

H0558

10 December 2009

Minister of Fisheries

## **2009-10 SQU6T Operational Plan: Final Advice Paper**

1 This paper provides you with the Ministry of Fisheries' (MFish's) recommendations for managing the interactions between the southern squid fishery (SQU6T) and New Zealand sea lions (sea lions) during the 2009-10 fishing year.

### **Structure of this paper**

2 This paper consists of the following sections:

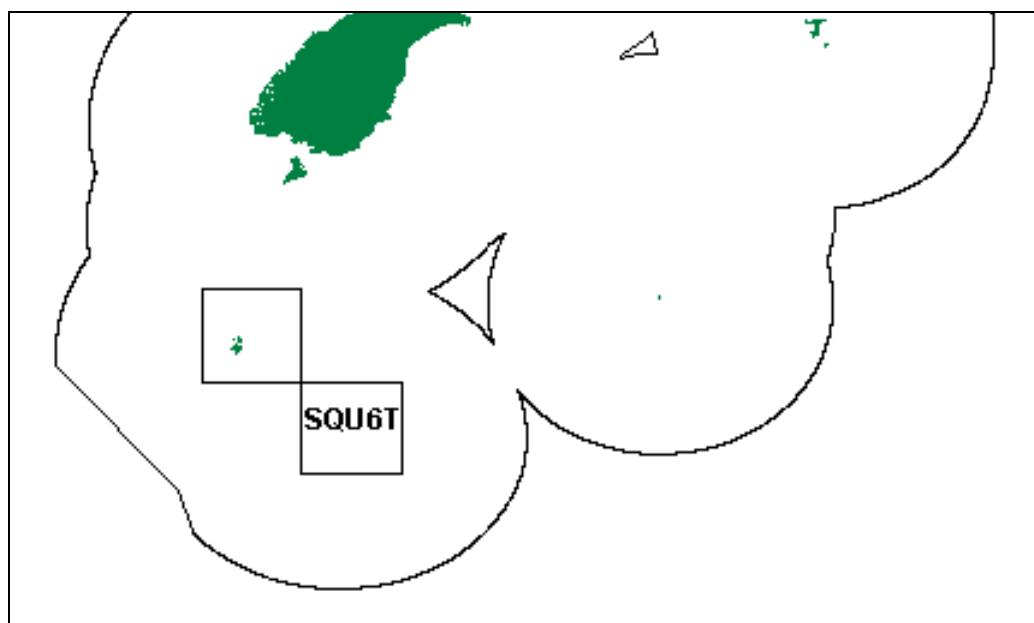
- a) Part 1: Introduction – Executive summary and summary of consultation conducted.
- b) Part 2: Problem definition and legislative obligations.
- c) Part 3: Strike Rate and SLED Discount Rate – Recommendations for the strike rate and SLED discount rate for the 2009-10 fishing year.
- d) Part 4: Fishing Related Mortality Limit (FRML) – an overview of the population model and an assessment of the FRML options available for you.
- e) Part 5: Monitoring and reporting requirements for the 2009-10 SQU6T fishery.
- f) Part 6: Recommendations.

## **PART 1: INTRODUCTION**

### **Executive summary**

3 The fishing grounds of the SQU6T fishery overlap with the foraging range of sea lions that inhabit the Auckland Islands; this leads to the incidental capture of sea lions by squid trawl vessels (Figure 1).

4 Section 15(2) of the Fisheries Act 1996 (the Act) permits you to take such measures as you consider necessary to avoid, remedy, or mitigate the effect of fishing-related mortality on any protected species—such measures may include setting a limit on fishing-related mortality (FRML). The proposed management regime for the 2009-10 SQU6T season is similar to that used in previous years and uses a population model to set an FRML to constrain sea lion mortalities to an acceptable level. This will be implemented through an Operational Plan that outlines the management settings that will apply to the SQU6T fishery for the 2009-10 season.



**Figure 1.** Location of SQU 6T – both boxes.

5 Each of the proposed FRMLs for the 2009-10 season is derived from a series of harvest control rules that were assessed by the population model to have met the agreed management criteria when certain assumptions are made. As with all models there is some uncertainty about how closely the model approximates real life. Sensitivity trials were conducted to test the effect that some of this uncertainty has on determining which harvest control rules and hence FRMLs meet the management criteria.

6 For the 2009-10 fishing year, the FRMLs that meet both management criteria range from 0 to 106. In choosing a harvest control rule, and hence an FRML for the coming fishing season, you are being asked to form a view as to the extent to which utilisation of SQU6T should be allowed to impact upon the sustainability of the sea lion population. MFish recommends applying a harvest control rule that results in an FRML between 52 and 90 sea lions.

7 A predetermined strike rate is used to assess fishing performance against the FRML. The assumed strike rate for 2008-09 was 5.65% and was 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. This is also an important input into the population model. MFish does not consider there is any new information that would warrant changing the strike rate for the coming SQU6T season.

8 Those vessels that use an approved sea lion exclusion device (SLED) currently receive a discount on the strike rate to reflect the increased likelihood that sea lions can escape from nets. Recently all vessels in SQU6T have used SLEDs; however, there is some uncertainty about their efficacy. The discount rate for the 2009 season was 35% which assumes that 35% of sea lions that enter a trawl net escape from the net through the SLED. MFish considers the 35% SLED discount rate to be appropriate given the following

---

<sup>1</sup> Thompson FN and Abraham ER. 2009. Estimation of the capture of New Zealand sea lions (*Phocarctos hookeri*) in trawl fisheries, from 1995-96 to 2006-07. New Zealand Aquatic Environment and Biodiversity Report 2009.

considerations: the science information, additional management information and the previous decisions by yourself and the previous Minister to use a 35% SLED discount rate. Therefore, MFish recommends that the SLED discount rate remains unchanged at 35% for the 2009-10 fishing year.

9 MFish intends to implement, in conjunction with the Deepwater Group Ltd (DWG), a similar monitoring and reporting regime for the 2009-10 fishing year to the one that was in place during the 2008-09 season.

## **Consultation**

10 Consultation on the initial position paper (IPP) was undertaken with such persons or organisations representative of those classes of persons having an interest in the stock or the effects of fishing on the aquatic environment in the area concerned, including Maori, environmental, commercial and recreational interests. The IPP was circulated to relevant stakeholders and posted on the MFish website on 25 September 2009; submissions closed on 2 November 2009. The IPP is attached for your reference in Appendix A.

