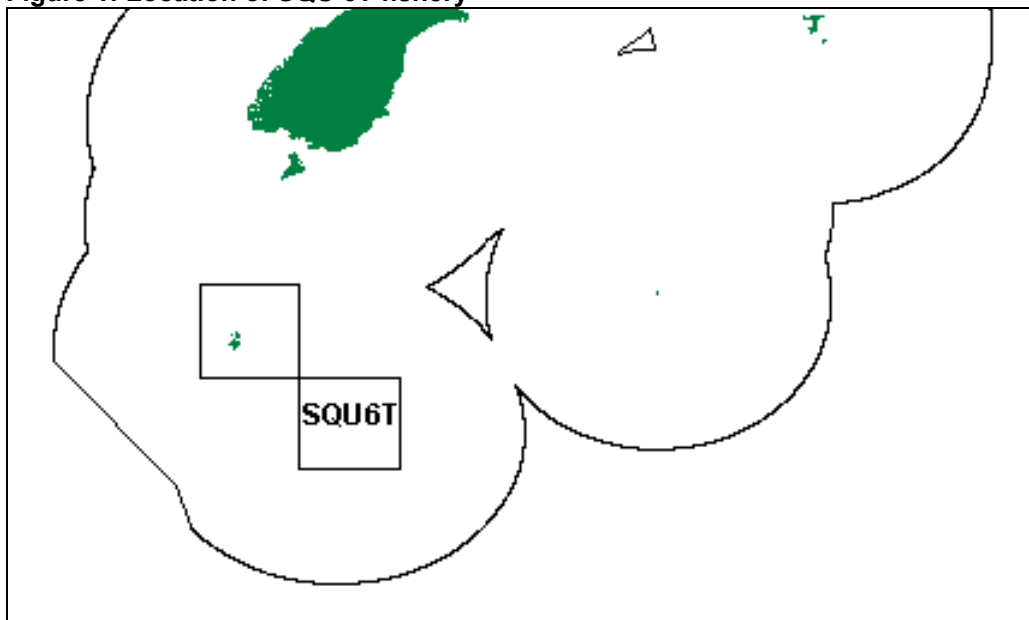


# 2008-09 SQU6T OPERATIONAL PLAN: INITIAL POSITION PAPER

## Purpose

- 1 This paper sets out the Ministry of Fisheries (MFish) initial position on proposed management measures for the squid fishery operating around the Auckland Islands (SQU6T) for the 2008-09 fishing season.
- 2 MFish reminds stakeholders that the initial position paper (IPP) is not presented to the Minister of Fisheries (the Minister). Its purpose is to provide information to stakeholders, including the initial views of MFish where appropriate, so that stakeholders can provide relevant feedback. The contents of the IPP, the views of stakeholders and any additional information and analyses are then formulated as final advice to the Minister.

**Figure 1: Location of SQU 6T fishery**



## Executive summary

- 3 The foraging range of New Zealand sea lions (sea lions) that inhabit the Auckland Islands overlaps the fishing grounds of the SQU6T fishery and leads to the incidental capture of sea lions by squid trawl vessels.
- 4 Under s 15 (2) of the Fisheries Act 1996 (the Act) the Minister of Fisheries may take such measures as he considers necessary to avoid, remedy, or mitigate the effect of fishing-related mortality on any protected species, and such measures may include setting a limit on fishing-related mortality (FRML). The proposed management regime for the 2008-09 SQU6T fishery is similar to that used in previous years and focuses on the use of a FRML to constrain sea lion mortalities to an acceptable level.
- 5 For the 2008-09 decision, the Breen-Kim model, which is used to generate possible FRMLs has been updated. More information on this update can be found later in this paper.
- 6 Each of the proposed FRMLs for the 2008-09 season is derived from a series of harvest control rules that were assessed by the Breen-Kim model to have met the agreed

management criteria. For the 2008-09 fishing year, the FRML options range from 0 to 283. In choosing where to set the FRML for the coming fishing season the Minister must balance the sustainability and utilisation requirements in the fishery. MFish's initial view is that the FRML is most appropriately set by applying a harvest control rule that results in a FRML within the range of 85 -170.

- 7 A predetermined strike rate is used to assess fishing performance against the FRML. Last year the Minister increased the strike rate from 5.3% to 5.65%. This new strike rate is based on the modelled assessment of the mean strike rate for three fishing seasons from 2004 to 2006.<sup>1</sup> Applying this strike rate means that for every 100 tows undertaken in the squid fishery 5.65 sea lions are presumed killed and counted against the FRML. MFish does not consider there is any new information that would warrant changing the strike rate for the coming SQU6T season.
- 8 Vessels that deploy an approved sea lion exclusion device (SLED) (see Appendix 1) have received a discount on the strike rate in the past to reflect the increased likelihood that sea lions can escape from nets fitted with these devices. The Minister increased the discount rate at the start of the 2007-08 season, from 20% to 35%, following consideration of information on SLED efficacy and sea lion interactions with squid fishing gear. MFish considers that following an assessment of the new information currently available on the use of SLEDs and sea lion survivability from the 2007-08 season, a change to the discount rate is not warranted for the 2008-09 fishing year. Therefore MFish is proposing that the SLED discount rate remains unchanged at 35% for the 2008-09 fishing year.
- 9 Each year the Minister is required to consider all relevant information and make a decision on the sea lion operational plan. All relevant information necessary to make this decision is discussed in this IPP and stakeholders are invited to provide their views. This IPP highlights the information received since the 2007-08 operational plan advice including:
  - a) Results of the revision to the Breen-Kim model.
  - b) Camera footage of sea lion and SLED interaction from the 2007-08 squid season.
  - c) Performance of operators in deploying and using SLEDs during the 2007-08 squid season.
  - d) 2007-08 pup count numbers.
- 10 The necropsy information on the sea lions returned during the most recent SQU6T season is not yet available but it is likely that the results will be available before final advice is provided to the Minister. Stakeholders will have an opportunity to review the research results before they are included in the final advice, through the aquatic environment working group (AEWG) process.
- 11 MFish intends to implement, in conjunction with the Deepwater Group Ltd (DWG), a similar monitoring and reporting regime for the 2008-09 fishing year to the one that was in place during the 2007-08 season. The 2007-08 SQU6T season was the first season that there was full vessel and operator compliance with the SQU6T Operational Plan.

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<sup>1</sup> M.H. Smith. "Recent strike rates for New Zealand sea lions in the SQU6T fishery". NIWA July 2007

## Summary of management measures

- 12 MFish is proposing the following measures for the SQU6T fishery for the 2008-09 fishing season.
- a) Implement an operational plan for the 2008-09 fishing season.
  - b) Set a FRML for the coming season based on one of the following harvest control rules set out in Table 1 below. MFish preference is that an FRML is selected from one of the rules in bold. However, the Minister may set the FRML for the 2008-09 fishing year at any level he considers appropriate.

**Table 1: FRMLs for the 2008-09 SQU6T fishing season for each of the harvest control rules that met the management criteria (the shaded section refers to those rules that MFish is considering recommending to the Minister).**

Rule	Estimated FRMLs (numbers rounded)
Rule 0	0
Rule 305	28
Rule 310	57
<b>Rule 315</b>	<b>85</b>
<b>Rule 320</b>	<b>113</b>
<b>Rule 325</b>	<b>142</b>
<b>Rule 330</b>	<b>170</b>
Rule 340	227
Rule 350	283

- c) Use a predetermined strike rate of 5.65%.
- d) Use a discount rate of 35% for vessels deploying an approved SLED and where the requirements of the operational plan are fully met.
- e) Advise the Minister when he should close the SQU6T fishery under s 15 (5) of the Fisheries Act 1996 in the event the FRML is reached.

## Background information

- 13 The foraging range of sea lions that inhabit the Auckland Islands overlaps the fishing grounds of the SQU6T fishery and leads to the incidental capture of sea lions by trawl vessels.
- 14 The New Zealand sea lion is the world's rarest sea lion and is currently listed as a threatened species under s 2(3) of the Marine Mammals Protection Act 1978. The threatened species classification is made on the basis of the small number of breeding colonies, rather than the estimated population size of approximately 12,000 adult animals. Under this classification, the New Zealand sea lion is considered not immediately threatened with extinction, but could be vulnerable to population decline.
- 15 Section 15 of the Act sets the Minister of Fisheries' (the Minister) responsibilities for managing the fishing-related mortality of marine mammals. In the absence of a Population Management Plan (PMP) which is the case for sea lions, the Minister is required to consult with the Minister of Conservation before taking such measures as he considers necessary to avoid, remedy, or mitigate the effect of fishing-related mortality on sea lions. Available

measures include setting a limit on sea lion mortality.

