

**Proposed Operational Plan To Manage
The Incidental Capture Of New Zealand
Sea Lions In The Squid6T Trawl Fishery
For The 2003-04 Fishing Year**

Initial Position Paper

Consultation Document
15 August 2003

TABLE OF CONTENTS

TABLE OF CONTENTS	2
INTRODUCTION	3
BACKGROUND INFORMATION	3
THE STATUS OF THE NEW ZEALAND SEA LION	5
MANAGEMENT OBJECTIVE	5
LEGAL CONSIDERATIONS	6
THE PREVIOUS FISHING SEASON (2002-03)	7
<i>2002-03 Operational Plan</i>	7
<i>The 2002-03 season</i>	7
Estimated number of New Zealand sea lion captures.....	8
SEA LION EXCLUSION DEVICE TRIALS.....	8
2003 ESTIMATES OF NEW ZEALAND SEA LION PUP PRODUCTION AND TOTAL POPULATION SIZE	10
PROPOSED MALFIRM FOR THE 2003-04 SQU6T FISHERY.....	11
MALFiRM DECISION RULES EVALUATED.....	12
DECISION RULE EVALUATION CRITERIA	13
<i>Evaluation Results</i>	14
MFISH RECOMMENDATIONS ON OPTIONS TO ESTIMATE THE MALFIRM	15
<i>Option A (rule 310)</i>	15
<i>Option B (rule 320)</i>	15
<i>Option C (rule 4)</i>	16
<i>Preliminary MALFiRM Recommendations</i>	16
PROPOSED ARRANGEMENTS TO MONITOR THE MALFIRM.....	16
OPTION 1 - DEDICATED ‘MALFiRM’ VESSELS	17
OPTION 2 – PREDETERMINED STRIKE RATE.....	20
MALFiRM MONITORING CHANGES BETWEEN OPTION 1 AND OPTION 2 DURING THE SEASON	22
DISCOUNT STRIKE RATE	22
ADDITIONAL CONSIDERATIONS RELATING TO THE MALFIRM	26
ACKNOWLEDGEMENT OF OTHER SEA LION MORTALITIES	26
REPORTING REQUIREMENTS	27
POSSIBLE CLOSURE PROCESS.....	27
NGAI TAHU CLAIMS SETTLEMENT ACT 1998	28
IMPACT OF A MALFIRM ON THE FISHING INDUSTRY	28
PRELIMINARY RECOMMENDATIONS	30

INTRODUCTION

1 In accordance with s 12(1) of the Fisheries Act 1996 (the Act), the purpose of this Initial Position Paper (IPP) is to commence a consultation process on a proposed management regime to manage the interactions between the New Zealand (or Hooker's) sea lion and southern squid trawl fishery (SQU6T) during the 2003-04 fishing year. This regime will focus, as it has in past years, on the use of a Maximum Allowable Level of Fishing-Related Mortality (MALFiRM) to constrain New Zealand sea lion mortalities to an acceptable biological level.

2 This document provides you with the Ministry of Fisheries' (MFish) initial position on a proposed management regime that will be implemented under an Operational Plan approved by the Minister of Fisheries. The Operational Plan will set a MALFiRM for the SQU6T season and establish specific operational procedures to estimate and monitor the total number of sea lions caught by the fleet against the MALFiRM. The plan will also set out closure procedures by the Minister of Fisheries if the MALFiRM is reached.

3 MFish requests that you provide comments on the proposed MALFiRM for the 2003-04 SQU6T fishery and the options proposed to estimate and monitor the total number of sea lion mortalities against this MALFiRM. In September 2003, MFish will prepare a final advice paper and an Operational Plan for the Minister of Fisheries to establish the operational procedures that will apply to the 2003-04 SQU6T fishery.

4 MFish requests that all comments in response to this IPP are received by **Friday, 29 August 2003**. These comments are to be sent to Jim Cornelius, Senior Fisheries Management Advisor, Ministry of Fisheries, Private Bag 14, Nelson, or faxed to (03) 546 9327, or emailed to cornelij@fish.govt.nz. MFish anticipates the final advice paper conveying the Minister's decision on the 2003-04 Operational Plan will be signed off before the beginning of the 2003-04 fishing year (ie, commencing 1 October).

5 If you have any questions about this document, please contact Jim Cornelius at the Ministry's Nelson office on (03) 548 1069, or e-mail cornelij@fish.govt.nz

BACKGROUND INFORMATION

6 A 12 nautical mile exclusion zone¹ was imposed around the Auckland Islands in 1986 to prohibit fishing close to the major breeding areas of the New Zealand sea lion. In 1994, the Auckland Islands Marine Mammal Sanctuary was established within this same area, with the same controls on fishing. This area became part of the Auckland Island Marine Reserve in January 2003, continuing the existing prohibition on all fishing activities within the 12-mile exclusion zone. Outside the 12-mile exclusion zone, there are active commercial fisheries for various species, including arrow squid in quota management area SQU6T.

7 The foraging range of New Zealand sea lions that inhabit the Auckland Islands overlaps the fishing grounds of the SQU6T fishery. This overlap leads to the incidental captures of sea lions by trawl vessels that are targeting squid. In the past decade, the captures of sea lions within the SQU6T fishery has lead to the development and implementation of operational plans to mitigate the effects of fishing on the New Zealand sea lion population. These plans have focused primarily on the use of a MALFiRM to constrain the total number of captures of sea lions to a biologically

¹ Regulation 15 of the Fisheries (Southland and Sub-Antarctic Commercial Fishing) Regulations 1986

acceptable level within a particular fishing year. The basic objective of these plans is to allow the SQU6T fishery to continue to operate until the MALFiRM is reached. At this point, the SQU6T fishery is closed even if the Total Allowable Commercial Catch (TACC) is not fully taken.

Table 1 Squid 6T fishery – sea lion interaction statistics

fishing year	SQU6T TACC (t)	SQU6T catch (t)	sea lion MALFiRM	estimated mortalities	closure date
1987-88	32,333	7,021	--	33	--
1988-89	35,933	33,462	--	141	--
1989-90	42,118	19,859	--	117	--
1990-91	30,190	10,658	--	21	--
1991-92	30,190	10,861	32	82	--
1992-93	30,369	1,551	63	17	--
1993-94	30,369	34,534	63	32	--
1994-95	30,369	30,683	69	109	--
1995-96	30,369	14,041	73	101	4 May
1996-97	30,369	19,843	79	123	28 Mar
1997-98	32,369	7,344	63	62	27-Mar
1998-99	32,369	950	64	14	--
1999-00	32,369	6,241	65	71	8-Mar
2000-01	32,369	3,254	75	67	-- ^a
2001-02	32,369	11,502	79	84	13-Apr
2002-03	32,369	6,847	70	39	-- ^b

^a The fishery was not officially closed in 2000/01. Industry voluntarily withdrew the majority of vessels on 7 March 2001. Some observed vessels with closed cover nets remained in SQU6T for a short period in an effort to obtain SLED performance data.

^b Under the Operational Plan the SQU6T fishery was closed on 29 March 2003 when the MALFiRM count reached 79 sea lions. A High Court Ruling in April 2003 allowed for continued fishing in SQU6T and established a separate procedure for estimating sea lion mortalities resulting in the 39 mortalities indicated. This estimate (39) is derived from a different procedure from that set out in the 2002-03 Operational Plan. Fishers had voluntarily withdrawn from SQU6T as at the end of June.

8 Squid landings in SQU6T have been irregular over time. The variable nature of catches reflects both unpredictable squid availability and season closures because of sea lion mortalities. Table 1 compares reported landings, the TACC, MALFiRM, estimated sea lion mortalities, and closure date if triggered by the MALFiRM. Estimated mortalities have exceeded the MALFiRM in some fishing years because of the unpredictability of sea lion bycatch, and the time needed to communicate ongoing vessel operations data required to extrapolate MALFiRM estimates.

9 The squid fishing industry is a key stakeholder in managing sea lion interactions in the SQU6T fishery, both in supporting the operational plan and seeking ways to eliminate the bycatch of sea lions. In recent years, the industry has experimented with sea lion exclusion devices² ('SLEDs') installed inside trawl nets, intended to reduce sea lion mortalities by directing live animals out of the trawl net. There evidence about the effectiveness of SLEDs in successfully reducing sea lion mortalities is not conclusive. While there is information to indicate that some sea lions ejected from SLEDs are not mortally injured, the technical working group has recommended that further information gathering is necessary before it is possible to reliably predict long-term sea

² A sea lion exclusion device or SLED consists of a metal grid inside the trawl net to allow squid to pass through into the net cod-end while directing a sea lion and other large bycatch species (such as sharks, rays, etc) out through an escape hatch at the top of the net.

lion survival across all SQU6T fishing activity employing SLEDs. A review is currently underway of the criteria used for determining survivability. The assessment of the performance of SLEDs and means of dealing with this uncertainty is discussed later in this document

The status of the New Zealand sea lion

10 The New Zealand sea lion is New Zealand's only endemic pinniped (seals and sea lions) and one of the rarest sea lions in the world. This species primarily occurs in New Zealand's Sub-Antarctic zone, with small numbers present along the southern parts of the South Island. Remains of sea lions found in the North, South and Chatham Islands suggest that this species may have once been more widespread than today. The geographic distribution of the New Zealand sea lion is limited and localised in comparison to other pinnipeds, increasing the vulnerability of the species.

11 Breeding behaviour concentrates the adult New Zealand sea lion population at two breeding sites (rookeries). Over 95% of the breeding population of this species occurs on two small rookeries on Dundas and Enderby Islands in the Auckland Islands. A small breeding population also exists on Campbell Island. No established rookeries are found on the New Zealand mainland. Breeding generally commences in late November when adult males establish territories. Males leave the rookery in February, but females stay on to suckle their pups. Female sea lions alternate periods ashore nursing their pups with periods at sea foraging. At any one time during the breeding season, approximately 50% of the females are foraging at sea.

12 The New Zealand sea lion is classified as a *Category B "threatened species"* under s 2 of the Marine Mammals Protection Act 1978 (August 1997). Under this classification, the New Zealand sea lion is considered not immediately threatened with extinction but potentially still vulnerable to population decline.

