Ministry for Primary Industries
Manatū Ahu Matua

Consultation on the Squid 6T Operational Plan

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Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
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Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

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Submission Information

The Ministry for Primary Industries (MPI) welcomes written submissions on any or all of the proposals contained in the Consultation Document. All written submissions must be received by MPI no later than 7 September 2017.

Submission can be emailed to: FMsubmissions@mpi.govt.nz

Alternatively, the postal address is:

Squid 6T Operational Plan Consultation
Fisheries Management
Ministry for Primary Industries
P O Box 2526
Wellington 6011

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1 Executive Summary

The New Zealand sea lion is one of the rarest sea lions in the world with a current estimated population of around 11,800. The commercial southern squid trawl fishery (SQU6T) overlaps with the foraging range of sea lions that breed at the Auckland Islands. This can lead to the incidental capture of sea lions in fishing gear.

Sea lion interactions with the SQU6T fishery are currently managed through the 'Operational Plan to Manage the Incidental Capture of New Zealand Sea lions in the Southern Squid Trawl Fishery (SQU6T) 2016/17' which expires on 30 September 2017. The Operational Plan specifies a mixture of regulatory and non-regulatory measures to manage interactions between the SQU6T fishery and sea lions.

The main management measure in the Operational Plan is a Fishing-Related Mortality Limit (FRML), which is set by the Minister for Primary Industries, after consultation with the Minister of Conservation, under section 15 of the Fisheries Act 1996. Arrangements to monitor the FRML, including the 'Strike Rate', 'Discount Rate', and notification and reporting requirements are also set out in the Operational Plan. Other components include triggers for early review of the Operational Plan, a commitment to a minimum level of MPI Observer coverage in the fishery, and the process to close the fishery if the FRML is reached.

A review and update of management settings in the Operational Plan is included as an action in the 'New Zealand Sea lion/Rāpoka Threat Management Plan' (NZSL TMP). The NZSL TMP provides a framework for all sea lion research and management of threats to sea lions. An initial discussion with stakeholders on current and future Squid 6T Operational Plan management settings and content was undertaken by the inaugural meeting of the Squid 6T Operational Plan Technical Advisory Group (TAG) on 14-15 June 2017.

MPI is consulting on management settings for the next Operational Plan and welcomes information and views from tangata whenua and stakeholders on the following options for the SQU6T Operational Plan (Table 1).

Table 1: Proposed options for key management settings

Option	Proposed setting
Fishing-related mortality limit	
1 – Status Quo	68
2	38

Option	Proposed setting
Strike Rate	
1 – Status Quo	5.89
2	4.78
3	6.34
4	5.89*
5	7.58

Option	Proposed setting
Discount Rate	
1 – Status Quo	82%
2	75%
3	50%

* Option 4 for Strike Rate would result in the same Strike Rate as the status quo, however it is based on a distinct rationale and is therefore proposed as a separate option.

2 Purpose

The purpose of this consultation paper 'Operational Plan to Manage the Incidental Capture of New Zealand Sea lions in the Southern Squid Trawl Fishery (SQU6T)' is to set out the Ministry for Primary Industries' (MPI) initial position on management measures for the squid trawl fishery operating around the Auckland Islands (SQU6T). It provides the most recent information and options for management settings, including the initial views of MPI where appropriate, so that tangata whenua and stakeholders can provide relevant feedback. The contents of the consultation paper, the views of stakeholders from submissions received and any additional information will be used to formulate final advice for the Minister's consideration.

3 Background

THE NEW ZEALAND SEA LION

The New Zealand sea lion (rāpoka) is an endemic, protected species that is a taonga for tangata whenua. New Zealand sea lions have been protected since 1894 when their hunting was prohibited. As a result of intense hunting prior to 1894, the breeding distribution is now concentrated in the subantarctic islands with around 98% of annual pup production coming from Auckland and Campbell Islands. The New Zealand sea lion is currently categorised as a threatened species under section 2(3) of the Marine Mammals Act 1978.

New Zealand sea lions were classified by the Department of Conservation (DOC) in 2010 as 'Nationally Critical' under the New Zealand Threat Classification System. This was based on their population size, the observed decline in pup production at the main breeding sites on the Auckland Islands and the limited number of breeding sites.

The New Zealand sea lion population is monitored using pup counts to estimate pup production which then provides an index of total population size. A total species population estimate of 11,800 New Zealand sea lions (including pups) was generated for the year 2014/15[1]. Pup counts at the main breeding site at the Auckland Islands have been completed annually for over 20 years. Pup production declined by 50% between 1998 and 2009 but appears to have stabilised in the last eight years (Figure 1). Pup numbers have been increasing at the three other main breeding sites.

[1] Roberts, J.; Doonan, I. (2016). Quantitative Risk Assessment of Threats to New Zealand Sea Lions. *New Zealand Aquatic Environment and Biodiversity Report No. 166.* 111 p.

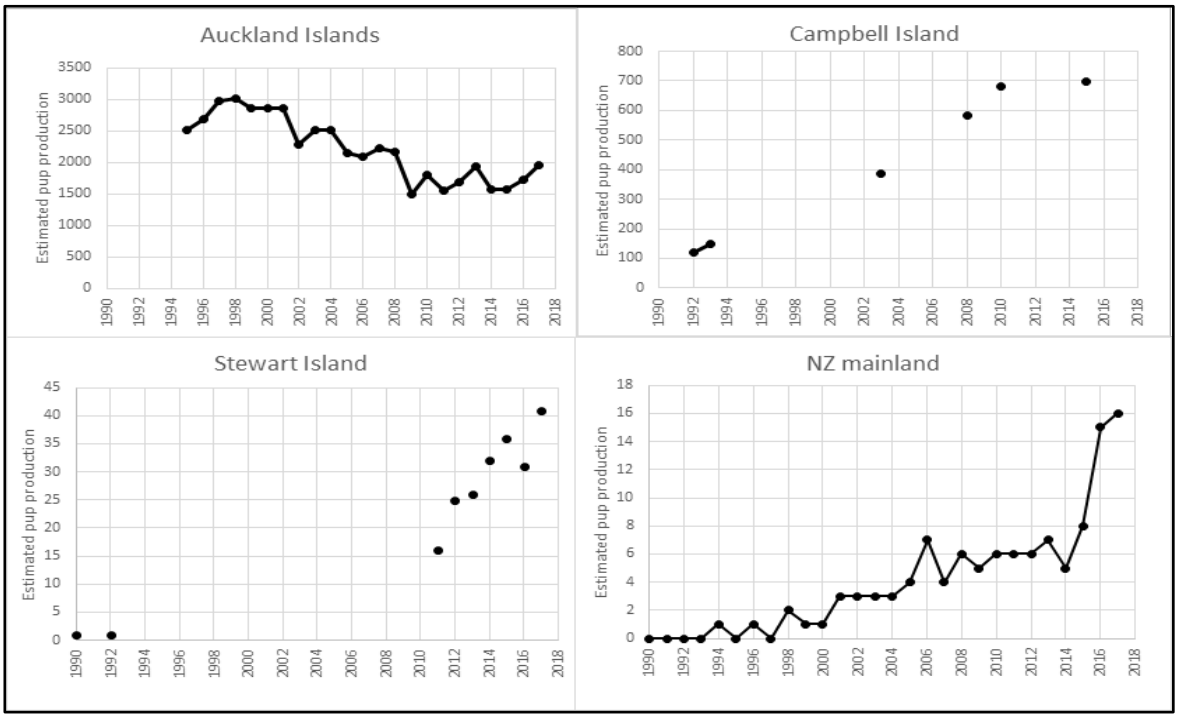


Figure 1: Annual sea lion pup count estimates from breeding sites. Note that the scale for each figure is different. Trendlines are not included for Campbell and Stewart islands as count methodology has changed and counts are not necessarily comparable. (Adapted from Roberts and Doonan, 2016 and updated with the most recent pup counts from 2016 and 2017.)

