Development of a Prototype fur seal exclusion device (SED)

Following a broad ranging review of marine mammal exclusion devices in commercial trawls it is proposed to develop, construct and trial a fur seal exclusion grid of similar design to the sea lion exclusion devices (SLEDs) currently used in the SQU 6T squid trawl fishery for the following reasons:

- Advanced SLED design and construction technology already exists in NZ;

- Similar devices continue to be used in the trawl fishery for squid in New Zealand waters and in the hoki/blue grenadier fishery in Tasmanian waters where Australian fur seals (albeit larger than NZ fur seals) are part of the bycatch;

- All vessels in the New Zealand SQU 6T fishery carry exclusion devices and crews are experienced with their safe deployment and recovery;

- Video evidence[1] has demonstrated 'soft' grids are not as efficient as the 'hard' grids currently used in NZ. Their inherent flexibility allows animals to sink into the mesh and does not readily direct animals to the escape hatch;

- The only major modification necessary to the existing SLED design will be an alteration to grid bar spacings to exclude smaller animals.

Determining appropriate bar spacings

Seal exclusion devices in commercial trawls are designed to allow the free flow of undamaged target fish species into the codend while excluding adult and subadult seals which have free access out of the net via a permanently open escape hatch in the top panel of the net.

A critical feature of exclusion device grids is the bar spacing, which prevents all but the smallest seals from passing through into the codend. Spacings between the bars must be smaller than the average diameter of the animals likely to come into contact with the grid. The greatest circumference of a fur seal or sea lion is measured immediately behind the insertion of the fore flippers at the "armpit" or axilla encompassing the powerful shoulder and pectoral muscles and the rib cage.

Initially, bar spacings in SLEDs were set at 28cm. However in 2005 Dr. Louise Chilvers[2] (DoC) noted that up to 22% of the of female sea lions anaesthetised and measured over 4 years in the field could pass through bars at this spacing. Anaesthetised sea lions are fully relaxed and their lungs are inflated; the girth measured at the axilla is the maximum. To calculate the diameter of sea lions at this point Chilvers divided the girth by Pi (3.14159) getting an average diameter of 35.8cm (0.2cm s.e., range 30.6 – 40.7). Chilvers suggests the axillary girth in water would be more than 5cm smaller as the sea lions' muscles are tensioned when swimming, the lungs are empty of air, and water pressure compresses the rib cage. To compensate for this reduction, Chilvers therefore suggested the bar spacing should be reduced to 23cm to prevent 95% of the adult NZ sea lions measured, at their expected underwater diameter, from passing through the bars. This suggestion was considered and adopted by the SLED WG and 23cm bar spacing (inside measurement) became the standard SLED bar spacing used in the SQU6T fishery.

NZ fur seals, like sea lions and other otariid seals, are sexually dimorphic. The females are about 50% of the weight of males, axillary girth is 15%-20% less, and the circumference of their skulls about 15% smaller than males. Unlike sea lions, which are insulated from the cold seawater by a layer of dense subcutaneous fat (blubber) underlying the skin, NZ fur seals' insulation is provided by air trapped against the outside of the skin by the dense underfur overlain by guard hairs. Like sea lions, NZ fur seals empty their lungs before submerging, their rib cage is compressed and their muscles when swimming are contracted. Thus their in-water dimensions are expected to be less than when relaxed on land. To calculate minimum bar spacings for exclusion of fur seals, measurements from the 5th percentile of axillary girth of NZ fur seals was used. Measurements recovered during autopsy of by-caught fur seals provide the basis for this as per Table 1 below.

Table 1: NZ fur seal diameter calculations based on autopsy measurements reported by Duignan et al (2003):

NZ fur seals	Females	Males	Both sexes
Number of animals	32	94	126
Average girth at axilla (cm)	83.9	103.7	98.7
Average diameter at axilla (cm)	26.7	33.0	31.4
5th percentile of girth (cm)	71.7	72.6	70.8
Diameter (cm)	22.8	23.1	22.5
Diameter - 5 cm (cm)	17.8	18.1	17.5

Using Chilvers' method for deriving diameter (girth/π) a minimum inside bar spacing of 17.5cm (i.e. 5th percentile axillary girth/π - 5cm) would be required to stop 95% of fur seals of a size composition represented by the by-caught animals autopsied from passing through the grid bars.

[1] Lyle, J..M. and Willcox, S.T. 2008. Dolphin and seal interactions with midwater trawling in the Commonwealth Small Pelagic fishery including an assessment of bycatch mitigation strategies. Final report. Project R05/0996 TAFI.
[2] Chilvers,L. 15 June 2005. Female New Zealand sea lion body size and SLED specifications. Unpublished report to SLED Working Group.
[3] Duignan, P. et al 2003. Autopsy of pinnipeds incidentally caught in fishing operations 1997/98. DoC Science Internal Series 118. May 2003.