Management Objective

13 The initial management objective established for this species was to retain existing breeding locations, and allow population size to increase with the aim of moving this species towards a 'non-threatened' status within a 20-year time-frame. In practice, MFish has little direct ability to bring about an increase in the number of sea lion breeding locations through management of the SQU6T fishery, and has therefore sought more explicit objectives for managing SQU6T sea lion interactions in the Operational Plan.

14 A group comprised of industry, environmental, Department of Conservation, and MFish interests was established in early 2003 within the Ministry of Fisheries Aquatic Environment Working Group (AEWG) to examine research findings and scientific matters relating to bycatch of the New Zealand sea lion. For purposes of the Operational Plan, this working group adopted the following objective for gauging the effectiveness of SQU6T sea lion management:

Management interventions will be designed to ensure the sea lion population remained above 90% of its carrying capacity, K, or else remained above 90% of the level it would obtain in the absence of fishery bycatch, 90% of the time in 20- and 100-year runs.

15 The intent of this objective is to provide a criterion for evaluating alternative management measures affecting sea lions, including setting of MALFiRMs at varying levels. Three criteria were established for assessing how alternative fishing rules performed against this objective. These criteria and the results of their assessment against alternative rules are discussed later in this paper.

Legal considerations

16 The primary legislative mechanism to manage the impacts of fishing-related mortality on marine mammals is the development of a *Population Management Plan* (PMP) under the Marine Mammals Protection Act 1978. A PMP is developed and approved by the Minister of Conservation, and requires the concurrence of the Minister of Fisheries.

17 Under a PMP, the Minister of Fisheries shall take all reasonable steps to ensure the maximum allowable fishing-related mortality level set by the PMP is not exceeded, and may take measures that are considered necessary to further avoid, remedy, or mitigate any adverse effects of fishing on the relevant protected species.

18 In determining a MALFiRM for a species that is gazetted as “threatened” under a PMP (such as the New Zealand sea lion), the following criterion is prescribed in the Marine Mammals Protection Act 1978:

"In the case of any threatened species, the level of fishing-related mortality should allow the species to achieve non-threatened status as soon as reasonably practicable, and in any event within a period not exceeding 20 years."

19 The responsibility to ensure the maximum mortality level is not exceeded under a PMP lies with the Minister of Fisheries under s 15(1) of the Fisheries Act 1996.

20 There is no PMP for the New Zealand sea lion. The Department of Conservation is developing a PMP. Once approved, the PMP will outline the status of the New Zealand sea lion and establish objectives for the medium and long-term management of this species.

21 Without a PMP, the Fisheries Act 1996 provides alternative mechanisms to manage the effects of fishing-related mortality on the New Zealand sea lion. In particular, s 15(2) of the Fisheries Act 1996 states that without a PMP, the Minister of Fisheries, after consultation with the Minister of Conservation, may take such measures as are considered necessary to avoid, remedy or mitigate the effect of fishing-related mortality on any protected species and this may include setting a limit on fishing related mortality. No MALFiRM has been set under a PMP. It is proposed that a limit on fishing related mortality is set under s 15(2). For the purposes of this paper the term "MALFiRM" is used not in a technical sense applicable to a PMP, but as shorthand for a limit on fishing related mortality established under s 15(2) of the Act. To give effect to any established MALFiRM, s 15(5) states the Minister may, by notice in the Gazette, prohibit all or any fishing or fishing methods in an area to ensure that any limit on fishing-related mortality is not exceeded.

22 When setting a MALFiRM under s 15(2) of the Fisheries Act 1996, it is appropriate for Ministers to consider the specific legislative provisions dealing with the establishment of maximum allowable mortality limits on protected species. This includes the criterion for establishing a MALFiRM under a PMP pursuant to the Marine Mammals Protection Act 1978 (as noted above). The Minister is not specifically required to meet this criterion, as is required when a PMP is in place, but this criterion does provide a guide for any MALFiRM that may be established.

23 Because a PMP is not available for the New Zealand sea lion, MFish considers it is appropriate under s 15(2) of the Fisheries Act 1996 to develop options for implementing a MALFiRM-based approach to manage the effects of the SQU6T fishery on the New Zealand sea lion population. Until a PMP is in place, MFish proposes to establish a MALFiRM based on the operational objective developed by the Aquatic Environment Working Group, as set out in paragraph 14, above.

The previous fishing season (2002-03)

2002-03 Operational Plan

24 The incidental catch of sea lions in the 2002-03 SQU6T season was managed under an Operational Plan approved by the Minister of Fisheries (after consultation with the Minister of Conservation) on 16 December 2002. Officials of MFish and the Department of Conservation developed this plan, after consultation with the Squid Fishery Management Company Limited, Ngai Tahu, and relevant groups.

25 The 2002-03 plan was based on a MALFiRM of 70 New Zealand sea lions. The plan required the fishery to be closed if the estimated total number of sea lions reached the MALFiRM during the season.

26 The Operational Plan initially implemented a monitoring plan to estimate total sea lion captures by the SQU6T fleet. This monitoring plan was based on using designated 'MALFiRM' vessels to get an actual in-season strike rate. MALFiRM vessels were required to carry observers and to fish in a way that retained all sea lions that entered the trawl nets. The capture rate of sea lions on those vessels would be extrapolated to the entire fleet, provided those vessels performed at least 20% of tows in SQU6T; if they did not, then a default strike rate of 9.4% would apply. A permit issued under the Marine Mammals Protection Act 1978 allowing capture of sea lions was carried on these vessels. Capture of sea lions was necessary to monitor the MALFiRM and to allow autopsies to determine SLED efficacy.

27 The requirement to retain a proportion of all sea lions caught by fishing was considered necessary to determine an actual strike rate for the fleet, as there was no other way to verify the number of sea lions that were encountered by nets using a SLED with the cover net open. The actual in-season strike rate was used to extrapolate total sea lion catch across the entire fleet (i.e., actual strike rate multiplied by the total number of tows in the fleet).

28 The Operational Plan required MFish observers to be placed on all MALFiRM vessels when fishing in the SQU6T fishery to count all sea lions caught by these vessels. All remaining vessels were given the option of using SLEDs when fishing. MFish observers were not placed on these vessels.

29 Development of the 2002-03 Operational Plan included consideration of a discount factor applied to the strike rate that would acknowledge possible survival of sea lions ejected by those SLED vessels operating without cover nets over the escape hatch. Although a 10% discount to the actual strike rate was put forth for consideration, the Minister decided against this option in light of the uncertainty over SLED survival rates, and no discount to the strike rate was allowed for SLED vessels. The High Court held that the minister did not have all the information before him that he should have when deciding not to allow a discount for the use of SLEDs.

30 Details of the above monitoring mechanism are outlined in the 2002-03 SQU6T sea lion Operational Plan dated 16 December 2002, available from the Ministry of Fisheries.

The 2002-03 season

31 Fishing commenced in the first week of February 2003. On 29 March 2003, acting on what he believed to be the best available information, the Minister of Fisheries closed the SQU6T fishery. He did so on the basis that the estimated sea lion mortality had reached 79 animals,

exceeding the limit of 70 set by the Operational Plan. On 3 April, following litigation in the High Court, the fishery re-opened, and further fishing was subject to the orders made on 3 April. Among other things, those orders set the MALFiRM count at 30, and required vessels fishing in 6T to maintain the 20% observed tow threshold for the rest of the season.

32 A total of 6,847 tonnes of squid was reported caught in the 2002-03 SQU6T fishing year as at the end of July, amounting to 21% of the TACC. Although two months remain in the current season, it appears that the fleet withdrew from the fishery at the end of June because of low squid catches.

Estimated number of New Zealand sea lion captures

33 A total of 1,383 tows had been conducted in the 2002-03 SQU6T season as at the cessation of periodic vessel reporting up until the week ending 11 May 2003. A total of 322 observed tows were reported (using closed nets). Nine sea lion mortalities were recorded in SQU6T by observers during this period. Four additional mortalities were reported from vessels with no observers, and another mortality was reported for SQU1T from a non-observed vessel. Observers reported another sea lion mortality on 10 June from a vessel still fishing in SQU6T.

34 MFish adopted a procedure set forth by the 3 April High Court ruling to estimate mortality count toward the MALFiRM, as well as the annual strike rate for the balance of the 2002-03 SQU6T season. Among other considerations, this procedure prescribed that the actual strike rate would be calculated as the ratio of total observed tows to total tows conducted by all vessels so long as observer coverage requirements were satisfied.³ Applying this criterion generates an observer coverage rate of 23.3% ($322 \div 1,383$). The 322 observed tows caught 9 sea lions, resulting in a seasonal strike rate of 2.8% per 100 tows ($9 \div 322$; or 0.028 sea lions per tow).

35 Extrapolating the 2.8% strike rate to the entire 1,383 tows, a total of 39 sea lions (95% confidence interval of 21-68) is estimated to have been caught by the SQU6T fleet as of the last weekly NIWA sea lion bycatch report made on 11 May 2003.

36 Observer coverage in SQU6T during the first several weeks of the season was below the 20% minimum required, such that empirical estimates of sea lion bycatch as well as statistically valid estimates of the actual strike rate from this period are unknown. Under provisions of the original 2002-03 Operational Plan, total estimated sea lion bycatch in the SQU6T fishery would have totalled 91 mortalities through the week ending 11 May. Of this total, 79 are based on the 9.4% default strike rate in effect during seven of the first eight weeks of SQU6T fishing that began 1 February.

Sea lion exclusion device trials

37 The squid industry has conducted dedicated trials over the past three years to develop and evaluate the effectiveness of SLEDs to successfully eject captured sea lions from trawl nets. These industry trials demonstrate that SLEDs are successful in ejecting sea lions from the escape hatches. However, there remains considerable uncertainty about the survival of animals ejected from SLEDs. The uncertainties arise from questions over the effect of sea lion injuries on their subsequent survival. Autopsies were conducted by a Massey University marine mammal pathologist during the past three seasons on animals that were ejected from the SLED but retained

³ The Judge made orders in respect of several additional conditions that attached to fishing for the remainder of the 2002-03 season relating to observer coverage and MALFiRM count. Copies of the High Court Ruling are available from the Ministry of Fisheries.

in a closed cover net. Evidence presented in a subsequent section (Table 6) indicates that a significant proportion of these animals suffered moderate and severe injuries due to blunt trauma, and some had regurgitate in their airways.