- 16 In making this decision the Minister is required to balance utilisation opportunities in the squid fishery and the sustainability risk to the sea lion population. In particular he is required to consider:
- a) The purpose of the Act and the need to provide for utilisation while ensuring sustainability.
  - b) That s. 10 requires that any decision the Minister makes should be based on best available information recognising that not all information is of the same standard.
  - c) That some of the best available information is uncertain. When dealing with uncertain information the Minister is required to adopt a cautious approach, both in terms of the impacts on utilisation and the risks to sustainability, that is appropriate to the circumstances.
  - d) Section 15 (2) of the Act permits the Minister to take measures he considers are necessary to avoid, remedy or mitigate the effects of fishing-related mortality on any protected species.
  - e) The environmental principles set out in s. 9 of the Act
    - i) Associated or dependent species should be maintained above a level that ensures their long-term viability
    - ii) Biological diversity of the aquatic environment should be maintained
    - iii) Habitats of particular significance for fisheries management should be protected.
  - f) That the sea lion is a protected species under the Marine Mammals Protection Act 1978.
  - g) The selection of the FRML, the predetermined strike rate and the SLED discount factor are individual and separate management decisions.
- 17 In giving effect to his statutory obligations the Minister should also be particularly mindful of:
- a) The impact the abundance of squid in any particular fishing season has on the likelihood of the FRML being reached
  - b) The uncertainties that surround setting the predetermined strike rate
  - c) The uncertainties that surround the levels of sea lion survival after they come into contact with a SLED.

### **Population management plan**

18 As noted above, the Minister of Fisheries is permitted to set a FRML in the absence of a PMP for sea lions. DOC released an initial version of the PMP for consultation in 2007. The PMP has yet to be finalised and therefore will not be available to inform the Minister's decision for the 2008-09 SQU6T fishing year. The Minister of Fisheries will continue to set the FMRL for the coming season. The PMP may be in place to inform the management of the 2009-10 SQU6T fishing season.

## **Rationale for management options**

### ***Fishing-related mortality limit***

19 The FRML sets a limit on the number of sea lions that can be caught annually as bycatch in the SQU6T fishery.

20 Since the 2003-04 fishing season the Breen-Kim model has been used to derive an appropriate FRML. The model, in itself, does not determine FRMLs; these are calculated annually from the various harvest control rules that met the agreed management criteria. The Breen-Kim model allows the impact of different levels of sea lion mortality, or 'harvest control rules', to be examined, both in terms of their biological effects on the sea lion population and the potential fishing opportunities foregone as a result of constraining fishers from catching the squid Total Allowable Commercial Catch (TACC).

### ***Breen-Kim model update***

21 The Breen-Kim model has recently been updated and this revised model has been used to assess the harvest control rules, and in turn the FRMLs for the 2008-09 SQU6T season. The model was updated for the following reasons:

- a) The model is a representation of the actual squid fishery and sea lion population interaction and what is sustainable in theory may in reality be unsustainable if the model is not an accurate representation of real life. The earlier model did not use information which has since become available and there were concerns that it might no longer provide an accurate representation of what is happening in the fishery.
- b) The original version of the model was built around an assumed level of variability in the abundance of sea lion pup numbers. In recent years the pup production numbers have been lower than the assumed range considered by the model. Given that the predicted pup numbers used by the model were higher than recent pup observations, there were concerns that the model outputs might result in overly optimistic harvest control rules meeting the management criteria.
- c) Dr. Paul Breen had identified a range of issues with the 2003 model which are described in more detail in Appendix 2, which meant that the results from the 2003 model were likely to be more optimistic in some areas and perhaps more pessimistic in others. To the extent possible these issues have been addressed as part of the model revision.

22 The key changes that have been made to the model include:

- a) The assessment of harvest control rules against a set of management criteria proposed by DOC, in addition to the original MFish management criteria.<sup>2</sup> These criteria are described in the following section.
- b) The model now takes into consideration the management measures (strike rate and SLED discount) which are used to monitor performance against the FRML.
- c) A more comprehensive range of information is used in the model including:

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<sup>2</sup> DOC criteria have been included for the first time so that the model results can be used to inform PMP decisions.

- i) Population datasets not used in 2003 were added.
- ii) Datasets used in the 2003 version of the model were extended and included data from population studies in 2007 and the fishery in 2008.
- iii) The logic of predicting tagged animal resightings was reworked in light of new information.

23 In previous fishing years the Minister has been advised that he should be mindful of the model limitations when making any decision on where to set the FRML. Many of these existing concerns have now been addressed in the model update which means that some of the uncertainty around the original model and its outputs has been removed.

24 However, as part of the model update it is apparent that there are still areas of uncertainty around three key areas:

- a) Pupping rate
- b) How strongly the sea lion population is density dependent and how density dependence may or may not affect the sea lion population<sup>3</sup>
- c) Extent of sea lion survivability following interaction with squid trawl gear that has SLEDs fitted.

25 The model results also identified issues around sea lion ‘catchability’ defined by Dr. Paul Breen, as the rate at which sea lions are caught and killed if nets were deployed without SLEDs (although ‘catchability’ is relevant to all tows). It is difficult to accurately assess a reliable ‘catchability’ rate given that in recent years most, if not all, tows have occurred with SLEDs fitted to the gear. However, the model estimates that the ‘catchability’ rate has increased in recent years and there are concerns that if this rate continues then although certain harvest control rules meet the criteria in theory, this may not be the case in practice.

26 These factors have been considered by the revised model as part of the sensitivity trials that were assessed against the management criteria. These trials are discussed in more detail later in the paper. However, the continued uncertainty around these areas is a factor that the Minister must be aware of when making his decision on where the FRML should be set for the 2008-09 fishing year.

### ***Management criteria***

27 The updated Breen-Kim model assesses the range of harvest control rules against the following MFish criteria:

- a) A harvest control rule must provide for an increase in the sea lion population to more than 90% of carrying capacity, or to within 10% of the proportion of carrying capacity that would have been attained in the absence of fishing, and that these levels must be attained with 90% certainty, over 20-year and 100-year projections.
- b) A harvest control rule must attain a mean number of mature mammals that exceeded 90% of carrying capacity in the second 50 years of 100-year projection runs (to

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<sup>3</sup> Regulation of the size of a population by mechanisms that are themselves controlled by the size of that population (e.g. the availability of resources) and whose effectiveness increases as population size increases

allow for build up of numbers in hypothetical depleted populations over time).

28 The Minister is required to consider the harvest control rules that meet the MFish criteria. The range of harvest control rules are essentially points on a continuum between utilisation (Rule 1) and conservation (Rule 0). Higher numbered harvest control rules provide for more utilisation while lowered numbered rules favour conservation. A brief summary of the rules that meet the management criteria is set out below:

- a) Rule 0: permits no fishing and is the most conservative of all the harvest control rules available to the Minister.
- b) Rule 1: permits ‘unconstrained fishing’ based on an average number of tows per season of 2,856 tows. This is the most utilisation focused of all the harvest control rules.
- c) Rule 3 variants (which consider the pup count information from the last two fishing seasons)
  - i) Rule 310, is an analogue of the New Zealand Potential Biological Removal Rule (colloquially known as the Wade Rule);
  - ii) Rule 305, being half the exploitation rate of 310; and
  - iii) Rules 315, 320, 325, 330, 340 and 350 being 1.5, 2, 2.5, 3, 4 and 5 times the respective exploitation rate of Rule 310.

29 There are also two changes, in terms of the harvest control rules that have been assessed against the management criteria, from the previous version of the model:

- a) In previous years the management criteria were assessed so as to identify the harvest control rule that would just meet the management criteria. This was known as the Cusp Rule. The Cusp Rule has not been included specifically in the revised model but it is included indirectly as the performance of the management criteria against the sensitivity trials described later in the paper (Table 4) are essentially Cusp Rules, as they indicate the harvest control rule that would just meet the management criteria.
- b) Under the old model the management criteria were also assessed against an adaptive rule known as Rule 4. The performance of this harvest control rule changed in response to an increase or decrease in sea lion pup numbers. Rule 4 was considered to be more responsive to changes to pup production numbers than any of the Rule 3 series. Rule 4 was not included in the model update because AEWG considered that the Rule 3 series provided sufficient consideration of the utilisation and sustainability issues.

30 Tables 2 & 3 below, set out the performance of the range of harvest control rules against the management criteria and a series of fishery indicators, over a 100 year period. The model assessed the performance of the harvest control rules against the MFish criteria using two assumptions; the first assumed that the SLED discount rate was 35% while the second assumed that the discount rate was 20%. These two base cases are discussed in more detail later in the paper.

31 All of the harvest control rules, including unconstrained fishing, met the two management

criteria when assessed against Base Case 1 while under Base Case 2 the management criteria were met between Rule 325 and Rule 330. These tables also show that some indicators, such as maximum sea lion catch and mean sea lion catch, increase as the rule multiplier increases, while the indicators around fishery closure and lost fishing effort decrease as the rule multiplier gets higher. Rules within the increments provided are still available for the Minister to consider and the performance of these rules can be interpreted from the table above. For example Rule 327 will exhibit characteristics between Rule 325 and Rule 330.