NEW ZEALAND **SEA LION/RĀPOKA THREAT** MANAGEMENT PLAN

The New Zealand sea lion/rāpoka Threat Management Plan (NZSL TMP) provides a five-year strategic programme of work with four work streams: Engagement, Direct Mitigation, Targeted Research and Evaluation. The NZSL TMP includes population level initiatives and site-specific actions for mitigating all main threats at the four breeding sites.

The vision of the NZSL TMP is to '*promote the recovery and ensure the long-term viability of New Zealand sea lions, with the ultimate goal of achieving 'Not Threatened' status*[2]*'*.

The objectives are to:

1. Halt the decline of the New Zealand sea lion population within 5 years and
2. Ensure the New Zealand sea lion population is stable or increasing within 20 years, with the ultimate goal of achieving 'Not Threatened' status.

The objectives of the NZSL TMP need to be considered in the context of the need to balance sustainability with utilisation in the Fisheries Act 1996. The information supporting the development of the NZSL TMP (detailed below) indicates that the direct impacts of fishing are not the major factor of the observed population change and that the population appears to

[2] Threat classification considers the following criteria: number of mature individuals, predicted population trend, number of populations, number of mature individuals in the largest population, and area of occupancy of total population. To achieve Not Threatened status, the overall population trend would need to be stable to 10%, the number of mature individuals over 20,000, and more than the two current populations/breeding colonies (Auckland Islands and Campbell Island).

be stabilising. The more conservative options in this paper will more significantly impact utilisation opportunities, however MPI considers that none of the options provided will prevent the achievement of the vision or objectives of the NZSL TMP.

For the Auckland Islands breeding site, specific actions in the NZSL TMP include establishment of a Technical Advisory Group to review the SQU6T Operational Plan in 2017.

NEW ZEALAND SEA LION RISK ASSESSMENT AND DEMOGRAPHIC POPULATION MODEL

A key aspect supporting the NZSL TMP is the development of a quantitative risk assessment of threats to New Zealand sea lions.[3] A demographic population model was used to inform a multi-threat risk assessment for the Auckland Islands sea lion population including both fishery and non-fishery threats. The risk assessment evaluated the likely impacts of eliminating the effects of each identified threat on the affected population. Projected population outcomes from the population model and results of the risk assessment are summarised below.

Demographic Population Model

The integrated Bayesian demographic population model for sea lions at the Auckland Islands incorporates all available data relevant to the Auckland Islands sea lion population including pup count data, age distribution data from lactating females, and tag-resight/recapture data from the past 20+ years to 2014/15 to inform estimates of critical demographic rates for different components of the population.

The model structure allows the underlying demographic rates responsible for the observed population decline to be identified. In this case, the model indicates that the observed population decline since 2000 is a consequence of both low pup survival and low adult survival. The importance of low pup survival, which has also been confirmed by direct observations, indicates that direct fishing-related mortality is not the only cause of the population decline, because the fishery does not directly impact pups, and the apparent levels of pup mortality are far higher than could be explained as a consequence of impacts on lactating mothers.

The demographic model was updated in June 2017 to include two additional years of pup count data (January 2016 and 2017 counts). Pup production has increased slightly in recent years, and outputs of the updated model suggest that the population may be stabilising. Greater certainty regarding the population trend will be achieved via inclusion of two additional years of tag resight/recapture data; this work is not yet completed.

The population model has been reviewed by the MPI Aquatic Environment Working Group, DOC Conservation Services Programme Technical Working Group, and by an independent expert panel at two NZSL TMP expert workshops.

[3] Roberts, J.; Doonan, I. (2016). Quantitative Risk Assessment of Threats to New Zealand Sea Lions. *New Zealand Aquatic Environment and Biodiversity Report No. 166.* 111 p.

Risk Assessment

To assess the impact of individual threats to the sea lion population, an expert workshop was held to identify and quantify the level of mortality from each threat. These threats were then 'triaged' using the upper bounds of mortality estimates to screen out threats that had little effect on projected population growth rate. The impacts of the remaining threats were explored in more detail using 'best-estimates' as agreed by the first TMP expert workshop.

For the Auckland Islands population, threat evaluations were completed for *Klebsiella pneumoniae*-related mortality of pups (disease), trophic effects (food or nutritional limitation), direct fishing-related mortality, pups drowning in holes, male aggression, and hookworm mortality. When mortality from each threat was individually removed and the resulting population trajectory was compared with baseline projections with all threats included, only three threats were estimated to change the expected population growth rate by more than 1 percentage point in 20 years time. Of those three, there was only one threat, *Klebsiella pneumoniae,* for which elimination of the threat in isolation resulted in a positive population growth rate.

Direct fishing-related mortality was only estimated to have changed the population growth rate by more than 1% when modelled using implausibly pessimistic estimates of cryptic mortality (e.g. assuming every interaction results in mortality even when the sea lion successfully exits the net). Projections using a more realistic estimate of cryptic mortality (e.g. assuming that 18% of interactions result in a mortality), indicate that eliminating direct fisheries mortality would result in less than half of one percentage improvement in the population growth rate.

Population Sustainability Threshold

New Zealand is implementing a risk-based framework for managing impacts of fisheries on the aquatic environment. One aspect of this framework includes calculating a 'population sustainability threshold' (PST) to identify where fishing may be having an adverse impact on a non-target population. The PST is an estimate of the maximum number of annual human-induced mortalities that can occur while still allowing the population to achieve a defined population outcome. The PST is defined with reference to a defined population recovery or stabilisation outcome with a specified level of certainty (e.g. 'the population will recover to or stabilise at a level no more than X% lower than would occur in the absence of human caused mortality, with Y% certainty').

The demographic model for New Zealand sea lions at the Auckland Islands was used to generate PST estimates corresponding to a range of population outcomes based on recommendations of the Squid 6T Operational Plan Technical Advisory Group. In every instance, the PST reflects recovery to or stabilisation of the population at a defined proportion of what the population would otherwise be (in the absence of human-caused mortality), with 90% certainty.

SQUID 6T OPERATIONAL PLAN TECHNICAL ADVISORY GROUP

MPI established the Squid 6T Operational Plan Technical Advisory Group (TAG) and held the first meetings on 14 and 15 June 2017. The Terms of Reference of the TAG are attached as Appendix 1. The purpose of the Technical Advisory Group is to provide advice and recommendations to MPI on:

- Management settings and content of the current Operational Plan (2016/17) in preparation for the 2017/18 Operational Plan
- Updated 'population objective' criteria for future Operational Plans
- If Strike Rate and Discount Rate remain key components of future Operational Plans:
    - Information gaps/research needs to better inform setting of Strike Rate and
    - Information gaps/research needs to better inform setting of the Discount Rate (focused on understanding SLED non-retention)

The TAG made a number of recommendations both general and specific to the management measures included in the SQU6T Operational Plan.

The recommendations of the Group are attached (Appendix 2) and are reflected in the following sections.