## **Submissions received**

11 The following submissions were received:

- a) The New Zealand Seafood Industry Council and Deepwater Group Ltd (Industry).
- b) Royal Forest and Bird Protection Society of New Zealand Inc (Forest & Bird).
- c) WWF – New Zealand (WWF).
- d) The Environmental Defence Society (EDS).
- e) Dr Bruce Robertson – Otago University (Bruce Robertson).

12 Submissions traversed a wide range of issues. In general, environmental NGOs supported conservative measures that favoured lower FRMLs. Forest and Bird submitted that the FRML should be no more than 38 for the coming season. WWF and Bruce Robertson submitted the FRML should be no more than 50 and 52 respectively. Industry submitted that an FRML is not required in the SQU6T fishery, but in the alternative, submitted that if an FRML should be imposed, it should be set at 127 for 2009-10.

13 Similar stances were adopted by submitters regarding the SLED discount rate, Forest and Bird and EDS submitted that the discount rate should be set at 0% for vessels using SLEDs. Bruce Robertson favoured reducing the discount rate to 20%. Conversely, Industry supported a SLED discount rate of at least 50%.

14 Major issues of relevance are discussed in the associated sections of this advice and copies of all submissions are provided in Appendix B.

## PART 2: PROBLEM DEFINITION AND LEGISLATIVE OBLIGATIONS

### Problem definition

15 The fishing grounds of the SQU6T fishery overlap with the foraging range of sea lions that inhabit the Auckland Islands; this leads to the incidental capture of sea lions by squid trawl vessels. Intervention is required to manage the effects of fishing on the sea lion population. The current management approach is to set an FRML to constrain sea lion mortality to an appropriate level; this is done using a population model that tests the likely performance of different management settings.

16 The New Zealand sea lion is currently listed as a threatened species under s 2(3) of the Marine Mammals Protection Act 1978. Sea lions are listed by the Department of Conservation (DoC) as Range Restricted on the basis of the small number of breeding colonies; however, this classification is currently under review. The New Zealand sea lion was re-classified last year by the International Union for Conservation of Nature (IUCN) as being vulnerable due to population decline rather than the initial classification which stated that it was vulnerable due to a small or restricted population size.<sup>2</sup>

17 The entire 12 nautical mile territorial sea around the Auckland Islands is a marine reserve. As such, all fishing is prohibited in this area which provides some measure of protection to the sea lion populations that inhabit the Auckland Islands. The SQU6T fishery operates outside the territorial sea.

### Sea lion pup production numbers

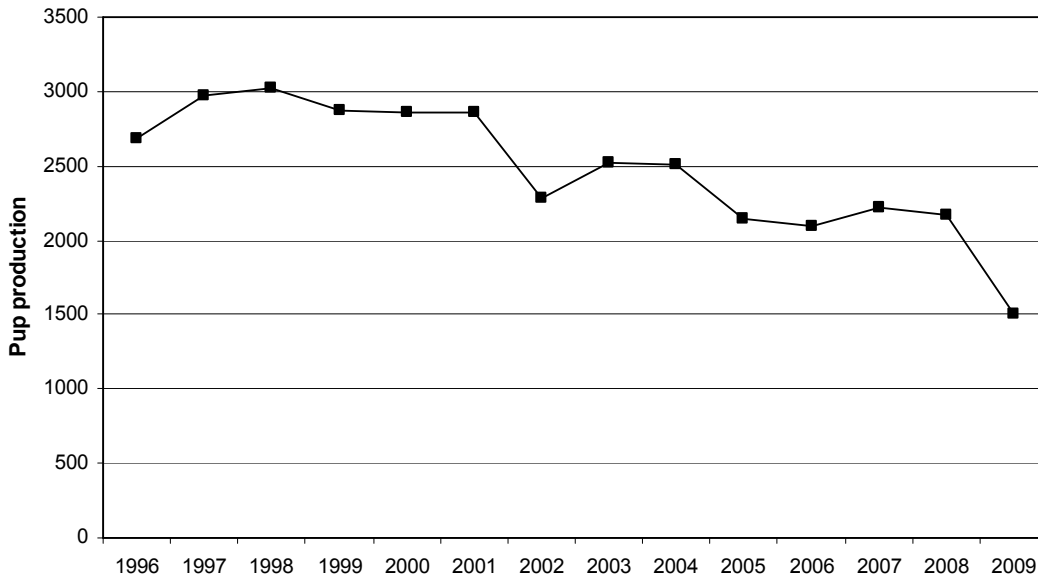
18 Pup production from the Auckland Islands is used to estimate sea lion population size. Pup numbers are an important input into the population model. The 2009 pup count was significantly lower than that of any other year (Table 1 and Figure 2). Although the population model provides for pup numbers lower than those observed in 2009, the model cannot replicate the steep decline between 2008 and 2009.

19 MFish and DoC convened a workshop in May 2009 to discuss the possible causes for this decline. Possible causes included predation, pollution, dispersal or absence of sea lions from the Auckland Islands (as opposed to mortality), bacterial infection, climate change and the direct and indirect effects of fishing. The cause of the decline is not yet known and there is no information to determine whether fluctuations in sea lion pup numbers are the direct result of fishing activity.

**Table 1.** Pup production estimates from the Auckland Islands rookeries combined, 1996-2009 (Source: Department of Conservation).

Year	1996	1997	1998	1999	2000	2001	2002
Pup numbers	2,685	2,975	3,021	2,867	2,856	2,859	2,282
Year	2003	2004	2005	2006	2007	2008	2009
Pup numbers	2,518	2,515	2,148	2,089	2,224	2,175	1,501

<sup>2</sup> The IUCN is the world's largest conservation network. It consists of 90 states, 120 government agencies and more than 900 NGOs.



**Figure 2.** Pup production estimates from the Auckland Islands rookeries combined, 1996-2009 (Source: Department of Conservation).