**Table 2: Results of Harvest Control Rules against the MFish management criteria using Base Case 1 (SLED discount rate of 35%)**

Indicators	Rule 0	305	310	315	320	325	330	350	Rule 1
MFish Criteria 1	100	100	100	99.81	98.4	95.79	93.42	91.12	91.12
MFish Criteria 2	0.965	0.95	0.936	0.925	0.917	0.911	0.908	0.906	0.906
maxcatch	0	68.8	127.2	180.1	227.4	267.2	294.9	322.1	322.1
meancatch	0	30.7	56.4	74.9	86.9	94.3	98.4	101	101
meanFRML	0	32.2	63.5	94.2	124.6	155	185.4	308.3	0
minFRML	0	24.4	48.3	71.9	95.2	118.3	141.4	235	0
maxFRML	0	41.8	82.1	121.5	160.6	199.8	239.1	397.9	0
%closure	100	90	75	52	34	21	11	0	0
effortlost	2856	2014	1295	769	419	200	78	0	0
pupmin	1810	1803	1790	1774	1762	1754	1747	1741	1741
pupmax	3457	3386	3326	3285	3258	3241	3232	3228	3228
puprange	1651	1589	1544	1516	1502	1495	1494	1496	1496

**Table 3: Results of Harvest Control Rules against the MFish management criteria using Base Case 2 (SLED discount rate of 20%)**

Indicators	Rule 0	305	310	315	320	325	330	350	Rule 1
MFish Criteria 1	100	100	100	99.74	97	91.9	86.91	79.45	79.29
MFish Criteria 2	0.965	0.95	0.935	0.922	0.912	0.904	0.898	0.89	0.89
maxcatch	0	70.3	128.8	183.1	234.1	279.7	318.6	391.7	393
meancatch	0	31.1	58.2	79.9	95.5	106.5	114	123.3	123.4
meanFRML	0	32.3	63.6	94.1	124.2	154	183.7	303.7	0
minFRML	0	24.4	48.4	71.9	95	117.7	140.4	231.8	0
maxFRML	0	41.8	82.1	121.2	159.7	198.2	236.6	392	0
%closure	100	92	83	66	48	34	23	1	0
effortlost	2856	2162	1548	1049	681	415	2333	3	0
pupmin	1814	1806	1792	1774	1758	1745	1733	1716	1715
pupmax	3465	3392	3329	3280	3243	3217	3200	3180	3180
puprange	1648	1585	1538	1502	1483	1472	1470	1476	1476

32 To help interpret Tables 2 & 3 the following provides an explanation of the numbers relating to Rule 320 for Base Case 1. The results of the performance of Rule 320 against the alternative Base Case 2 are provided in []:

- a) MFish Criterion 1: The chances that the modeled population was either greater than 90% of carrying capacity or greater than 90% of the level in the absence of fishing, based on a set of 100 year runs, was 98.4% [97%]. A harvest control rule would not meet the management criterion with a value of less than 90%.
- b) MFish Criterion 2: The mean number of mature sea lions in the second 50-year period of a set of 100 year runs was 91.7% [91.2%] of carrying capacity. A harvest control rule would not meet the management criterion with a value of less than 90%.
- c) Effort lost: The median annual number of tows forgone by the fishery when the

FRML was set using Rule 320 was 419 [681].

- d) Early closure: The median percentage of seasons closed early when the FRML was set using Rule 320 was 34% [48%].
- e) Max Catch: The median of the maximum sea lion bycatch over the set of 100-year runs when the FRML was set by Rule 320 was 227 [234] sea lions.
- f) Mean Catch: The median annual bycatch over the set of 100-year runs when the FRML was set by Rule 320 was 87 [95.5] sea lions.
- g) Max/Mean/Min FRML: When Rule 320 was used to produce the FRML in a set of 100-year runs, the median FRML was 124.6 [124.2] sea lions; the median minimum FRML was 95 [95] sea lions and the median maximum FRML was 160.2 [159.7] sea lions.
- h) Pupping: When Rule 320 is used to set the FRML, the median number of pup births in a set of 100 year runs was 1762 [1758]; the median maximum number of pup births in a set of 100 year runs was 3258 [3243] pups.

33 The FRML calculated from each of the individual harvest control rules is expected to vary from year to year because the key model input, the average of the previous two year's pup production numbers, will vary annually. As the pup numbers increase or decrease the FRMLs derived from each harvest control rule will also increase or decrease.

### **Strike rate**

34 Once the FRML has been determined, fishing activity is then monitored against this limit. However, the actual number of sea lions that are incidentally caught in squid fishing gear cannot be directly recorded due to the use of SLEDs, which are designed to prevent sea lions from getting trapped in the trawl cod end by enabling them to escape.

35 Therefore a proxy for mortal interaction between squid vessels and sea lions is used. This is known as the predetermined strike rate (strike rate) and at the start of the 2007-08 SQU6T season it was increased from 5.3% to 5.65%. Applying this strike rate means that for every 100 tows undertaken in the squid fishery 5.65 sea lions are presumed killed and counted against the FRML.

### **Sea lion exclusion devices**

36 SLEDs are installed inside trawl nets to reduce sea lion mortality levels by allowing live animals to escape from the net. Two factors influence how effective SLEDs are at reducing sea lion mortalities.

- a) The escapement rate of individuals from the net through the escape hatch following interaction with the trawl
- b) The survival rate of animals that escape.

37 Industry considers the deployment of SLEDs on squid trawl vessels results in far fewer sea lion mortalities and therefore vessels deploying SLEDs should be able to undertake more tows before reaching the FRML. However, information on SLED efficacy is incomplete; in particular the rate of survivability of sea lions that escape from SLEDs is still unclear.

38 Some sea lions enter a net, leave it again and survive even when the net has no SLED. The ‘discount rate’ refers to the relative survival of sea lions encountering a net with a SLED that would have drowned in a net without a SLED. It is the product of escapement rate and subsequent survival.

39 As part of the decisions the Minister made on the 2007-08 SQU6T Operational Plan the SLED discount rate was increased from 20% to 35%. This increase was made following the Minister’s consideration of a range of information including sea lion necropsy information and recent improvements to SLED design. A discount of 35% reduces the strike rate from 5.65% to 3.67%, meaning that for every 100 tows from a vessel deploying a SLED, 3.67 sea lions are counted against the FRML. A discount rate of 35% implies an assumed survival rate of 48% for sea lions exiting through a SLED.

40 In order for vessels to secure this discount, vessel operators must deploy an approved SLED and fulfil all monitoring and reporting obligations set out in the operational plan. These obligations are discussed in more detail in the later section on monitoring.

## **Assessment of management options**

### ***Model results<sup>4</sup>***

41 The updated Breen-Kim model determines the point at which a harvest control rule just meets MFish management criteria. To make this assessment all harvest control rules were assessed against two base cases:

- a) Base Case 1 which uses the management measures in place for the 2007-08 fishing year (35% SLED discount and 5.65% strike rate). When assessed against Base Case 1 all harvest control rules met both MFish criteria meaning that theoretically, no FRML is required in the fishery.
- b) Base Case 2 which uses a lower SLED discount rate of 20% rather than the current SLED discount rate of 35%. This alternative base case was included at the request of the Chair of AEWG because there were concerns, amongst some stakeholders, that a SLED discount of 35% may be too high. These concerns meant that assessing the performance of the harvest control rules against a base case that includes a 35% SLED discount, might result in more optimistic harvest control rules meeting the management criteria. There are also concerns that assuming a higher survival rate than may occur in reality will affect rule performance.

Under Base Case 2 the harvest control rule that meets MFish Criterion 1 is Rule 327, while Rule 328 just meets the MFish Criterion 2, see Table 4 below. Both these rules exhibit characteristics between Rules 325 and 330 as set out in Table 3 above. Selecting the FRML based on these two rules would result in a sea lion limit of 153 sea lions.

42 MFish does note that the Minister selected a discount rate of 35% for the 2007-08 SQU6T fishery based on his assessment of the best available information on the use of SLEDs and likely sea lion survivability which was provided to him by MFish. In MFish’s view there is no new information which suggests the Minister should re-set the SLED discount rate at 20% for the 2008-

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<sup>4</sup> Paul A. Breen, Dan Fu, David J Gilbert, “Sea lion population model projections and rule evaluations for Project IPA200609, Objective 4. July 2008 (Draft Report)

09 fishing year. For that reason, it is likely to be more appropriate for the Minister to consider the harvest control rules that just meet the management criteria when they are assessed against Base Case 1.