COMMERCIAL FISHERIES

Commercial fishing is excluded from the Auckland Islands out to a distance of 12 nautical miles by the designation of the area as a Marine Mammal Sanctuary. However, sea lions forage beyond 12 nautical miles from shore, and therefore some overlap between foraging sea lions and the SQU6T fishery remains.

Squid (SQU6T)

The southern squid trawl fishery (SQU6T) started in the late 1970s, and targets arrow squid on the Auckland Islands shelf from January to June each year (Figure 2). The Total Allowable Commercial Catch is 32,369 tonnes but landings have not reached this level since 2004. In the last 10 years (2006/07 to 2015/16) the average annual catch has been 16,464 tonnes, ranging from 6,127 tonnes in 2014/15 to 28,872 tonnes in 2008/09. The number of vessels participating in the SQU6T fishery has declined over time, from 63 vessels operating in 1990 to 17 in 2017. In 2016/17, 1,294 tows targeted squid in the SQU6T fishery. The estimated export value of SQU6T in the 2016 calendar year was $68M.

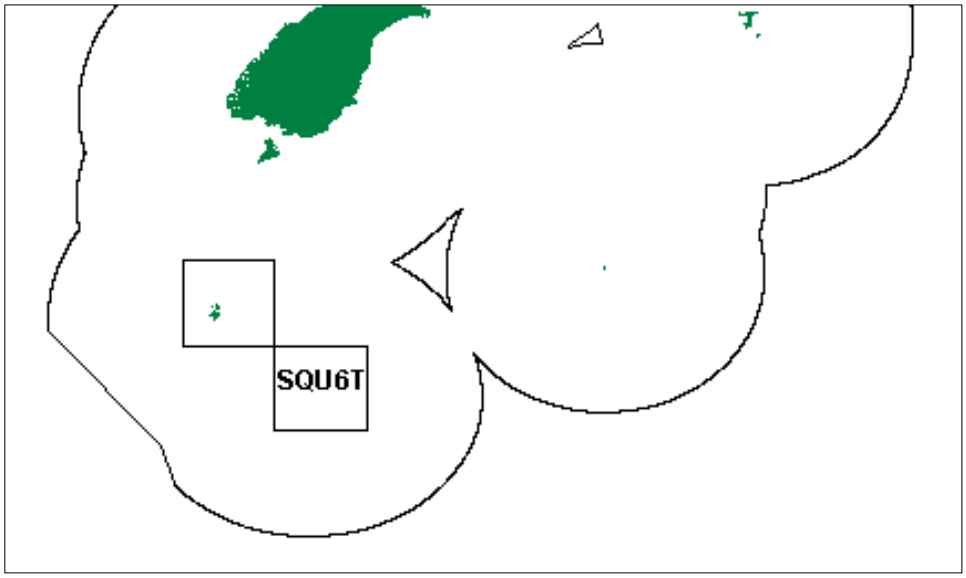


Figure 2: Quota Management Area SQU6T

Scampi (SCI6A) and other fisheries

The trawl fishery for scampi around the Auckland Islands (SCI6A) operates nearly year-round, however the most effort is generally in November and April-June. Interactions with sea lions have previously been reported. While no captures have been observed in over five years, observer coverage in the scampi fishery is generally low. Exports from SCI6A were estimated to be worth $7.7M in the 2016 calendar year.[4]

In the 10-year period between 2005/06 and 2014/15, 3 sea lion captures were observed in scampi target and other commercial trawl fisheries around the Auckland Islands. An average of 10.9% of tows were observed annually over this period and modelling estimated that seven sea lions are killed annually in scampi and other trawl fisheries around the Auckland Islands (Abraham and Berkenbusch, in prep.)[5].

SEA LION EXCLUSION DEVICES (SLEDS)

The most important mitigation initiative developed and used by the fishing industry to mitigate impacts on sea lions is the sea lion exclusion device (SLED). SLEDs are designed to guide actively swimming sea lions to an escape hole to exit the net. From their introduction in 2000 to 2007, the design of SLEDs was regularly adjusted to improve performance. In 2007 the 'Mark 3/13' design became the agreed SLED standard for SQU6T (Appendix 3).

The use of SLEDs is not regulated, however, under the Operational Plan, all vessel operators that intend to fish for squid in SQU6T agree to deploy SLEDs on all tows. Vessels carry at least two SLEDs which are inspected at the start of every season by a registered net making company to make sure they meet the Mark 3/13 specifications. MPI Observers on vessels in

[4] Based on export figures for 2016 calendar year of $29.25/kg. Precise revenue is difficult to estimate and will be influenced by factors such as commodity prices, exchange rate, catching costs and export state.
[5] Abraham, E.R. and Berkenbusch, K. in prep. Estimated captures of New Zealand fur seal, New Zealand sea lion, common dolphin, and turtles in New Zealand trawl and longline fisheries, 1995-96 to 2014-15

the SQU6T fishery also audit SLED specifications, confirm that SLEDs are in good working order and are being deployed in the correct manner.

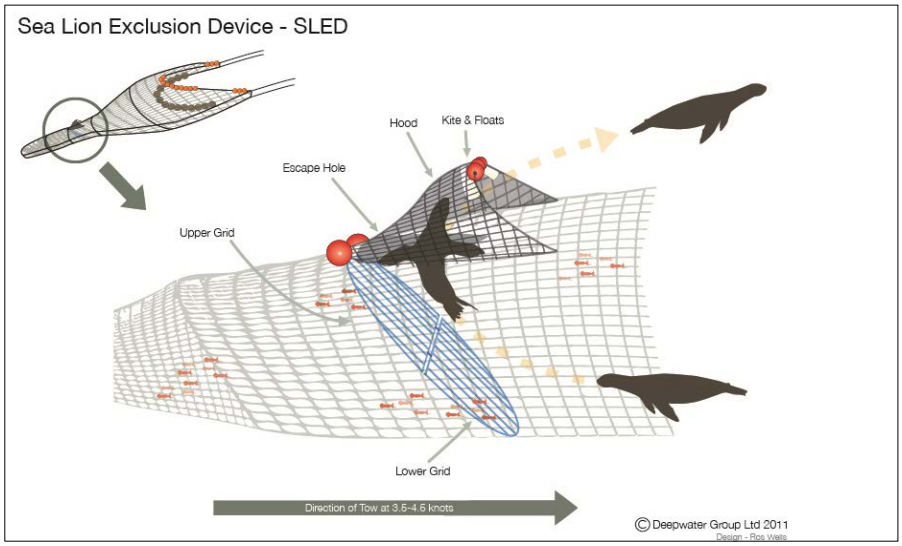


Figure 3: Diagram of a SLED[6]

4 Management Context

STATUTORY CONSIDERATIONS

Marine Mammals Protection Act 1978

The New Zealand sea lion is categorised as a threatened species under section 2(3) of the Marine Mammals Protection Act 1978.

Section 3E provides the opportunity for the Minister of Conservation to approve a population management plan (PMP) for New Zealand sea lions. A PMP may contain an assessment of known fisheries interactions with sea lions, an assessment of the risk caused by fishing-related mortality and can also be used to set a maximum allowable level of fishing-related mortality.

There is no PMP currently in place for New Zealand sea lions.

Fisheries Act 1996

Section 9

Section 9 of the Fisheries Act 1996 sets out environmental principles which any person exercising or performing functions, duties, or powers under the Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account. The principles are:

a) associated or dependent species should be maintained above a level that ensures their long-term viability:
b) biological diversity of the aquatic environment should be maintained:
c) habitats of particular significance for fisheries management should be protected.