38 The uncertainty in interpretation of evidence of injuries to ejected animals retained in tied down cover nets prevents unequivocal reliance on the use of SLEDs to mitigate the effects of fishing on sea lions in the SQU6T fishery at this time.

39 The cause of injuries to ejected sea lions cannot be determined at this time. There are at least three possible causes that could lead to these injuries, as summarised below.

- a) the animal may be injured on entry into the trawl net and before it reaches the SLED ejection grid;
- b) the animal may be injured by hitting the metal grid device and then be ejected out of the net (the grid used is concertinaed or 'Z' shaped to flex when the net is towed and hauled back on to the vessel; thereby creating blunt edges);
- c) the animal may be injured in struggling while retained under the cover net placed over the escape hatch (the cover net is used for trial purposes to retain an ejected animal for subsequent autopsy and video monitoring of animals held under cover nets).

40 The available information suggests that SLEDs appear to be very effective at ejecting sea lions. Aside from noted gear failures (cover nets tied down too tight to allow passage of an animal, damage to the SLED, large rocks or other material present in the trawl net) all animals were ejected, regardless of their pathology. It is therefore important to determine what percentage of animals is likely to survive, before deploying SLEDs throughout the fishery. The most recent SLED configuration developed by Industry is designed to retain moribund or mortally injured animals, but the effectiveness of this device has not been proven in differentiating between sea lions likely to survive or die following ejection.

41 Video recording equipment has been employed by industry at various times over the past several seasons in an effort to visually document sea lion interactions with SLEDs. These trials have provided very limited insight into such interactions owing to equipment failures and the difficulty in obtaining clear video footage of sea lions under the conditions present during fishing operations. Since the 2000-01 season, only three video captures of sea lions have been available to compare with subsequent autopsy results, and even these have provided inconsistent results about the likelihood of survival. MFish notes that the communication it has received from stakeholders in the past concerning SLED trials, video footage, and autopsy results has been poor, further undermining consensus interpretations of survival evidence that does exist.

42 There are differences of opinion over the interpretation of the pathological findings from Massey University study of dead sea lions recovered from trawl nets. While there is consensus that the quality of the examinations is of a sufficient standard, alternative prognoses have been advanced that suggest that the level of injuries experienced by the captured sea lions may not compromise their survival, in at least some cases.⁴ The AEWG meeting held on 16 June 2003 recommended that a panel of experts be set up to review autopsy findings, and the criteria on which

⁴ The Squid Fishery Management Company presented an affidavit in support of application for judicial review from pathologist KJ Thomson, critical of the survival prognosis put forth in the Massey University reports. Subsequent opinions have been obtained from other pathologists supporting this view, and are discussed elsewhere in this paper.

these are assessed. Suitable terms of reference for the expert panel are to determine the duration over which survival outcome would be judged, and setting criteria for determination of survival probability for ongoing autopsy analysis, and where possible to provide alternative prognoses for the existing autopsied animals dating from 2001-02 and 2002-03 fishing seasons. The AEWG agreed the main questions and issues to consider in assessing survivability of ejected sea lions from SLEDs are:

- a) What are the criteria for survival (time-scale, pathological findings)
- b) What are the methods used for assessment
- c) Clear definitions of scientific design for testing SLED efficacy
- d) Establishment of agreement on implementation and evaluation

43 Some progress is anticipated in advancing the understanding of SLED effectiveness and causal factors of injuries to ejected animals as a result of ongoing research. It should be cautioned, however, that definitive solutions are likely to be several years in development given the magnitude of scientific unknowns, including the logistical difficulty in monitoring sea lions once ejected from SLEDs.

2003 estimates of New Zealand sea lion pup production and total population size

44 Department of Conservation estimates of New Zealand sea lion pup production and total population size since 1994-95 are shown in Table 2. The Department's estimate of the mean New Zealand sea lion population in 2002-03 is 13,608 animals (11,812 – 15,663; 95% confidence limits).

Table 2 Pup production and the estimation of population size

Season	Total estimated pup production (std. error)	Per annum increase in pup numbers	Population size estimates using 1996 Gales & Fletcher model		
			mean	95% CI	20th percentile
94/95	2,640 (20.8)		12,797	10,883 - 14,339	11,730
95/96	2,807 (22.3)	6.3%	13,606	11,564 - 15,239	12,472
96/97	3,097 (25.5)	10.3%	14,661	12,732 - 16,826	13,742
97/98	3,143 (93.8)	1.5%	14,868	12,812 - 17,175	13,884
98/99	2,989 (32.5)	-4.9%	14,163	12,337 - 16,262	13,272
99/00	2,978 (42.6)	-0.3%	14,104	12,272 – 16,230	13,199
00/01	2,980 (24.3)	0.1%	14,108	12,305 – 16,163	13,222
01/02	2,404 (33.7)	-20.2%	11,376	9,896 – 13,058	10,653
02/03	2,875 (70.0)	19.6%	13,608	11,812 – 15,663	12,737

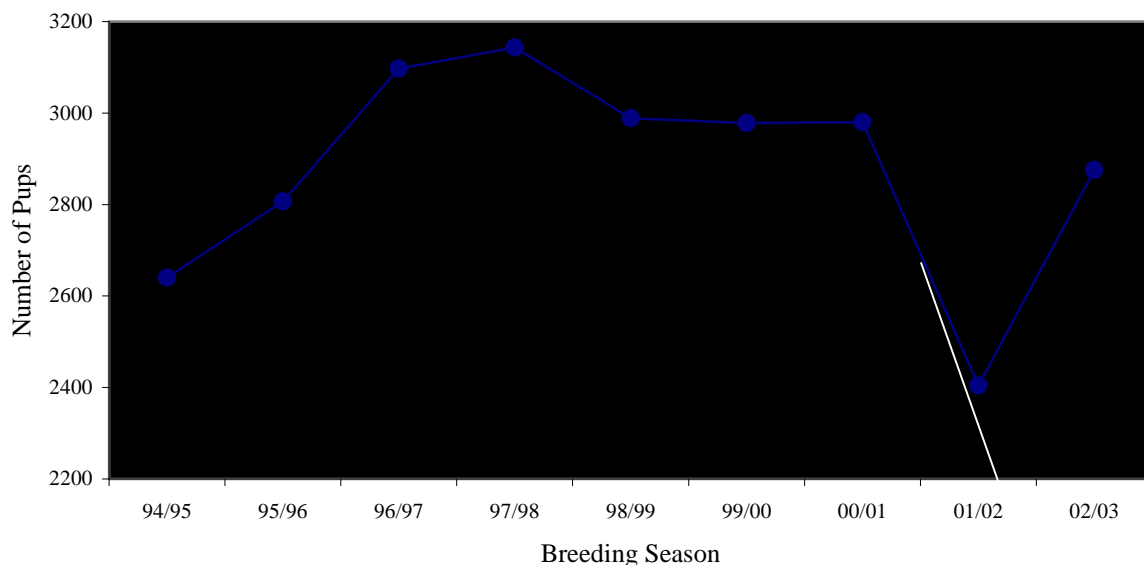
45 Specific to the Auckland Islands, during 2002-03 there was a significant mortality event among pups that resulted in deaths of over 20% of pups born at Sandy Bay. It is unclear if similar levels of mortality occurred at Dundas Island. No adult females were seen to be affected during this mortality event. Estimates of pup production at the Auckland Islands made in January 2003 are approximately 10% higher than those seen in 2002, a year in which there was a significant pup mortality event, but about 12% lower than the 1999, 2000, and 2001 seasons.

46 Pup production at Campbell Island was estimated during the 2002-03 breeding season. 136 dead pups were found during the survey at Davis Point and 2 elsewhere. A further 161 live pups were tagged during the summer. The total estimated pup production for Campbell Island in 2002-03 was 358 animals (95% CI 330 – 440). This estimate is about three times the previous estimate of 122 animals obtained in 1991-92, and which has been used to estimate pup production at this site in all previous operational plans.

47 The total pup population (Auckland Islands and Campbell Island combined) in 2002-03 is estimated to be 2,875 animals. This estimate indicates that total sea lion pup production in 2002-03 is about 20% higher compared with the 2001-02 count, and about equal to the average of the previous eight years (2,880 pups). However, it should be noted that these comparisons are influenced by the significant three-fold increase in the Campbell Island pup count estimate this year. The combined Auckland and Campbell Island pup production estimates since 1994/95 are illustrated in Figure 1.

48 MFish notes that the population estimates shown in Table 2 are based on the 1996 Gales and Fletcher model. A new sea lion population model has been developed by Breen and Kim, overseen by the AEWG. This working group accepted the model on 11 June 2003 as presenting a realistic model of the New Zealand sea lion population, and providing a sufficient scientific basis for decision making in managing sea lion interactions in the SQU6T fishery. The model, discussed in detail in the next section, is currently undergoing external review by an independent fisheries scientist.

Figure 1 New Zealand sea lion pup production estimates since 1994/95



PROPOSED MALFiRM FOR THE 2003-04 SQU6T FISHERY

49 The Breen-Kim research compares the existing, and several alternative management strategies for determining a MALFiRM, using formal evaluation criteria (see below). The previously used National Marine Fisheries Service (NMFS, hereafter ‘current’) MALFiRM is closely approximated by a rule that allows a constant exploitation rate (0.46% on average), from an estimated population size in any year. Population in any year is derived by averaging the pup numbers from the previous two years and multiplying by a constant.

50 All of the management strategies evaluated using the model use pup production as an index of population size, because direct estimation of numbers of adult sea lions is hampered by their periodic foraging trips at sea. In the Breen and Kim research, the population is modeled using a fully-age-structured Bayesian approach. It differs from the previous work of Breen and others by taking into account the full range of biological and fisheries data available to date, including observed maturity schedules, variable pupping rates, vulnerability at age information from by-caught animals, survival rates, and late-season pup mortality data.

51 MFish considers that the management strategies tested in this model are applicable over a wide range of variation in the dynamics effecting the sea lion population. In the absence of evidence to the contrary, it is recommended that the model be applied in the future with little or no modification, but is subject to further refinement of input data and parameters. The Breen and Kim modelling incorporated a level of environmental and biological variability that allows management strategies tested to remain robust against fluctuations in survivorship and productivity, along with varying levels of sea lion catchability in the fishery. Variability that has been observed over the last 15 years in the sea lion population has been incorporated into the modeled environment.