43 The revised model also investigates the harvest control rule that would just meet the management criteria when assessed against a range of sensitivity trials; each trial represents an area of uncertainty around the management of squid trawl and sea lion interaction. The range of sensitivity trials was identified by both Paul Breen and the AEWG. Each sensitivity trial was assessed against Base Case 1 which used a 35% SLED discount. A total of 15 trials were assessed which are summarised as follows:<sup>5</sup>

- a) Trial 2: Assumes there is no survivability of sea lions that enter a trawl net which has a SLED fitted; assumes the SLED discount rate is 0%
- b) Trial 3: Assumes that 50% of the sea lions that enter a trawl survive the encounter; assumes a SLED discount rate of 50%.
- c) Trial 4: Assumes that the fishery would operate for up to 16 weeks rather than the 13 weeks assumed in the base case analysis.
- d) Trial 5: Provides an alternative estimate of the level of sea lion bycatch that occurred in previous years; all bycatch estimates from 1998 to 2007 were multiplied by 1.5.
- e) Trial 6: Assumes there is no density dependence meaning there is no upper limit on potential sea lion abundance and very little opportunity for the population to bounce back if the population is depressed.
- f) Trial 8: During the annual pup count study on the Auckland Islands the likelihood of re-sighting a breeding sea lion is fixed at 90%, whereas in the base case this is estimated.
- g) Trial 9: The sea lion pupping rate is fixed at 0.31 meaning that 31% of the total number of mature sea lions give birth to a pup. In the base case analysis the pupping rate is not fixed but is estimated.
- h) Trial 10: Assumes that the sea lion population's maximum annual rate of increase is 6% which is a more conservative estimate than exists in the base case where the population is assumed to be able to grow by 8% each year.
- i) Trial 11: Is similar to Trial 10 above but assumes that the population's maximum annual rate of increase is even more conservative, at only 4%.
- j) Trial 12: Assumes that pup mortality remains relatively high as population abundance decreases; assumes that  $z = 2$  rather than 3 which was included in the base case. A low  $z$  value means that pup mortality remains high as population abundance decreases. Pupping mortality is a critical component of the assumptions around the sea lion population being density dependent.
- k) Trial 13: Assumes that pup mortality decreases as population abundance decreases;

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<sup>5</sup> Note that the numbering used to describe these sensitivity trials reflects the numbering used in the final report produced by Dr. Paul Breen on the model update.

assumes a more optimistic  $z$  value of 4.1 rather than 3 which was included in the base case analysis.

- l) Trial 14: The threshold of adult sea lion survivability is lowered from 95% to 93% - meaning that in any one year, for every 100 adult sea lions, 93 of sea lions will survive.
- m) Trial 15: The threshold of adult sea lion survivability is increased from 95% to 97% meaning that in any one year for every 100 adult sea lions, 97 of sea lions will survive.
- n) Trial 16: Alternative aging matrix - An alternative technique to estimate the age distribution of breeding females in the population by using the first count of age-related rings in teeth extracted under anaesthetic as opposed to the mean of the last three readings.
- o) Trial 18: Re-sampling sea lion catchability ( $q$ ) from 1988 to 2007. This gives a greater sample size from which to estimate sea lion catchability but requires that the average has not changed since 1988 (whereas the data suggests that catchability has increased). In the base case only sea lion captures from 1997 were used.

44 The table below indicates the harvest control rule that just meets the agreed management criteria for each of these trials. For example, Trial 2, which assumes there is no sea lion survivability following interaction with a SLED, would just meet both MFish criteria at Rule 323.

**Table 4: Assessment of the harvest control rules that just meet the management criteria when assessed against the two base cases and the sensitivity trials - the projected FRMLs for the 2008-09 season are presented in ( )**

Analysis trials	MFish Criteria 1	MFish Criteria 2
Base Case 1 (35% SLED discount)	Rule 1* (FRML of 0)	Rule 1 (FRML of 0)
Base Case 2 (20% SLED discount)	Rule 327 (FRML of 153)	Rule 328 (FRML of 159)
Sensitivity trials against Base Case 1		
Trial 2: 0% survivability	Rule 323 (FRML of 130)	Rule 323 (FRML of 130)
Trial 3: 50% survivability	Rule 1 (FRML of 0)	Rule 1 (FRML of 0)
Trial 4: 16 week fishery	Rule 332 (FRML of 181)	Rule 344 (FRML of 249)
Trial 5: Increased sea lion bycatch estimate	Rule 323 (FRML of 130)	Rule 325 (FRML of 142)
Trial 6: No density dependence	n/a**	n/a**
Trial 8: Re-sighting fixed at 90%	Rule 325 (FRML of 142)	Rule 324 (FRML of 136)
Trial 9: Pupping rate fixed at 31%	Rule 335 (FRML of 198)	Rule 1 (FRML of 0)
Trial 10: Population increase 6%	Rule 329 (FRML of 164)	Rule 329 (FRML of 164)
Trial 11: Population increase 4%	Rule 318 (FRML of 102)	Rule 315 (FRML of 85)
Trial 12: $z=2$	Rule 318 (FRML of 102)	Rule 316 (FRML of 91)
Trial 13: $z=4.1$	Rule 1 (FRML of 0)	Rule 1 (FRML of 0)
Trial 14: Adult survivability is 93%	Rule 324 (FRML of 136)	Rule 326 (FRML of 147)
Trial 15: Adult survivability is 97%	Rule 1 (FRML of 0)	Rule 1 (FRML of 0)
Trial 16: Alternative ageing matrix	Rule 1 (FRML of 0)	Rule 1 (FRML of 0)
Trial 18: Sealion catchability	Rule 1 (FRML of 0)	Rule 1 (FRML of 0)

\* Rule 1 equates to unconstrained fishing effort

\*\* Is not relevant for the MFish criteria because carrying capacity (K) does not exist in the absence of density dependence. This sensitivity trial was included in the model analysis for comparison against the two DOC criteria.

45 If the sensitivity runs were assessed against Base Case 2 then it is possible that the harvest control rules shown in Table 4 would all be displaced to lower values. This analysis has not been undertaken but the Minister would likely only consider the implications of these sensitivity runs if he believed that a SLED discount rate of 35% was unacceptable and that it should be reduced to 20%.

46 Another area of uncertainty is assessing which harvest control rule would just meet the agreed management criteria if the individual sensitivity trials were combined (rather than being treated as separate entities which has been the case). For example, assessing the harvest control rules that would meet the agreed management criteria if Trials 1, 5 and 8 were combined and then assessed against either base case.

47 This analysis was outside the scope of the Breen-Kim model update and therefore was not contracted as part of the original research project. However, it is likely that some combinations would result in a more conservative range of harvest control rules meeting the management criteria while other combinations will give more optimistic results.

48 In order to address the continued uncertainty associated with the Breen-Kim model assessments, particularly around the sensitivity trials, MFish is proposing to present the Minister with additional harvest control rules at the more conservative end of the continuum (Rule 0 (zero fishing activity), Rule 305 and Rule 310). The FRMLs produced from these additional harvest control rules are presented in Table 1.

49 Based on the results of the sensitivity trials against Base Case 1, MFish considers that selecting the FRML from within the range of Rule 315 to Rule 330 provides the most appropriate balance between sustainability and utilisation. However, MFish does acknowledge that the Minister can select a rule from outside this range if he believes the model uncertainty requires more caution.

### ***FRML for the 2008-09 fishing year***

50 Based on the updated Breen-Kim model, MFish is proposing that the nine harvest control rules, as listed in Table 1 above, with their corresponding FRMLs are presented to the Minister for his consideration. These harvest control rules provide the Minister with the option of selecting a FRML from within the range of 0 to 283.

51 Harvest control rules greater than Rule 330 (Rule 340 and 350) will also be provided for the Minister's consideration. However, these rules result in either marginal amounts of lost utilisation (Rule 340) or no lost utilisation (Rule 350). MFish does not intend to recommend these rules for the Minister's consideration because of the continued uncertainty with aspects of the model analysis.

52 Following the assessment of the revised Breen-Kim model, described above, MFish's initial proposal is that the Minister should select a harvest control rule within the range of Rule 315 to Rule 330 ( 85 to 170 sea lions). The reasons for this proposal are as follows:

- a) When assessed against Base Case 1, the harvest control rules that meet both MFish criteria permit unconstrained fishing (Rule 1).
- b) When assessed against the alternative base case (Base Case 2) both MFish criteria are satisfied by harvest control rules that will result in a FRML of 153 sea lions.
- c) When the sensitivity trials were assessed against Base Case 1 the lowest harvest

control rule that meets the MFish criteria is Rule 315, which corresponds to a FRML of 85 sea lions (see Table 4 above).

53 MFish does note that the FRML associated with each rule is valid only for the 2008-09 fishing year as it is based on the 2007 and 2008 pup count numbers

54 Choosing a harvest control rule requires that the Minister balance the results and analysis from the Breen-Kim model with the level of uncertainty that still exists around sea lion survivability and density dependence, the actual information available that shows that sea lion pup numbers have declined in recent years and the need to provide for utilisation of the squid resource.

55 Section 15 of the Act only permits the Minister to set a FRML that he considers is necessary because the utilisation of the squid resource poses an unacceptable risk to the sea lion population. In setting the FRML he must consider the point at which the utilisation of the squid resource conflicts with conservation of the sea lion population. The Minister is not required to set the FRML at a level beyond that which he considers is necessary to achieve this point. The Minister is also not required to set the FRML at a level that removes all the potential risk to the sea lion population. However knowing where this point rests is uncertain and the Minister is required to consider s. 10 of the Act when making his decision, which requires him to proceed with caution when information is uncertain.

56 The Minister is not permitted to set a FRML to take into account the possible impacts on the sea lion population from other factors such as natural disease events or other anthropogenic events such as an oil spill.

57 MFish acknowledges that there is still uncertainty associated with the Breen-Kim model and for this reason the range of rules available for the Minister's consideration will include more conservative rules (Rule 0 to Rule 310). Even if the management criteria have been met, the Minister is still permitted to act in a more cautious manner and select a lower harvest control rule, but the appropriate degree of caution is that which he considers necessary in the circumstances.

