



**Forest
& Bird**
GIVING NATURE
A VOICE

Ministry of Fisheries
PO Box 1020
WELLINGTON

2 November 2009

Submission: 2009-10 SQU6T Operational Plan - Initial Position Paper

Forest & Bird appreciates the opportunity to comment on the Initial position paper (IPP).

Summary

- The IPP fails to consider legal obligations to protect New Zealand sea lions under other legislation. In particular, it has failed to take into account the Marine Mammal Protection Act and the requirement that anyone involved in the taking of a marine mammal (alive or dead) is required to first obtain a permit from the Minister of Conservation, irrespective of whether this taking is accidental or incidental.
- The 2009-10 IPP is poorly presented, is highly selective in the information given, does not present some information and is ultimately very misleading.
- The process of setting a fishing related mortality limit (FRML) is fundamentally flawed due to inappropriate management objectives and assumptions and the fact that the fishery avoids penalties on tow number by making tows longer in duration.
- The model used to estimate FRMLs and its ongoing limitations have been very poorly explained.
- An extremely cautious approach to setting an FRML is needed due to high levels on uncertainty and following the alarming 31% reduction in pup numbers last summer.
- The current predetermined strike rate of 5.65 per 100 tows may be a significant underestimate and should be considered the minimum when estimating sea lion captures against the FRML. A strike rate of 11.65 is the best estimate as it is the only one derived from 100% observer coverage.
- There should be no award system or discount factor applied for using sea lion exclusion devices (SLEDs) as nets with SLEDs are still killing sea lions and they are not yet been proven to allow sea lions exiting trawl nets to survive.

- The FRML for the 2009-10 fishing year should be closer to zero than previous years. The FRML calculated under rule 308 (38 sea lion deaths) is the only estimated FRML that meets the Ministry's management criteria under all of the possible scenarios. We consider that such an FRML is the maximum limit that the Minister should approve for the 2009-10 fishing season as part of a cumulative reduction strategy to achieve zero mortality by 2013.
- The FRML should be applied across all fisheries known to have caught NZ sea lions.
- The monitoring and reporting regime is supported. However, observer coverage should be increased closer to 100% to avoid and remedy biased reporting experienced in past years.
- In addition to tools under the Fisheries Act, the Operational Plan should be supported by:
 - Extension of the no-trawl Marine Mammal Sanctuary around the Auckland Islands to the continental shelf edge (500m contour);
 - Promotion and trialling of squid jigging around the Auckland Islands;
 - Transfer of quota to other fishing areas or fishing methods.

Forest & Bird

Forest & Bird (The Royal Forest & Bird Protection Society of New Zealand Inc) is New Zealand's largest independent conservation organisation. Established in 1923 we have campaigned for over 80 years for the protection of New Zealand's native species and the habitats on which they depend.

We have grown to number around 50,000 members and supporters - many of whom join us to save their local species and habitats. Our members are people who care passionately about New Zealand's unique and special natural environment and native species, and want to make sure that these natural treasures are protected so that they can continue to be enjoyed by future generations.

The constitutional purpose of Forest & Bird is to:

"To take all reasonable steps within the power of the Society for the preservation and protection of the indigenous flora and fauna and natural features of New Zealand, for the benefit of the public including future generations."

Protection of natural features includes indigenous forests, mountains, lakes, tussocklands, wetlands, coastline, marine areas, offshore islands and the plants and wildlife found in those areas.

Forest & Bird has a long history of advocacy for the protection of New Zealand's marine mammals and has been at the forefront of efforts to protect New Zealand sea lions (*Phocarctos hookeri*).

In much the same way that we do not support an allowable kill of Kiwi or Kakapo, Forest & Bird considers that no sea lion or other marine mammal that has full protection under the Marine Mammal Protection Act should be killed in any fishing operation, either accidentally or deliberately.

Forest & Bird considers the management objective for the Ministry of Fisheries in relation to New Zealand sea lions should be:

Zero mortality of New Zealand sea lions from fishing activities as soon as reasonably practicable, and in any event by 2013.

Introduction

Last year's decision

Forest & Bird consider that the Final Advice Paper (FAP) on the 2008-09 SQU6T Operational Plan was inadequate and that as a result, the Minister's decision on the Plan was flawed.

It is our view that the advice was misleading, was selective in the information presented, overstated some of the available information while understating or ignoring other relevant information and was framed in a manner that favoured the utilisation of squid. In doing so, the advice did not provide for obligations under the Fisheries Act to ensure sustainability (s8), maintain the New Zealand sea lion population above a level that ensures their long-term viability (s9) and take measures necessary to avoid, remedy or mitigate the adverse effects of fishing-related mortality on New Zealand sea lions (s15).

This year's Initial Position Paper

The Ministry of Fisheries (MFish) initial position paper (IPP) on the 2009-10 SQU6T Operational Plan exhibits similar problems. The structure of the IPP is very awkward, making it difficult to read and understand, with important information and explanations scattered across different sections. The information is also presented in a highly technical manner that is very difficult for non specialists to understand. It is also highly selective in the information presented while understating or ignoring other relevant information, is framed in favour of squid utilisation and is therefore very misleading.

New Zealand sea lions are in decline.

The population demise of our sea-lions began in the 1800s, when they fell victim to sealers' clubs bringing them to the brink of extinction and leaving only scattered populations on our remote sub-Antarctic islands. These populations have not been able to recover. The only positive sign of some recovery is the few breeding animals now found on the mainland around Otago. However, over 80% of NZ sea lions breed around the Auckland Islands.

Since 1998, the Auckland Island population of NZ sea lions has declined by 50%. It has suffered catastrophic reductions in numbers due to disease events and this summer suffered an alarming 31% reduction in pup numbers. The status of New Zealand sea lions was revised in 2008 to recognise this worrying trend.

Fishing, by both the SQU6T fishery and other fisheries in the area, is by far the greatest known source of human-caused deaths of NZ sea lions.

The IPP fails to give due attention to the status of NZ sea lions and this should be highlighted at the very front of the Final Advice Paper (FAP) to the Minister.

Management of sea lion bycatch in our fisheries is clearly not working and does not meet the minister's obligations under the Fisheries Act, the Marine Mammal Protection Act, nor other pieces of legislation.

Setting a fishing related mortality limit (FRML) has only resulted in condoning the role of fishing (both direct and indirect impacts) in the ongoing decline of this threatened species. Use of the highly complex and problematic model used to estimate FRMLs has also compounded poor decision making processes.

The assumption when implementing an FRML is that the effects of fishing are regulated to reduce the impact on NZ sea lions. It does this by limiting the number of tows the SQU6T trawl fishery can conduct. However, in practice, restrictions to the number of tows are simply worked around by extending the duration of tows. Since FRMLs and sea lion exclusion devices have been used in the SQU6T fishery, this is exactly what has happened. This information is not presented in the IPP, but should be included in the FAP.

1. Legal obligations

While the Operational Plan falls under the Fisheries Act, other Acts still provide guidance to the Minister of Fisheries in making a decision.

The Marine Mammal Protection Act is mentioned briefly on page 5 of the IPP. However, the Marine Mammal Protection Act is completely omitted from part five of the IPP on statutory considerations (pages 28 and 29).

This indicates that wildlife protection provisions of the Marine Mammal Protection Act have not been considered in developing the IPP.

The IPP needs to specifically address what is being done to recognise the threatened status of the New Zealand sea lion.

In particular, the Marine Mammals Protection Act gives particular guidance to s.15 of the Fisheries Act in relation to implementing measures to avoid, remedy or mitigate the effects of fishing on NZ sea lions:

*"In setting any area-based limit for a threatened species under section 3E(1)(g) of this Act, the Minister shall determine a level of fishing-related mortality for a discrete population referred to in subsection (1) of this section which should **neither cause a net reduction in the size of the population nor seriously threaten the reproductive capacity of that population**" – section 3G(2).*

and

"Notwithstanding anything in any other enactment, but subject to this Act, no person shall-

(a) Hold a marine mammal in captivity; or

(b) Take a marine mammal, whether alive or dead, in or from its natural habitat or in or from any other place -

Without first obtaining a permit to do so from the Minister [of Conservation] or from any person or persons authorised in that behalf by the Minister.” – section 4(1).

In other words, IPP fails to consider legal obligations to protect New Zealand sea lions under other legislation. In particular, it has failed to take into account the Marine Mammal Protection Act and the requirement that anyone involved in the taking of a marine mammal (alive or dead) is required to first obtain a permit from the Minister of Conservation, irrespective of whether this taking is accidental or incidental.

2. Management objectives

Forest & Bird do not support the Ministry of Fisheries (MFish) management objectives (criteria) (para 26 of the IPP) for setting a FRML.

The single most important problem with the objectives is that they are based on the assumption that we know what the carrying capacity (k) of the population is. Unfortunately we have no reliable estimates of carrying capacity and there is no agreement within the Aquatic Environment Working Group (AWEG) as to what it might be. Previous work by scientist Dr Paul Breen (NIWA) suggested the Auckland Island population was close to k. However, this year his estimates suggest this to be incorrect, with the population estimated to be far lower than this critical parameter.

Another problem is the assumption that it is acceptable to allow a percentage kill of NZ sea lions – a threatened species that is in decline and is protected under other Acts. Implementation of this management objective thereby contravenes other Acts the Minister must take into consideration. It also fails to adequately address the role of fishing during the 11 year decline of sea lions. It is an inadequate objective that Forest & Bird has repeatedly objected to.

We note that the Department of Conservation have developed alternative management criteria, largely based on concerns about the role density dependence plays in allowing the depleted sea lion population to recover. We note that the DOC criteria are not presented in the IPP.