52 The model has only been applied to the sea lion population at the Auckland Islands. Insufficient data exists for the other sites (Campbell, Snares and South Island of New Zealand) and convergences cannot be obtained incorporating other sites. The flux of animals between this central cluster of breeding sites and other locations is little understood, and is considered to be minor in the overall dynamic of the population, although it may influence the establishment of breeding populations at other sites.

MALFiRM Decision Rules Evaluated

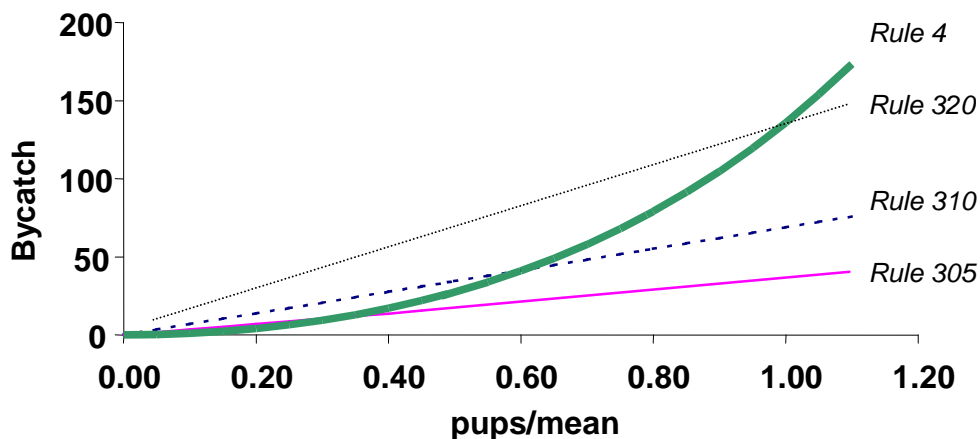
53 Several alternative decision rules for establishing a MALFiRM were tested using the Breen-Kim model. The rules were compared with respect to how well they achieved specified management objectives. The rules are:

- a) Rule 0 - no fishing;
- b) Rule 1 - unconstrained fishing at current levels of effort (13 weeks of fishing with 2871 tows, derived from mean fishing effort in 1998-2003);
- c) Rule 3 variants - three variants of the current MALFiRM were tested:
 - i) 310, approximating limitation on the level of sea lions captures at the rate of the current MALFiRM;
 - ii) 305, being half the rate of 310; and
 - iii) 320, being twice the rate of 310;
- d) Rule 4 - the adaptive rule (see Figure 2). This rule is adaptive, in that the exploitation rate is a not constant but changes in proportion to the pup count. It was set at an arbitrary level by the AEWG, using a polynomial function that fitted a line equating to $\frac{1}{2}$ the current MALFiRM at less than 50% of current pup production levels, and twice the current MALFiRM level when the current pup production is over 80% of current levels.
- e) Several other potential management strategies were considered by the AEWG for

evaluation, including fishing exclusion zones, but these were not advanced pending further analysis.

54 The four management strategies evaluated using the Breen-Kim research model are illustrated in Figure 2. Rule 4 (heavy solid line) represents the adaptive rule, with an increasing rate of sea lion exploitation as production increases. Rule 310 (dashed) represents sea lion mortality at the rate of the ‘current’ MALFiRM, while rules 305 (light, solid) and 320 (dotted) represent one half and double that rate, respectively. The horizontal axis is expressed as the ratio of the current two-year average pup count to the longer term 1998-2003 average pup count.

Figure 2 Sea lion bycatch in relation to pup count, by decision rule



Decision Rule Evaluation Criteria

55 Criteria for acceptance of management strategies were developed by the AEWG. The probabilities of different outcomes were determined for several criteria. Specific criteria were chosen to ensure that a successful management strategy:

- a) Provided for increase in the sea lion population to more than 90% of carrying capacity (K), or to within 10% of the proportion of K that would have been attained in the absence of fishing;
- b) Attained the levels in a), with 90% certainty, over 20-year and 100-year projection periods (*crit20* and *crit100*, respectively);
- c) Attained a mean number of mature animals that exceeded 90% K (*crit Nmat/K*)%, in the second 50 years of 100-year projection runs (to allow for build-up of numbers in depleted, hypothetical populations over time).

56 Aside from these three primary criteria, evaluation of the management strategies was made using a larger suite of performance indicators. Also elaborated here are: mean annual and maximum bycatch during 100 year projection runs, population level at the end of 100 year runs as a proportion of K ($N100/K$), and the percentage of fishing seasons closed as an index of cost to the fishery. The lowest number of animals as a proportion of K (*nadir/K*), attained during the projection runs was examined, but showed very little difference between strategies (79 – 83%), hence is not discussed further.

Evaluation Results

57 All fishing rules tested passed the *crit20* and *Nmat/K* criteria, while only rule 1 (unconstrained fishing) marginally failed the *crit100* criteria. This indicates that even when the fishery is unconstrained (at current fishing effort levels), the population of sea lions remains at or increases through time to attain over 90%*K*, with high certainty.

58 Table 3 shows the evaluations of each of potential decision rules (310, 320 and 4), along with rules 0 and 1 as controls, for each of seven key performance indicators. *Crit20* and *crit100* show the sum of years in projection runs when the criterion was true. *Nmat/K* is the mean of the distribution. *Lost fishing effort* is an indicator of revenue loss to the fishery in terms of reduced fishing opportunity due to closure. The other indicators are the median of the distribution for each index.

Table 3 Rule performance against key indicators, from the base case projections from Breen and Kim, 2003.

Performance Indices	Fishing Rules				
	0	1	310	320	4
<i>Crit20</i> ^a	N/a	97,781	100,000	99,989	99,997
<i>Crit100</i> ^b	N/a	447,570	499,052	487,109	489,846
<i>Nmat/K</i> ^c	98.2%	91.7%	95%	93.4%	93.5%
<i>Lost fishing effort</i> ^d	100%	0%	31.5%	11.4%	12.2%
<i>Seasons closed</i>	100%	0%	52%	23%	24%
<i>Maximum bycatch (100 yr runs)</i>	0	545	77	151	169
<i>Mean annual bycatch</i>	0	99	53	76	75

^a pass level for this index is 95,000 out of 100,000 projection-run years

^b pass level for this index is 450,000 out of 500,000 projection-run years

^c pass level for this index is 90% of *K*

^d based on average annual fishing effort (2,871 tows) conducted during the years 1988-2003

59 Rule 0 - (no fishing) results in a population at 98% of *K* on average, but with maximum lost fishing effort and lowest sea lion bycatch, by definition.

60 Rule 1 – (unconstrained fishing). This rule failed the *Crit100* index by 0.54%, but successfully passed the other two criteria. Mean and maximum bycatch exceeded those for other rules considerably. Despite this higher bycatch, the population under this rule attains >91%*K* on average during 100 year projection runs. This rule showed the lowest level of lost fishing (0% closure, by definition).

61 Rule 310 – (approximating the current MALFiRM). This rule passed all the criteria for an acceptable management strategy. The proportion of *K* attained was 95%. Of the management options subsequently recommended (rules 310, 320, 4), this rule shows least bycatch but highest lost fishing effort.

62 Rule 320 – (two times the current MALFiRM). This rule passed the three acceptance criteria. A maximum and mean annual bycatch of 151 and 76 animals, respectively, allows the population to attain 93% *K* on average. Lost effort is less than half that of rule 310 with 11.4% foregone tows and 23% of seasons closed.

63 Rule 4 – (adaptive rule). This rule performed on average similar to rule 320, except that lost effort was slightly higher (24% closed) and maximum bycatch 18 animals higher. Although the MALFiRM value appears to be a compromise between Rules 310 and 320, Rule 4 is based on a changing rate of sensitivity to annual pup count numbers. The year class decline in 2001-2002 pup counts has tempered the MALFiRM using this rule, but future increases in pup counts could lead to growth in the MALFiRM to levels above that of option B. Similarly, proportional declines in the pup count will lead to a MALFiRM below that of option B (refer to Figure 2.)

MFish recommendations on options to estimate the MALFiRM

64 MFish has evaluated several options (decision rules) described above that can be used to determine the MALFiRM target in light of the objectives established for managing sea lions in the SQU6T fishery. Of these, rules 0 and 1 are considered primarily as references for relative performance. Although rule 0 (no fishing) meets the sea lion population management objectives, MFish considers that this option is needlessly restrictive in meeting squid fishery utilization objectives, and the rule is not recommended as an option. By similar rationale, rule 305 is not recommended on the basis that the reduction in MALFiRM unnecessarily reduces utilization objectives for the SQU6T fishery.

65 Rule 1 (unconstrained fishing) does not meet the lion management objectives (although close), and is not recommended by MFish. MFish considers that unconstrained sea lion bycatch is inconsistent with the intent of s15(2) of the Act, whereby the Minister is required to avoid, remedy, or mitigate the effects of fishing related mortality on any protected species.

66 MFish feels that the remaining three rules are reasonable options for consideration in setting the MALFiRM, presenting a range of perspectives on acceptable sea lion mortalities, utilization of the squid fish stock, and the flexibility of the decision rule to variation in the pup count. The relative merits are discussed as follows:

Option A (rule 310)

67 The current rule (rule 310) using only Auckland Island pup count data generates a MALFiRM limit of 62 sea lions for the 2003-04 SQU6T season. This rule effectively maintains the status quo MALFiRM estimation procedure from prior seasons. The fishery would be closed in nearly half of the modelled seasons, and this is the most restrictive of the three options in terms of fish stock utilization opportunities. This option satisfies all three criteria for managing sea lion populations, but results in an average over time of 31% less tows than the 1988-2003 mean fishing effort.

Option B (rule 320)

68 The double rule (rule 320) using only Auckland Island pup count data generates a 2003-04 MALFiRM limit of 124 sea lions. The fishery would be closed in less than 25% of the modelled seasons. This option satisfies all three criteria for managing sea lion populations, resulting in an average over time of 11% less tows than the 1988-2003 mean fishing effort in the SQU6T fishery and satisfies all three criteria for managing sea lion populations. The greater utilization potential under this option provides the fishing industry with a more stable and predictable calculation to plan for the annual season.