### *Utilisation*

58 In choosing where to set the FRML for the 2008-09 fishing year, the Minister must assess the likely impact of his decision on squid utilisation opportunities. As noted in previous advice papers it is difficult to assess the potential lost utilisation associated with the harvest control rules for the following reasons:

- a) The availability of squid varies from fishing season to fishing season, which influences the number of tows undertaken and the amount of squid caught. During the 2007-08 SQU6T season, even though the fishery opened on 1 February squid availability was patchy until early March.
- b) Market price is influenced by the size and quality of squid, and the global availability and demand for squid. Market prices are currently depressed as New Zealand squid competes on the global market with squid from the South Atlantic.
- c) Accurate information on the value of squid caught from the SQU6T fishery is not available. In its place MFish uses average port price per kg, which for 2008-09 is \$720 per tonne. This is an indication of gross product (greenweight) value.

59 Squid continues to be one of the main export earners for the seafood industry. In 2007 the

total export value for squid was \$85 million. This figure relates to exports from the entire squid fishery and it is not possible to determine how much of this export value has come from squid harvested in SQU6T. However, SQU6T produced approximately 25% of the total squid landings during the 2007-08 fishing year. Typically squid harvested from SQU6T is larger and commands a higher price.

60 In the past when preparing IPPs and FAPs MFish has estimated potential lost utilisation opportunities in terms of tows forgone and landed value of squid using the port price. However, MFish does not consider it useful to compare the potential lost utilisation opportunities associated with each FRML in terms of percentage of the TACC forgone.

61 MFish notes that the FRML imposes a theoretical cap on utilisation which may result in lost revenue but there are also other relevant factors:

- a) Fluctuations in squid abundance mean that in many years it would not have been possible to catch the full TACC, even without the constraints of a FRML. Equally in years of good abundance the TACC may act as the limit in the fishery, not the FRML although MFish does note that fishers have the option to seek an in-season TACC increase under s. 14 (6), as squid is listed on the Third Schedule of the Act.
- b) The use of port price to determine squid value is problematic and is likely to provide conservative estimates of lost revenue.
- c) Calculating potential loss of earnings based on port price does not take into account the fixed and variable costs associated with fishing activity.

62 The Minister will be advised that if he chooses a FRML from the lower end of the range of harvest control rules available this is likely to constrain fishing activity and may reduce both export earnings and the direct value of the fishery to industry, particularly if squid abundance is good.

### *Sea lion pup production numbers*

63 Pup production from the Auckland Islands is used to estimate sea lion population size for that region. Table 5 below details the pup production estimates from 1995 – 2008. The 2008 pup count is lower than that of 2007. Since 1995 sea lion pup numbers have fluctuated; DOC indicates that there is evidence of a declining trend in population numbers with Auckland Island pup production declining by 14% since that time and by 28% since the disease outbreak of 1998. There is no information to suggest that fluctuations in sea lion pup numbers are the direct result of fishing activity.

**Table 5: Pup production estimates from the Auckland Islands rookeries combined, 1995-2008 (Source: Department of Conservation).**

Year	Pup numbers
1995	2518
1996	2685
1997	2975
1998	3021
1999	2867
2000	2856
2001	2859
2002	2282
2003	2518
2004	2515
2005	2148
2006	2089
2007	2224
2008	2175

64 FRMLs calculated from the various harvest control rules take into account pup production in the two most recent years. Therefore the recent pup count decrease is reflected in the FRMLs calculated for the 2008-09 season.

*Uncertainty around the biology and survivability of sea lions*

65 There are also concerns about the status of the sea lion population particularly given that:

- a) The population is believed to be operating at its physiological limit in terms of diving depth and foraging distances which would mean that if the population is put under further pressure it may not be able to recover.<sup>6</sup>
- b) The majority of the sea lion captures returned in recent years for necropsy have been females and the implications this has on the survivability of pups already born and future pup numbers should be considered – some of the female sea lions caught have also been in the early stages of pregnancy. MFish can confirm that the updated Breen-Kim model does factor in the implications on pup survivability for those pups whose mothers have a fatal interaction with squid trawl gear.
- c) Recent work by NIWA suggests that the Auckland Island sea lion population is less productive than previously thought. MFish can confirm that this information has been factored into the revised model.<sup>7</sup>
- d) There is also the concern that the population is subject to severe mortality events due to epidemics caused by bacterial infections. Three such mortality events were recorded between 1992-93 and 2004-05 when higher than usual numbers of both adult sea lions and sea lion pups died as a result of disease outbreaks. Since the 1998 disease outbreak the pup numbers have declined by 28%.

<sup>6</sup> Chilvers, BL. 2008. New Zealand sea lions *Phocarcetos hookeri* and squid trawl fisheries: bycatch problems and management options. Preprint, Endangered Species Research

<sup>7</sup> D.J. Gilbert & B.L. Chilvers: Pupping rate estimates for New Zealand sea lions. 2008 (Draft report)

66 There are also concerns about the survival chances for a sea lion that gets caught in squid fishing gear even after it escapes out through the SLED. This issue is discussed in more detail in the section on SLEDs.

67 MFish does note that the above factors are not directly attributable to fishing effort but that the Minister may bear in mind these issues when deciding where to set the FRML for the coming fishing year.

### **Strike rate**

68 MFish proposes to continue to estimate sea lion mortalities using a predetermined strike rate. The current strike rate of 5.65%, currently in place in the fishery is based on the modeled assessment of the mean strike rate for SQU6T vessels for each of the following three fishing seasons; 2003-04, 2004-05 and 2005-06. Since 2003 the actual strike rate has not been monitored directly because the use of SLEDs means it is not possible to assess the actual number of squid trawl gear and sea lion interactions that occur because sea lions are now able to escape from the net.

69 While this modeled period does coincide with a period of continuous increased tow duration there is still uncertainty associated with this value, or indeed any strike rate used to assess performance against the FMRL, for the following reasons:

- a) It is likely that some of the tows used in the modeled analysis used some form of SLED which means the actual strike rate might be underestimated.
- b) The actual strike rate is likely to vary from season to season and in some years it could be above the mean while in other years it is likely to be below the mean. This level of variation is not necessarily a problem as long as over time the actual average strike rate is close to 5.65%.

70 One of the reasons why the strike rate was increased last season from 5.3% to 5.65% was to take account of the increase in tow duration. Between 2003-04 and 2005-06 the median observed tow length had steadily increased from just over 4 hours to 5.8 hours. Research indicates there is a correlation between tow duration and rate of sea lion capture, although tow duration is not the most significant factor to influence capture rates (for example, distance from the sea lion colony and time of year of capture are more important). There were concerns that a strike rate of 5.3% could underestimate the extent of the interactions between squid fishing vessels and sea lions and for this reason the Minister chose to increase the strike rate.

71 The average tow duration during the 2007-08 season was 6.1 hours which is a small reduction on the 6.8 hours recorded during the 2006-07 fishing year. However, tow duration from the two most recent fishing years is still above the tow duration used to provide the 5.65% estimate. For this reason MFish does not consider that the decline in average tow duration observed in the current fishing year is sufficient to warrant a further review of the strike rate at this time.

72 Therefore, MFish is proposing that the strike rate for the 2008-09 SQU6T season remains unchanged at 5.65%. MFish welcomes stakeholder's views on this proposal.

### **SLED Discount Rate**

#### *Calculation of discount rate*

73 Since the 2003-04 SQU6T season a discount on the strike rate has been applied to tows

where vessels have deployed approved SLEDs and where vessel operators have complied with the monitoring and reporting requirements set out in the SQU6T Operational Plan. The current discount rate is 35%. This means that for all eligible tows during the 2007-08 SQU6T fishery the strike rate was reduced from 5.65% to 3.67%.

74 In 2007 the Minister made a decision to increase the discount rate from 20% to 35%. This decision was based on the best available scientific and management information.

75 Some stakeholders continue to have concerns that a strike rate of 35% is too high and that maintaining the strike rate at 20% is more appropriate. Equally other stakeholders consider that sea lions have a greater chance of survivability than the current strike rate implies and therefore the discount should be higher than 35%. Much of the concern rests on the likelihood that a sea lion will survive if it goes through the squid trawl gear and escapes through the SLED. Survivability remains one of the key areas of uncertainty around the management of this issue. A copy of the Final Advice Paper provided to the Minister for the 2007-08 decision can be found at [www.fish.govt.nz](http://www.fish.govt.nz) under completed consultations, and final decisions for 2007. This paper sets out in more detail the rationale for increasing the discount rate from 20% to 35%.

76 What remains unclear is the likely impact on the sea lion population if the SQU6T fishery is managed with a SLED discount of 35% when in reality the escape rate of sea lions from a net fitted with a SLED is lower (perhaps 20%). As part of the sensitivity trials against Base Case 1, the revised model assessed the point at which the harvest control rules would meet the MFish criteria if the assumption that there is zero sea lion survivability following interactions with a SLED is valid. This analysis indicated that, even with an assumption of 0% survivability, the harvest control rules that would meet the management criteria would still permit a FRML of 130 sea lions (recognising that this assessment is based on one base case only, and that the uncertainties with the model described above remain valid). MFish does not support the concept of 0% survivability with SLED usage but does acknowledge this is an area of uncertainty. The Minister was required to consider all available information, and the uncertainty associated with that information, when determining where to set the discount rate for the 2007-08 fishing year.