Forest & Bird recommend that the DOC criteria be presented to the Minister in the FAP to ensure he is made aware of the different concerns and the resulting outcomes of applying alternative management criteria.

For example, sensitivity trials assuming no-density-dependence show that the mature sea lion population is expected to decline markedly under both no fishing and unlimited fishing scenarios. The population is projected to recover after this collapse only under no fishing conditions and would only start to do so after 2045.

The Society considers that the MFish management objective, in relation to New Zealand sea lions, should be:

Zero mortality of New Zealand sea lions from fishing activities as soon as reasonably practicable, and in any event by 2013.

3. Model used to estimated FRML

Setting of a FRML for the SQU6T fishery was originally derived using the Potential Biological Removal model (known as the PBR or New Zealand Wade Rule). Use of this model for the 2009-10 fishing year, would result in an FRML of 47 according to Table 1 of the IPP (which assumes a 5.65 strike rate and 35% discount rate).

Since the 2003-04 fishing season, FRML options have been derived using the Breen-Kim model. In 2008 this was revised into the Breen-Fu-Gilbert model following considerable debate about its limitations. In 2009, it was further modified to correct for its previous failure to predict the low pup count observed over the summer.

At the front of the IPP the MFish simply state that the model has improved. However, the very important ongoing limitations with the revised model are not presented until much later in the IPP.

Whilst the IPP comments on the ongoing uncertainty of the Breen-Fu-Gilbert model at the front of the document (para28) it does so in a broken manner (with important details given later) and asserts that the sensitivity trails conducted are adequate enough to understand this uncertainty.

Forest & Bird have expressed considerable concern about the use of the model in the past and do not support the use of the Breen-Fu-Gilbert model to set an FRML for the 2009-10 fishing season. Our reasons for objecting to the use of this model are quite simple. There are far too many assumptions, uncertainties and problems associated with the model and it's use to have any confidence in avoiding, remedying or mitigating the adverse effects of fishing on New Zealand sea lions.

Our principle concerns, outlined below, should be given far greater attention in the FAP, as this information is either absent or it is poorly explained in the IPP.

3.1 Sensitivity, uncertainty and the enormous range of options

The IPP understates the huge uncertainties associated with the Breen-Fu-Gilbert model and its ability to give appropriate estimates of FRMLs.

The IPP introduces the model and lists 4 of the uncertainties (page 7). It then goes on to explain how the rule series work (pages 7-10). Then the reader is taken back to the 4 listed problems (focussing on discount rate) and poorly describes the limited sensitivity trails that were conducted (pages 10 – 13). Only after this does the IPP come back to listing the other problems associated with the model (page 14 and the top of page 15).

Due to the uncertainties in critical parameters (such as pupping rate, maximum growth rate, density dependence) and its inability to fit other parameters (such as the far lower pupping rates estimated by Gilbert & Chilvers and by another contractor), the Breen-Fu-Gilbert model's estimation of FRMLs is highly sensitive to any small changes in assumed values for these variables. In other words, a minor tweek in any one parameter may considerably alter the estimated FRML values.

The AEWG discussed the need to run a number of sensitivity trials. Due to the limited time of Dr Breen (who leads this work as NIWA contractor to MFish), only a few of the requested sensitivity trials were able to be completed. This important point is not covered in the IPP, leaving the impression that the sensitivity trials run are comprehensive enough to make a fully informed decision.

As a result, the information presented in Table 4 of the IPP are only a very small sample of the range of options resulting from use of this model and decisions around influential parameters such as discount rate.

Table 2 of the IPP illustrates the huge variation in FRML values simply within the base case scenario (strike rate 5.65 and discount rate of 35%). For example, it shows that for each FRML value presented the number of sea lions killed could be significantly higher in reality. Under the PBR or 310 rule for example, the FRML is 47, when actually up to 143 sea lions could possibly be killed. This is not clearly explained in the IPP.

The scale of risk in the Minister's decision is therefore only partially explained. The FAP should include a comprehensive and clear explanation of the model's limitations.

3.2 Increased catchability

Projections of the new model have shown that catchability of NZ sea lions has increased markedly¹, with estimated values after 1997 being much higher than those before 1997. In their report, the authors note:

'Catchability may show a time trend (Figure 1), thus uncertainty about future catchability must translate to uncertainty about rule performance.'

The IPP briefly recognises an increase in catchability (para 54d), but rather than identify the need for caution, suggests that catchability trends may also be decreasing. The figure presented in the research report should be included in the FAP along with a more detailed explanation of the impacts of this finding in relation to legislative obligations. A statement in the executive summary about increased catchability and the resulting uncertainty about rule performance is also warranted.

3.3 Increased number of female sea lion captures

For the last 8 years, New Zealand sea lions captured in the SQU6T fishery have been dominated by female sea lions (Table 1)². Prior to the year 2000, the male to female capture ratio was roughly 50:50.

Since the SLEDs have been in full time use in the fishery (2004) the proportion of adult females captured on observed vessels has increased to 82%³. Adult females are the most important in terms of rebuilding the depleted NZ sea lion population. This trend is therefore very important and both the % change in capture rates and Table 1 should be included in the FAP.

Of the 6 dead females reported in the SQU 6T fishery during the 06-07 fishing year, autopsies revealed all 6 were mature, were pregnant and had produced a pup in the 06-07 breeding season. In the 2007-08 fishing season, all 3 reported females were pregnant. This suggests that for each female sea lion killed in the fishery, the indirect effects of fishing mortality may be up to three times that reported and used for monitoring the estimated number of captures against the FRML.

Whilst the increased capture of female sea lion is noted in the IPP (para 59a) and the model now corrects for the impact on pups, this information should be given greater emphasis in the FAP.

1 Breen, P. A., Fu, D., Gilbert, D. J (2008) Sea lion population model projections and rule evaluations for Project IPA200609, Objective 4. NIWA Research Report.

2 The 2008-09 sea lion captures have not yet been reported.

3 Chilvers, B. L. (2008) New Zealand sea lions *Phocarctos hookeri* and squid trawl fisheries: bycatch problems and management options. *Endangered Species Research*.

Table 1. Observed New Zealand sea lion captures in SQU6T in the seasons 1991/02 to 2007-08 (modified from Chilvers, 2008) (The predominant sex killed in each fishing year is shown in bold.)

Fishing Year	NZ sea lion captures			Pregnant females	Lactating females
	Males	Females	TOTAL		
1991/92	5	3	8		
1992/93	2	3	5		
1993/94	2	2	4		
1994/95	4	4	8		
1995/96	3	10	13		
1996/97	20	9	29		
1997/98	11	4	15		
1998/99	1	4	5		
1999/00	13	11	24		
2000/01	16	22	38		
2001/02	6	16	22		
2002/03	4	6	10		
2003/04	2	14	16		
2004/05	3	6	9		
2005/06	1	10	11		
2006/07	2	6	8	6	6
2007/08	2	3	5	3	0

* One sea lion was unsexed in the 2000 season

3.4 Sea lion deaths in other fisheries

The Breen-Fu-Gilbert model is only applied to the SQU6T fishery and so does not take into account the number of sea lion deaths in other fisheries and the likely effects this has on the population.

Whilst the current approach uses just the Auckland Islands sea lion data, the Minister should be made aware of the number of sea lion deaths from this region in other fisheries. For example, both the executive summary and the main body of the FAP should state the fishery and number of sea lions captured in fisheries other than SQU6T.

In our submission on the Department of Conservation's draft Population Management Plan (PMP), we included the following table (Table 2). We consider that a table such as this should be updated and included in the FAP. It is an appropriate way to illustrate the degree of risk associated with the current management approach on the Minister's ability to avoid, remedy or mitigate the adverse effects of fishing-related mortality on New Zealand sea lions (s15).

A current MFish contracted report by Dragonfly, referenced in the IPP (page 22), suggests that other fisheries may kill more sea lions than the SQU6T fishery

The southern blue whiting fishery and the scampi fisheries are particularly worrying. For example, sea lion deaths in the southern blue whiting fishery have increased in recent years, with 2 reported dead in the 2005-06 fishing year and 3 reported dead in the 2007-08 fishing year⁴. At a 2008 AEWG meeting (22 October 2008) Massey scientist Wendi Roe reported that two of the animals returned from the

4 DOC (2008) DRAFT Conservation Services Programme observer report for the period 1 July 2004 until 30 June 2007.

2007-08 fishing year showed that the sea lions had sustained similar trauma to those returned from the SQU6T fishery, including one with a brain contusion. This information, along with a table such as the above Table 2 should be included in the FAP to illustrate the possible risk associated with other fisheries.

Table 2. Crude estimation of the number of New Zealand sea lions killed in trawl fisheries other than SQU6T south of 46o – 1997/98 to 2003/04 (modified from information in the draft PMP, Table 2).

Fishing Year	SCI			ORH			JMA			HOK			SBW			Total Estimated
	R	%OC	EB	R	%OC	EB	R	%OC	EB	R	%OC	EB	R	%OC	EB	
1997/98	0	4	0	1	22	5	0	15	0	0	9	0	0	10	0	5
1998/99	0	2	0	1	14	7	0	9	0	0	7	0	0	7	0	7
1999/00	0	4	0	0	19	0	2	17	12	1	4	25	0	9	0	37
2000/01	4	4	100	0	1	0	0	45	0	0	2	0	0	18	0	100
2001/02	0	4	0	0	10	0	0	18	0	0	3	0	1	10	10	10
2002/03	1	9	11	0	13	0	0	18	0	1	3	33	0	15	0	44
2003/04	3	9	33	0	25	0	0	8	0	0	5	0	1	10	10	43
Total (7 yrs)	8		144	2		12	2		12	2		58	2		20	246
Average (7 yrs)			21			2			2			8			3	35

R - Recorded bycatch (taken from draft PMP, Table 2)
 %OC - % observer coverage (taken from draft PMP, Table 2)
 EB - Estimated bycatch

The mish-mash explanation of this technical modelling information makes it very difficult for the reader. It also results in an understatement of the enormous importance of the ongoing uncertainties associated with the model's use and it's inability to fit best available information on some parameters. This ultimately makes the use of this model to estimate FRMLs highly problematic.

