and scope of the work proposed is conservative when regarded from our current level of understanding of the species and its vulnerable status, but is still currently beyond the resources allocated to it. It will be the responsibility of the New Zealand Sea Lion Conservation Team to assess this current imbalance and make recommendations to rectify it.

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Much of the data on the history of the squid fishery and Table 1 came from the 1994 Report of the MAF Fisheries Assessment Working Group on Nonfish Species and Fisheries Interactions compiled by S.J. Baird.

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