#### *Information from the 2007-08 season*

77 As in previous seasons there is some new information that contributes to an improved understanding of the use of SLEDs and the possible survivability of sea lions. This information includes:

- a) Camera footage of SLEDs in use
- b) Necropsy data from the sea lions returned during the 2008 SQU6T fishery.

#### *Camera footage*

78 Camera footage results from the 2007-08 season show animals interacting with the SLED hood but do not show any animals escaping through the SLED. However, the results did provide some useful footage showing how sea lions interact with fishing gear and the SLED hood. White light cameras were used to record this footage and it is possible that the white light may have attracted the sea lions to the trawl gear. This footage showed up to three sea lions interacting with the SLED hood and scavenging squid caught in the hood mesh.<sup>8</sup> It is not possible to confirm from

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<sup>8</sup> MFish does note that squid caught in the SLED hood is an indication that the hood was not working as effectively as it could have been.

this camera footage the impact that interacting with a SLED or trawl gear has on sea lion survivability. Initial results suggest that the animals are able to move freely around the fishing gear with little impediment although it is impossible to validate these claims.

79 The footage also provided information on how the SLED specification could be further improved to ensure the SLED hood is deployed correctly so that sea lions have every chance to escape from squid trawl gear.

80 As a result of camera footage taken during the 2006-07 fishing season it was agreed that the SLED specification would be modified to ensure that SLED kite and hood were constructed of robust material so that they kept their shape when the gear was deployed. It was also a requirement to attach a float to the hood to ensure it remained buoyant. These changes to the SLED specification were implemented before the start of the 2007-08 fishing season.

81 However, results from the cameras deployed during the most recent fishing season indicated that the SLED hood would operate more effectively if there were three floats attached to it rather than a single float, as originally proposed. Vessel operators were advised of this information part way during the season and all operators were encouraged to deploy SLEDs with an additional two floats attached to the hood. This has now become a requirement of the SLED specifications for the 2008-09 season and all SLEDs will be audited by MFish observers and fishery officers to ensure operators deploy SLEDs with the correct number of floats and that the floats meet the agreed specification.

82 MFish does not think that the camera footage from the 2007-08 season provides no further information that would mean a revision of the SLED discount rate is required for the 2008-09 fishing year.

### *Necropsy data*

83 The necropsy results from the five sea lions captured during the 2008 SQU6T fishery are not yet available but the results should be released in time for the final advice to the Minister. Stakeholders will have the opportunity to review the research results through the AEWG process.

84 The results of these necropsies may provide some new information that can contribute to the sea lion survivability and SLED efficacy debate. Three of the five animals captured during this season were female. There is also some concern given that two of the five sea lions were recovered from the cod end which meant they had managed to get through the SLED grid. SLED grids have been developed with larger animals in mind and initial reports from the observers and the pathologist at Massey University suggest that these sea lions were unusually small adults.

85 Forest & Bird has voiced its concerns about these two captures and is proposing that the SLED grid is modified further. MFish will await the results of the necropsy reports before making a determination on this but it is likely that these two captures were unusual events and therefore it may not be appropriate to start altering the grid specifications at this time.

86 Further research to investigate the effect that freezing may have on the injuries observed during sea lion necropsies is also underway at Massey University. This research is focusing on fur seals as it is not possible to return sea lions caught in the squid fishery to shore in time for them to be necropsied fresh. Once again the results should be available in October and the Minister will be advised of these results as part of the final advice to him on this matter. Before the results are presented to the Minister they will be reviewed by the AEWG. This is a public forum and all

stakeholders and interested parties are welcome to attend.

87 The results of both the necropsy research and the freezing study may warrant a review of the SLED discount rate but at this time MFish does not consider that the new information from the 2007-08 season indicates that the SLED discount rate should be amended before the start of the 2008-09 season.

### *Assessing sea lion survivability*

88 MFish recognises there is still some uncertainty around sea lion survivability and therefore the SLED discount rate. MFish is keen to explore ways in which this information gap and uncertainty can be reduced.

89 One method that has been used previously to assess possible survivability is to require vessel operators to tie down cover nets on their SLEDs. This would mean that the sea lions that do manage to escape from the SLED would be retained in the cover net where they would be unable to escape and would eventually drown. These animals could then be returned for necropsy to assess the extent of their injuries and the likelihood of them having survived if the cover net had not been tied down and they had managed to escape from the SLED. This type of research could also provide more up to date information on the strike rate.<sup>9</sup>

90 There have been some requests, particularly from environmental stakeholders, to repeat this study. However, MFish has the following concerns with this proposed research:

- a) It will require the deliberate drowning of sea lions by the fishing industry. MFish would prefer to use non-lethal approaches to determine sea lion survivability.
- b) It is likely that any study of this nature would have to take place over multiple years to ensure there is sufficient information available for a robust scientific analysis.
- c) It is not clear what the impact of being trapped in a cover net does to the sea lion and consideration must be given to the possibility that injuries may occur due to the animal trying to escape the cover net, rather than due to interactions with the SLED. These are injuries that the sea lion would not have incurred if it had escaped from the SLED and there is the potential for these injuries to be misinterpreted as being caused by the interaction with the SLED.

91 However, alternative research projects are currently under discussion which may contribute useful information to the sea lion survivability debate. The nature and scope of these research projects will be dependent on research funding but a summary of the possible research projects is set out below.

92 There have been requests made during recent AEWG meetings to collate and formally

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<sup>9</sup> This would be a repeat of the study that was done in 2001 where 7 animals, caught in SLEDs with cover nets tied down, were sent for necropsy. An additional 4 animals were retained in the net and did not enter the cover net. An assessment was made, based on the likely cause of death and the extent of the injuries found on the sea lion as to its likely chance of surviving, had it not been retained in the SLED cover net. The pathologist's report on the necropsied animals was then reviewed by four additional veterinary pathologists with experience in this field. The results from this research study estimate that 18% of all eleven animals caught and retained in nets with SLEDs and closed cover nets would have survived following escaping through the SLED if they had been able to escape (if the cover net had been open). These results supported the 20% discount rate that was used until the start of the 2007-08 fishing year.

review all the information that is currently available on sea lion interactions, including observer reports, tow duration, tow speed and necropsy reports. MFish supports this proposal and will consider options for contracting such research during the next twelve months.

93 A research project may also be contracted during 2009-10 to further investigate sea lion survivability. The nature of this research has yet to be confirmed but one option is that it will focus on assessing possible methods to determine sea lion survivability in the first instance. If suitable methods are identified these could then be trialed at a later date to assess if they can provide useful information on sea lion survivability.

94 The DWG intends to continue its camera research project throughout the 2008-09 SQU6T season. This research project will monitor the deployment of SLEDs and potentially, the interaction of sea lions with SLEDs. The results from this project will be reviewed by the SLED working group<sup>10</sup>

95 Finally, through the SLED working group, a fishing gear specialist from Denmark will be tasked to investigate various aspects of SLED design and specification including:

- a) The appropriateness of using hoods
- b) Possible alternative design options for hoods including different mesh size
- c) How to provide the most appropriate lift and buoyancy for SLED hoods – floats or kites
- d) Investigating the pros and cons of a one piece SLED grid versus a two piece SLED grid
- e) The impact of using a solid SLED grid versus a grid manufactured out of a hollow material.

96 The results of this study should be available by the end of November 2008. Although this will be too late to inform the management advice for the 2008-09 fishing year, this information can be used to inform future decisions and may also identify further research that could improve SLED efficiency and design.

97 MFish also welcomes the views of stakeholders on other ways to improve knowledge of sea lion survivability following interaction with SLEDs.

98 In MFish's view the available information does not suggest that, at this time, the SLED discount rate should be revised for the 2008-09 fishing season. Therefore MFish is proposing that the SLED discount rate remains unchanged, at 35%, for the coming season. MFish welcomes stakeholder's views on this proposal.

### **Other management measures**

99 A recent paper in the Journal on Endangered Species Research on the New Zealand sea lion summarises the existing information on sea lion biology and the bycatch problem that exists in the

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<sup>10</sup> The SLED working group is a discussion forum addressing issues on SLED use and efficacy, and possible methods to avoid sea lion captures in the SQU6T fishery. It is not a fisheries management decision making forum.

squid fishery.<sup>11</sup> However, this paper also sets out possible management options that the author believes could be used to manage the squid /sea lion interaction issue. These options include proposals to reduce fishing effort in the areas around the Auckland Islands by:

- a) Creating a no-fishing area around the Auckland Islands which would extend out the existing marine mammal sanctuary;<sup>12</sup> or
- b) Transferring quota out of the SQU6T fishery into the SQUIT or SQU1J fisheries.

100 Forest and Bird has expressed its support for these measures as possible alternatives to managing the fishery through an annual FMRL.