If the Breen-Fu-Gilbert model is to be used in setting an FRML for the 2009-10 fishing season, the Minister should be advised that a very cautious approach is warranted.

4. Historical trends

Nowhere in the IPP is there a description of the history of the MFish management approach. Since the introduction of FRMLs the NZ sea lion population has undergone a marked decline. The decline in pup production should be reflected alongside the fishery management trends.

A table such as the one below (Table 3) would provide the Minister with existing data to help clarify the historical trends in relation to the FRML and the NZ sea lion population status.

The recent downward trend in the number of sea lions observed captured in the SQU6T fishery looks encouraging, but is not that dissimilar to captures of sea lions in the early 1990s.

Also, monitoring of the FRML is not based on actual captures of sea lions. It is based on the number of tows conducted by the fishery and a predetermined strike rate. Reduction of the strike rate by applying an award system or discount rate in recent years confounds this apparent trend.

Table 3. Historical trends in the management of the SQU6T fishery and the status of the NZ sea lion pup numbers, showing annual variations in monitoring, sea lion bycatch management, sea lion deaths, fishing practices and pup estimates (modified from Chilvers, 2008⁵).

Year	Observer cover (%)	FRML		Observed sea lion deaths	Estimated sea lion deaths	Fishery closure	Fishing duration (weeks)	Pup production estimate
		Start	Revised					
1991/92	10	32		8	82			
1992/93	29	63		5	17			
1993/94	10	63		4	32			
1994/95	8	69		8	109			2518
1995/96	13	73		13	105	4 May		2685
1996/97	20	79		29	123	28 Mar		2975
1997/98	23	63		15	62	27 Mar		3021
1998/99	37	64		5	14			2867
1999/00	35	65		25	71	8 Mar		2856
2000/01	100	75		38	67	^a		2859
2001/02	33	79		22	84	13 Apr		2282
2002/03	23	70		10	39	^b		2518
2003/04	31	62	124	16	118	^c		2515
2004/05	29	115		9	115	17 Apr ^d		2148
2005/06	28	96	150	11	110		14	2089
2006/07	41	91		8	56		14	2224
2007/08	47	81		5	46		14	2175
2008/09	38	113	95	4	72		24	1501

Red text denotes the FRML was exceeded.

a. The industry voluntarily withdrew the majority of vessels on 7 March

b. The fishery was closed on 29 March, however a High Court ruling on 3 April allowed fishing to continue

c. The fishery was closed on 22 March, however a Court of Appeal ruling on 4 April allowed fishing to continue

d. The industry voluntarily withdrew upon reaching the 115 FRML on 17 April

Another important historical trend that has been omitted from the IPP is the dramatic reduction in the maximum FRML rule produced by the modelling work and recommended by the MFish under the Rule 3 series (Table 4).

Table 4. The range of FRML options presented in recent fishing years

Fishing year	Minimum	Maximum
2005-06	0	598
2006-07	0	504
2007-08	0	568
2008-09	0	283
2009-10	0	90

This information should be clearly presented to the Minister in the FAP with a suitable table such as Table 4.

⁵ Chilvers, B. L. (2008) New Zealand sea lions *Phocarctos hookeri* and squid trawl fisheries: bycatch problems and management options. *Endangered Species Research*, 5: 193-204.

5. Base case variables and their impact on FRML use

The IPP presents MFish's preferred values to use as the 'base case' variables to insert into the model to derive FRML options. These values are:

Strike rate: 5.65

Discount Rate (for using a sea lion exclusion device or SLED): 35%

It is not clear in the IPP why these values are chosen without prior knowledge of the fishery's past operational plans and management decisions. Full explanations are needed in the FAP.

Forest & Bird does not support the proposed MFish base case values for reasons outlined in past submissions on SQU6T Operational Plans and for the reasons outlined below. As per the Breen-Fu-Gilbert model parameters, alteration of these variables has an enormous consequence on the estimation and use of FRMLs. It therefore has huge implications for NZ sea lions.

5.1 Strike Rate

A predetermined strike rate is set every year to include in the model for FRML calculation and to assess the fishery's performance against the FRML:

$$\text{Strike rate} \times \text{number of tows} = \text{estimated number of sea lions killed}$$

Due to the use of SLEDs in trawl nets in the SQU6T fishery, the actual strike rate is non-determinable. Instead, scientists estimate strike rate using models.

For some years the predetermined strike rate used to estimate FRMLs and assess a fishery's performance against the FRML was 5.3. However, in 2007 MFish justified increasing the strike rate for the 2007-08 fishing year on the basis that tow duration in the fishery had increased. MFish stated in the IPP at the time:

'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.' (Para 70)

The new predetermined strike rate is 5.65 sea lion deaths per 100 tows – a marginal increase.

However, it is important to note that this estimate smoothes over the data from 2001, when SLEDs were trialled in the fishery with cover nets tied down and vessels had 100% observer coverage. At this time the strike rate was **11.65**. In no other year has there been 100% observer cover.

A predetermined strike rate of 5.65 may therefore be a huge underestimate.

As noted in the IPP (para 82) recent research contracted by MFish⁶ suggests that even with SLEDs, the strike rate could be as high as 10%.

6 Thompson, F.N. and Abraham, E. R. (2009) Estimation of the capture of New Zealand sea lions (*Phocartos hookerii*) in trawl fisheries, from 1995-96 to 2006-07. New Zealand Aquatic Environment and Biodiversity Report 2009.

As noted in the IPP sea lion catchability in the SQU6T fishery is actually estimated to have substantially increased since 1998 – a fact also pointed out by the Deepwater Group and SeaFIC in their 2007-08 submission.

The most cautious strike rate estimate (11.65) should therefore be used.

The IPP does not include the 2001 information and gives only a small mention of the increase in catchability. This misleads the Minister and may cause a decision on strike rate that is not based on the best available information. It is very important that it is included in the FAP on the 2009-10 operational plan for the SQU6T fishery and that the Minister be provided with the option to increase the predetermined strike rate.

5.2 Discount Rate

The management approach of rewarding a discount on the strike rate if a vessel uses a sea lion exclusion device (SLED) has a significant influence on the FRML and strike rate decisions.

For example, for the 2008-09 fishing season the Minister decided to set a predetermined strike rate of 5.65. Application of a 35% discount rate then dropped this to an assumed strike rate of just **3.67**. As noted above, however, recent modelling work suggests that even with SLEDs, the strike rate could be as high as 10 sea lions per 100 tows.

The logic of using a discount rate is therefore clearly flawed.

In recommending a discount rate, MFish is assuming that SLEDs are effective in allowing sea lions to survive interactions with trawl nets. However, to date, there is little information available to adequately answer to this question. The issue is therefore how much confidence can we assign to the information we do have?

5.2.1 Available information

Research when cover nets were tied down

The only hard data we have on sea lion survivability follows the study in 2001 in which sea lions were caught in nets with SLEDs and the cover net tied down. As noted in footnote 9 of last year's IPP (sections in bold represent our emphasis):

*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).*

It is with this information that MFish originally chose to apply a 20% discount rate.

The 2001 research based estimate is the only data available on sea lions that would have lived had they not been purposely drowned. All other years, the exit hole of the SLED has been open and so survival of sea lions exiting the hatch is unknown.

This means that even with SLEDs inserted in trawl nets, 82% of sea lions entering nets are estimated to die. However, the 2001 estimate is based on a very limited data set (11 sea lions). Given that sea lions are still dying in SLEDs with the cover net open, an 18% survival estimate may be too high.

Necropsy information

The IPP for the 2009-10 operational plan notes that this year's pathology report is not yet available. This report will present the findings of necropsies on sea lions captured and returned from SQU6T fishing vessels operating this year, with SLEDs in place.

Information used to support an increased discount rate for the 2007-08 Operational Plan (suggesting that abdominal fluid and renal capsule haemorrhaging are freezing artefacts), is based on a VERY small sample size of just two sea lions that drowned in fully operational SLEDs. It therefore needs to be treated with caution and at best, may illustrate *possible* evidence sea lions existing SLEDs may have a higher survival rate than previously thought.

What is not mentioned in the IPP or in the information provided in 2007-08 and 2008-09 advice to the Minister, is that the necropsy findings have also identified a number of animals with pre-mortem brain or cranial injury. One possible explanation for these injuries discussed at the AEWG meetings over the years is the impact of sea lions hitting the SLED grid (metal bars inserted in the SLED to prevent sea lions entering the cod end of the net).

In their submission on the 2007-08 IPP, necropsy contractors Massey University stated:

“It is therefore possible (or even likely) that brain contusions are indeed caused by interaction with the grid bars of the SLED”.

If sea lions are sustaining serious head injuries and exiting the SLEDs, current estimates of survivability may be overestimates.

This differs substantially from the assumed survivability reported in the 2007-08 FAP to justify an increase in the discount rewards system.

Other information presented in past necropsy reports that have not been included in the IPP include the fact that some sea lions found in the cod end of the trawl net (beyond the grid) were juveniles.

All information relevant to the Minister's decision should be presented in the FAP.