### ***Population Management Plan***

20 The Marine Mammals Protection Act 1978 provides the opportunity for the Minister of Conservation to approve a population management plan (PMP). DoC released a draft PMP for consultation in 2007; however, DoC has since announced that it does not intend to continue developing a PMP at this time. Consequently, decisions you make on the annual Operational Plan will manage the interactions between sea lions and the SQU6T fishery.

### **Legislative obligations and considerations**

21 Section 15 of the Act sets out your responsibilities for managing the fishing-related mortality of protected species; including marine mammals. The New Zealand sea lion is a protected species under the Marine Mammals Protection Act 1978.

22 Section 15(2) states that you may take such measures as you consider are necessary to avoid, remedy or mitigate the effect of fishing-related mortality on any protected species, and measures may include setting a limit on fishing-related mortality. Your decision to set an FRML is made under s 15(2).

23 As the Minister of Conservation has not approved a Population Management Plan (PMP) for sea lions, you are required to consult with him before taking any measures under s 15(2).

24 In making your decision on management measures for the SQU6T fishery you are required to consider those measures that are “necessary” to avoid, remedy or mitigate the effect of fishing-related mortality on the sea lion population. In so doing, you are required to:

- a) Act in a manner consistent with New Zealand’s international obligations relating to fishing and with the provisions of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 (s 5).

- b) Consider the purpose of the Act which is to provide for utilisation while ensuring sustainability (s 8).
- c) Take into account the environmental principles set out in the Act (s 9):
  - 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) Habitat of particular significance for fisheries management should be protected.”
- d) Take into account the information principles in s 10 which require that:
  - i) “Decisions should be based on the best available information:
  - ii) Decision makers should consider any uncertainty in the information available in any case:
  - iii) Decision makers should be cautious when information is uncertain, unreliable, or inadequate:
  - iv) The absence of, or uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act.”
- e) Take into account the requirements regarding sustainability measures set out in s 11 of the Act.
- f) Note that there is currently no fisheries plan in place in the SQU6T fishery under s 11A.

25 You should also be mindful of the following:

- 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 sea lion survival after they come into contact with a SLED
- d) The selection of the FRML, the strike rate and the SLED discount rate are individual and separate components of the management decision. This means you should not deliberately try to compensate or offset one decision by being more optimistic or pessimistic in another. MFish acknowledges that, in terms of the day to day management of the fishery, the FRML, strike rate and SLED discount rate are inextricably linked.
- e) 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 the Ngai Tahu Claims Settlement Act 1998.

## **PART 3: STRIKE RATE AND DISCOUNT RATE**

26 The strike rate and SLED discount rate are important components of the population model. The FRML is derived from the Rules that meet the management criteria and for this reason strike rate and SLED discount rate are discussed prior to discussing possible FRMLs for the coming season.

### **Strike Rate**

27 When the FRML is set, fishing activity is 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 enable sea lions to escape the trawl net.

28 Therefore an approximation of fatal interactions between squid vessels and sea lions is used. This is known as the strike rate and is currently set at 5.65%. Applying this strike rate means that for every 100 tows undertaken, 5.65 sea lions are presumed killed and counted against the FRML.

29 The current strike rate is based on the modelled assessment of the mean strike rate for SQU6T vessels for each of the following three fishing seasons: 2003-04, 2004-05 and 2005-06. Further modelling of the strike rate was undertaken in 2008 which estimated a strike rate of 5.6% with a 95% confidence interval from 2.7% to 10%. This is very close to the current strike rate of 5.65% and well within the estimated confidence interval.<sup>3</sup>

30 There remains some uncertainty associated with the modelled strike rate which is likely to vary from season to season. 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 the average strike rate is close to 5.65%.

### **Submitters' views**

31 Forest and Bird, EDS and Bruce Robertson submitted that a strike rate of 5.65% may be a significant underestimate and should be considered the minimum. They considered the best estimate to be 11.65% which was estimated when observer coverage was 100%.

32 WWF submitted that the strike rate should be updated; however, no additional detail was given on how this update should be conducted.

33 Industry agreed that the current modelled estimates are the best available information on the strike rate and the value of 5.65% should be retained.

### **MFish recommendation**

34 MFish recommends continuing to estimate sea lion mortalities using a predetermined strike rate and considers that the recent modelling represents the best available information.

---

<sup>3</sup> Thompson FN and Abraham ER. 2009. Estimation of the capture of New Zealand sea lions (*Phocarctos hookeri*) in trawl fisheries, from 1995-96 to 2006-07. New Zealand Aquatic Environment and Biodiversity Report 2009.

The strike rate is an important input into the population model that is used to calculate FRMLs that meet the management criteria discussed below. Any change to the strike rate would require the model to be re-run with the new value. For these reasons, MFish recommends that the strike rate for the 2009-10 SQU6T season should remain unchanged at 5.65%.

## **SLED Discount Rate**

35 SLEDs are installed inside trawl nets and allow sea lions to escape alive from the net. The “discount rate” refers to the relative survival of sea lions encountering a net with a SLED that would have otherwise drowned in a net without a SLED. Since the 2003-04 season a discount on the strike rate has been applied to tows where vessels have deployed an approved SLED 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% which means that for all eligible tows during the 2008-09 SQU6T fishery the strike rate was reduced from 5.65% to 3.67%.

36 Information on SLED efficacy is incomplete. Two factors influence how effective SLEDs are at reducing sea lion mortalities: the escapement rate of individuals from the net through the escape hatch of the SLED, and the survival rate of animals that escape. New information is available and further work is being undertaken that may help improve the certainty about SLED efficacy; this work is described briefly below.

## ***Best available information***

### ***Scientific information***

37 The best available completed science information is from a 2001 study where seven animals, caught in SLEDs with cover nets tied down, were sent for necropsy. These animals were sea lions that were able to make their way through the fishing gear and would have escaped if the cover net had not been tied down. An assessment was made, based on the likely cause of death and the extent of the injuries sustained, as to these seven animals likely chance of survival, had they not been retained in the SLED cover net. The results from this research study estimate that two of the seven animals would have survived if they had managed to escape from the trawl net. The remaining five animals were shown to have sustained injuries that would have impaired their survival. The pathologist’s report on the necropsied animals was also reviewed by four additional veterinary pathologists with experience in this field.

38 However there remain some outstanding areas of uncertainty associated with this research which includes:

- a) the very small sample size
- b) the difficulties that surround distinguishing between injuries caused by interactions with the SLED and injuries that the sea lions might have sustained when trying to escape through the cover net.

