1 Project Background

The Marine Management Organisation has to provide advice on interactions between seals and fishing gears. Policy is that prior to shooting, non-lethal methods should be tried and shown to be ineffective, but effective deterrent alternatives to shooting are limited particularly for application from fishing vessels in open water. To improve the specificity of advice, this project seeks to understand the interactions between seals and fishing gear and non-lethal deterrent options. The first step in the project was to undertake a literature and data review. The findings are summarised below.

2 Seal-Fishery Interactions

There are two species of seal that occur in UK waters: grey seal *Halichoerus grypus* and harbour seal (also known as common seal) *Phoca vitulina.* Within England, the main breeding colonies of grey seals are on the north and east coasts (around the Farne Islands, Donna Nook and on the Norfolk coast including the Wash) and the south west (primarily around the Isles of Scilly and Lundy), whilst harbour seal populations are concentrated around the Wash and the Thames.

Fishing activity and seals share fish resources and overlap spatially, resulting in interaction and conflict. Depredation (feeding on fishermen's catches) by seals has economic costs to the fishing industry (it is possible to identify catch damaged by seals vs. other species). Whilst feeding, seals increase their risk of entanglement, and by-catch of seals in fishing gear can result in injury to or death of seals.

3 Seal Behaviour

Grey seals can undertake wide-ranging seasonal movements over several thousand kilometres. Tracking has shown that most foraging probably occurs within 100 km of a haul-out site. Harbour seals normally feed within 40 to 50 km of their haul-out sites.

Seals use a variety of mechanisms to detect and hunt for prey. They do not use active biosonar systems but may listen for prey noise and use sight. Seals also use their whiskers to detect movement and can follow vibrations from hydrodynamic trails/wakes several minutes after the disturbance has been generated. The use of smell is less documented.

Net-foraging behaviour appears a learnt behaviour and 'specialised' seals repeatedly return to depredate from nets. Most scientific studies suggest it is small percentages of local seal populations that are responsible for depredation.

4 Fishing Tactics and Gear Modifications

An understanding of the factors at an operational fishing level that affect seal depredation in static-net fisheries could theoretically be exploited to reduce seal depredation.

Soak time: Soaking times can increase depredation by approximately 5% per hour when nets are within seals' diving range.

Depth: Seals preferentially depredate on shallower nets due to easier accessibility; dive ranges and nets set in waters over 60m depth are outside of usual diving behaviour although could be depredated during hauling.

Hauling and haul speeds: Hauling nets provides an opportunity for seals to feed on the catch, especially if hauling is slowed or stopped to clear catch from net.

Fishing activity: Seals may be gradually attracted to areas of fishing operation by the noise of a vessel, or fishing activity in general, resulting in a 'dinner bell' effect. The haul sequence of nets, amount of gear deployed and noise can affect this.

Location: A relationship between the location of nets, and areas of usage by seals is observed due to shared resource and proximity to seal colonies or foraging areas although this does not necessarily align with fishermen's experiences of seal will follow a vessel.

Season: Seasonality may also influence depredation. Grey seals tend to spend most time at sea during summer, and ashore during breeding and moulting periods (between September and April).

Day/night deployment: Evidence of seal preference for both day and night feeding is recorded in different studies, attributed to differences in prey behaviour.

Gear type: The type of netting or mesh size does not appear to affect depredation rates but may impact seal by-catch. Some gears such as towed gear or mid-water cod traps can be less vulnerable to depredation.

Modifications: grey and harbour seals in captivity are responsive to low voltage electrified netting in seawater. Barrier nets can also be effective. In both cases there are practicality problems.

But it is difficult to separate these co-existing factors, and modifications to fishing operations need to be balanced with the implications they may have on overall landings.

5 Acoustic Deterrents

Acoustic deterrent devices (ADDs) are the most documented method of deterring seals from fisheries to prevent depredation. They work by emitting a noise that either causes pain or is distracting enough to create an aversion. There are many examples where ADDs have shown to be at least partially effective.

Predicting the aversiveness of an ADD relies on many contextual and species-specific factors such as ambient noise, bathymetry, water depth, geology, and hearing thresholds of seals. Ineffectiveness has sometimes been attributed to habituation and in a few cases ADDs have attracted seals. Some initial evidence suggest startle response type ADDs may successfully avoid habituation challenges.

Sound from an ADD is often designed to exceed a discomfort threshold or inflict pain, therefore hearing damage to seals and other species is possible. In addition, it may exclude seals and other species from areas where ADD are used.

6 Review Conclusions

Based on the literature review there is no clear single approach identified to reduce depredation, and a range of pros and cons exist for the various options. The following might be explored further for trial in English static net fisheries:

- ADDs deployed from vessels during hauling or on nets (multiple units probably required), if appropriate battery technology is available;
- Faster haul times, shorter soak times in shallow net fisheries and night setting.