Camera footage

The SLED camera work is grossly misrepresented in the IPP. As a member of the SLED working group, Forest & Bird is very disappointed with the overemphasis given to this information considering its limitations, which have recently been discussed by the group (including Mfish).

The camera footage has been recognised by the SLED working group as being useful for uncovering problems in SLED design and/or application – for example to recent failures of the 'kite'. The kite is designed to keep the hood lifted and so the exit hatch open. The footage showed failure of the kite and therefore closure of the exit opening, especially during turns.

We note that in past working group meetings preferences of not having a hood at all were discussed by the group but were dismissed by the Deepwater Group due to concerns about the escapement of the fishery's target – arrow squid.

The footage has also shown three animals – a NZ sea lion, a fur seal and a deepwater shark – exiting the SLED. The IPP reports the NZ sea lion to have been '*actively swimming from the SLED, and perhaps pausing to feed opportunistically*'.

This is inaccurate.

It was the fur seal that was seen taking food and both the sea lion and fur seal were not observed actively swimming out. Indeed so quick was the event observed on the camera footage that both the SeaFIC researchers and MFish deepwater team misidentified a sea lion as a fur seal – a very different looking animal.

The only animal observed swimming was the deepwater shark, which took some time to escape and was observed thrashing around to exit the SLED.

The camera work has also taught us that it can not be used at depth or on vessels using bottom trawl gear or mid water gear deployed near the seabed. The Deepwater Group estimated the number of vessels fishing in this manner to be around 90% at present, with variations from year to year. The IPP characterises the fishing gear use in footnote 16 as 55% bottom trawl and 45% midwater trawl. However, this is misleading because it does not reflect the use of midwater gear used near the seabed.

The problem with the camera footage is the sediment lifted by these two fishing methods when used on or near the sea floor. In the SLED working group meeting we were told that practically all mid water trawl vessels fished for squid very close to the sea floor.

Assuming the anecdotal or combined presented values are correct, between 90 and 100% of SQU6T trawl tows are not represented by the camera work.

The FAP should reflect the camera work and its limitations in its entirety, rather than selectively presenting the 'good news' that favours a high discount rate.

SLED design

The intention of installing SLEDs is to reduce NZ sea lion mortality levels by allowing live animals to escape from the net. Whether or not they actually achieve this goal is still unknown.

Ongoing NZ sea lion captures in the SQU6T fishery demonstrate that SLEDs are not working optimally.

As noted above, the camera work has helped us identify and correct poor kite design. Captures of sea lions in the cod end (beyond the grid) have also raised doubts about the SLED design. More specifically, it has raised questions about the appropriateness of the grid bar spacing.

Concern about the grid bar spacing has been an issue since the beginning of SLED operational use in 2003⁷. The sea lion necropsy report last year, noted that the animals captured in the cod end were small juveniles. Capture in the SLED grid itself, however, is more commonly reported.

In 2009 members of the SLED working group requested that the SLED bar spacing be revised on the basis of this information. The Department of Conservation specifically drafted a recommendation of a more appropriate bar spacing.

Despite agreement to look at this at the April SLED meeting, no such meeting was held until September. At that meeting the industry representatives said it was too late to change the bar spacing and that they were not convinced it was necessary⁸.

Captures of sea lions in the SLED grid and in the cod end of nets should not be understated. It means the SLED design is still in question and these devices could still be posing an unnecessary risk of capturing NZ sea lions.

This important information is omitted from the IPP but should be highlighted in the FAP.

5.2.2 Outcomes

The efficacy of SLEDs is highly uncertain, with numerous pieces of information presented in the IPP either absent, incomplete or misleading.

We note that in the FAP for the 2007-08 Operational Plan, MFish recommended the Minister choose a 30% discount rate from a range of options from 20% (status quo at the time) to 40%. Information obtained under the Official Information Act makes it clear that the MFish Science team, the National Environment team (NET) and the Department of Conservation strongly opposed any move from the status quo.

The decision to recommend an increased discount rate was made by MFish senior managers in support of the MFish Deepwater team. In doing so, those senior managers placed considerable confidence in the Deepwater team's interpretation of the limited information available rather than the advice of the two more relevant MFish teams and the Department of Conservation.

It is Forest & Bird's view that the advice provided to the Minister was biased in favour of utilisation of squid over the sustainability of the fishery and the impact it has on NZ sea lions.

If MFish intend to continue to recommend a discount, then justification of a 35% discount rate needs to be presented in the FAP.

The uncertainties around survivability also need to be further clarified in the FAP so that the Minister is presented with the full information.

Of particular importance is the fact that the discount rate is not equivalent to the survival rate of sea lions exiting trawl nets. The difference between these estimates and the resulting effect on the strike rate should be clearly presented to the Minister in a table such as the one presented below (Table 5).

7 MacKenzie (2003) Research on sea lion exclusion device efficacy: final report. Ministry of fisheries Project report (MOF2002-01D)

8 This exemplifies the problem with this industry led working group and the lack of positive responses to best available information.

Table 5. Assumed survival rate relative to the awarding discount rate and its effect on the predetermined strike rate. (Information in the table obtained from MFish. Bold emphasis added by Forest & Bird to highlight the range of the best survival estimate (18%) and the associated discount rates and resulting strike rates)

Assumed survival of NZ sea lions existing SLEDs (%)	MFish Discount rate (%)	Applied strike rate (%) after discount
0	0	5.650
7	5	5.368
14	10	5.085
20	15	4.803
27	20	4.520
34	25	4.238
41	30	3.955
48	35	3.673
55	40	3.390

Using this information it is clear that if a discount rate were to be applied, it should **not be greater than 13%** - as this is equivalent to the best estimate of sea lion survivability (18%).

In addition to this information, the points raised by the two MFish teams and the Department of Conservation on the 2007-08 FAP should be presented to the Minister in the FAP. In particular, the FAP should present the advice of the MFish Science and NET teams that:

- *“Any discount for using a SLED is of direct benefit to industry.”*
- *“The characterisation of the information in the 2007-08 FAP and in this IPP gives a false impression about the appropriateness of a 30% discount.”*
- *“There is not sufficient new information to recommend a 30% SLED discount.”*
- *“If the choice of a discount higher than 20% is offered to the Minister, he should be advised he is taking a bit of a punt.”*
- *“AEWG have recommended that no discount be given until better information was available due to the small sample size”.*

Forest & Bird strongly opposed the decision to increase the discount rate (to 35%) for the 2007-08 and the 2008-09 Operational Plans. We continue to oppose this recommendation for the 2009-10 Operational Plan.

Forest & Bird recommends that no discount rate be awarded to vessels using SLEDs as the SLED design is not yet optimal, sea lions are still be captured and killed (especially females) and the survivability of sea lions exiting SLEDs is unknown.

A zero discount rate should be applied.

6. Rule Selection

As presented in parts 1-4 of this submission, there are wide problems and uncertainties with the information used to derive an FRML.

Forest & Bird do not support the use of the Breen-Fu-Gilbert model favouring the NZ Wade rule as the alternative approach. If the Breen-Fu-Gilbert model were to be used for the 2009-10 SQU6T fishing year, an extremely cautious approach should be taken.

Table 8 of the IPP presents the reader with an indication of suitable rules under the MFish base case, relative to 10 different possible scenarios. These scenarios propose different variables including discount rate, density dependence and maximum growth rate – just some of the possible variables that are highly uncertain and the Minister should be made aware of.

The most realistic of the 10 scenarios presented is the 8th scenario: assuming a 20% discount rate and applying weak density dependence (identified in AEWG meetings).

The table shows that the range of rules recommended by MFish (Rules 311 to 319) only meet the Ministry's own management criteria in 3 to 7 (30 to 70%) of the possible scenarios (excluding scenario 8):

- For 100% of scenarios to be met, Rule 308 or lower should be selected
- For 90% of scenarios to be met, Rule 309 or lower should be selected
- For 80% of scenarios to be met, Rule 310 or lower should be selected
- For 70% of scenarios to be met, Rule 311 or lower should be selected
- For 60% of scenarios to be met, Rule 312 or lower should be selected
- For 50% of scenarios to be met, Rule 313 or lower should be selected
- For 40% of scenarios to be met, Rule 315 or lower should be selected
- For 30% of scenarios to be met, Rule 319 or lower should be selected

This means that the range of preferred options provided in the IPP (rules 311 to 319) will not provide the Minister with confidence in meeting MFish's management criteria, which are themselves highly problematic (see section 1 of this submission).

The only presented option that will give the Minister confidence in meeting the Ministry's management criteria and accounting for the huge number of uncertainties in the available information, is **Rule 308 or lower**. This means an FRML of **38 sea lions**.

However, given the FRML's presented in Tables 1, 7 and 8 have been derived using the MFish base case variables, which are also problematic, the Rule 308 FRML estimate should be treated as the maximum number of sea lions that can be killed by the SQU6T fishery in the 2009-2010 fishing year.

An alternative option available to the Minister is to set the FRML at zero.

7. Additional comments

In addition to the key decisions for the 2008-09 Operational Plan, we submit the following general comments on the IPP.

Selective information

The IPP fails to present some important pieces of information, including:

- Necropsy results on brain and skull injuries;
- The fact that sea lions are still entering the cod end;
- The sensitivity trials are limited due to the lack of time available
- Trends in past fisheries management decisions and information
- The large reduction in the maximum allowable FRML
- The limitations of the camera work

These omissions, and other information noted in this submission should be corrected in the FAP. Failure to reflect all information leads to misrepresentation of the available information and may cause the Minister to make decisions that he would otherwise not if given all information.