[6] Image provided courtesy of Deepwater Group Ltd

Section 10

Section 10 of the Act set out information principles which any person exercising or performing functions, duties, or powers under the Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account. The principles are:

a) decisions should be based on the best available information:
b) decision makers should consider any uncertainty in the information available in any case:
c) decision makers should be cautious when information is uncertain, unreliable, or inadequate:
d) the absence of, or any 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.

Section 15

Section 15 of the Act sets out the Minister for Primary Industries' responsibilities for managing the fishing-related mortality of marine mammals or other wildlife.

Section 15(2) states that, in the absence of a PMP, the Minister may, after consultation with the Minister of Conservation, take such measures as he or she considers are necessary to avoid, remedy or mitigate the effect of fishing-related mortality on any protected species, and such measures may include setting a 'Fishing Related Mortality Limit'(FRML).

In making his/her decision on management measures for the SQU6T fishery, the Minister is required to consider those measures that are 'necessary' to avoid, remedy or mitigate the effects of fishing-related mortality on the New Zealand sea lion.

If the FRML is reached, the fishery may be closed via Gazette notice in accordance with section 15(5) of the Act.

Case Law

In 2004 the fishing industry sought judicial review of the Minister's decision to set a FRML of 62 sea lions (including a strike rate of 5.3 and a SLED discount rate of 20%).[7]The Court Of Appeal set-aside the 2003-2004 Operational Plan and the FRML was increased to 124 for that season. In doing so, the Court emphasised that section 15(2) only authorises measures that are "necessary" to avoid, remedy or mitigate the effect of fishing-related mortality on the sea lion population and stated:

> *[7] "Fishing related mortality" refers only to the death of sea lions in the course of fishing activity. It does not extend to impacts on the sea lion population associated with, for instance, competition for squid. Further, what is important is the impact of fishing on the sea lion population as a whole and the section does not provide for measures aimed simply at eliminating or reducing individual deaths."*

The assessment should be guided by the purpose and principles of the Fisheries Act. Further, the Court commented that the Minister was required to balance utilisation objectives and

[7] Squid Fishery Management Company Limited v Minister Of Fisheries and Chief Executive of Ministry Of Fisheries, CA 39/04

conservation values, and in the context of a harvestable species, this requires utilisation to the extent that it is sustainable. However, the Court recognised that and stated:

> *[77]"The point of the exercise is not to arrive at a number of sea lions which can be harvested sustainably, and thinking associated with sustainability of a harvestable species is not appropriate."*

Given the underlying uncertainties involved, the Court noted that any FRML chosen is likely to carry some degree of risk (perhaps negligible) to sea lions and that optimum usage does not equate to maximum usage. They were not aware of a simple method by which risk can be balanced against utilisation advantages and that a precautionary approach to the required balancing exercise is open to the Minister. The Court also commented that a value judgment was called for and the Court was satisfied that the legislative framework required the Minister to form a view as to the extent to which (or perhaps the point at which) utilisation of the squid SQU6T resource threatened the sustainability of the sea lion population.

MANAGEMENT APPROACH – OPERATIONAL PLAN

The current management approach is to set a fishing-related mortality limit (FRML) for the New Zealand sea lion in the SQU6T fishery which is effected through the Operational Plan. Performance against the FRML is predetermined by the parameters used to monitor the fishery which set a limit on effort in the fishery. The conservation benefits of application of these parameters need to be balanced against the utilisation objectives for the fishery.

The Operational Plan defines the FRML and other measures to manage interactions with New Zealand sea lions and the SQU6T fishery.

Because of the use of SLEDs it is not possible to directly count sea lion mortalities in the fishery. Monitoring of the FRML is therefore based on an approximation of fatal interactions between squid fishing and sea lions.

Fishing Related Mortality Limit (FRML)

The FRML defines the maximum number of sea lion mortalities that may occur in the fishery before it is closed.

The FRML is intended to ensure that fishing does not have an adverse impact on the Auckland Islands sea lion population. Since 2003, an adverse impact, for the purposes of setting the FRML, has been defined as fishing having more than a 10% impact on the Auckland Islands sea lion population.

Specifically, the FRML was set based on modelling which required direct mortality from the squid trawl fishery to result in a population that was more than 90% of carrying capacity or no less than 10% lower than the population size that would have been attained in the absence of fishing, with 90% certainty over 20 years.

Strike Rate

'Strike Rate' is a management setting used to approximate the assumed rate of sea lion 'interactions' that would be fatal in the absence of SLEDs. The Strike Rate represents the number of sea lion mortalities that would occur per 100 tows if no SLEDs are deployed. Where a SLED is deployed, the Strike Rate is adjusted downward from the estimated interaction rate based on the 'Discount Rate' described below to account for the probability of survival of the sea lion.

Before the introduction of SLEDs to the fishery all 'interactions' resulted in a capture, by definition (SLEDs were adopted gradually from approximately 2000 to 2007). For this reason, observed capture data from the early years of the fishery is very important in the estimation of the interaction rate. Since the introduction of SLEDs the data used to inform the setting of the strike rate is very uncertain because sea lions entering the net and successfully exiting via the SLED cannot currently be observed.

Estimates of the interaction rate and resulting captures are updated annually by MPI using Bayesian models, as a function of multiple variables (e.g. distance from sea lion colony and tow duration). However for sea lions, these models become less precise and less stable over time due to an increasing proportion of the data coming from years in which all vessels are utilising SLEDs. Interaction rate estimates arising from models based only on recent data (in which all vessels use SLEDs) are not informed by meaningful capture data. In contrast, interaction rate estimates from early years including vessels for which SLEDs were not used are more precise, but may be biased if fishery conditions or sea lion behaviour have changed considerably.

Discount Rate

The 'Discount Rate' is a management setting intended to reflect the probability that, in an interaction with fishing gear equipped with a SLED, a sea lion will escape from the net via the SLED and will subsequently survive. The Discount Rate is applied as a proportional reduction in Strike Rate for tows where a Mark 3/13 SLED has been deployed and vessel operators have complied with the notification and reporting requirements set out in the Operational Plan.

To understand uncertainty in factors affecting the discount rate, it is useful to distinguish between the possible fates of animals interacting with a trawl net (with SLED). The sea lion may:

a) successfully escape the net via the SLED, and survive (survivor)
b) drown in the net despite the presence of a SLED, and the body retained (observable capture)
c) exit the net via the SLED but nonetheless die as a consequence of the interaction (cryptic mortality)

Possible causes of cryptic mortality include:

a) the sea lion suffers 'mild traumatic brain injury' due to interaction with the SLED, and either drowns before reaching the surface or otherwise dies of its injuries after exiting via the SLED (MTBI)

b) the sea lion dies in the net but the body is subsequently lost via the SLED prior to retrieval (body non-retention)
c) the sea lion escapes via the SLED but is otherwise confused or at the limit of its breath hold ability, and drowns before reaching the surface (post-escape drowning)

MPI has invested considerable scientific resources to estimate sources of cryptic mortality. Extensive 'crash-test dummy' modelling suggests that mortality from mild traumatic brain injury will be very low (less than 3% of interactions). Anecdotal evidence from other jurisdictions suggests that body non-retention is likely to be negligible. Post-escape drowning is impossible to quantify but is judged unlikely to be high based on camera observations of sea lion behaviour in SLEDs, and known physiological characteristics.