These results were used as the basis for the 20% discount rate that was used until the start of the 2007-08 fishing year.

39 Further analysis is currently underway to assess the nature and extent of the injuries

observed from sea lions that are recovered from the trawl gear. Provisional results show that some injuries which previously were thought to be due to the interactions with SLEDs are likely to be caused by the effects that freezing has on the sea lion carcass and are not actually trauma. MFish is having all information from previous necropsies collated and formally reviewed. This is to assess if previous assumptions about sea lion survivability, based on assumed trauma incurred following interactions with SLEDs, may in fact be due to the effects of freezing. These data, and the results of the freezing study described above, may be important in assessing the survival prognosis of sea lions that interact with SLEDs.

40 MFish science advise that, after considering the whole range of science information on the survival of sea lions that encounter trawls equipped with SLEDs (including the 2001 experiment, the more recent necropsy programme, underwater camera work, and the preliminary study of freeze-thaw artefacts), that they favour the 2001 estimate as the most reliable. However, there remains substantial uncertainty around the real survival rate and MFish science considers that a broad continuum of values is plausible. This was the basis for the most recent revision of the Breen-Fu-Gilbert model including base case assumptions of 0, 20, 35, and 50% survival. Overall, MFish science considers 20 and 35% to be better assumptions than 0 and 50% and, on balance, 20% should be preferred over 35%. MFish science will review new information as it becomes available or is finalised and will reassess this position as appropriate.

### ***Management information***

41 The SLED discount rate was increased in 2007-08 on the basis of new management information. This information related to improvements in SLED design and improved performance around the deployment of SLEDs onboard squid trawlers.

42 The improvements to the SLED design included decreasing the space between the grid bars to ensure sea lions were less likely to swim through the grid and get caught in the cod-end. More recent modifications include changes to the SLED kite and hood to make sure they are deployed correctly to give sea lions every chance to escape from the trawl gear.

43 In recent years considerable effort has gone into ensuring all vessels are using compliant SLEDs when they trawl for squid in SQU6T. This has included pre-season SLED audits, observers measuring SLEDs and monitoring SLED use during trips, and MFish fishery officers inspecting SLEDs when vessels return to port. This now means that MFish is satisfied that all vessels use approved SLEDs.

### ***New information from the 2008-09 season***

44 As in previous seasons there is some new information from camera footage that contributes to an improved understanding of the use of SLEDs and the survivability of sea lions.

### ***Camera footage***

45 For the first time, camera footage from the 2008-09 season showed animals escaping from the trawl net through the SLED. Camera footage clearly shows a sea lion, a fur seal and a large shark swimming out of the escape hatch in the top of the trawl net. On each occasion animals appear to be actively swimming and competent. These are the only two observations of marine mammals and what subsequently happens to sea lions that swim from the net

remains a source of conjecture. However, observing a sea lion actively swimming from the SLED lends weight to the argument that some sea lions suffer no long term adverse effects from interacting with a SLED. This footage was presented to and discussed by the SLED Working Group<sup>4</sup> on 1 September 2009, although this has yet to be peer reviewed by the Aquatic Environment Working Group (AEWG).

46 The observed escapes occurred under conditions of artificial white light which is thought to be an attractant to sea lions and may influence their behaviour. Although it is not known to what extent the use of white light may affect sea lion behaviour in or around a trawl net, researchers recommend using low intensity or infrared light to minimise these artefacts.

47 MFish notes that the majority of trawls in SQU6T occur on the seabed and this causes bottom sediments to be suspended which obscures the escape hatch of the SLED from the camera; as such, observations of sea lion interactions with SLEDs cannot be made under these conditions. The lack of sediment disturbance may mean this camera footage may not be representative of a large proportion of tows.

### ***Necropsy data from 2009***

48 Four sea lions were reported captured from the SQU6T fishery in 2009; three female and one male. Two captures were reported by vessels carrying an MFish observer and two were reported by vessels without an MFish observer. Three of the four animals were returned for necropsy, the results of which were presented to the AEWG on 27 November 2009.

49 Death was attributed to drowning in all three cases. However, the injuries to each sea lion were assessed to help determine whether the injuries would have reduced the likelihood that these animals would have survived had they escaped from the trawl net. For each sea lion three categories of injury were considered: body wall trauma, body cavity trauma and head trauma. The pathologist considered that “bruises” on the body wall and body cavity trauma are likely to be artefacts of freezing and thawing the bodies. Consequently, these would not have affected the survival prognosis of these animals had they escaped from the net.

50 Two sea lions had apparent bruising to the back or the head or neck; the third had no bruising. Although there is still uncertainty about the cause of the apparent bruising, it could have been caused by an interaction with a SLED. Equally, there is also the possibility that these are also some form of artefact caused by freezing and this possibility warrants further investigation. Given that head injury may impair consciousness, a cautious approach is taken and a trauma severity of ‘moderate’ was assigned.

51 In summary, one sea lion had mild trauma and was assessed as having a good to excellent chance of survival had it escaped the net. Due to the bruising on the head, the other two sea lions were considered to have had moderate trauma which was likely to decrease the survival prognosis had they been able to escape the net.

### ***Submitters' views***

52 Forest and Bird and EDS submitted that the discount rate should set at 0% for vessels

---

<sup>4</sup> The SLED working group is a discussion forum made up of scientists and managers from MFish and DoC and also representatives from NGOs and the commercial fishing industry. The group addresses 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 nor is it a formal science evaluation forum.

using SLEDs because they have not yet been proven to allow sea lions to escape nets and survive. Bruce Robertson favoured reducing the discount rate to 20% as a more cautious approach based on previous experimental data. WWF submitted that the efficacy of SLEDs must be assessed.

53 Conversely, Industry submitted that the best available information supports a SLED discount rate of at least 50%. This view was based on the recent camera work, continuous improvements to SLED design and the preliminary work on the effect that freezing may have had on survival prognosis.

### ***MFish recommendation***

54 The various assertions made by stakeholders are largely based on differing interpretations of the available information discussed above. Although new information is available this has yet to be peer reviewed or remains incomplete. As such, MFish recommends that the SLED discount rate remain unchanged at 35% for the coming season.