Style and Framing

The FAP for the SQU6T Operational Plan requires a clear, well balanced explanation of the wide number of issues the Minister must consider when making a decision. These include a complex model, a large number of assumptions about sea lion interactions with the fishery and substantial consequences for NZ sea lions should those assumptions be wrong.

Unfortunately the IPP presents information in a complicated manner making it very difficult to follow and understand. Even technical specialists have found the IPP awkwardly structured and difficult to follow.

The IPP scatters important information and explanations across different sections. The information is presented in a highly technical manner that is very difficult for non specialists to understand. It is also highly selective in the information presented, is often framed in favour of squid utilisation and is therefore very misleading.

It is important that the framing of the FAP for the 2008-09 Operational Plan be more balanced than the IPP, with the appropriate weight given to the available information.

Monitoring and reporting regime

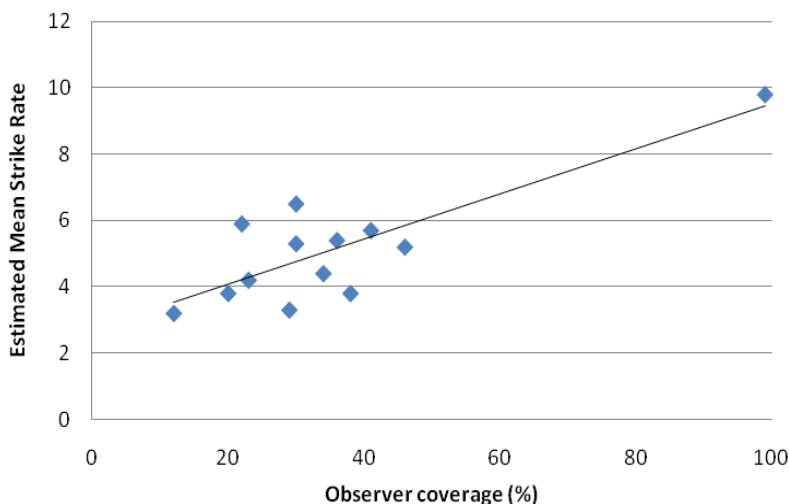
Forest & Bird supports the regular monitoring and reporting regime currently being implemented in the SQU6T fishery.

However, we still consider that there are ongoing problems that have yet to be addressed. Issues such as the bias in sea lion capture reporting and SLED use compliance are unlikely to be resolved in the 2009-10 fishing year unless there is 100% observer coverage. This was acknowledged in the 2008-09 IPP (para 105), but there is no mention of it in the 2009-10 IPP nor any outline of how MFish intends to address it other than to 'stress the importance of accurate reporting' – which is clearly inadequate.

A minimum target of 30% observer coverage (para 112) is far too low and MFish should seek to increase this to 100% for the 2008-09 season – a target level that the Deepwater Group have communicated to Forest & Bird.

The pattern of under reporting sea lion captures when independent observers are not present is well established both in New Zealand and overseas. In the SQU6T fishery, this is particularly obvious (Figure 1).

Figure 1. Estimated mean sea lion strike rate (number per 100 tows) relative to observer coverage. (Based on information in the draft MFish contracted report referenced in footnote 15 of the IPP⁹)



We note that even without the high strike rate estimated during SLED trials in 2001, a strong positive correlation exists in this fishery – with higher estimated strike rates with greater observer coverage.

This information and graph should be presented in the FAP.

In-season alteration of the FRML

Forest & Bird supports the use of a fishing related mortality limit (FRML) for the 2008-09 fishing season.

However, we do not support any mid-season increase to allow for an in-season TACC increase (as has happened in the past) as this would unfairly bias utilization of squid over sustainability issues.

Should the pup counts reported back from the Department of Conservation in January 2010 illustrate a continued low level of pup production, we recommend a decrease in the chosen FRML closer to zero.

This year the fishing industry voluntarily reduced the FRML. However, due to compliance problems in the SQU6T fishery, a mandatory reduction in the FRML is required to ensure all vessels comply with the rules and prevent more sea lions being killed.

9 Thompson, F.N. and Abraham, E. R. (2009) Estimation of the capture of New Zealand sea lions (*Phocartos hookeri*) in trawl fisheries, from 1995-96 to 2006-07. New Zealand Aquatic Environment and Biodiversity Report 2009.

Should the pup counts look close to 'normal' levels this summer, we would not support an increase in the FRML. A mid-season increase in the FRML would be contradictory to the precautionary approach and would continue to put the declining NZ sea lion population at undue risk.

Other management actions

Forest & Bird supports inclusion of other management measures in the IPP (para 117). An additional management options not included in the IPP is to:

- apply the FRML across all fisheries known to have caught NZ sea lions in the last few years.

The option of closing an area to the SQU6T fishery is only mentioned in the IPP under this section. However, the Minister should also be informed that it is a valid option under section 15(5b) of the Fisheries Act in other sections of the advice paper (e.g. paras 15 and 16).

Requests for a management workshop

Following the alarming drop in the number of pups born during the 2008-09 summer field program, the Department of Conservation hosted a workshop to discuss possible theories for this decline. At this meeting, the management of NZ sea lions was agreed not to be discussed.

Forest & Bird asked the Ministry if we could hold another workshop to discuss current management and possible new approaches to the management of NZ sea lions with technical specialists, managers and stakeholders. This request was declined.

This is very disappointing as it would have been the only forum by which some of the management criteria and decision making could be discussed and progressed with stakeholder input.

We continue to suggest that such a meeting would be useful and would like to ask MFish to reconsider our request.

8. Specific comments on the IPP text

Executive Summary

Para 3: Need to include 'and other fisheries'

Para 4: Define acceptable level. MFish has no sea lion standard so it is known what this means.

Para 5: What about DOC management criteria? Should state alternative DOC criteria and their concern about density dependence.

Para 7: Replace 'some uncertainty' with 'considerable uncertainty' about SLED efficacy

Para 8: State what 'additional research on SLEDs is underway – Forest & Bird are not aware of any new research on NZ sea lions and SLEDs.

Part One: Summary of proposed management measures and background information

There are several important pieces of background information that have been omitted or poorly presented from this front section of the IPP:

- Fishery characterisation:
 - 1) Where the fishery operates and where the fishery overlaps with the SL foraging range

- 2) % bottom trawl, mid water trawl gear etc. gives and indication of possible direct and indirect effects of fishing that are not taken into account in the IPP, but were discussed at the MFish-DOC workshop about the summer counts. Deepwater Manager said this would be included in the IPP at the SLED WG meeting, but it is only inserted as a footnote towards the back of the IPP (page 23);
 - 3) Change in tow duration in recent years;
 - 4) Fished longer than previous years, despite major concerns about sea lion population following the decline in sea lion pups born over the summer; and
 - 5) Value of the fishery– trends in squid abundance, catch and economic value.
- (Some of this info is provided towards the back of the IPP. Given it is important background information characterising the issue, it should be inserted under Part One.)
- Status of New Zealand sea lions:
 - 1) Population estimate
 - 2) IUCN and DOC status
 - 3) Declining trend - % change rather than simply stating a decline
 - 4) 2008/09 pup counts
 - High levels of uncertainty:
 - 1) Breen-Fu-Gilbert model still has considerable limitations and its use results in enormous uncertainty and a wide range of possible options.
 - 2) Strike rate
 - 3) Sea lion survival after exiting the trawl net through a SLED

Para 16: Should state the % decline and/or show the data on a graph.

Para 18a: Why are only some of the legal requirements spelled out fully. All legal considerations should be fully explained, including section 8 of the Fisheries Act and relevant sections of the Marine Mammal Protection Act (e.g. 3G(2))

Para 18g: Whilst separate issue, the Minister's decision on strike rate and discount rate have connected consequences. Whilst the Minister should consider the variables separately, the decisions made should also take into account the impacts of altering each on the overall outcome.

Para 19: Number of important issues that need to be added:

- The declining status of NZ sea lions
- The inter-relatedness of the decision components and the effect varying one has on the other and the overall outcomes.
- Uncertainties that remain with the Breen-Fu-Gilbert model (see Appendix 3)
- Inappropriate application of the Breen-Fu-Gilbert model, which assumed same rule applied for 100 years rather than current approach of different rule every year.
- Popping rate is lower than assumed by the model, (making FRML estimates optimistic)

Para 19: Replace the work 'escape' with the term 'exit' as the former implies survival of sea lions, which is unknown.

Para 21: Need to specify the DOC SMP goals, including:

- To avoid or minimise adverse human interactions on the population and individuals
- To ensure comprehensive protection provisions are in place and enforced

The IPP illustrates that neither of these goals are currently being met. The Minister should therefore be made aware of this.

Part Two: Fishing-related mortality limit (FRML)

This section is not well explained, is very complicated and, in places, is very misleading.

e.g. need clear explanation of base case – why used

- e.g. need far greater reflection of the ongoing problems uncertainties with the model up front
- e.g. wording needs to be plain English (translate technical language)
- e.g. need to reflect the enormous range of options
- e.g. need to reflect that only limited sensitivities were run due to time constraints – there are still a huge number of uncertainties untested.
- e.g. the FAP should reflect that the AEWG recognised need for an alternative modelling approach as the Breen-Fu-Gilbert approach is not working as well as required.

Para 26: There is no mention of the DOC management criteria, nor why and how these differ. For example, the concern about density dependence is largely omitted from the IPP. AEWG looks at all management criteria. It is important that the different objectives are made clear to the Minister. The FAP should insert DOC's management criteria and note that all are subject to problems.