101 MFish notes there is insufficient time to undertake a full assessment of these alternative options before the 2008-09 decision is made. MFish has signaled to Forest & Bird that it will review these options in more detail over the coming months, although an initial assessment does suggest there could be some substantial legal issues associated with both options, particularly in terms of their consistency with the Fisheries Act 1996.

## **Monitoring and reporting requirements**

### **Overview of 2007-08 season**

102 For the 2007-08 SQU6T fishery the estimated sea lion mortality was 46.13 (46) sea lions from a FRML of 81. MFish Observers observed 47% of all tows in the fishery during the season. The total number of recorded mortalities was five sea lions, all of which were recorded by vessels which had an MFish Observer onboard.

103 A total of 1257 tows were undertaken during the 2007-08 and all tows were eligible for the discounted strike rate. No vessels were penalised for non-compliance with SLED requirements. This is the first year that there appears to have been full compliance with the SLED discount requirements although MFish does acknowledge the difficulties in monitoring compliance onboard non-observed vessels.

104 All SLEDs were audited prior to the start of the season to ensure they met the specification. During the season, camera footage of SLEDs in use indicated that the SLED hood should be fitted with three floats rather than the specified single float. The additional floats are to ensure the SLED hood remains upright and buoyant at all times. Vessel operators were encouraged to make the necessary modifications to their SLED part way through the season and observer reports indicate that these changes were made onboard many of the vessels in the fleet. As noted previously the SLED specification will be updated to reflect the three float requirement and will be in place in time for the 2008-09 season.

105 The only outstanding area of concern is that all reported mortalities occurred onboard MFish observed vessels (one un-observed vessel did report a sea lion but it was later confirmed as a fur seal). While this is statistically possible, it is unlikely that sea lion captures would be limited to observed vessels only. MFish and the DWG will continue to stress the importance of accurate reporting to vessel operators but this is undoubtedly an area that must be improved on.

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<sup>11</sup> Chilvers, BL. 2008. New Zealand sea lions *Phocarctos hookeri* and squid trawl fisheries: bycatch problems and management options. Preprint, Endangered Species Research.

<sup>12</sup> There is currently a marine mammal sanctuary in place around the Auckland Islands out to 12 nautical miles.

## **Monitoring and reporting requirements**

- 106 MFish proposes to implement the same monitoring and reporting procedures that were in place for the 2007-08 season. This will require:
- a) The fishing vessel operator to notify the MFish Observer Programme at least 72 hours before leaving port to ensure there is sufficient time to place an observer on board the vessel before it sails. This notification may also be used as an opportunity for fishery officers to undertake a port inspection of the SLED.
  - b) The Master of the fishing vessel is required to report to MFish, at the end of the fishing trip, any encounter with a marine mammal that resulted in death or injury. MFish observers will notify the Observer Programme immediately following the capture of sea lions.
  - c) All vessels in the SQU6T fishery will participate in a weekly reporting regime managed by the Deepwater Group Ltd (DWG). When 70% of the FRML is reached, reporting will be daily. The information reported will include:
    - i) Each tow undertaken in the SQU6T fishery
    - ii) Whether the tow was observed by an MFish Observer
    - iii) If an approved SLED was deployed during the tow
    - iv) If any sea lions were caught during the tow and whether they were released alive, retained or returned dead to the sea.
- 107 Before a vessel can receive the recommended SLED discount rate certain conditions must be met.
- a) Vessels must deploy a SLED that meets the approved design specification (Mark 3/13 design).
  - b) The SLED must be deployed with the escape hatch open at all times during fishing operations.
  - c) Each SLED must be stamped with a unique number and photographed before the start of the fishing season by the DWG.
- 108 MFish will continue to work closely with the DWG to ensure these conditions are met and there is accurate monitoring against the FRML throughout the squid fishing season. MFish is confident that the good performance experienced in the 2007-08 will continue and further improvements will be made.
- 109 Both the MFish Observer Programme and MFish Compliance will continue to inspect SLEDs throughout the season to ensure:
- a) The vessel is carrying the SLED for which it was given approval and,
  - b) The SLED has not been adjusted or modified and is in working order.
- 110 As in previous seasons, MFish intends to retrospectively remove the discount rate accreditation for all tows where a non-approved SLED was deployed or where the reporting requirements have not been met. This will take place during the SQU6T decision.
- 111 MFish also intends to request vessel operators, in cooperation with DWG, to continue to return all dead sea lions caught during the SQU6T season irrespective of whether the vessel

is carrying an MFish observer. These sea lions will be returned to Massey University for necropsy. They will be identified in subsequent reports as animals recovered from non-observed vessels.

- 112 MFish also intends to continue with a minimum target of 30% observer coverage across the SQU6T fishery during the 2008-09 fishing season.

### **Closure procedures**

- 113 Under s 15 (5) of the Act the Minister may close the SQU6T fishery when the FRML is reached.
- 114 MFish will work with the DWG to monitor in-season performance against the FRML. Should the estimated mortality get close to the FRML, MFish will advise the Minister of this fact so he may close the SQU6T fishery by Gazette Notice once the limit is reached.
- 115 This closure will be undertaken without consultation but MFish will ensure all participants in the fishery are kept updated on levels of fishing activity against the FRML throughout the fishing season. For the past two seasons, MFish has sent weekly reports to all stakeholders providing information on progress towards the FRML, so ample warning of the closure will be available.

### **Future management**

- 116 MFish and the DWG are in the process of developing a squid fisheries plan that will include the SQU6T fishery. This plan will build on recent initiatives to manage seabird and marine mammal interactions and will also include key bycatch species. This squid fisheries plan will be developed with environmental stakeholders and will be consulted on widely before being provided to the Minister for approval. MFish hope that the fisheries plan will be in place during the 2008 – 09 SQU6T fishing season.

### **Consultation**

- 117 MFish is seeking views from stakeholders on the management options presented in this IPP. Stakeholder submissions will be considered before final advice is prepared for the Minister. **MFish reminds stakeholders that submissions received will be posted on the MFish website.** If for any reason a submission contains confidential information and it should not be made public then MFish should be advised at the time the submission is made.

### **Statutory considerations**

- 118 The following statutory considerations have been taken into account in developing this consultation paper on the interactions between the SQU6T fishery and sea lions.
- 119 **Section 8:** MFish considers the management options proposed in this paper provide for utilisation in the SQU6T fishery while ensuring the sustainability of the squid stock and managing non-fish interactions.
- 120 In deciding where to set the FRML the Minister must balance the need to provide for utilisation while ensuring the sustainability of sea lions. If the Minister chooses a higher FRML he is giving greater emphasis to utilisation over sustainability. If he decides to choose a lower FRML he is giving greater emphasis to sustainability over utilisation.

- 121 **Section 5(a) International and Settlement Obligations:** Decision-makers are required to act in a manner consistent with New Zealand's international obligations relating to fishing, including the Law of the Sea and the Fish Stocks Agreement as well as regional fishery management agreements. Decision-makers must also act in a manner consistent with the provisions of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992. MFish considers the proposed options are consistent with both New Zealand's international obligations relating to fishing and the provisions of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992.
- 122 **Section 9 (a):** The management proposals in this paper have been developed so as to ensure the sea lion population around the Auckland Islands will be maintained above a level that ensures its long term viability.
- 123 **Section 9 (b) and (c):** The specific impact of squid trawling in the SQU6T fishery on biological diversity and habitats of particular significance is not known. Squid vessels engage in both mid-water trawling and bottom trawling in SQU6T.
- 124 **Section 10:** MFish considers the information used to support the proposals set out in this paper is the best available information. Given the uncertainties associated with some aspects of this information the management options proposed balance the risks to both potential utilisation and the sustainability of the sea lion population.
- 125 **Section 11A – Fisheries plans:** There is currently no fisheries plan in place in the SQU6T fishery. However, work is progressing on developing a fisheries plan for squid which will include SQU6T and this is discussed in this paper in the section on future management.
- 126 **Section 15 (2):** MFish considers that providing proposals on a FRML satisfies the Minister's requirements to take such measures as he considers necessary to avoid, remedy or mitigate the effect of fishing-related mortality on the sea lion population.
- 127 **Section 15 (5):** This section provides the Minister with the discretionary power to prohibit all or any fishing if the fishing-related mortality limit has been met.

### ***Ngai Tahu Claims Settlement Act 1998***

- 128 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/Whakaha) as a taonga species under this Act.