## **PART 4: FISHING RELATED MORTALITY LIMIT (FRML)**

55 The FRML is an annual limit on the number of sea lions that can be incidentally caught in the SQU6T fishery. Since the 2003-04 fishing season a population model has been used to evaluate the performance of harvest control rules against the agreed management criteria to derive an appropriate FRML.<sup>5</sup> Each harvest control rule is examined to estimate 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).

56 This Part of the paper discusses:

- a) The management criteria.
- b) The population model.
- c) MFish recommendation on the FRML for 2009-10.

### **Management criteria**

57 The population model assesses the range of harvest control rules against the following criteria:<sup>6</sup>

- 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 population size 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

---

<sup>5</sup> The Breen-Kim model used in previous SQU6T operational plans was updated in 2008 and published as the Breen-Fu-Gilbert model; the updated Breen-Fu-Gilbert model has been used for the 2009-10 season.

<sup>6</sup> These management criteria were developed and approved in 2003 by a Technical Working Group (TWG) comprised of MFish, Department of Conservation, squid industry representatives, and environmental groups. MFish considers that these management criteria best describe what is necessary in terms of s 15(2).

projection runs (to allow for build up of numbers in hypothetical depleted populations over time).<sup>7</sup>

### **Submitters' views**

58 Forest and Bird does not support the management criteria and recommends that you are provided with the following alternative management objective: *Zero mortality of New Zealand sea lions from fishing activities as soon as reasonably practicable and in any event by 2013*. Forest and Bird considers that you should use this management objective as the basis for your management decisions for the 2009-10 fishing year.

59 Similarly, WWF submitted that it is important that the fishery moves to a zero sea lion mortality as soon as possible.

60 Industry submitted that the management criteria are very conservative, far more so than the US marine mammals legislation.

### **MFish comment**

61 You are only permitted to implement management measures that you consider are necessary to manage the interactions between sea lions and SQU6T vessels. It is likely that any management response that meets the management objectives proposed by Forest and Bird or WWF would be beyond what is permitted under the Act and could be legally challenged due to the impact that they would have on utilisation.

## **The Population Model**

62 This section describes the structure of the model in terms of the two series of rules the model uses, effect of uncertainty about the SLED discount rate and the effect of other sources of uncertainty in the model.

### **Two Series of Rules**

63 The population model assesses two series of rules. The first is the Rule 3 series that uses the population model to determine whether each harvest control rule meets the management criteria. From these harvest control rules, FRMLs are generated based on the average of the last two years' pup counts; the FRMLs will vary annually as pup counts vary. The Rule 2 series generates fixed FRMLs that do not rely on estimating the pup numbers each year.

64 In recent years, the Rule 3 Series has been used to set the FRML each season. MFish recommends continuing to use the Rule 3 Series to set the FRML. The reason for this recommendation is that the Rule 3 Series takes into account recent pup numbers which is appropriate given the decline in pup numbers reported earlier this year. Consequently, the following discussion about the uncertainty associated with the population model focuses primarily on the Rule 3 Series.

---

<sup>7</sup> The model results indicate that even in the complete absence of fishing the population would only reach approximately 95% of carrying capacity, which suggests that the model assessment of rule performance against carrying capacity is more conservative than it should be, as the population should be expected to reach 100% of carrying capacity in the absence of fishing.

## Uncertainty about the SLED discount rate

65 To reflect the uncertainty associated with the SLED discount rate, and therefore sea lion survivability, four different model runs are presented. These show the effect that different assumptions about the SLED discount rate have on which rules, and therefore the FRMLs, meet the management criteria. The four SLED discount rates are 0%, 20%, 35% and 50%. The following paragraphs discuss the model results that appear in Table 2.

66 Despite the uncertainty about the SLED discount rate, MFish recommends that it should remain at 35% for the 2009-10 fishing year. Both you and the previous Minister have selected a discount rate of 35% for the 2007-08 and 2008-09 SQU6T seasons. As discussed previously MFish does not consider that there is sufficient new information that would justify a different SLED discount rate at this time.

67 Based on the assumption of a 35% SLED discount rate, Rule 319 (FRML 90) is the highest rule that meets the management criteria. However, if the SLED discount rate is assumed to be 0%, 20% or 50%, different rules will meet the management criteria.

68 For example, if the SLED discount rate is assumed to be 20%, Rule 317 (FRML 81) is the highest rule that meets the management criteria (Table 2). This is because a SLED discount rate of 20% assumes a lower survival rate for sea lions that interact with the trawl gear. As such, the rules and FRMLs that meet the management criteria are also lower.

69 Each FRML will allow a set number of tows based on the assumed strike rate of 5.65%. If you select Rule 319 (FRML 90), based on the assumption of a 35% SLED discount rate, the number of permissible tows would be 2,450. Under a 20% SLED discount assumption the difference in FRML is only nine sea lions but the actual reduction in the number of tows is greater because the strike rate would only be discounted by 20% rather than 35% (1,740 tows would be permitted; 710 fewer). For comparison, there were 1,916 tows last season.

**Table 2.** The highest rules and FRMLs that meet the management criteria when assuming four different SLED discount rates (0%, 20%, 35% and 50%). MFish recommends using the 35% SLED discount rate in the shaded area. Double plus signs indicate that the criteria were met under unconstrained fishing (i.e. no FRML is required). The number of allowable tows for each rule using a strike rate of 5.65%, is also provided.

	35% SLED discount rate		0% SLED discount rate		20% SLED discount rate		50% SLED discount rate	
	Rule	FRML	Rule	FRML	Rule	FRML	Rule	FRML
Base Model	319	90	315	71	317	81	++	++
Permissible Tows	2,450		1,291		1,740		Unconstrained fishing	

70 Although MFish recommends a 35% SLED discount rate, the actual sea lion survival rate may be higher or lower than what is reflected in a discount rate of 35%. This could mean that any FRML chosen based on a 35% discount assumption might not meet the management criteria or conversely could constrain utilisation.

71 If a 35% model assumption is used but the actual sea lion survival rate corresponds with a 50% SLED discount rate then unconstrained fishing would meet the management criteria as opposed to an FRML of 90. Under this scenario no FRML is required (noting that

this does not include the sensitivity trials that are discussed in the following section).