Table 2: This table and the source of its information is very unclear:

- Why are the FRML values in Table 2 different from Table 1 in the executive summary and tables 7 and 8 elsewhere in the IPP?
- How is percentage lost effort calculated and where does the 2737 maximum number of tows value come from? For the last few years the fishery has completed nowhere near this many tows. The largest number of tows were those completed this year (2008-09 fishing season) – 1916 tows, 52% more than the previous year. Also, the % closure values do not match the presented effort lost values.
- Why is maximum pupping rate so high (up to 5141)? The values presented in the table are only the mean values according to the explanation. However, the highest ever recorded rate was 3021 in 1998. The most recent pupping rate was just 1501. New Zealand sea lions have been in decline for the last 11 years. The values presented in the table are not justified and do not fit with the current population trend.

Para 42: Insert 'However' at the start of the 2nd sentence.

Para 43: Should insert a footnote to clarify that not all sensitivity trials requested were run due to time constraints. (This was discussed at the AEWG.)

Could also add at the start of the 2nd sentence: 'In the time available,' a total of

Para 45: Use of the term 'conservative' is inappropriate. Forest & Bird strongly object to this term as we do not consider the range of options presented to the Minister to be conservative. Rather, the range presented are the most **realistic** range of rules, as opposed to the unrealistic rules of 320 and above. Conservative should be replaced with 'realistic'.

Table 4: Provide more explanation and use non-technical terminology. For example, in the title of Table 4 the FAP should state what the base case is (assumed maximum growth rate (λ) of 8%, density dependence (z) of 3 and a pupping rate (R0)):

Base Case	35% Base Case	
	Rule	FRML
Sens 1: reduced population growth rate ($\lambda= 5\%$)		
Sens 2: no assumed maximum growth rate		
Sens 3: weaker density dependence (z=2)		
Sens 4: stronger density dependence (z = 4)		
Sens 5: lower pupping rate (fixed at R0=.0315)*		

* The best estimate of pupping rate is about 0.27, lower than both the base case and the sensitivity trail

- Para 54b Delete text 'small number of...', as the number of sea lions killed in other fisheries is not small and to say so is misleading. As reported by Thompson *et al* (2009), in the 2007-08 fishing year there was an estimated 35 sea lion captures and 86 sea lion interactions. The highest rate of estimated capture was 165 sea lions (1995-96 fishing year).
- Para 55 This is not a true reflection of that workshop. The FAP should add the minutes of that workshop to the appendix of FAP, as have done for the minutes of the AEWG meeting (see appendix I of this submission). The summary written by the NZ Sea Lion Trust (in the interim to the DOC minutes being released) could also usual be made available (see Appendix II).
- Table 6 We recommend that this information also be presented in a graph.
- Para 63 The last sentence should be amended to add the following at the end: '*...though the Minister may chose to do so should he consider it necessary to avoid, remedy or mitigate the effects of the fishery on the declining New Zealand sea lion population.*' Such language has been used elsewhere in the IPP to defend the option of higher rules.
- Para 66 The commercial export values need to be further explained and detail given on how these numbers were derived. We note that on the MFish website, the following information is given:
- SQU6T value in 2008: \$23.56, which is equal to 33% of the total \$71 million squid value
 - SQU6T value in 2007: \$22.55, which is equal to 27% of the total \$85 million squid value
 - SQU6T value in 2006: \$29.42
- Around 20-30% of total export value is more in keeping with our understanding of the value of the SQU6T fishery. These figures should be clearly presented to the Minister, which an explanation or reference of where these numbers were derived.
- As there is a section on the effect of the FRML on utilisation, there should be a section on FRML effect on the sustainability of NZ sea lions. Failure to include this prevents the minister making a balanced decision as required by the Fisheries Act.
- Para 76 F&B questions the numbers used in Table 2 and presented in para 76 re the % lost fishing effort. See comments on Table 2 above. This para should be altered to reflect any errors.

Part Three: Assessing performance against the FRML

- Para 85 The first sentence is very misleading. Whilst the SLEDs are designed to allow sea lions to escape alive, in practise we do not know if this is the case. Certainly the ongoing captures and deaths of sea lions in SQU6T trawl nets indicate that this is not the case all of the time. The text should be modified to state that SLEDs are installed and 'are designed to' allow sea lions to escape alive. The following text should also be inserted: 'However, the ability of SLEDs to achieve this aim is unknown.'
- This para also fails to outline the history of the SLED discount (i.e. 20% based on period of 100% observer coverage), nor does it outline the reasoning for the 35% discount recently applied.
- Para 89 + This whole section is very misleading, overemphasises the value of the fishing industry's camera work and misleads the reader into thinking it was reviewed by the SLED WG, which it was not! It was simply presented to the SLED WG. We have yet to see a report and many concerns were raised about its value, inc from Rob Mattlin (marine mammal scientist) and DOC.
- The camera footage was also discussed as being not representative of the SQU6T as it was at shallow depth, with white light (which has proven to attract sea lions). Rather, the SQU6T fishery operates in deeper waters, with an estimated 90-100% of trawls using bottom trawl gear. There were long discussions about this at the SLED WG and it is disappointing MFish have chosen not to reflect this important information.

The following should be inserted to ensure the Minister has a comprehensive understanding of the camera work:

- the research was designed and carried out by the fishing industry
- the research is not peer reviewed, either by the SLED working group or via MFish's peer review process – the AEWG.
- the camera footage was presented to SLED WG (which the IPP states in para 92).
- the camera footage available is from shallow depths relative to the normal fishing depths and so not representative of 90-100% of trawl tows.
- the camera footage is of limited use at normal fishing depths due to the view being obscured by sediment (lifted during bottom trawl operation). (This is noted in para 91 of the IPP.)
- the footage was collected in conjunction with the use of white lights (attractive to NZ sea lions). (This is noted in para 90 of the IPP.)
- Some members of the SLED WG (DOC, Rob Matlin (ex. MFish marine mammal scientist) and F&B) deemed the camera work of limited value and useful only to assess and correct SLED kite and hood design. Other members (SeaFIC, who conducted the research, DWG and MFish-DWT) deemed it of higher value.

Para 92 Forest & Bird strongly objects to the IPP stating that footage shows sea lions 'swimming'. It was the deepwater shark that was seen thrashing to get out of the SLED and exit the escape hatch. This language should be changed to 'exit' or 'exiting'. It was also a fur seal seen feeding – not a sea lion. This should be corrected.

Part Four: Monitoring and reporting requirements

Para 113 It would be good to insert the wish of the DWG to make observer coverage 100%. Forest & Bird supports this and thinks a minimal of 30% is too low.

Para 118 Forest & Bird does not agree with MFish's view of the alternative management options. The FAP should give a full explanation as to the reasons for not supporting these options (either within body of FAP or as an appendix).

Part Five: Statutory considerations

Both the Marine Mammals Protection Act and the Wildlife Act should be inserted to this section.

Appendix 2

(a) Insert '(lambda)' at end of the first sentence to clarify use of term later.

Should you have any queries regarding our comments, please do not hesitate to contact me.

Yours sincerely,

Kirstie Knowles

Marine Conservation Advocate
Royal Forest and Bird Protection Society of New Zealand
DDI: ++ 64 4 801 2210

Appendix I

Official DOC minutes of the DOC / MFish / Stakeholder workshop: 19 May 2009

Present:	
Buddle Findlay (Chairperson)	Paul Beverley (PB)
DOC	Louise Chilvers (LC), Igor Debski (ID), Ian Angus (IA)
MFish	Martin Cryer (MC), Nathan Walker (NW), Eric Mellina (EM), Rob Mattlin (RM), Aoife Martin (AM), Jeremy Helson (JH)
SeaFIC	David Middleton (DM), Greg Lydon (GL)
DWG	Richard Wells (RW)
Forest and Bird	Kirstie Knowles (KK)
NZSL Trust	Shaun McConkey (SM)
Otago University	Chris Lalas (CL)
NIWA	Paul Breen (PBr)
ECO	Barry Webber (BW)
Massey University	Wendi Roe (WR)
	Andy Maloney (AMal)
	Dave Gilbert (DG)
	Martin Cawthorn (MCr)
Apologies:	
WWF	Rebecca Bird
NIWA	David Thompson

The aims of the workshop were fourfold:

- To present NZ sea lion field data collected at the Auckland Islands;
- To identify hypothetical cause(s) or reason(s) for the 2008/09 decline in pup production;
- To facilitate discussion over the hypotheses identified;
- To identify potential means by which the hypotheses might be investigated.

The workshop outcomes DOC and MFish sought to achieve were as follows:

- To present to stakeholders the Auckland Islands' fieldwork, and to allow time for questions and answers over the data;
- To identify, with stakeholders, the hypothetical cause(s) or reason(s) for the 2008/09 decline in pup production;
- To facilitate a discussion over the hypotheses and obtain suggestions for future research on the hypotheses identified;
- To provide, within 10 working days, a report on the workshop discussions.

The attached record attempts to reflect all points raised during discussions and relevant to the workshop aims and outcomes. Suggestions and ideas concerning future research are noted. Any points or information missed or incorrectly recorded should be raised with Ian Angus (Email: IAngus@doc.govt.nz; Tel: 04 471 3081).

Introduction

Participants were welcomed. An apology for the short notice prior leading up to the workshop was made. The chairperson, PB, was introduced. The workshop aims and outcomes were outlined. Participants then introduced themselves.

Forest and Bird requested that DOC and MFish arrange a follow-up workshop to examine the management of the NZSL.

Royal Forest and Bird Protection Society of New Zealand Inc., Central Office, Level One, 90 Ghuznee St., PO Box 631, Wellington. Tel: 04 385 7374, Fax: 04 385 7373 www.forestandbird.org.nz

The CSP report "NZ sea lion research trip, Auckland Islands, December 2nd 2008 to February 16th 2009" was circulated by DOC.