5 Options

Table 2: Proposed options for key management settings

Option	Proposed setting
Fishing-related mortality limit	
1 – Status Quo	68
2	38

Option	Proposed setting
Strike Rate	
1 – Status Quo	5.89
2	4.78
3	6.34
4	5.89*
5	7.58

Option	Proposed setting
Discount Rate	
1 – Status Quo	82%
2	75%
3	50%

* Option 4 for Strike Rate would result in the same Strike Rate as the status quo, however it is based on a distinct rationale and is therefore proposed as a separate option.

FISHING RELATED MORTALITY LIMIT

The integrated demographic population model for sea lions was used to calculate PSTs for the Auckland Islands sea lion population for a range of desired population outcomes as per recommendations of the TAG. The PST was subsequently adjusted to account for sea lion moralities in fisheries other than SQU6T.

Section 15 of the Fisheries Act requires that the Minister set measures as 'necessary' to avoid, remedy or mitigation the impacts of commercial fishing on the whole of the New Zealand sea lion population. The options proposed here may be considered conservative as they are based on a model which incorporates population trend information only for the Auckland Islands population.

Table 3: Proposed options for fishing-related mortality limit for SQU6T

	Proposed FRML
Option 1 (status quo)	68
Option 2	38

Option 1 – Status Quo

The FRML has been set at 68 sea lions since 1 October 2010. This FRML was based on a New Zealand sea lion-specific population model known as the Breen-Fu-Gilbert Model[8]. The Breen-Fu-Gilbert model was reviewed in 2013. The review concluded that the model was correctly implemented, however some aspects of the model were unclear, and a recommendation was made to explore other modelling options, which led to the development of the demographic population model used to inform the other options.

Option 2

The PST that underpins Option 2 was modelled to meet a desired population objective of the Auckland Islands population being no more than 5% lower than it would be in the absence of human-caused mortality with 90% confidence, over five years, also incorporating uncertainty. This resulted in a PST of 46 sea lions.

As recommended by the TAG, the PST was then adjusted to allow for sea lion mortalities in fisheries other than SQU6T which may impact on the Auckland Islands sea lion population. The allowance of eight is based on the five-year average annual estimated captures from scampi and other trawl fisheries around the Auckland Islands (7) plus one additional to allow for capture in the Stewart Snares shelf fishery area of one sea lion (1) originating from the Auckland Islands population[9].

Following incorporation of the allowance for sea lion mortalities in other fisheries, a fishing-related mortality of 38 sea lions is proposed.

MPI present this option as the mid-point of the range of desired population objectives proposed by the TAG, and welcomes submissions on how 'adverse effects' should be defined with regards to providing for the utilisation of fisheries resources while ensuring sustainability. Note that the proposed FRML would increase if the desired population objective allowed for a higher percent impact on the population (e.g. >5% difference). Likewise, the proposed FRML would decrease if the desired population objective allowed a lower percent impact on the population (e.g. <5% difference).

STRIKE RATE

Estimates of interaction rate are modelled/estimated as part of MPIs annual protected species capture estimation project. The proposed options for Strike Rate are based on the average estimated interaction rate over three different time periods, including the period recommended by the TAG and an additional option using what MPI considers to be the most robust estimate but accounting for the associated uncertainties.

[8] Breen, P.A.; Fu, D.; Gilbert, D.J. (2016). Sea lion population modelling and management procedure evaluations. *New Zealand Aquatic Environment and Biodiversity Report No. 175*. 89 p.

[9] From https://psc.dragonfly.co.nz/2016v1/released/explore/ accessed 5 July 2017.

Table 4: Proposed options for Strike Rate

Option	Strike Rate	Reference period	95% Confidence Range
1 – (Status quo)	5.89	2000/01 – 2009/10 Mean	
2	4.78	1995/96 – 2004/05 Mean	3.64 - 6.34
3	6.34	1995/96 – 2004/05 Upper 95% Confidence Bound	
4	5.89*	1995/96 – 2014/15 Mean	3.43 – 14.7
5	7.58	2005/06 – 2014/15 Mean	2.14 – 29.6

* Option 4 for Strike Rate would result in the same Strike Rate as the status quo, however it is based on a distinct rationale and is therefore proposed as a separate option.

Option 1 – Status Quo

The current Strike Rate of 5.89 was set in 2012 based on the mean interaction rate over the ten year period from 2000/01 to 2009/10 as per Thompson et al.[10] which was reviewed by MPI's Aquatic Environment Working Group but was never published as a final report.

Option 2

Option 2 proposes a Strike Rate of 4.78 sea lions per 100 tows. This is based on the 10 earliest years of available strike rate data, including all data from the period prior to the implementation of SLEDs. This option is informed by direct observations of sea lion captures in the SQU6T fishery.

While this is likely to be the best informed estimate of the interaction rate, it is possible that there have been changes in sea lion abundance or behaviour (e.g. changes in diet or foraging patterns) and/or changes in fishing operations (changes in vessel numbers, tow duration) that may have impacted on strike rate.

Option 3

Option 3 proposes to use the upper 95% confidence bound of the 1995/96 – 2004/05 time series. This option is similar to Option 2 but more explicitly recognises that there are likely to have been changes in factors that affect interaction rate and therefore proposes a more conservative Strike Rate of 6.34 sea lions per 100 tows.

Option 4

Option 4 proposes a Strike Rate of 5.89 sea lions per 100 tows based on the average of the full 20 years of the fishery where estimates of interaction rate are available. Coincidentally, this rate appears the same as the Status Quo.

A key uncertainty with this option is the lack of empirical data on sea lion interaction rate to underpin all estimates later than the early 2000s.

Option 5

Option 5 proposes a Strike Rate of 7.58 sea lions per 100 tows based on the average of the most recent 10 years where estimates of interaction rate are available.

[10] Thompson. F.N. et al (unpublished). Marine mammal bycatch in New Zealand trawl fisheries, 1995–96 to 2009–10.

The model used to estimate interaction rate is informed by the data collected prior to full implementation of SLEDs. However, all interaction rate estimates incorporated into this average are based on model results supported by few empirical data which results in a very uncertain estimate.

DISCOUNT RATE

Setting of the Discount Rate requires consideration of two key factors:

1) Probability that the sea lion exits the net via the SLED (exit probability)
2) Probability that a sea lion that has exited the net survives the encounter (cryptic mortality), which includes MTBI, body non-retention, and post-escape drowning

The TAG recommended that multiple options be provided including clear consideration of the best available data and uncertainty with regards to cryptic mortality. A sub-set of TAG members also requested that a specific option be provided for consultation (Option 3).

Note that the Discount Rate is calculated based on the exit probability multiplied by the proportion of those that exit that don't survive.

Table 5: Proposed options for Discount Rate

Option	Discount Rate	Considerations
1 – (Status quo)	82%	1) 85% exit probability 2) 3% allowance for MTBI
2	75%	1) 86% exit probability 2) 3% allowance for MTBI; 10% allowance for body non-retention and post-escape drowning
3	50%	Arbitrary – from Bradshaw et al 2013

Option 1 – Status Quo

The status quo is based on modelling of the change in observed captures in SQU6T pre and post-SLED deployment. This modelling, completed in 2011, indicated that 85% of sea lions that enter a trawl net can be expected to exit through a SLED when one is fitted. [11] Additional work looking at potential injuries to sea lions encountering a SLED grid estimated that 3% of encounters with a grid could potentially prove fatal by causing a mild traumatic brain injury. [12]

Option 2

Option 2 is based on an updated exit probability using the same model and approach as previously, but incorporating an additional three years of data. This results in an estimated exit probability of 86%[13].

