



# Marine Management Organisation

## Assessing Options for Non-Lethal Seal Deterrents: Stakeholder Engagement Report (MMO1131)



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# Assessing Options for Non-Lethal Seal Deterrents: Stakeholder Engagement Report (MMO1131)

January 2019



Report prepared by: ABPmer & NFFO

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# 1 Background

Interactions between seals and fishing gear include depredation of fish catches by seals and bycatch of seals in fishing gear. Throughout England, particularly in the south-west, north-east and east, depredation is an issue for static net fisheries in particular, that leads to significant economic costs from loss of commercial catch, increased gear handling or gear damage. Seal-gear interactions can also lead to seal mortality through either legal shooting ('Netsmen's Defence') or as a result of accidental bycatch.

The Marine Management Organisation (MMO) Marine Conservation Team has to provide advice on interactions between seals and fishing gears. It is a legal requirement under the [Conservation of Seal Act \(1970\)](#) that prior to shooting, non-lethal methods should be tried and shown to be ineffective. However, effective non-lethal seal deterrent alternatives to shooting are limited for application from fishing vessels in open water. In order to improve the specificity of advice, MMO would like to understand the interactions between seals and fishing gear and non-lethal deterrent options better to be able to offer advice that can reduce the need for shooting. This may also have positive side effects on fishing by reducing seal by-catch and net-based feeding.

The project therefore aims to explore the following seven objectives:

- I. Understand how seals take fish from nets and what factors assist them (for example location, visual cues etc.);
- II. Identify what factors influence depredation behaviour (for example opportunistic, or specialist);
- III. Identify the breeding populations of individuals undertaking depredation;
- IV. Review non-lethal deterrent measures currently available that may be appropriate for reducing the seal–gear interactions at sea;
- V. Review what modifications to fishing gear or fishing tactics may mitigate seal depredation and bycatch;
- VI. Clarify potential impacts and benefits and risks to the fishing industry, managers and seals of implementing non-lethal measures, gear modifications or tactics identified through V) and VI) and prioritise a sub-set of mitigation measures for testing;
- VII. Design and undertake testing in collaboration with the fishing industry of the most promising depredation deterrent measures.

The project will meet these objectives through undertaking the following tasks:

1. A desk-based literature and data review to further inform understanding of the nature of fishing gear/seal interactions, the factors which influence these interactions and potential non-lethal deterrent methods and their effectiveness;
2. A programme of stakeholder engagement through survey and interview to gain a detailed understanding of the issue of seal depredation and by-catch in fisheries throughout England (this report);

3. An expert/steering group workshop to review the above outputs and agree on the preferred deterrent to be trialled, the geographic area for the trials and the trial design (this report);
4. Undertaking at-sea trials of the chosen deterrent method to determine its effectiveness.

The results of task 1, a literature and data review, is available as a separate report, [MMO \(2018\)](#). This Stakeholder Engagement Report presents results from a stakeholder survey to further inform on task 2 and the task 3 workshop engagement. The report provides a summary of the stakeholder engagement undertaken up to December 2018<sup>1</sup>.

## 2 Aims and Objectives for Stakeholder Engagement

The specific aims of the stakeholder engagement programme were:

- To raise awareness of, and hence engagement with, the project amongst fishermen, regulators and other key stakeholders;
- To gain detailed information (through the survey and follow up interviews and stakeholder workshop) regarding:
  - The nature and magnitude of interactions between seals and different fishing gears;
  - The geographical areas where these interactions occur;
  - Non-lethal deterrents or strategies that have been/are being used and their efficacy at deterring interactions;
- To identify stakeholders that are willing to participate in trials of the seal deterrent chosen to test; and
- To inform the experimental design and deterrent approaches to trial.

To help achieve these objectives, the study engaged with stakeholders to gain a detailed understanding of the issue of seal depredation and by-catch in fisheries throughout England.

The key activities of the stakeholder engagement work were to:

- Raise awareness of the study;
- Carry out an online stakeholder survey to capture fishermen's knowledge and experience regarding where, how and why seals interact with fisheries and potential options for deterring this behaviour;
- Conduct telephone interviews with fishermen and other key informants; and
- Carry out a stakeholder workshop to obtain expert input and stakeholder views on options for at-sea trials.

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<sup>1</sup> Further stakeholder engagement in support of fieldwork is not included herein.

## 3 Implementation and Outcomes of Stakeholder Engagement

### 3.1 Raising Awareness of the Study

Effort was initially directed towards raising awareness of the project amongst stakeholders throughout England to encourage input and participation in the survey, interviews and trials.