Presentation and Discussions

Auckland Islands 2008/09 fieldwork (slides 1- 8)

A presentation on the NZ sea lion was initiated. Initial slides provided an overview (for the Auckland Islands) on pup production for 2008/09 plus the period 1997 -2009 and on the daily numbers of females / males ashore. DOC suggested the data provided evidence that the 2008/09 decline in pup production may have been caused by an absence of breeding females but noted that the cause / reason for their absence was unclear.

During the early part of the presentation discussion focussed on:

- Factors that may have contributed to the decline in pup production.
- Interpretation of the data presented.

Suggestion for further examination / research:

- Examine whether, rather than being driven by an absence of females, a decline in pup numbers had led to a decline in females ashore- during the mid-morning breakout, the following were posted as causal hypotheses, together with information on the evidence that required further examination:

Hypotheses	Evidence
Low pup rate	Can estimate from tag data but not for recent years
Low early survival of cohorts	Can estimate from tag data
Low survival of adults	Can estimate from tag data but not for recent years
Emigration of cows	Will give some data as for low adult survival
A combination of the above	

Potential causes for NZ sea lion decline (slide 9)

A number of hypotheses that might have led to the decline in NZ sea lions were presented. DOC suggested that each be discussed in turn.

A counter suggestion that perhaps, before considering these hypotheses, more time might be dedicated to assessing what might be driving the decline.

Discussions focussed on male and female dispersal and behaviour. Some participants considered that current data might not provide a clear picture of any decline in males. DOC acknowledged that it difficult to detect changes in male numbers as only 10-20% of the available males are observed ashore at any one time and the number of males ashore changed daily.

Suggestions:

- Cohort survival – differences be examined to see if a particular cohort might have contributed to the decline. An observation was made that a change in early cohort survival could not explain such a large single drop in pup production. The mean cohort size in any given year, subject to mortality, was noted as around 1500 animals and that, even were an entire cohort to die, this could not drive the reported decline of 650 adult female animals.
- Popping rates – tag resightings be examined to help identify whether or not early pup survival had changed.
- Adult survival - the possibility of a sex-related decline (females more affected than males) be examined. Perhaps by examining the time males spent holding territory compared across breeding seasons (the theory put forward was that a reduction in male numbers might possibly lead to an increase in territory

holding)? Tagged individuals might also be examined to see if they returned to shore as regularly over the past season?

It was concluded that several more seasons of data are needed to better distinguish between alternative hypotheses for the low number of pups in 2008-09.

Past and Current Distribution, Foraging and Diving, Otago and Auckland Island Comparison (slides 10- 13)

Information relating to the distribution (past and current) of NZ sea lions, their foraging and diving profiles and comparing Otago and Auckland Island breeders was provided.

The difference between the Otago and Auckland Island breeders (size, breeding patterns, foraging behaviour, diet) was noted as useful for background information but it was agreed that comparisons were inconclusive. This was due to the small sample size of the Otago animals and because all originated from one female.

Predation hypothesis (slide 14)

Data on shark bites were presented. It was suggested that, based on the data, predation was unlikely to have led to the 2008/09 decline in NZ sea lion numbers.

The following points were raised / noted:

- Predation by killer whales (orca)? Had not been reported around the Auckland Islands.
- Definition of a "fresh bite wound"? Red flesh, skin with jagged edges observed, usually thought to be inflicted in recent few days.
- Wound healing rates? Depended on severity of injury with skin regrowth given as approximately 1mm a day.
- Were males more susceptible to shark predation as they spend more time in the surf and travel greater distances during dispersal? Unclear. Noted that whilst it is known that juvenile males are present around the Auckland Islands all year around, less is known about adult male dispersal rates. Outside the breeding season, some males had been recorded as dispersing outside the Auckland Islands whilst others had been observed remaining within the Islands.
- Shark predation increasing? Comment made that as shark populations globally thought to be declining, shark predation was an unlikely cause for the recent decline.

PCB / Toxin hypothesis (slide 15)

Data on earlier tests undertaken for organochlorines and polychlorinated biphenyls were presented. It was suggested that neither were likely to play a role in disease outbreaks or NZ sea lion mortalities.

There was some discussion over other testing for other potential toxins.

Suggestion:

- Test for other toxins, such as those used in previous terrestrial bio-control poison programmes - the need to identify what toxins / substances was raised. Also noted was that, whilst previous bio-control programmes had been undertaken on Enderby, these events were an unlikely candidate for the decline as the programme was undertaken in 1993 and the rat poison used was not thought to impact on animals so late on.

Genetics hypothesis (slide 16)

Data on the NZ sea lion heterozygosity were presented as evidence that the animals were at least as genetically diverse as other pinniped species.

Suggestion:

- Auckland University should be contacted to enquire whether their current studies on the NZ sea lion examined histocompatibility - as a means to assess what foreign antigens the NZ sea lions may have / have not been exposed to.

Dispersal / Absence hypothesis (slide 17)

Previous philopatric behaviour and of the lack of anecdotal evidence of higher than average numbers outside the Auckland Islands (over the 2008/09 breeding season) were presented as possible indicators that dispersal was an unlikely explanation for the decline. To reduce misunderstandings during discussions the need to differentiate between dispersal / absence and resightability was raised.

Following discussion on NZ sea lion female and male dispersal patterns, it was observed that it was reasonable to presume that no new breeding colonies had been established during the 2008/09 season.

Bacterial epizootic hypothesis (slide 18 – 26)

Data relating to bacterial epizootics were presented. The data were used as evidence for the suggestion that bacterial epizootic events, similar to those previously recorded, might not be the cause of this latest decline.

The following points were raised during discussion:

- What qualified as “normal behaviour” for the NZ sea lion over winter? What data were available for winter? The group was informed that following the breeding season the animals disperse from the breeding beaches but that there were only limited data for the period. The foraging work by Nick Gales was noted as one source of information on the issue. An anecdotal report of “nothing unusual noted” from the researcher Simon Childerhouse, following his visit to the Auckland Islands over winter 2008, was mentioned.
- It was noted that pup mortality in 2008-09 was low, especially relative to the epizootic years of 1998-99, 2001-02, and 2002-03. This is contrary to what would be predicted if a bacterial infection occurred during 2008-09 at the breeding colonies when pups were present.
- An observation was made that for the bacteria epizootic hypothesis to be applicable, infection and the disease spread would need to have occurred in late in the 2007-08 breeding season (after the 2007-08 survey but before the animals disperse for winter) and to have killed the females outright or caused them to abort.
- Potential for the spread of a bacterial infection over winter? It was noted that the dispersal of the animals over winter would likely limit the spread of an infection.
- Possibility for infection agent to cause females to die or abort after the 2007-08 pupping and lead to the same animals not returning in 2008-09? It was noted that exposure to a new disease agent, with a long incubation period, was a possibility that could not be ruled out. It was pointed out that, if such an event had occurred, it would be reasonable to expect that, as females died and failed to return to feed their pups during 2008, pup mortality rates would likely have increased. No observations to support this hypothesis were, however, available.
- Peak pupping age? Noted as 8-13 years.
- Contribution of 1998 cohort? Some participants noted that low pup production from the 1998 cohort would contribute to a gradual decline, not a sudden drop in pup production.
- Potential for animals to reabsorb foetus prior to implantation and possible cause for this? It was reported that this was a possibility following a period of physiological stress.
- Possible that the females aborted early at the breeding beaches? Possible, but difficult to observe by the time the researchers arrived.
- Were there more deaths this season compared to previous? Evidence suggested a higher number of dead females from non trauma-related causes compared to the last three years, but many fewer than observed in previous bacterial event years.
- Possible bacteria or bacterium missed? Possible but samples taken were grown on agar and observed under microscope. Some evidence of decreased lymphocytes was observed. It was noted that even if a bacterium is observed following sampling, it may be part of the normal bacterial fauna, but also that even these may grow and cause disease if an animal is under stress.

- It was noted that, during sampling, *Strep. constellatus* was recorded for the first time this year. It could be possible to test old samples using antibodies to determine if this agent has been overlooked in previous years.
- Were all dead animals examined? It was confirmed that providing decomposition was not too advanced, all dead animals were necropsied.
- Other visitors to the Auckland Islands note anything? DOC confirmed that permits to the Auckland Islands had been reviewed. Most were issued for periods over the NZ sea lion breeding season, when researchers were on the islands, so were therefore of limited value. It was mentioned that one permit that covered the winter period made no unusual observations on NZ sea lion. The crew had included a former DOC staff member with previous visits.

Suggestion:

- Was there a need to review data already available on a range of issues such as by-catch, modelling but to also look wider for other related sources of information?
- Was there other research on-going or data available on bacterial epizootic events in other pinnipeds or species?
- Were other researchers in the area outside the breeding season?
- Has any similar or related decline been observed in other pinniped species?

Direct Fishing hypothesis (slides 27 – 30)

Data on fishing-related mortalities were presented.

It was noted that a heading within the third column of the table of *slide 26* was incorrect (is should read "... reported captures on observed and non-observed boats...")

MFish informed the group that a report on estimated total NZ sea lion fishery by-catch was nearing completion. It was caveated that the data presented was in draft at this stage but that the estimated captures and interactions (based on observer coverage) were as follows:

Estimated captures

Fishery	2004-05	2005-06	2006-07
SQU6T	35	34	20
SB Whiting	5	7	14
Other trawl	12	11	12

Estimated Interactions

Fishery	2004-05	2005-06	2006-07
SQU6T	142	144	74

MFish suggested that the true number of mortalities in SQU6T might lie between the estimated captures and interactions values. It was hoped that the report would be finalised shortly.