Cryptic mortality is then accounted for in two ways: firstly by incorporating an assumption that 3% of those sea lions that escape will not survive as the result of MTBI from impact with the SLED and secondly by including a conservative and somewhat arbitrary assumption that an additional 10% of those that exit the SLED will not survive, potentially from running out

[11] Thompson, F.N.; Abraham, E.R. (2011). Estimation of the capture of New Zealand sea lions (Phocarctos hookeri) in trawl fisheries, from 1995–96 to 2008–09. New Zealand Aquatic Environment and Biodiversity Report No. 66. 25p.
[12] Abraham, E R (2011) Probability of Mild Traumatic Brain Injury for sea lions interacting with SLEDs. Final Research Report for Ministry of Fisheries project SRP2011-03 (Unpublished report held by the Ministry for Primary Industries, Wellington). 21 pages
[13] Abraham, E.R.; Berkenbusch, K. (in prep). Estimated captures of New Zealand fur seal, New Zealand sea lion, common dolphin, and turtles in New Zealand trawl and longline fisheries, 1995-96 to 2014-15.

of oxygen before they can return to the surface or from drowning in the net and falling out of the SLED.

Applying this allowance for cryptic mortality to the updated exit probability leads to the following calculation of the Discount Rate of 75%:

0.86	x	(1-	(0.03	+	0.1))	=	0.748 (75%)
Exit probability (assumed survivor)		Convert cryptic mortality into a proportion that survive (to be comparable to exit probability)	Proportion that die from MTBI		Proportion body non-retention and/or drowning		Proposed Discount Rate
			Cryptic mortality				

Option 3

Option 3 was proposed by environmental stakeholders at the Technical Advisory Group. The Technical Advisory Group recognised that there are uncertainties associated with the calculation of Strike Rate and Discount Rate and it was therefore requested that a precautionary option be provided to account for those uncertainties.

The 50% is based on the report of an independent review of models and data underpinning the management of fishing-related mortality of New Zealand sea lions in the SQU6T fishery. In the view of the authors, until real data to inform the setting of the Discount Rate becomes available, MPI's options are limited to, among others, 'setting a coin toss discount rate of 0.5 (which would be arbitrary)'(Bradshaw et al 2013).

Other Settings

Other proposed Operational Plan settings on which MPI requests views include:

Duration of Operational Plan

MPI is proposing that this Operational Plan apply to the 2017/18 and 2018/19 fishing years. The TAG recognised and supported the need for a multi-year plan but expressed some concern about maintaining the status quo for two years, as that could be viewed as delaying action. In addition, the TAG recommended that there be trigger points to allow for the Operational Plan to be reviewed if significant new information becomes available.

Notification requirements

Vessel operators must provide MPI's Observer Programme with 72 hours' notice prior to the vessel leaving port for each fishing trip where the vessel intends to operate in SQU6T. If a vessel is already out fishing, the operator must still provide 72 hours' notice prior to entering SQU6T and the vessel must be available to return to port to pick up an MPI Observer if required.

The notification provides the MPI Observer Programme time to organise and deploy observers as required. Tows undertaken in SQU6T by any vessel for which a full 72 hours' notice was not received are not eligible for the 'Discount Rate'.

Reporting requirements

All vessel operators must report weekly to MPI, through Commercial Fisheries Services Ltd (FishServe), including the number of tows, whether a SLED was deployed, if each tow was observed, and if any sea lions were captured.

If 80% of the FRML is reached, the above information must be reported daily.

Tows which are not reported as per this requirement are not eligible for the 'Discount Rate'.

Trigger points

Trigger points set out conditions under which the Operational Plan will be reviewed in advance of the scheduled expiry of the Operational Plan.

It is proposed that for this plan, the only trigger point will be to review the Operational Plan if significant new information becomes available (e.g. significantly low pup count in January 2018, major changes in fishing operations or level of effort).

Observer Coverage

MPI commits to a minimum observer coverage of 50% of tows observed. MPI Observers will continue to audit SLED measurements and ensure that they observe all hauls in SQU6T.

In recent years, this coverage target has been exceeded, with average observer coverage over the most recent five years of 84% of tows observed.

Fishery Closure Process

If the FRML is reached, the SQU6T fishery will be closed without consultation via gazette notice. MPI will work with DWG to ensure that all fishers are aware of levels of fishing activity against the FRML throughout the season and are informed in advance of any impending closure.

MPI will continue to provide a weekly update to interested stakeholders providing information on the number of vessels, tows, observer coverage, and notification of any sea lion captures.

6 Next Steps

The submission period is open for four weeks.

MPI welcome written submissions on the Operational Plan to Manage the Incidental Capture of New Zealand Sea lions in the Southern Squid Trawl Fishery (SQU6T) for 2017/18 and 2018/19

The deadline for all submissions is:

• 5pm on 7 September 2017

Please make sure you include the following information in your submission:

- the title of this consultation document
- your name and title
- your organisation's name (if you are submitting on behalf of an organisation), and
- your contact details (e.g. phone number, address and email).

Appendix 1 - Squid 6T Operational Plan Technical Advisory Group Draft Terms of Reference

Background
The Ministry for Primary Industries and Department of Conservation have worked jointly to develop a Threat Management Plan for New Zealand sea lions with an objective to 'promote the recovery and ensure the long-term viability of New Zealand sea lions to ultimately achieve non-threatened status'. A number of threats to the New Zealand sea lion population have been identified including disease, food availability changes, direct effects of fishing, and deliberate human interactions.

An holistic programme of work is proposed through the Threat Management Plan including the management of direct effects of fishing. Historically, the management of sea lion interactions with the southern squid trawl fishery (SQU 6T) has been effected through the setting of fishing-related mortality limits (FRML) and the deployment of Sea Lion Exclusion Devices (SLEDs) combined with intensive monitoring in the fishery.

The monitoring of the FRML is currently undertaken by estimating the number of sea lions that interact with the fishing gear and would have died if there were no SLED deployed ('Strike Rate') and estimating the proportion of sea lions that enter the net but escape through the SLED and survive the encounter ('Discount Rate'). Both of these settings were based on the best available science when originally determined, but it is now timely to review these management settings.

Purpose
The purpose of the Squid 6T Operational Plan Technical Advisory Group is to provide advice and recommendations to MPI on:

- Management settings and content of the current Operational Plan in preparation for the 2018 Operational Plan
- Updated 'population objective' criteria for future Operational Plans
- If Strike Rate and Discount Rate remain key components of future Operational Plans: – Information gaps/research needs to better inform setting of Strike Rate
- Information gaps/research needs to better inform setting of the Discount Rate (focused on understanding SLED non-retention)

Scope
The Squid 6T Operational Plan Technical Advisory Group is not a decision-making group. Final decisions on recommendations and advice will be at MPI or the Ministers discretion.

This Technical Advisory Group is also not a technical review body, and therefore, previously reviewed science on post-SLED escape mortality related to SLED impact/injury will be out of scope.

Membership
The membership of the group will be comprised of representatives from:
- Ministry for Primary Industries;
- Department of Conservation;

- Iwi;
- Environmental NGOs (x3);
- Fishing Industry (x3); and

Technical expert/advisors (x4)

Technical experts/advisors will be selected by MPI, incorporating nominations from members of the New Zealand sea lion/rapoka Forum and Advisory Groups.