Option C (rule 4)

69 The adaptive rule 4 using only Auckland Island pup count data generates a MALFiRM limit of 103 sea lions. Option C also satisfies all three criteria for management of sea lion populations. The fishery would be closed in less than 25% of the modelled seasons and would represent a 12% decline in the 1988-2003 mean fishing effort in the SQU6T fishery.

70 Option C prescribes a variable response rate in the MALFiRM relative to the change in annual pup count, compared to a fixed rate under Options A and B. The MALFiRM increases under each option as the pup count increases, but Option C results in proportionately smaller MALFiRMs when pup counts are low, and relatively larger MALFiRMs as the pup count increases. Of the three options considered, option C generates the greatest maximum MALFiRM at high pup counts.

Preliminary MALFiRM Recommendations

71 MFish proposes that option B, resulting in a MALFiRM of 124 sea lions in the 2003-04 season, offers a considered balance between sea lion management objectives and SQU6T fish stock utilisation opportunities for fishers. Implicit in this is the expectation that option B would serve as the preferred MALFiRM estimation procedure in the future.

72 Accordingly, MFish also recommends that the decision rule adopted for the 2003-04 season would continue to be applied over the next five years, and would be subject to review during this period only where assumption of the modeling work underpinning the management strategy evaluation framework are violated, or the model itself is found to be in error.

73 It is prudent to note that in the event MALFiRM monitoring occurs under option 1, the actual level of sea lion mortalities is likely to exceed the levels established under the three decision rules evaluated. Sea lion mortalities resulting from capture in tied down cover nets over escape hatches are not included in the MALFiRM count, nor have they been accounted for explicitly in the performance measures.

74 MFish notes that the variable responsiveness in MALFiRM to pup counts offered in Option C represents a more precautionary approach in setting bycatch limits relative to Option B at low pup counts. However, the progressive increases in sea lion bycatch allowed under Rule 4 at higher pup counts raises concerns relative to s 15(2) in the Fisheries Act. A modification of Rule 4 to cap bycatch at some upper limit might address these concerns, but this modification has not been evaluated in terms of the impact on performance criteria.

PROPOSED ARRANGEMENTS TO MONITOR THE MALFIRM

75 Estimation of the MALFiRM as described above is the measure of allowable sea lion mortalities attributed to unintentional bycatch in associated fisheries, predominately the SQU6T fishery. A separate procedure is necessary to monitor sea lion mortalities against the MALFiRM. Monitoring the MALFiRM involves counting sea lion deaths that accrue as a result fishing.

76 In the event an observer oversaw each and every tow undertaken, the SQU6T fishery would be monitored based on an empirical count of actual bycatch. More typically in recent years,

observer coverage has been less than 100%⁵, such that the MALFiRM is monitored based on an estimate of total sea lion bycatch. To estimate total mortalities, a strike rate is multiplied by the number of trawls conducted in order to project total sea lion bycatch. The strike rate is a measure of the number of sea lions captured per 100 tows. This is conveyed as a percentage; if 5 sea lions are captured in 100 tows, the strike rate is 5%. Use of a strike rate for monitoring the MALFiRM is founded in the concept that sea lion interactions with squid trawl nets in this fishery occur with some level of predictability, and that this predictability can be used to estimate the number of mortalities associated with unobserved vessels.

77 MFish has considered several options to monitor and estimate the total number of sea lion captures within the SQU6T fleet consistent with the MALFiRM target. These range from closely monitored plans with empirical verification of sea lion deaths, to less structured plans based on expected or simulated outcomes. From these, MFish proposes two options to monitor and estimate the total number of sea lion captures within the SQU6T fleet:

- a) option 1 - dedicated 'MALFiRM' vessels
- b) option 2 - predetermined strike rate

78 The two options provide a contrast in measures available to manage sea lion bycatch in the SQU6T fishery, weighing considerations of scientific evidence, MALFiRM monitoring ability, commercial use of the squid fishery, and industry incentives to reduce or eliminate sea lion mortalities. The options vary in terms of how each arrives at an estimate of the strike rate. Each option is discussed below.

Option 1 - Dedicated 'MALFiRM' vessels

79 Option 1 is similar to the monitoring arrangements adopted for the 2001-02 and 2002-03 seasons. MFish observers will be placed on selected vessels ('MALFiRM' vessels) intending to target squid to provide coverage for a representative 20% minimum sample of all tows undertaken in the SQU6T fishery. MFish emphasizes that this coverage requirement applies explicitly to quota management area SQU6T. Observer coverage outside quota management area SQU6T does not provide observer coverage representative of sea lion bycatch in SQU6T. In the past, less than 1% of observed sea lion captures have come from outside area SQU6T. All MALFiRM vessels fishing in SQU6T must use trawl nets that either do not employ an exclusion device, or use a SLED that is closed (ie, a cover net is placed over the escape hatch). All sea lions caught by MALFiRM vessels will be retained in nets where they can be accurately counted by the observers.

80 In the 3 April hearing, the High Court ruled that the Ministry of Fisheries bears responsibility for ensuring that observer resources are available to provide coverage necessary to meet vessel requirements under the plan. In turn, MFish requires the cooperation of Industry in providing the logistical information necessary to plan and meet observer coverage needs. This information includes:

- a) a list of all vessels participating in the fishery,
- b) advance notice of arrival and departure dates,

⁵ Nearly 100% observer coverage of SQU6T vessels was obtained during the 2000-01 season under the sea lion Operational Plan in effect at that time, but observer coverage has averaged less than 50% in all other seasons since 1987-88.

- c) planned area of fishing activity (whether SQU6T or elsewhere), and
- d) other data that may facilitate efficient use of observer resources.

81 If total observer sea-days in the squid fishery required under this coverage plan exceed those days already levied to the Industry, the additional sea-days will be charged to the Squid Fishery Management Company.

82 To ensure the minimum 20% observer threshold on MALFiRM vessels under option 1 is achieved with a high level of confidence (75%), MFish observers will be placed on a minimum of 25% of vessels targeting squid at any one time.⁶ The Squid Fishery Management Company will assist MFish in ensuring achievement of the 20% threshold and that designated vessels fish in a manner representative of the SQU6T fleet.

83 The number of MALFiRM vessels fishing in SQU6T cannot exceed 30% of total vessels fishing in SQU6T during any one reporting period. This is in order that sea lion bycatch from observed vessels (which cannot be applied to the MALFiRM count under the April High Court ruling) not become excessive relative to the underlying MALFiRM.

84 Should the number of observed MALFiRM vessels fishing in SQU6T during a designated reporting period (defined below) exceed 30%, those vessels in excess of the 30% maximum must remove cover nets. This action is to be coordinated through the Squid Fishery Management Company and MFish to ensure that minimum coverage levels are maintained. Prior to removing cover nets in this situation, vessels must notify the MFish Observer programme to ensure that onboard observers are aware of the change in reporting status.

85 SQU6T vessels without scientific observers have discretion to employ SLEDs when fishing.

86 Up to the point where 70% of the MALFiRM is reached, the reporting period used to measure observer coverage is to be the seven day calendar week commencing at 0001 hours Monday and ending at 2400 hours the following Sunday.⁷ At the point when 70% of the MALFiRM is reached the reporting period will switch to a daily basis, including provisions for maintaining a minimum 20% and maximum 30% observer coverage with tied down cover nets on MALFiRM vessels. MFish emphasizes that this is a reduction in the percentage of MALFiRM threshold for shifting reporting period from a weekly to daily basis; from 80% in previous years to 70% in the 2003-04 SQU6T season.

87 The underlying rationale for shifting from a weekly to daily reporting period as the MALFiRM count progresses is based on recurring MFish difficulties in monitoring bycatch as the MALFiRM limit is approached. Week-long delays in obtaining tow statistics and observer coverage have often lead to the MALFiRM being exceeded before closure can come into effect. Lowering the sea lion bycatch threshold to 70% of the MALFiRM is intended to improve MFish's ability to monitor the MALFiRM and more efficiently affect closure procedures if required. MFish also

⁶ This level of coverage is based on a NIWA estimate of a statistically valid level of observer coverage in the SQU fishery (SQU1T and 6T) that would enable a level of assurance that at least 20% coverage will be maintained at any time in SQU6T. Results indicate that requiring 25% observer coverage of SQU vessels would provide coverage of 20% or more with a probability of 75%, while requiring 30% coverage ensured similar coverage with 90% probability.

⁷ MFish anticipates that fishers will begin fishing in SQU6T on 1 February 2004. For purposes of the applicable reporting period, the week covering the opening of the SQU6T fishery on 1 February will be extended to the eight-day period commencing 1 February 2004 at 0001 hours and ending at 2400 hours on 8 February 2004.

acknowledges that daily monitoring procedures, including requirements for observer coverage rates, may pose difficulties for fishers, and solicits industry comment on this proposal.

88 Any tow where a sea lion is retained by a MALFiRM vessel for research purposes will not be counted towards the MALFiRM. Where the fishing industry follows the instructions to tie down cover nets to prevent the escape of sea lions, research permits under s 5 of the Marine Mammals Protection Act will be obtained as a precautionary measure. MFish anticipates that these research permits will be issued by the Department of Conservation in the name of the Chief Executive of the Ministry of Fishery, on behalf of fishers.

89 The observers will confirm sea lions caught by nets and report all mortalities on a timely basis. These mortalities will also be used for autopsy analysis when the carcasses are returned to shore and sent to Massey University.

90 An actual in-season strike rate (per tow) is calculated on the basis of the applicable weekly or daily reporting periods as follows:

$$(\text{total confirmed sea lion captures by MALFiRM vessels}) \div (\text{total number of tows by MALFiRM vessels})$$

91 The estimated total number of sea lion captures for purposes of monitoring the MALFiRM is determined by extrapolating the actual in-season strike rate to the total number of tows reported by all vessels in SQU6T (ie, MALFiRM and non-MALFiRM vessels), minus the number of actual sea lions captured in MALFiRM designated vessels⁸ (refer below).

$$[(\text{actual in-season strike rate}) * (\text{total number of tows by all vessels})] - (\text{actual number of sea lions captured})$$

92 The use of option 1 will be contingent on the following two criteria:

- a) that a minimum of 20% and a maximum of 30% of all tows in SQU6T are undertaken by MALFiRM vessels with MFish observer coverage.
- b) The distribution of tows by all MFish observed vessels is generally representative of fishing activity undertaken by the SQU6T fleet.⁹

93 If either of the above two criteria are not upheld for a given reporting period (weekly or daily, as determined by the proportion of the MALFiRM reached) during the season, a predetermined strike rate is applied in order to effectively estimate total sea lion catches (refer to option 2, below).