72 Conversely, if the actual sea lion survival rate corresponds to a 20% SLED discount rate then setting the FRML at 90 sea lions would allow greater fishing effort than should be permitted and would result in the management criteria not being met. Under this scenario an FRML of 62 sea lions would provide a more cautious choice (noting that this does not include the sensitivity trials that are discussed in the following section). A FRML of 62 reflects the number of tows permitted under a 35% SLED discount assumption when the strike rate is discounted by 20% rather than 35%.

73 Although MFish does not recommend using a SLED discount rate other than 35%, the Rules that meet the management criteria using discount rates of 0%, 20% and 50% are provided in Table 2 for your information.

### ***Model uncertainty – Sensitivity trials***

74 In previous years, Ministers have been advised that they must be mindful of the model limitations when making any decision to set an FRML. To describe the remaining uncertainty about the sea lion population some of the model assumptions were altered. These changes are described as sensitivity trials and test the influence that varying these parameters has on which harvest control rules and therefore FRMLs meet the management criteria (Table 3).

75 These different model assumptions do not reflect the management criteria nor are they management targets that must be met—they provide the basis for estimating the likely consequences of different management choices.

76 The following areas of uncertainty were addressed using the sensitivity trials:

- a) The maximum rate of population growth (sensitivity trials 1 & 2)
- b) How pup survival responds to population size (sensitivity trials 3 & 4)
- c) The maximum pupping rate (sensitivity trial 5)

77 The five sensitivity trials were run for the each of the four models that assumed 0%, 20%, 35% and 50% SLED discount rates.<sup>8</sup>

78 When MFish's recommended 35% model is run using the base model (i.e. no changes to the model) the rule that just meets the management criteria is Rule 319 with an FRML of 90. When the sensitivity trials are run, the rules and FRMLs that meet the management criteria range between Rule 311 (FRML 52) and Rule 323 (FRML 109) (Column A, Table 3).

---

<sup>8</sup> Sensitivity trial 2 did not meet the management criteria at any point. Based on the assumptions associated with this sensitivity trial, even with no fishing, the sea lion population would go extinct. Dr Paul Breen (the primary author of the population model) considers this is very unlikely given the population's significant reduction due to sealing in the early nineteenth century from which it has subsequently rebounded to a stable higher level. Consequently, MFish questions the credibility of this sensitivity for both the Rule 3 series and for the Rule 2 Series (see later).

**Table 3.** The highest harvest control rule and associated FRML that meets the management criteria for the models run without any sensitivity trials (Base Model). The range of Rules and FRMLs that meet the management criteria for the four sensitivity trials is given for each assumption about SLED discount rate: 0%, 20%, 35% and 50%. Double plus signs indicate that the criteria were met under unconstrained fishing (i.e. no FRML is required).

	Column A		Column B		Column C		Column D	
	35% SLED discount rate		0% SLED discount rate		20% SLED discount rate		50% SLED discount rate	
	Rule	FRML	Rule	FRML	Rule	FRML	Rule	FRML
Base Model	319	90	315	71	317	81	++	++
Sensitivity trials	311 - 323	52 - 109	310 - 317	47 - 81	310 - 319	47 - 90	312 - ++	57 - ++

79 MFish considers that the assumptions that result in an FRML of 109 (sensitivity trial 4) may be too optimistic and may expose the sea lion population to too much risk. Equally, there is a risk that the assumptions that result in an FRML at the lower end of the range (sensitivity trial 3, FRML 52) may be too pessimistic and should only be considered if you wish to remove a significant proportion of the risk to the sea lion population at the expense of the utilisation of the squid fishery. You are not required to choose an FRML based on the results of the most extreme sensitivity trial but you should be mindful of this range of uncertainty when making any decision.

80 As before, if our assumption about sea lion survival is incorrect and a higher or lower SLED discount rate is more accurate then the results of these sensitivity trials also change (Table 3).

81 If sea lion survivability corresponds to a SLED discount rate of 20%, rather than 35%, then the range of FRMLs that meet the management criteria when assessed against the sensitivity trials changes (Column C). Using the base model (no changed assumptions) the rule that just meets the management criteria is Rule 317 (FRML 81). When the sensitivity trials are conducted, the range of FRMLs that meet the management criteria is 47–90 sea lions.

82 As before, if a 35% model assumption is used but the actual sea lion survival rate corresponds to a 20% SLED discount rate then setting the FRML from a range of 52 – 109 sea lions could result in the management criteria not being met. Under this scenario setting a FRML between 38 and 76 sea lions would provide a more cautious choice. This range of possible FRMLs reflects the number of tows permitted under a 35% SLED discount assumption when the strike rate is discounted by 20% rather than 35%.

83 If the 50% SLED discount rate assumption is used then unconstrained fishing would meet the management criteria (i.e. no sea lion FRML is required). When assessed against the sensitivity trials, a range of FRMLs between 57 and “unconstrained fishing” meet the management criteria (see “++” in Column D).

84 Equally if sea lion survivability corresponds to a SLED discount rate of 50% and a 35% SLED discount assumption is used then setting an FRML based on the 35% model run will be unnecessarily restrictive. This would constrain utilisation. In this instance setting management measures based on an incorrect assumption may result in the squid fishery closing early, lost utilisation opportunities and reduced export revenue. Under this scenario setting the FRML between 76 sea lions and unconstrained fishing would provide a more

cautious choice.

85 As described above MFish recommends that you base your decision on the 35% discount rate. However, MFish considers it is important that you are aware of the uncertainty associated with each of the model runs and the likely impact of an incorrect assumption about one or more of the model parameters.

### **Rule 2 Series**

86 Rule 2 allows fixed FRMLs to be generated and does not rely on estimating the pup numbers each year. As was done for Rule 3, Rule 2 was assessed against the management criteria assuming a strike rate 5.65%.

87 The same four assumptions about the SLED discount rate were used to assess Rule 2 against the MFish management criteria. The same sensitivity trials were also run against each of the four models. When assessed against the recommended 35% discount rate, an FRML of 106 meets both MFish criteria. Table 4 shows the highest FRML that meets the management criteria for each sensitivity trial for each of the four models that assume different SLED discount rates.