# Appendix 1: SLED specification for 2008-09 SQU6T season

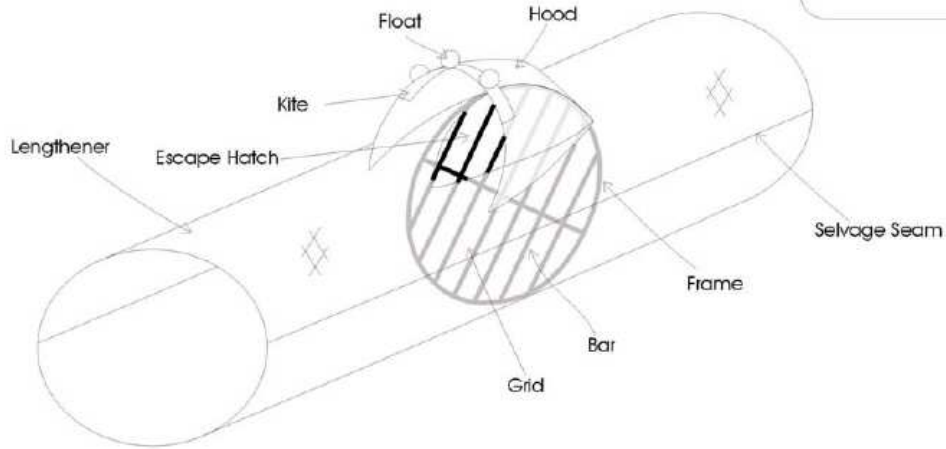
## DWG and MFish SLED Specification for SQU 6T 2009 Operational Plan DRAFT

October 2008 MK 3/13 SLED approved by SLED WG April 2008

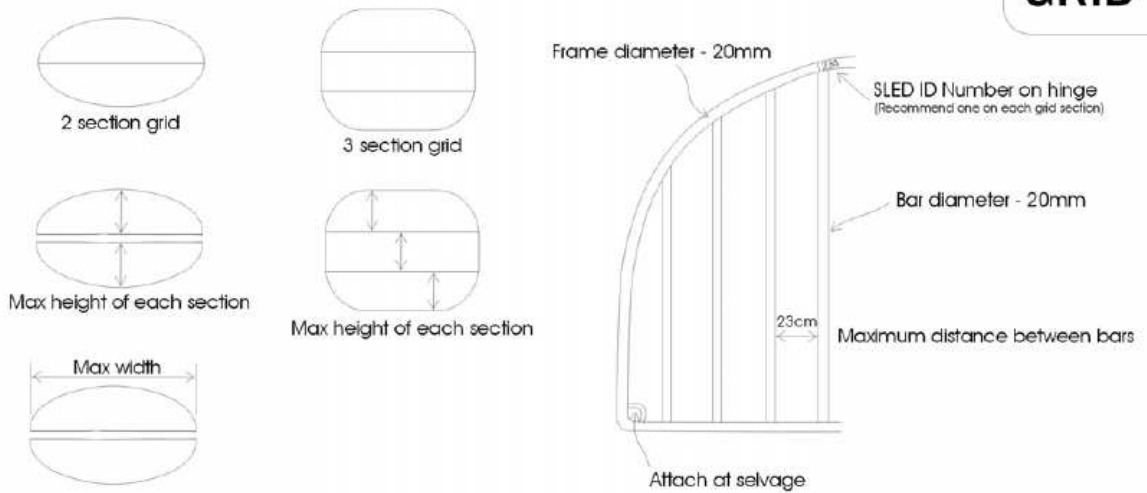
The SLED required for use by all vessels in the 6T squid fishery is an approved type that meets the following criteria:

1. The SLED must consist of a lengthener section of net, with either 2 or 4 seams, containing a 2 or 3 piece grid, hinged horizontally along the middle. The grid should be set in the net at about  $45^{\circ} \pm 5^{\circ}$  from the vertical with the top of the grid closest to the codend section and continuously sewn to the net meshes around its outer edge.
2. The grid must be constructed of **minimum 20mm outside diameter solid stainless steel bar** and should be shaped to conform to the working parameters of the net (refer diagram).
3. Vertical **grid bars** must be **evenly spaced at a continuous maximum distance of 23cm between bars** (see diagram). There will be no minimum number of bars, provided they are **evenly spaced** and do not exceed the recommended maximum spacing. It may be necessary to have the last spacing between the final bar and the grid frame differing from the rest of the spacings provided they are **less than 23cm** apart between bars and frame.
4. The escape hole must be triangular and let into the upper surface of the lengthener section. This hole must be a **minimum of 130cm wide at the base**, measured along the top bar of the grid. The apex of the triangle must be a **minimum of 150cm forward** of the base (refer diagram).
5. Above the escape hole, a hood-shaped mesh scoop must be attached with its open (leading) end facing into the water-flow and its closed (trailing) end attached & over stretched to the top bar of the grid. The leading edge of the hood must be a **minimum of 90cm high** when fully open and the leading edge rope around the mouth of the hood must be a **minimum of 320 cm long, the back edge must be overstretched when fitted to the grid & minimum length of 170cm long** (refer diagram).
6. The hood must have a semi rigid kite 220cm long by 32cm wide (both measurements  $\pm 10\%$ ) (a piece of conveyor-belt is ideal) attached under the meshes of the hood. The leading edge of the kite must be continuously stitched to the leading edge of the hood and the back edge also attached to the hood netting. The leading corners of the hood must extend forward of the escape hole.
7. A three floats of between 20cm & 30cm in diameter (a centre hole float is best) must be each attached to the centre and outside edges of the leading edge on the kite.
8. The SLED must be inserted into the trawl (between the body of the trawl and the lengthener) with the escape hole on the upper surface when the net is fishing.
9. Each SLED grid frame must have a unique registration number, identifying it as a unit, clearly stamped into the frame bar at each end of each hinge section. Deepwater Group Ltd will record each SLED registration number. DWG's register of SLED numbers must be provided to MFish on an annual basis before fishing commences.
10. There are elements of the SLED configuration that may vary, including: the presence or absence of floats attached to the outside of the grid or back of the kite, the shape, width and height of the grid, the number of vertical bars in the grid, the number of meshes in the hood and the number and size of meshes in the lengthener section, depending on the net in which the SLED is inserted.
11. No extra panels or mesh material may fitted inside the net before the SLED. Additional floats may be fitted inside the lengthener behind the grid or frame.
12. Alterations are not to be made to the design outside of this specification. For new builds or major repairs contract Motueka Nets Ltd or Hampidjan NZ Ltd.

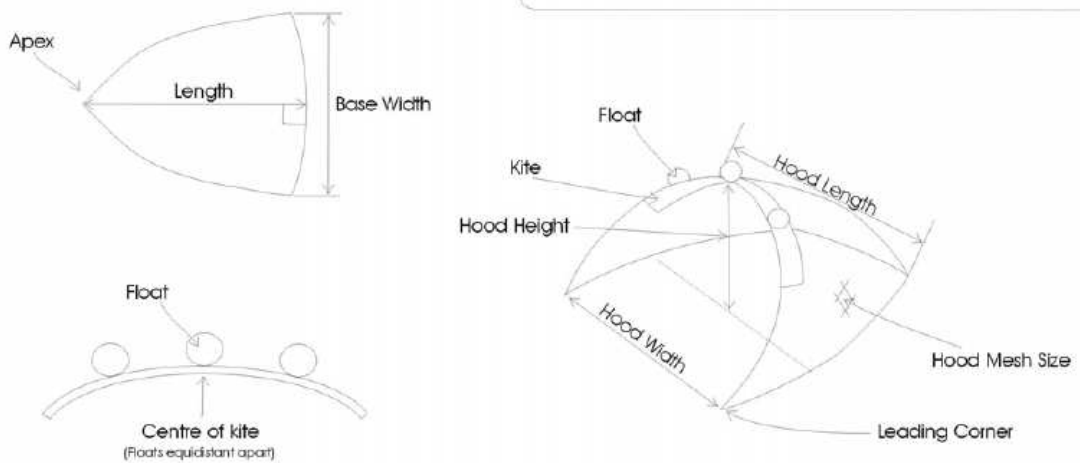
## SLED TERMS



## GRID



## ESCAPE HATCH and HOOD



**Appendix 2: Issues with the previous version of the Breen-Kim model, raised by Paul Breen at the AEWG meeting held 1 September 2006. These issues have subsequently been addressed in 2008 with the revised model.**

1. Recent pup counts were lower than the minimum estimates generated by the model, suggesting that insufficient process error was allowed in the model. The model cannot reproduce the declines seen recently, and survival rate or pupping rate may have changed. The effect of introducing more variability would be that high-numbered harvest control rules would no longer meet the 90:90:90 sustainability criterion, and the cusp rule would be some lower-numbered rule than 392. Lower pup counts would also cause uncertainty in the minimisation of the model because it assumes observation error and no process error.
2. Late-season pup mortality estimates were not included in the original model. Late season mortality appears to be more variable than early season mortality. This suggests that the model should include process error on pup mortality.
3. Some other data sets not available in 2003 have since become available.
4. The 2003 model had no implementation error, even though actual mortality of sea lions is poorly known.
5. The 2003 model was restricted to SQU6T even though some sea lions are caught elsewhere and some other fisheries have sea lion interactions in the SQU6T box.
6. It was acknowledged that, in hindsight, different parameterisations of survival might have been better to avoid parameter correlations.
7. The model assumed homogeneous dynamics in the four rookeries and this may not be realistic.
8. The “strike rate” may have a time trend but this was not modelled in the 2003 projections.
9. The very low growth rate favoured by the model is thought to be unrealistic and suggests problems in the specification of density dependence. It is possible that there is density dependence in survival as well as, or instead of, in pupping rate.
10. Catch and effort data are assumed known.