94 MFish accepts there may be some vessel operators that will object to being a MALFiRM vessel. Option 1 accommodates these views by exempting those vessels that do not wish to comply with the requirement to use closed nets, so long as a representative 20% observer coverage can be maintained over the SQU6T fleet. This requires industry to identify participating vessels well before the commencement of the fishing season.

95 To ensure there are sufficient vessels for placement of observers and to accommodate vessels not wishing to become MALFiRM vessels, industry must provide a list of all vessels

⁸ The April 2003 High Court ruling held that sea lions captured by cover nets placed over escape hatches were not to be counted against the SQU6T MALFiRM since such captures were deliberate rather than accidental.

⁹ In this context, 'representative' means that observed vessels are fishing in the same general vicinities, with similar trawl patterns as unobserved vessels. Verification will be based on interpretation of vessel ALC transmissions interpreted by MFish.

intending to fish in SQU6T and whether those vessels will operate as MALFiRM vessels. This list is to be delivered to the Manager, MFish Observer Programme by 1 December 2003. In addition, all vessel operators must advise the Manager, MFish Observer Programme by facsimile (04 460 4675) or e-mail (observer@fish.govt.nz) at least 72 hours before the vessel leaves port to target squid in SQU6T and/or SQU1T.¹⁰

Option 2 – Predetermined strike rate

96 In the event fishers do not achieve the required minimum 20% observer coverage rate during any relevant reporting period (weekly or daily, as described above) necessary to compute the actual strike rate, the procedure for estimating sea lion captures for the SQU6T fishery will rely on the application of a predetermined strike rate. This strike rate will apply to the *total* number of tows reported by all vessels in SQU6T during the relevant reporting period as follows:

$$(\text{predetermined strike rate}) * (\text{total number of tows in SQU6T by all vessels})$$

97 Option 2 provides an alternative means of monitoring the MALFiRM if the SQU6T fleet does not comply with option 1 criteria. The industry may elect to operate under option 2 rather than option 1, but MFish notes that the use of option 2 will not allow for the calculation of an actual strike rate for the 2003-04 fishing year. Given the high level of variability in the strike rate over time, (Table 4), MFish recommends that use of a predetermined strike rate in 2003-04 is contingent on implementation of an actual strike rate monitoring procedure in the 2004-05 season, such as offered by option 1. Thus, MFish recommends that option 2 not be continued as a long run MALFiRM monitoring regime unless provisions can be made to update or verify the predetermined strike rate.

98 A key determination with option 2 is designating the predetermined strike rate to apply to the 2003-2004 season. This strike rate might be estimated from the Table 4 data based on alternative time series procedures. Table 5 compares alternative methods, time series, the resulting strike rate, and the equivalent number of tows for a representative MALFiRM of 100 sea lions. Strike rate projections are highly sensitive to the underlying methodology, varying from 3.6% to 7.1% in just these examples. Selection of the predetermined strike rate thus bears directly on the number of tows allowed for any given MALFiRM.

99 MFish considers that there is no reliable basis for specifying causal factors that could be used to predict the future strike rate. At the 10 July 2003 sea lion Operational Plan meeting involving representatives from MFish, the Department of Conservation, SFMC, SeaFIC, the World Wildlife Fund, NIWA, and Te Ohu Kai Moana, all parties agreed that the use of a simple average of the actual strike rate achieved during recent years, and for which a minimum 20% annual observer coverage was achieved was the most appropriate method for setting a default strike rate. This agreement results in methodology 4 (simple 7-year average) in Table 5, giving a strike rate of 5.3% (or 5.3 mortalities per 100 tows). This procedure provides a mid-range rate compared to other methods.

¹⁰ This is in view of the fact that vessels may not have definite plans on intended fishing activity in SQU6T vs. SQU1T during the duration of each voyage, in which case observer coverage must anticipate switching between the two areas.

Table 4 **Reported strike rate of New Zealand sea lions (mortalities per 100 tows) by MFish scientific observers in the SQU6T fishery.**

Fishing year	Strike rate ^a (%)	Observer Coverage ^b (%)
1987-88	1.8	24
1988-89	3.7	19
1989-90	2.2	12
1990-91	0.6	10
1991-92	3.8	10
1992-93	2.6	32
1993-94	0.7	10
1994-95	3.0	8
1995-96	2.3	13
1996-97	3.5	20
1997-98	4.4	23
1998-99	3.6	37
1999-00	6.0	35
2000-01	11.8	100
2001-02	5.1	46
2002-03	2.8	23

^a Source: 2002-03 Operational Plan and Doonan (NIWA)

^b Source: Doonan (NIWA), Paul Starr (SeaFIC), and Baird (NIWA)

100 Ongoing research to explain factors influencing the actual strike rate have to date revealed little that might be used to adjust the predetermined strike rate in season. That is, there is no obvious means other than relying on a statistically valid actual strike rate to base changes in the predetermined strike rate. Year-to-year variation in the actual strike rate, as shown in Table 4, demonstrate that the 5.3% predetermined strike rate may prove unrepresentative of the actual strike rate. For this reason, MFish recommends that changes to the predetermined strike rate might be undertaken in season if evidence from actual strike rate calculations reveals the predetermined strike rate is not representative of the observed strike rate.

Table 5 **Comparison of alternative strike rates and corresponding number of allowable tows using five different methods of calculation**

Method	Time period	Strike Rate (%)	Representative tows ^a
1. Simple 15 year average	1987/88-2002/03	3.6	2,778
2. 3 rd order polynomial fit	1987/88-2002/03	3.9	2,464
3. Simple 8 year average	1995/96-2002/03	4.9	2,041
4. Simple 7 year average	1996/97-2002/03	5.3	1,887
5. 2 nd order polynomial fit	1987/88-2003/04	7.1	1,408

^aIndicative only for purposes of comparison based on a representative MALFiRM of 100 sea lions.

101 MFish proposes that the predetermined strike rate be compared with the ongoing, most recent 4-week moving average of actual strike rate as a basis for changing the predetermined strike

rate in season.¹¹ Time series data from NIWA reveals that actual in season strike rates can be highly variable from week to week. During April 2003, the actual strike rate ranged from 0% to 15.8% over a four-week period. Thus, some averaging of the weekly strike rate is appropriate in order to avoid reliance on singular or unique results. The relevant period for purposes of determining the strike rate will be the weekly reporting period used by NIWA to estimate an actual strike rate if statistically valid observed strike rates are available for such calculations. The initial 5.3% predetermined strike rate will be replaced by the 4-week moving average strike rate for all subsequent reporting periods in calculating the MALFiRM count under option 2. MFish notes that this in season adjustment requires that a least four previous weeks where at least 20% coverage was recorded within the current 2003-04 season be available to justify such changes.

102 Under the option 2 predetermined strike rate MALFiRM monitoring option, MFish therefore proposes that an initial strike rate of 5.3% be used for the 2003-04 fishing year in the event minimum observer coverage of 20% of MALFiRM vessels is not achieved. The 5.3% predetermined strike rate will be adjusted within the season by the procedure described above if actual strike rate information is available, but criteria necessary to apply the option 1 actual strike rate procedure are not satisfied.

103 Ongoing estimated mortalities by the fleet, whether from strict “MALFiRM” vessel extrapolation or predetermined strike rate extrapolation, will be applied cumulatively to the sea lion MALFiRM in SQU6T. The SQU6T fishery will be closed when MFish determines that the MALFiRM is about to be, or has been, reached.

MALFiRM monitoring changes between option 1 and option 2 during the season

104 Over the course of the 2003-04 SQU6T fishing season, it is intended that the MALFiRM monitoring options may shift from one regime to the other, based on industry choices or as a consequence of coverage rates achieved during the relevant (weekly/daily) reporting period. For example, option 1 monitoring may be in effect but during any reporting period where there is less than 20% coverage the monitoring regime will shift to option 2. In the event 20% observer coverage is reestablished in a subsequent reporting period, bycatch monitoring would resume under option 1. The ongoing sea lion bycatch count against which the MALFiRM is measured is the cumulative running total of the weekly/daily bycatch estimated under the monitoring regime in effect at the time. MFish notes that this accounting procedure can produce different MALFiRM counts than that derived in prior years, particularly if option 1 and option 2 bycatch monitoring regimes are combined during the season.

DISCOUNT STRIKE RATE

105 Under MALFiRM monitoring options 1 and 2, the industry may employ SLEDs when fishing in SQU6T to potentially mitigate the sea lion mortalities. As noted in paragraphs 37-43, however, the efficacy of SLEDs in reducing sea lion deaths remains uncertain. In the event that SLEDs reduce mortalities by returning animals to the sea in a condition such that they survive the encounter, adverse impacts on sea lions can be reduced. Lower sea lion bycatch also allows fishers to increase squid catch by reducing the ongoing mortality count applicable to the MALFiRM limit.

¹¹ A moving averages is a standard statistical smoothing technique used where a data series is thought to have a large random factor. In this application, the moving average is the most recent 4 weeks with actual strike rate information (these do not have to be consecutive) averaged to develop the strike rate estimate. As a new weekly strike rate estimate becomes available, the earliest period observation is dropped, and replaced with the most recent..

106 The potential to increase utilization of the SQU6T fish stock through SLED use has inspired consideration of a “discount” factor applicable to vessels employing this technology.¹² If SLEDs were known to reduce sea lion mortalities by a given level, the strike rate applied to non MALFiRM vessels employing a SLED might be reduced by that appropriate level in compiling the MALFiRM count. Thus, if SLEDs were proven to be 50% effective, the strike rate derived from vessels with closed cover nets might be reduced by one half when applied to SLED vessels where escape hatches were open.