**Table 4:** The highest harvest control rule and associated FRML that meets the management criteria for the Base Model. The range of FRMLs that meet the management criteria for the four sensitivity trials is given for each assumption about SLED discount rate: 0%, 20%, 35% and 50%. Double plus signs indicate that the criteria were met under unconstrained fishing (i.e. no FRML is required).

	35% Discount Rate	0% Discount Rate	20% Discount Rate	50% Discount Rate
	FRML	FRML	FRML	FRML
Base Case	106	87	93	++
Sensitivity trials	61 – 124	57 – 97	59 – 105	68 -- ++

## **MFish recommendation for the FRML for the 2009-10 fishing year**

### **Rule Series**

88 For the reasons outlined above, MFish recommends that you select an FRML based on the Rule 3 Series rather than the Rule 2 Series.

### **Utilisation**

89 In choosing a harvest control rule and hence an FRML for the 2009-10 fishing year, you should be mindful of the likely impact of your decision on squid utilisation opportunities in the coming year. It is difficult to assess the potential lost utilisation, and therefore revenue, associated with the harvest control rules for the following reasons:

- a) The availability of squid varies from season to season, which influences the number of tows undertaken and the amount of squid caught. During the 2008-09 SQU6T season vessels remained fishing long after the traditional end of the season.
- b) Fishing effort is influenced by the market price and the global market price is influenced by the size and quality of squid, and the global availability and

demand for squid. Market prices are currently high relative to recent seasons, this high price was likely a factor in this year's SQU6T season continuing for longer than normal.

- c) 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 an FRML. Equally, in years of good abundance the TACC, not the FRML, may act as the limit in the fishery. However, MFish notes that fishers have the option to seek an in-season TAC increase under s 14(6), as squid is listed on the Third Schedule to the Act.
- d) The use of export price to determine squid value is problematic and is likely to provide conservative estimates of lost revenue.
- e) The fixed and variable costs associated with fishing activity.

90 Squid continues to be one of the main export earners for the seafood industry. In 2008 the total export value for squid was \$71 million; this is down on 2007 earnings of \$85 million. Only partial export figures are available for 2009, up to September this year squid exports have so far totalled \$71 million.

91 These figures relate 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, about 60% of the reported total squid landings from the 2008-09 fishing year were from SQU6T. In addition, squid harvested from SQU6T is typically larger and commands a higher price.

### **Selecting the FRML**

92 Choosing an FRML requires that you consider the results of the population model, including considering the associated uncertainty, and the need to provide for utilisation of the squid resource.

93 Section 15 of the Act only permits you to take such measures that you consider are *necessary* to avoid, remedy or mitigate the effect of fishing on the sea lion population. In making your decision on where to set the FRML for the 2009-10 fishing year you should consider the harvest control rules that meet the management criteria, MFish considers that these management criteria best describe what is "necessary" in terms of s 15(2).

94 You should form a view as to the extent to which (or perhaps the point at which) utilisation of the squid resource threatens the sustainability of the sea lion population and allow utilisation of squid up to that point. However, there is uncertainty about where this point rests and you should consider s 10 of the Act.

95 You may take into account other possible impacts on the sea lion population when selecting a harvest control rule (e.g. natural disease events or other anthropogenic events such as an oil spill). However, you are not permitted to set an FRML to avoid, remedy or mitigate the effects of any non-fishing activity on the sea lion population.

96 MFish recommends using the Rule 3 series using the current assumptions of a 5.65% strike rate and 35% SLED discount rate while keeping in mind the uncertainty discussed above. Using these assumptions, 12 harvest control rules ranging from Rule 0 (no fishing) to Rule 319 (FRML 90) are presented in Table 5. From within this range, MFish recommends

that you select a Rule between Rule 311 (FRML 52) to Rule 319 (FRML 90). Rule 311 is the lowest Rule that meets the management criteria when the most conservative sensitivity trial is conducted, while Rule 319 is the highest rule that meets the management criteria without sensitivity trials. These Rules provide what MFish considers to be the most appropriate range within which utilisation of SQU6T can be pursued, whilst addressing sustainability risks to the sea lion population.

97 The effect of this range of Rules on the fishery is also estimated in Table 5. For example, based on the population model, Rule 317 (FRML 81) would likely result in a 45% chance of the fishery closing early and 654 fewer tows per year over the long run.

98 Even if the management criteria have been met, you may still act in a more cautious manner and select a lower harvest control rule; similarly, you may select a harvest control rule based on the Rule 2 Series that would set an FRML up to 106. The appropriate degree of caution is that which you consider is necessary in the circumstances.

99 MFish also notes that the range of recommended FRMLs for the 2010 season includes the “cusp rule”. The cusp rule is the point at which the management criteria are just met and for the 2009-10 season is Rule 319 (FRML 90). In previous seasons MFish has not included the cusp rule among its recommended options. The previous model was optimistic and resulted in higher FRMLs meeting the management criteria (e.g. 513 sea lions in 2007-08); consequently, MFish recognised there was significant risk in recommending that you select a FRML based on the cusp rule. The primary reason MFish is recommending up to the cusp rule this season is that changes have been made to the population model so that it better fits the sea lion population. You should be mindful that the validity of the cusp rule changes as the model assumptions change.

**Table 5:** FRMLs for the 2009-10 SQU6T fishing season for each of the harvest control rules that met the management criteria using the Rule 3 Series and the model that assumes a 35% discount rate (the shaded section refers to those rules that MFish is recommending to you).

Rule	Estimated FRMLs (numbers rounded)	Chance of fishery closing early (FRML reached)	Average tows per year lost over the long run
Rule 0	0	100 %	All
Rule 305	24	92 %	1,932
Rule 310	47	74 %	1,260
Rule 311	52	70 %	1,164
Rule 312	57	65 %	1,068
Rule 313	62	61 %	973
Rule 314	66	56 %	877
Rule 315	71	52 %	781
Rule 316	76	49 %	717
Rule 317	81	45 %	654
Rule 318	85	42 %	590
Rule 319	90	38 %	527

**NB:** Lost fishing effort is calculated using assuming an average of 2,871 tows, 1,916 tows were conducted in the 2008-09 fishing year.