Members may be added to this group at the discretion of MPI with agreement from other members.

Chair
The Chair will be appointed by MPI following consultation with Technical Advisory Group members.

Operation
Documents and agendas will be distributed at least 5 days prior to any meeting of the Technical Advisory Group wherever possible.

Although management settings and objectives will be discussed, the Group should focus on the technical aspects of these, including feasibility, consistency with TMP objectives, monitoring and implementation.

High level discussions, conclusions, and recommendations will be recorded by MPI and distributed to the group following each meeting of the Technical Advisory Group. Wherever possible, conclusions and recommendations will be via consensus, however if this is not possible, the majority position and objections will be noted and attributed in the minutes.

Standards of Conduct
Members of the group are expected to attend and participate fully and constructively with the aim of reaching outcomes that facilitate achievement of the objectives of the TMP.

Members shall deal fairly with each other and observe a general standard of “good behaviour”
Any situation that involves or may be expected to involve a real or perceived conflict of interest must be declared immediately to the Chair and MPI.

General confidentiality requirements
Chatham house rules apply to the operation of the group. In order for the group to operate effectively, members and observers must maintain the confidence of the group, including maintaining confidentiality of matters discussed at meetings, and any information or documents provided to the group.

With the agreement of the Chair and MPI, members and observers may share information about the business of the group with the organisations they represent.

Any person presenting information to the group, whether written or oral, may request that some or all of that information be treated as confidential by the members and observers.

At the request of a member, the Chair may seek agreement from MPI and anyone who supplied confidential information to the group for confidentiality in that information to be waived.

Privacy Act
Members and observers must at all times comply with the requirements of the Privacy Act 1993 and keep information about identifiable individuals confidential.

Official Information Act
All information provided to the group will be treated as official information under the Official Information Act 1982 and, subject to the requirements of that Act, may be released to the public if there are no grounds for withholding it.

Where relevant, if MPI is considering releasing information under the Official Information Act 1982, MPI will consult with the person who provided the information before making a final decision on release.

Media
Members and observers must refrain from representing the group, or commenting on the business of the group, to the media.

The Chairperson may seek agreement from MPI for the group to release a media statement on any matter related to these terms of reference.

With the prior agreement of the Technical Advisory Group and MPI, a member may participate in a media interview or make some other public statement about the business of the group.

Appendix 2 - Recommendations from the Squid 6T Operational Plan Technical Advisory Group 14 and 15 June 2017

Ministry for Primary Industries
Manatū Ahu Matua

Squid 6T Operational Plan Technical Advisory Group 14 and 15 June 2017

CHAIR: Dr Neil Gilbert, Constantia Consulting Ltd

Attendees: Tiffany Bock, Ben Sharp, Greg Lydon (MPI), Laura Boren and Kris Ramm (DOC), Katrina Goddard (Forest & Bird), Amanda Leathers (WWF), Barry Weeber (ECO), Richard Wells (Deepwater Group Ltd (DWG)), Tom Clark (Fisheries Inshore NZ), David Middleton (Trident on behalf of DWG), Dr Bruce Robertson (University of Otago), Kirsty Wood (TOKM), Mike Gerner (Australian Fisheries Management Authority), Dr Alice Mackay (South Australian Research Development Institute), Dr Simon Childerhouse (Blue Planet Marine)
Apologies: Laws Lawson (TOKM)

Recommendations from 14 June:

Introduction

- Confirmation of Dr Neil Gilbert as the Chair of the Squid 6T Operational Plan Technical Advisory Group meeting for 14 and 15 June
- That the notes of this meeting will be an appendix in the Squid 6T Operational Plan Consultation Document
- That all presentations will be made available on the Group Website

Terms of Reference

- Agreement with the Terms of Reference, however noted that:

I. 'majority view' is subjective and that assenting views will be noted
II. that 'trust and confidence of the group' should be added to the 'General confidentiality requirements' section of the TOR
III. the role of observers should be defined and
IV. members of the Squid 6T Operational Plan Technical Advisory Group will be notified of any OIA requests regarding the Group and final OIA responses available upon request
V. Any relevant media announcements by MPI and DOC will be circulated to members of the Group in advance when possible (anything mentioning AFMA and/or SARDI must go through the respective agencies)

General Recommendations

The New Zealand Sea Lion Threat Management Plan should be released prior to the consultation on the SQU6T Operational Plan for 2017/18 and stakeholders notified

MPI to continue working with AFMA to identify collaboration opportunities to share knowledge, data and expertise on marine mammal bycatch issues

Consideration be given in the long term of the potential to move towards more direct estimation of mortality (and monitoring of FRML)

Clearly define ALL terms used in management and advice

MPI to continue considering all management options to manage interactions of sea lions with the SQU6T fishery (including spatial management) - link to TMP

Population objective criteria and setting of FRML

2017/18 –

- Test effects on PST of:
    - using 95% and 98% thresholds (5% and 2% impact from fishing) with 90% probability.
    - using 'estimated captures' as future mortality assumption
- Give explicit consideration to direct impacts from other fisheries when setting FRML
- Provide a range of options for the FRML (including consideration of option to reduce FRML from current number)

    - Specific statement from WWF, Forest & Bird, and ECO regarding the need to consider active fisheries mortality reduction as an option to reflect society's views and desire to reduce human impacts on threatened marine mammal species

Longer term –

- Ensure that consideration be given to the direct impacts of all fisheries that impact on Auckland Islands sea lion population.
- The Squid 6T Operational Plan needs to be consistent with the goals/objectives of the Sea Lion Threat Management Plan - Consideration be given towards setting an aspirational goal for the SQU6T fishery of zero bycatch under framework of TMP
- Projections should be made over 5 years and a longer timeframe as possible (at least 10 years) (consistent with capacity of model)(noting the TMP has 5-year and 20-year goals)
- MPI will work on a proposal for the next meeting of SqOPTAG (later in 2017) to discuss 'population objective' criteria for future Operational Plans

Strike Rate

2017/18

- MPI to confirm if/why early (pre-2000) data was discarded and see if it can be used to inform estimation of current Strike Rate.
- Provide multiple options on Strike Rate based on different reference periods and reflect uncertainty (including consideration of information in Smith & Baird 2005 and changes in fisher behaviour/fleet make-up)
    - If possible, model strike rate for entire period of available data but only use last 10 years (or other more recent period) to calculate mean

Longer Term

- Consideration be given to further exploration of tow duration and turns data (and/or other factors which may explain differences including changes in the make-up of the fleet)
- Note that if analysis of Smith & Baird 2005 etc cannot be completed for 2017/18, that work should still be progressed.

Discount Rate

2017/18

- MPI to provide multiple options for Discount Rate including clear consideration of best available data (including consideration of Bradshaw et al. 2013) and uncertainty with regards to cryptic mortality.

- Specific statement from WWF, Forest & Bird and ECO noting Bradshaw report, that until real data becomes available then a precautionary approach is recommended. A discount rate of 0.5 or less is recommended as an appropriate interim option.