107 Key to this logic, however, is accurate estimation of the sea lion survival from SLED-equipped trawl nets. MFish has established a set of criteria dating back to amendments in the 1999-2000 SQU6T Operational Plan that set out the basis for measuring sea lion survivability, and how this information would be applied in consideration of a discount factor to the strike rate. The criteria established at that time, and renewed under recommendation from the 16 June 2003 AEWG technical working group meeting on SLEDs, are that an animal must be noted to have been successfully ejected using video monitoring and also exhibit autopsy pathologies which do not compromise its long-term survival.¹³

108 Over time, the survival criteria have been reassessed periodically as researchers have obtained more information concerning the efficacy of SLEDs through filmed observation of sea lions encountering SLEDs, as well as autopsy reports from sea lions retrieved from both SLED and non-SLED squid trawl nets operating in SQU6T.

109 As at July 2003, the scientific criteria described above to establish SLED survivability have not been satisfied, such that statistically reliable conclusions on SLED efficacy cannot be made. MFish commissioned research to review the statistical basis for assessing SLED efficacy. As data from autopsies determining survival probability and corresponding video footage were unavailable for any single animal, the decision was made to explore the dataset using only the currently available, Department of Conservation contracted autopsy reports. This research identified several factors that may affect SLED efficacy, the most important of which was that the size and weight of the animals appeared to greatly influence its probability of survival. Small and light animals survived better than larger, heavier ones. Further, the utilization of cameras on trawl nets to facilitate filming of behaviour of captured animals may have influenced probability of survival. Rigorous testing of these and other factors needs to be undertaken in any future assessment of SLED efficacy. Where uncontrolled variables are affecting the outcome of experiments, erroneous conclusions may result.

110 The same 16 June 2003 AEWG meeting reviewed the criteria for implementing a scientifically defensible discount strike rate in the fishery. The working group agreed¹⁴ that to attain statistical surety of the efficacy of SLEDs to successfully eject sea lions in viable condition, probability of ejection and survival (P_{ES}) needed to attain 25% with 90% statistical confidence.¹⁵ In effect, this means that the lower bound of the 90% confidence interval of P_{ES} needed to be over 25% for any discount rate to be recommended by the working group for inclusion in the

¹² The use of a discount factor to the strike rate has been considered in previous SQU6T Operation Plans as well, in parallel with adoption of SLED technology. Specific criteria for establishing the discount factor were developed as an amendment to the 1999-2000 Plan based on prescribed methodology to estimate sea lion survival.

¹³ See paragraphs 58-61 of the 2001-02 SQU6T sea lion Operational Plan.

¹⁴ Representative of the fishing industry have expressed alternative perspectives about the point of agreement reached at the 16 June 2003 AEWG meeting, and have contested the notes of the meeting as unrepresentative of the discussions.

¹⁵ These criteria are set forth in paragraphs 20-24 of the 3 March 2000 amendment to the 1999-2000 sea lion Operational Plan approved by the Minister of Fisheries and the Minister of Conservation.

management procedure for 2003-04. The findings showed that P_{ES} was not sufficiently well estimated for a discount to be recommended for 2003-04.

111 Research commissioned from Mr Darryl MacKenzie (Proteus Research and Consulting Ltd) was also extended to examine the sample sizes needed to attain 25% P_{ES} . This work builds on that conducted by Fletcher and Mackenzie in 1999. Assuming that probability of ejection (P_E) is near to 1, which appears to be true except where gear failure occurs, probability of survival P_S is the only factor that influences the sample size necessary to allow a discount rate to be accorded, following the criteria described above. Where P_S is small (e.g. 0.3), sample sizes needed are high ($n > 200$) for a discount to be recommended, but where $P_S = 0.5$, required sample sizes fall to $n < 15$. These results assume that no factors, such as the differential survival of small and large animals, confound the results.

112 At the 16 June 2003 AEWG meeting, MFish set out guidelines for research necessary to meet scientific standards set by the industry in respect of testing of SLED efficacy. This was intended to assist the SFMC in formulating a research proposal that would adequately address issues of heterogeneity in the dataset relating to differential survival of small and large animals and the possible influence of lights on the SLED test outcomes.

113 MFish acknowledges that in the absence of a sound scientific basis to determine the survival rate of sea lions ejected by SLEDs, it is still required to use the best available information under s10 of the Fisheries Act 1996 in formulating management actions. Such information may be drawn from injury diagnosis provided in the sea lion autopsy reports, conditioned with factors thought to further influence survival beyond the condition of the sea lion at the time drowning occurred.

Table 6 Trauma condition of sea lions retrieved from SLED vessels as summarised from autopsy reports.

level of trauma	2000-01 ^a		2001-02 ^b		2002-03 ^c	
	number	%	number	%	number	%
severe	13	37.1%	6	60.0%	3	60.0%
moderate	7	20.0%	2	20.0%	1	20.0%
mild	6	17.1%	2	20.0%	1	20.0%
none	9	25.7%	0	0.0%	0	0.0%
all	35		10		5	

^a Gibbs et al. a, *in press*. Autopsy of pinnipeds incidentally caught in fishing operations. 1997/98, 1999/2000, 2000/01. Department of Conservation

^b Gibbs et al. b, *in press*. Autopsy of pinnipeds incidentally caught in commercial fisheries, 2001/2002. Department of Conservation

^c Duignan PJ. Unpublished. DoC Science Investigation 3026 Summary Preliminary Findings 31-07-03. These results are preliminary only. Several animals were recovered from vessels and/or tows where there was no SLED. The autopsies included here are only SLED recoveries.

114 Information from animals autopsied in the 2000-01, 2001-02, and 2002-03 seasons is shown in Table 6 indicating the physical condition of sea lions retrieved from SLEDs equipped nets. Dr. Pdraig Duignan, the veterinary pathologist overseeing these autopsies has also provided his survival prognosis for those autopsies conducted in 2001-02 and 2002-03. This prognosis indicates that those sea lions with mild or no trauma were likely to have survived, while those with moderate or severe trauma were likely to not survive based on the results of the autopsy. Thus, for the 2001-

02 season, 20% (2 sea lions) were judged likely to have survived based on their autopsy condition, and for the 5 sea lions autopsied to this point in 2002-03, 20% (1 sea lion) was judged likely to have survived. MFish is not aware of any direct survival prognoses for the 2000-01 season autopsies beyond the trauma levels noted in Table 6. MFish notes that aggregating survival prognosis information across years is problematic for purposes of estimating average survival rates, given the changes in SLED design that have occurred both within and across fishing years during this time. In the absence of controlled scientific tests of specific SLED configurations, generalisations about SLED survival without reference to such design characteristics are suspect.

115 MFish does not consider that the survival prognosis from the autopsy reports alone is sufficient to judge the efficacy of SLEDs, but it does indicate that not all sea lions entering SLED-equipped nets are mortally injured in the process. Industry have obtained professional assessments from independent pathologists suggesting that; Dr. Duignan's survival judgements are conservative, sea lions are known to be hardy animals, the injuries sustained may arise from struggling within the cover net, and that survival rates are likely higher than those estimated.¹⁶ These judgments also raised questions concerning the extent, timing, and protocol of the autopsies conducted in terms of their ability to consistently assess likelihood of survival.

116 Alternatively, Department of Conservation marine mammal specialist Dr. Ian Wilkinson has noted that judgments on survival based solely on autopsy information overlook critical variables such as the consciousness of the animal at the time of capture in the cover net, the animal's vulnerability after escaping the net, and undetected injury that may threaten long term survivability. Thus, information from the autopsy alone is insufficient to judge SLED efficacy. That sea lions have been retrieved in the SQU6T fishery in an advanced state of decomposition suggests that some animals may be ejected from SLED vessels only to die later on.

117 A panel of independent experts was established by MFish in late July 2003, to review existing autopsy information and to comment on criteria and protocols necessary for establishing a prognosis of survivability for use in future analysis of SLED efficacy. Five North American veterinary pathologists with marine mammal experience have agreed to undertake this work. Conclusions from this review are expected to be completed by 21 August 2003, and findings will be provided as an addendum to this paper shortly thereafter. In the event the panel review is delayed further, or proves inconclusive, MFish will proceed with the best available information available concerning SLED survival as presented here.

118 MFish advises a cautionary approach in establishing a SLED discount factor in light of the uncertainty concerning SLED effectiveness in ensuring sea lion survival. MFish further acknowledges that the survival criteria established in the 2000 amendment to the Operational Plan remains as the preferred protocol for estimating both sea lion survival, and the consideration of an appropriate discount factor. The technical working group meeting of the Aquatic Environment Working Group confirmed this on 16 June 2003.

119 In the absence of sufficient SLED evidence to draw conclusions under the preferred criteria, MFish recommends that a discount factor of 20% be applied to the actual or predetermined strike rate used to monitor the MALFiRM based on the limited evidence considered above. This discount factor acknowledges the likelihood of modest survival, but MFish withholds any scientific endorsement of SLED efficacy pending better information. MFish notes that the Autopsy Panel

¹⁶ Reports prepared by KJ Thomson, TD Koelmeyer and TR Spraker on behalf of the Squid Fishery Management Company. Copies available from the Ministry of Fisheries.

Review information described above could alter this advice in the event it is available and can be consulted on prior to the 28 August 2003 comment deadline established for this advice.

120 A discount factor will be applied to those vessels meeting the following conditions:

- a) That vessel used a SLED device approved by the Squid Fishery Management Company, and that the escape hatch on the SLED remained open during fishing operations.
- b) That device's specifications have been provided by the Squid Fishery Management Company to the Ministry of Fisheries for use in observer briefings.
- c) A Ministry of Fisheries observer was present on that vessel to document net deployment and report on sea lion interactions associated with fishing activity.

121 The 20% discount to the strike rate would only apply to those tows where the above criteria are satisfied. All remaining tows would be assessed at the strike rate applicable under either option 1 (actual strike rate), or option 2 (5.7% predetermined strike rate).

122 MFish notes that ensuring observer coverage of all SLED vessels seeking the 20% discount factor is likely to require a significant increase in observers available for the SQU6T fishery. MFish seeks the early cooperation of the SFMC in providing estimates and advanced notice of the likely number of SLED vessels operating in SQU6T in order that appropriate observer coverage can be arranged. MFish cannot guarantee that all requested observer coverage for SLED vessels could be satisfied in the event there is an unanticipated increase in demand for this service.

123 If total observer sea-days in the squid fishery exceed those days already levied to the Industry, the additional sea-days will be charged to the Squid Fishery Management Company.