## **Submitters' views on the FRML**

100 Forest and Bird submitted that Rule 308 (FRML 38) should be the maximum limit for the 2009-10 fishing year. This was based on a view that the 20% SLED discount rate combined with sensitivity trial 2 was the most realistic scenario. An alternative option of a zero FRML was also suggested.

101 Concerns were raised by Bruce Robertson about the current values used for the strike rate and SLED discount rate, and the significantly higher FRMLs used in previous years; he consequently submitted that the FRML should be set at no more than 52. Similar concerns were raised by WWF who submitted that the FRML should be set at no more than 50.

102 Industry submitted that an FRML is not required in the SQU6T fishery because the best available information indicates the SLED discount rate should be 50%. At a 50% discount rate, unconstrained fishing meets the MFish management criteria. In the alternative, Industry submitted that if an FRML should be imposed, it should be set at 127. Industry considered this appropriate for two primary reasons. First, the model has been revised to address much of the previous uncertainty and hence a conservative approach is not necessary.

103 Secondly, Industry points to one known area of conservative bias in the model. In the absence of fishing, the model population consistently stabilises at a level below the population's carrying capacity  $K$ . For most of the sensitivity trials, the stable level is approximately 95% of  $K$ . This makes it more likely that model runs will fall below 90%  $K$  and therefore fail the second management criterion. Industry argues that unconstrained fishing should in fact meet the second management criterion and therefore model performance should be based on the first management criterion which is met by Rule 327 (FRML 127).

104 MFish accepts that the bias identified by Industry exists in the model, but note that other areas of bias also exist that make the population model more optimistic.

## **MFish response**

105 Stakeholders' submissions on the FRML are largely based on their views on inputs into the model and the model uncertainty. MFish has responded to these issues in the relevant areas of this advice. In summary, the reasons for MFish's recommendations are as follows:

- a) MFish recommends using the Rule 3 series in preference to the Rule 2 series given it provides more protection to the sea lion population at small population sizes and allows more utilisation at higher population sizes. However, if Rule 2 was used, the highest FRML that meets both MFish criteria when assuming a 35% SLED discount rate is 106; any FRML up to 106 is available to you.
- b) MFish recommends that the SLED discount rate should remain unchanged at 35% for the coming season. As such, MFish recommends setting the FRML using the Rule 3 Series and an assumed SLED discount rate of 35%.
- c) When using the 35% SLED discount rate, the highest harvest control rule that meets both MFish criteria is Rule 319 (FRML 90). MFish recommends that Rules between 311 (FRML 52) and Rule 319 (FRML 90) reflect the most appropriate balance between sustainability and utilisation. The sensitivity trials, summarised in Table 3, provide some measure of the uncertainty

associated with the model and should be considered when making your decision.

## **PART 5: MONITORING AND REPORTING**

### ***Overview of 2008-09 season***

106 For the 2008-09 SQU6T fishery the estimated sea lion mortality was 72 sea lions from an FRML of 113. Based on the reduced pup count for the 2009 season, the fishing industry voluntarily reduced their effort to equate to an FRML of 95. MFish Observers observed 38% of all tows in the fishery during the season. Due to the use of SLEDs the total number of actual recorded sea lion mortalities was four; three were returned for necropsy.

107 A total of 1,916 tows were undertaken during the 2008-09 season and 1,826 (95%) tows were eligible for the discounted strike rate. Non-compliance with the SLED requirements was due to minor technical departures from the SLED specifications that were not detected during the pre-season SLED audit.

108 There has been concern in previous years that mortalities were only reported by vessels carrying an MFish Observer. In the 2008-09 season two of the four reported captures were from vessels which had an MFish Observer onboard and two were from unobserved vessels.

### ***Monitoring and reporting requirements for 2009-10***

109 MFish proposes to implement the same monitoring and reporting procedures that were in place for the 2008-09 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.

110 Before a vessel can receive the recommended SLED discount 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.

111 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 recent seasons will continue.

112 As in previous years, all SLEDs will be audited by MFish Observers and fishery officers to ensure operators deploy SLEDs that meet the agreed specifications. Both the MFish Observer Programme and MFish Field Operations 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.

113 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.

114 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 delivered to Massey University for necropsy. They will be identified in subsequent reports as animals recovered from non-observed vessels.

115 MFish also intends to continue with a minimum target of 30% observer coverage across the SQU6T fishery during the 2009-10 fishing season.

## **Closure procedures**

116 Under s 15(5) of the Act you may close the SQU6T fishery when the FRML is reached. Should the estimated mortality get close to the FRML, MFish will advise you of this fact so you may consider closing the SQU6T fishery by Gazette Notice once the limit is reached.

117 This closure would be undertaken without consultation but MFish would ensure all participants in the fishery are kept updated on levels of fishing activity against the FRML throughout the fishing season. For the past three seasons, MFish has sent weekly reports to all stakeholders providing information on progress towards the FRML, so ample warning of the closure would be available.

## PART 6: RECOMMENDATIONS

- 118 MFish recommends that in order to manage interactions between the SQU6T fishery and sea lions for the 2009-10 fishing year you:
- a) **Agree** to implement an Operational Plan for the 2009-10 SQU6T fishery to ensure the management objectives for the sea lion population are met.
  - b) **Agree** to use a strike rate of 5.65% (status quo) to estimate the total number of sea lion mortalities against the FRML.
  - c) **Agree** to apply a discount on the strike rate (SLED discount rate) of 35% to those vessels deploying an approved SLED and where the prescribed reporting procedures have been met (status quo).
  - d) **Agree** to set the FRML for the SQU6T fishery for the 2009-10 fishing year from within a range of 52 – 90 sea lions. Note that this range of options is based on the Rule 3 series using the 35% SLED discount rate assumption (\_\_\_\_\_ sea lions).
  - e) **Note** that you may close the SQU6T fishery under section 15(5) of the Fisheries Act 1996 in the event that the FRML is reached.
  - f) **Note** that Ministry officials are able to brief you on this issue at your convenience.
  - g) **Note** you are required to consult with the Minister of Conservation before you take measures under s 15(2). An additional copy of the Final Advice Paper and a letter to the Minister of Conservation are provided.

Aoife Martin

**Manager Deepwater Fisheries**

APPROVED/NOT APPROVED/APPROVED AS AMENDED

Hon Phil Heatley

**Minister of Fisheries**

/ / 2009