Recommendations 15 June:

- Update of Jim's demographic model with consideration given to in-depth review and/or getting clarity on the differences between Jim's model and Stefan's model (refer to TMP expert workshop report as a starting point)
- Update Smith & Baird using all available data, consider partitioning into pre-SLED and post-SLED periods and consideration of all explanatory variables
- Proposal to apply risk assessment framework to use best available information to estimate priors to quantify uncertainty and allow for informed prioritisation of future work
- Scoping exercise in conjunction with risk assessment to assess potential methodologies to address uncertainties in retention including consideration of cameras and/or PIT tags
    - Note interest of some members in investigating pseudo sea lion trials
    - Fishing industry does not support pseudo sea lion trials
- Operational Plan proposed for 2 years with trigger based on availability of significant new information

Appendix 3 - DWG and MPI Sled Specification for SQU6T Operational Plan

DWG AND MPI SLED SPECIFICATION FOR SQU6T OPERATIONAL PLAN

October 2010 MK 3/13 SLED approved by SLED Working Group September 2009. Clause 11 modified by MFish November 2010; clause 7 modified by MAF January 2012; clause 6 modified by MPI July 2012.

The SLED required for use by all vessels in the SQU6T fishery is an approved type that meets the following criteria:

1. The SLED must consist of a lengthener section of net, with either 2 or 4 seams, containing a 2 or 3 piece grid, hinged horizontally along the middle. The grid must be set in the net at about 45° ± 5° from the vertical with the top of the grid closest to the cod end section and continuously sewn to the net meshes around its outer edge.

2. The grid must be constructed of minimum 20 mm outside diameter solid stainless steel bar and should be shaped to conform to the working parameters of the net (refer diagram).

3. Vertical grid bars must be evenly spaced at a continuous maximum distance of 23cm between bars (see diagram). There will be no minimum number of bars, provided they are evenly spaced and do not exceed the required maximum spacing. It may be necessary to have the last spacing between the final bar and the grid frame differing from the rest of the spacings provided they are less than 23 cm apart between bars and frame.

4. The escape hole must be triangular and cut into the upper surface of the lengthener section. This hole must be a minimum of 130 cm wide at the base, measured along the top bar of the grid. The apex of the triangle must be a minimum of 150 cm forward of the base (refer diagram).

5. Above the escape hole, a hood-shaped mesh scoop must be attached with its open (leading) end facing into the water-flow and its closed (trailing) end attached and over stretched to the top bar of the grid. The leading edge of the hood must be a minimum of 90 cm high when fully open. The leading edge rope around the mouth of the hood must be a minimum of 320 cm long after attachment of kite and floats. The hood must be a minimum length of 170cm long (refer diagram).

6. The hood must have a semi rigid kite 220 cm long by 32 cm wide (both measurements + 10%; a piece of thick conveyor-belt is ideal) attached under the meshes of the hood. The kite must be attached to the hood by stitching at regular intervals the leading edge of the hood and the leading edge of the kite using a minimum of eight attachment points. The trailing edge of the kite should also be attached to the hood netting. The leading corners of the hood must extend forward of the escape hole.

7. Three floats of between 19 and 30 cm in diameter (a centre hole float is best) must be each attached to the leading edge on the kite. One float must be in the centre of the kite length and the other two equidistant between the centre float each end of the kite (refer diagram).

8. The SLED should be inserted into the trawl (between the body of the trawl and the lengthener) with the escape hole always on the upper surface when the net is fishing.

9. Each SLED grid frame must have a unique registration number, identifying it as a unit, clearly stamped into the frame bar at each end of each hinge section. Deepwater Group Ltd will record each SLED registration number. DWG's register of SLED numbers must be provided to MPI on an annual basis before fishing commences.

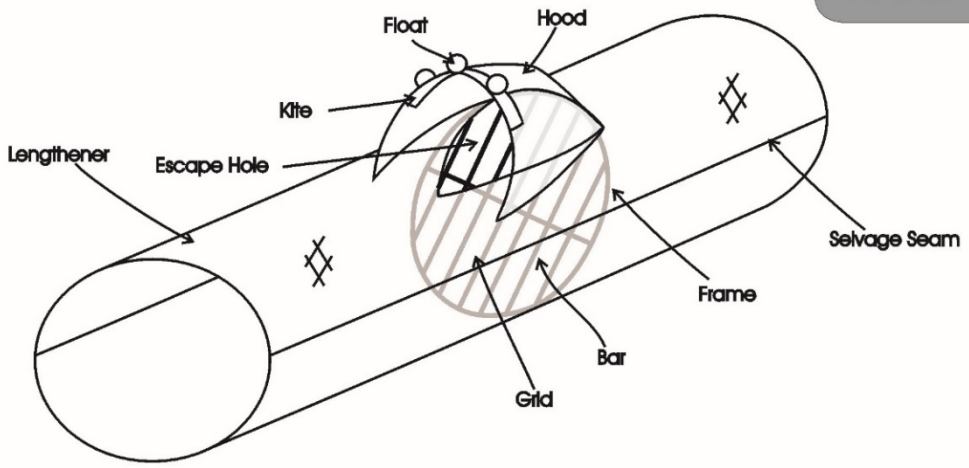
10. Depending on the net for which the SLED is built, there are elements of the SLED configuration that may vary, including: the presence or absence of floats attached to the outside of the grid or back of

the kite, the shape, width and height of the grid, the number of vertical bars in the grid, the number of meshes in the hood and the number and size of meshes in the lengthener section.

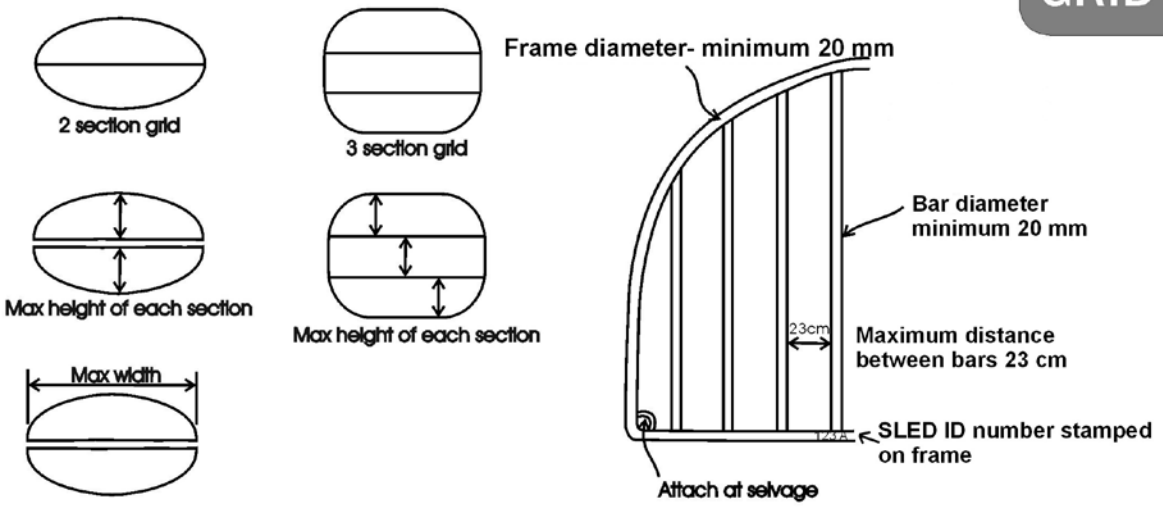
11. No extra panels or mesh material may be fitted inside the net or lengthener before the SLED. Additional floats may be fitted outside the lengthener to the top of the grid frame. Floats may also be fitted inside the lengthener behind the grid or frame but NOT in front of the grid.

12. Alterations are not to be made to the design outside of this specification. For new builds or major repairs contact Motueka Nets Ltd or Hampidjan NZ Ltd.

SLED TERMS



GRID



ESCAPE HOLE and HOOD