ADDITIONAL CONSIDERATIONS RELATING TO THE MALFiRM

Acknowledgement of other sea lion mortalities

124 The MALFiRM applies to the overall New Zealand sea lion population. Bycatch reports from MFish observers provide evidence that sea lions are also caught incidentally to other fisheries operating in this area, including scampi, southern blue whiting, hoki, mackerel, and orange roughy. MFish observer reports reveal that an annual average of 1.75 sea lions have been taken as bycatch from these non-squid fisheries each year since the 1991–92 season. This is a representative minimum in view of likely bycatch from unobserved vessels operating in these same fisheries. MFish therefore acknowledges that an adjustment in the MALFiRM might be appropriate, attributable to bycatch in other fisheries.

125 The MALFiRM estimates developed using the Breen-Kim model described earlier are based on sea lion pup counts for the Auckland Islands only. As such these are considered to be conservative MALFiRM estimates in light of the 358 additional sea lion pups counted on Campbell Island. Including the Campbell Island pups in the Breen-Kim model is expected to increase the MALFiRM by approximately 9%; significantly more than the 2-animal allowance for bycatch in non-SQU6T fisheries noted above. Thus, on balance, MFish recommends that no explicit downward adjustment in the MALFiRM options described earlier be made to account for sea lion

bycatch in other fisheries so long as Campbell Island pup numbers are not included in the MALFiRM estimate.

126 The April 2003 High Court ruling held that sea lions captured by cover nets placed over escape hatches were not to be counted against the SQU6T MALFiRM since such captures were deliberate rather than accidental. As a result, any sea lion mortalities resulting from the use of cover nets under the option 1 MALFiRM monitoring regime will not be counted towards bycatch limits as established by the decision rules. MFish notes that bycatch by MALFiRM vessels under option 1 could be significant; actual mortalities reported in recent years have ranged from 5 animals in the 1998-99 season, to 33 animals in 2000-01.

REPORTING REQUIREMENTS

127 MFish proposes to adopt the same reporting requirements as used in past operational plans. These requirements include the following:

- a) Masters of all vessels would submit a report on any encounter with a marine mammal, which resulted in death or injury, at the end of the voyage (as required under the Marine Mammal Protection Act 1978)
- b) MFish observers would immediately inform (by telex or fax) the Fisheries Communication Centre immediately following any New Zealand sea lion capture on their observed vessel.
- c) The Squid Fishery Management Company Limited, through the New Zealand Seafood Industry Council, would co-ordinate a vessel daily voluntary reporting regime. This information is required to generate in-season extrapolations of New Zealand sea lion catches against the MALFiRM.
- d) Given the proposed arrangements, all observed vessels would be required to report the following information:
 - i) each tow undertaken
 - ii) whether the tow was observed by a MFish observer
 - iii) whether a SLED was used on the tow
 - iv) whether the escape hatch on the SLED was open or closed, and
 - v) whether a sea lion was caught during a tow.

128 MFish notes that past audited comparisons between MFish tow-by-tow data and industry real time tow-by-tow data undertaken by the National Institute of Water and Atmospheric Research Limited have demonstrated no significant discrepancies. MFish believes the use of industry tow data remains appropriate at this time.

POSSIBLE CLOSURE PROCESS

129 The proposed procedures to close the SQU6T fishery if the MALFiRM is reached is similar to that followed in 2002-03 for the strictly monitored MALFiRM under option 1. MFish would closely monitor the fishery to provide an ongoing actual in-season strike rate for the fleet. Extrapolations using this strike rate would be undertaken on a weekly basis to estimate total sea

lion catch in the fishery. Once 70% of the MALFiRM has been reached, extrapolations would be undertaken on a daily basis to minimise the risk of exceeding the MALFiRM.

130 In the case of a predetermined strike rate regime (option 2), the monitoring effort would focus on fishery effort as conveyed in total vessel tows. Extrapolations using weekly tows would be used to estimate total sea lion bycatch in the fishery. Once 70% of the MALFiRM has been reached, extrapolations would also be undertaken on a daily basis.

131 Once information indicates that the point estimate for the total catch of sea lions by the entire fleet has reached the MALFiRM, either by monitored MALFiRM count, by vessel tows under the predetermined strike rate regime, or by a combination of the two, the Minister of Fisheries would be advised to immediately close the SQU6T fishery under s 15(5) of the Fisheries Act 1996. Given timing constraints in which to effectively monitor estimated total sea lion catch against the MALFiRM and the requirement to immediately close the fishery, no consultation will be undertaken with stakeholders during the closure procedures. Nevertheless, MFish will closely co-ordinate the fishery closure process with the Squid Fishery Management Company Limited to ensure that vessel operators are kept informed as to the status of the fishery in respect to the MALFiRM. Stakeholders will also be regularly informed by email on the estimated number of sea lions caught by the fleet.

NGAI TAHU CLAIMS SETTLEMENT ACT 1998

132 Section 288 of the Ngai Tahu Claims Settlement Act 1998 requires the Crown to acknowledge the cultural, spiritual, historic, and traditional association of Ngai Tahu with their taonga species. Section 287 prescribes the New Zealand sea lion (or Rapoka/Whakahao) as a taonga species under this Act.

133 Section 293 requires the Minister of Conservation to undertake the following actions in respect of making decisions on the management of the New Zealand sea lion:

- a) advise Te Runanga o Ngai Tahu in advance of any relevant conservation management strategy reviews or the preparation of any statutory or non-statutory plans, policies, or documents (including any amendments or reviews) relating to a taonga species
- b) consult with, and have particular regard to the views of, Te Runanga o Ngai Tahu when the Minister makes policy decisions concerning the protection, management, or conservation of a taonga species

IMPACT OF A MALFiRM ON THE FISHING INDUSTRY

134 Although catches and market returns vary from year to year, the New Zealand squid fishery is considered to be the second largest and seventh most valuable in terms of seafood exports. Annual SQU6T landings have averaged about 13,000 tonnes (40% of the current TACC) over the past 15 years, reaching the TACC in just two seasons (1993-94 and 94-95). Estimated sea lion mortalities in those two years were 32 and 109, respectively, indicating little correlation between squid catch and sea lion bycatch.

135 The SQU6T TACC has been under caught each year since the 1995-96 season, averaging 27% of the TACC. However, the portion of this foregone catch attributable to the MALFiRM limit is uncertain. Given the annual variation in squid availability in the 6T fishery, the TACC has not been reached in three of the past eight seasons even though the fishery remained open. Thus, estimates of the loss incurred by industry due to MALFiRM-triggered closure are conjectural, and it is misleading to presume that the economic cost of the MALFiRM is the dollar value of uncaught TACC. Depending on the availability of squid in 6T and sea lion bycatch, the adverse economic impact of MALFiRM limits may range from nil (based on those years when the MALFiRM was not reached), to as high as \$25 million (if early closure lead to significant foregone catch.)¹⁷

136 The majority of boats operating in the SQU6T fisher are charter vessels, many of which rely upon squid as one of several fisheries available during the year. Combined, this portfolio of fishing opportunities allows New Zealand fishing companies to efficiently augment harvest capacity with charter vessels where it may not be economically practical to invest in additional vessels. The predictability of fishing opportunities given MALFiRM constraints in the SQU6T fishery thus become an important consideration in a more complex array of charter vessel arrangements in other fisheries over the course of a year.

137 Catches made in SQU6T form a significant portion of the overall squid catch (SQU6T TACC comprises 25% of total SQU TACC). MFish acknowledges the significance of the squid fisheries to the fishing economy and the potential impacts on the industry if the SQU6T fishery is closed. However, these impacts must be balanced against the legislative requirements in both the Fisheries Act 1996 and the Marine Mammals Protection Act 1978.

138 MFish recognizes that the MALFiRM levels represented in the three decision rule options pose significantly different impacts on the potential returns to fishers in terms of the likely catch enabled with the greater number of tows, other things equal. In this regard, decision rule 320 (and to a slightly lesser extent, rule 4) provides fishers with the opportunity to achieve a much greater catch than rule 310. To the extent all three rules satisfy the underlying sea lion population management objective, those allowing greater catch from SQU6T represent increased utilisation, and are therefore more desirable in terms of economic benefits to fishers and related interests.

¹⁷ Gross economic impacts are based on an assumed average port price over time of \$1/kg.

PRELIMINARY RECOMMENDATIONS

139 MFish proposes that the Minister of Fisheries:

- a) **Note** that management interventions for sea lion interactions in SQU6T fishery have been designed to ensure that the sea lion population remained above 90% of its carrying capacity, K, or else remained above 90% of the level it would obtain in the absence of fishery bycatch, 90% of the time in 20- and 100-year runs.
- b) **Agree**, under s 15(2) of the Fisheries Act 1996, to establish a MALFiRM for New Zealand sea lions for the 2003-04 fishing year from the following options:
 - i) Decision rule 310 – 62 sea lions
 - ii) Decision rule 320 – 124 sea lions (preferred alternative)
 - iii) Decision rule 4 – 103 sea lions
- c) **Agree** to implement a monitoring and reporting regime to estimate the total number of New Zealand sea lion catches against the MALFiRM using dedicated ‘MALFiRM’ vessels to establish an actual strike rate contingent on the following two criteria:
 - i) that a minimum of 20% and maximum of 30% fleet observer coverage is maintained over the prescribed weekly or daily reporting period by all MFish observed vessels in SQU6T, and
 - ii) all MFish observed vessels fish in a way that is representative of the SQU6T fleet.
- d) **Agree** that if the above actual strike rate monitoring criteria are not satisfied during a reporting period, a predetermined strike rate is applied to all vessels to estimate the total number of sea lion catches against the MALFiRM.
- e) **Agree** that a predetermined strike rate of 5.7% should apply.
- f) **Agree** that the predetermined strike rate will be subject to in season adjustment by the procedure described.
- g) **Note** that continued research is necessary to establish the efficacy of SLEDs as they effect sea lion survival.
- h) **Agree** that, despite g) but based on best available information, a 20% discount be applied to either the actual (option 1) or predetermined (option 2) strike rate for vessels employing a SLED design approved by the Squid Fishery Management Company, and carrying an observer to document net configuration and use.
- i) **Agree** to close the fishery under s 15(5) of the Fisheries Act 1996 in the event that the MALFiRM is reached.