Discussion focused on a range of issues:

- Accuracy of by-catch data – queried by some participants.
- Fishing effort.
- Impact of non-SQU6T fishing-related mortalities? Some participants suggested the need to consider scampi, southern blue whiting related mortalities.
- Impact of entanglements - 1 animal a year was observed at Sandy Bay entangled with fishing gear. It was noted that NZ sea lions had previously been recorded entangled with jig lines.
- Proportion of females to males by-caught (noted during discussion as changing from a presumed 50:50 to 90:10) - the uncertainty of the data on this issue was highlighted. In particular, the impact of the introduction of SLEDs on females and male captures. It was also noted there have been fewer live

captures in recent years and that it was suspected that captured male NZ sea lions might not always have been returned to shore due to their large size.

- Observer coverage.

Suggestions:

- Further examination of estimated by-catch rates and strike rates to test accuracy.
- Explore increasing observer coverage in the scampi and perhaps southern blue whiting fisheries.

Indirect fishing hypothesis (slides 31 - 32)

Information on possible indirect fishing impacts was presented. Data included a study by Bradford-Grieve *et al.* 2003, squid and scampi catches 1999-2009, diving and foraging profiles, diet analyses as evidence for potential affects.

Discussion was undertaken on the following:

- Assumptions in the work by Bradford-Grieve *et al.* cited in *slide 31*.
- Possible affects from the scampi fishery. An observation was made that this fishery was unlikely to have led to the decline due to the relative small amounts of by-catch, 600 odd tonnes per year.
- Squid was reported as an important component of NZ sea lion diet, second only to opalfish in terms of numbers and octopus in terms of biomass - the information was noted as being incomplete, with sampling biased as most had been obtained from by-caught animals.
- Fatty acid analyses - ongoing and further information will become available. Analyses will be conducted on samples from animals caught in fisheries other than SQU6T, but there are only about two samples at present.
- Do the natal colonies of by-caught tagged NZ sea lions correspond to the patterns revealed by satellite tracking? Noted that no analysis has yet been conducted.
- Questions were raised whether males have been tagged to assess their foraging range and if there was evidence that the foraging areas of males differed from females to reduce competition? Only juvenile males had been tagged on the Auckland Islands. Their foraging range overlapped with females. DOC's tagging of two adult males in 2008 was noted as of interest for future work. This had been a pilot study to investigate the feasibility of tagging adult males – this had not previously been undertaken on the Auckland Islands due to animal and researcher safety concerns. One tagged male had travelled out to Campbell Island, the other outside the recorded foraging ranges of females.
- It was noted that there was no information on the diving and foraging behaviour of NZ sea lions around Campbell Island.
- The group was informed that earlier attempts to investigate body condition of Auckland Islands had not been successful due to equipment failure and that no attempt to investigate this had been made since, but that this could be possible in future years.
- If prey availability was limiting, should this be reflected by a reduction in pup weights? A reduction was not evident from the data but this may have been due to females sacrificing their own condition in order to maintain the weight of their pups. However, over time the difference between female and male pup weights has decreased. This was contrary to most predictions for polygamous species (where male pups are expected to be heavier than female pups) and might be indicative of poor condition.
- Had fish stock survey data for the sub-Antarctics been examined to see what, if any fluctuations were observed? Information for non-QMS species was noted as available from sub-Antarctic trawl surveys. MFish indicated that QMS finfish stocks in the sub-Antarctic region were generally noted as increasing at present.
- Should the Auckland Islands' fur seal population be examined for comparative purposes? An observation was made that sampling and surveying of fur seals on the Auckland Islands was extremely difficult given the terrain and exposure.

Suggestions:

- Investigate NZ sea lion diet over winter outside the squid season.
- Examine fur seal population trends.

Climate change hypothesis (slides 41 – 44)

Data on sea surface temperature and the southern oscillation were presented. It was caveated that, whilst there appeared no suggestion of an unusual event over 2008/09, climate change / fluxes were complex and the data provided were of limited resolution.

There was some discussion over the range of potential sources of data available and the complexities of analysing climate change / fluxes and connecting these to NZ sea lion population dynamics.

Suggestions:

- Fluctuations of the sub-Antarctic convergence zone, sea surface temperature and in chlorophyll production be examined in further detail (using fine resolution data of sea surface temperatures) - it was noted that had been no evidence of any toxic algal blooms in the area of the Auckland Islands over recent years.
- Investigate potential for impacts / changes in the Tasman Sea to be transported into the region of the sub-Antarctic islands - might surveys on prey stocks, such as hoki, reveal an impact in Tasman Sea?
- Examine other species within the Auckland Islands for comparative purposes – perhaps undertake population surveys of the yellow-eye penguin population given the overlap in foraging range? Survey other species with similar foraging range or with a similar diet?

Round-up

The following requests and suggestions were made:

- A full list of references from the presentation be circulated.
- An opportunity for further debate over whether the decline might be driven by an absence of females or a reduction in pup production.
- For more information on relative abundance of males.
- A review of the information available on issues, such as climate change, be undertaken to aid further work.
- The resightings data be examined to test whether there was a decline in sightings or whether fewer animals were being observed less regularly.
- Need to focus on data we have available (by-catch, modelling) and examine other potential sources of information.
- Review what other research is currently underway including examining other species to see if similar trends emerge.
- Parameter estimations by Gibert and MacKenzie to be considered carefully as the decline may be a result of longer-term trends in this species
- Examine how NZ sea lions doing on Campbell Island.
- Examine cumulative affects of both direct and indirect effects of fishing, in particular affects of bottom-trawling.
- Investigate prey availability and NZ sea lion diet.
- Examine data for sub-Antarctic fish stock surveys.
- Examine climate data for possible impacts.
- Investigate feasibility of bacterial epizootic inoculation.
- Examine for affects through a combination of hypotheses or influences, focussing on the long-term given continued decline in population.
- Investigate improving observer coverage in fisheries such as scampi.
- Examine data on all fisheries / NZ sea lion overlaps as not all fisheries currently considered.

Closure

Participants were thanked for their input. It was noted that participants were able to submit, to DOC or MFish, any further information after the workshop if they thought it relevant to discussions and the workshop aims and outcomes.

Appendix II

NZ Sea Lion Trust minutes of the DOC / MFish / Stakeholder workshop: 19 May 2009

Meeting Purpose

The purpose of the meeting was to discuss hypotheses for the dramatic decline in sea lion pup production this year, and to discuss what research can be conducted to gain a better understanding of the cause(s).

Louise's Summary

Louise presented data from the 2008/09 breeding season at the Auckland Islands that showed a 30% decline in the number of pups born from the previous season. Louise's tag re-sights from the Auckland Islands show both a lower number of females present and a lower frequency of sighting. This suggests not only fewer females but also a lower pupping rate. There was not a similar drop in the number of adult males ashore. If there was a reduction in the male population it may not be detected due to slightly smaller males moving in to take over territories or males staying for longer durations than previous seasons because of reduced competition. Alternatively, the cause of the decline may have been something that affected females more than males.

Potential Causes for Decline

The potential causes presented were:

- predation
- PCBs/toxins
- genetics
- dispersal/absence
- bacterial epizootic
- fishing - direct and indirect
- climate influence

The consensus seemed to be that there is no one factor likely to have been the sole cause. All available data suggest the first four causes were unlikely to have had a major effect. There were no obvious climatic differences over the last year to have caused such a large decline directly, and the effect of long-term events (such as El Nino), while unclear, show no patterns with long-term population trends. Bacterial epizootics are known to have caused mass mortalities in the past but there were no signs of any events in either summer, and no unusual number of dead bodies after winter. This combined with a greater dispersal of sea lions during the winter indicates bacterial agents are unlikely to be the cause either. This leaves bycatch and food supply.

Direct bycatch obviously has an influence but is unlikely to account for such a dramatic drop in pup production. However, the number of sea lions caught each year is only estimated and past data indicate the variability can be quite high. The proportional effect of the squid fishery can therefore only be estimated and in an unusual year may be higher than expected. The other likely influence is food related; either direct fishing or climate/environmental events causing a collapse in an important food source. Food shortages may lead to a combination of starvation of adults and abortion of foetuses.

Research Needed

In terms of research required, we need further information on the fish stocks that are an important food source for sea lions especially through the winter. Population data from any other species that might feed on similar prey to the sea lions to look for a similar decline would also be useful. It is also important to know as much as possible about the other known effects, such as bycatch. The New Zealand Sea Lion Trust finds it concerning that the only year with 100% observer coverage in the squid fishery was also the year with the highest catch rate. Very little is known about the effect of the SLEDs with data collected from very few animals. With such a dramatic decline in pup production on top of a steady decline over the last 10 years we feel it is important to collect maximum data and would suggest 100% observer coverage with hoods over the SLEDs to see exactly how many sea lions are being caught and what physical effect the SLEDs have on those sea lions. This should continue for a period of at least 5 years. Sea lions are also being caught in the Southern Blue Whiting and

Scampi fisheries. Again, better data is needed (we suggest 100% observer coverage for 5 years) to assess the full impact of these fisheries.

If there has been a decline in food supply this will reduce the carrying capacity of the region and this needs to be reviewed in the model.

Some attempt should be made to see if this event had a greater effect on females than males. This may be possible from tag re-sight data to see if the proportion of males sighted was higher than females. It may also be possible to look at duration of territory holding and comparing that with the previous study by Robertson.

Shaun McConkey
Chairman
New Zealand Sea Lion Trust