To achieve this, a media campaign was prepared to coincide with the launch of the online stakeholder survey, and involved the following:

- Posters in MMO and Inshore Fisheries and Conservation Authority (IFCA) Local Offices (see [Annex A](#). Poster for MMO and IFCA offices);
- Submission of a press release to Fishing News informing readers about the project, inviting opinions and providing instruction on how to participate in the survey;
- Press releases targeted at local papers in areas of England where seal interactions are understood to be an issue;
- Information distributed through the UK Harbour Master's Association list;
- Short articles and blog posts through NFFO and ABPmer (see [Annex B](#));
- Information or short articles circulated via social media (e.g. Twitter, LinkedIn, Facebook) and email distribution lists:
  - MMO's Twitter followers: 6875 (as of 19/06/18);
  - MMO's Facebook followers: 1248 (as of 19/06/18) – 2 posts, 17.08.18 and 14.08.18, with a combined 25 comments and 29 shares;
  - NFFO's Twitter followers;
  - NFFO's email or membership list;
  - ABPmer's LinkedIn followers: 1329 (as of 27/06/18) – post on 17.07.18;
  - Posts on various individuals and other organisations' Facebook pages.

The main drive of the campaign was to raise awareness of the online survey to obtain as many responses from fishermen in English waters as possible. In this respect, the campaign was successful.

### 3.2 Online Stakeholder Survey

The online stakeholder survey aimed to gain detailed information from commercial fishermen regarding the nature and magnitude of interactions between seals and different fishing gears, the geographical areas where these interactions occur, non-lethal deterrents or strategies that have been or are being used and their efficacy at deterring interactions.

The survey targeted fishermen only and those fishermen that experienced significant financial losses due to seal depredation were expected to be the most motivated to respond. It is likely therefore that findings represent the worst-case interpretation and survey results should be considered alongside those of the stakeholder workshops and literature and data review that consider different stakeholder groups.

The survey was implemented using Survey Monkey, and a pilot was carried out with a few fishermen to ensure the questions and possible responses were phrased appropriately. A copy of the questions is provided in [Annex C](#).

The survey was publicised through the means described in [Section 3.1](#). A prize draw for a £50 Amazon voucher was offered to encourage responses. The survey went live on 17<sup>th</sup> July 2018 and ran for a period of one month. The target number of respondents for the survey was 40.

After removing duplicate entries, entries with no/very limited data etc., the survey achieved 92 responses, with details by gear type as follows (each respondent could provide details of up to 3 different gears):

- Nets: 69;
- Lines: 21;
- Pots/traps: 12;
- Trawls: 10;
- Other gear: 4.

### 3.3 Telephone Interviews

In-depth telephone interviews were undertaken with a selection of survey respondents to explore some of the issues raised in more detail, and also with a number of key informants. Interviews were conducted with fishermen across different regions to ensure geographic spread. They explored gear/seal interactions in more detail, deterrent options, gear modifications or tactics to deter predation and the potential impacts, benefits and risks of implementing these. Interviews with non-fishermen were used to explore existing knowledge on, or potential factors that may influence fishery-seal interactions, any previous, current or planned future research on the topic, experiences and results of any previous deterrent trials.

Interviews were semi-structured, based around a list of issues to address, whilst allowing the interview to explore particular areas of interest or experience of the interviewee. A list of issues was developed for each stakeholder group (fishermen; regulators; Non-Government Organisations (NGOs); academics/researchers). These are provided in [Annex D](#).

The primary means of identifying informants from the fishing industry for in-depth interviews was by sub-setting of survey respondents from the online survey who had indicated they were happy to be contacted for follow-up discussions, that appeared to have useful information to share (experience of seal interactions, ideas or experience of deterrent methods), and to cover a range of gear types and regions.

Interviews were carried out with people from the following groups (number of individual interviews in brackets):

Fishermen (6)

Regulators and advisers (6):

- Cornwall Inshore Fisheries and Conservation Authority;

- Kent and Essex Inshore Fisheries and Conservation Authority;
- Eastern Inshore Fisheries and Conservation Authority;
- North Eastern Inshore Fisheries and Conservation Authority;
- Northumberland Inshore Fisheries and Conservation Authority;
- MMO (MMO officers from Brixham and Hayle offices also provided written input).

Non Government Organisations (2):

- Cornwall Wildlife Trust;
- Cornwall Seal Group (Research Trust).

Academics and researchers (3):

- Bord Iascaigh Mhara (BIM), Ireland (2);
- University of St Andrews.

Other stakeholders (1):

- Scottish Salmon Producers' Organisation.

15 interviews were initially planned; 18 interviews were carried out. Despite increasing the number of interviews, there was still a need for prioritisation and selection of interviewees; priority was based on the likelihood of obtaining useful information to contribute to the study, based on known involvement in seal/fishery research or regulation, and location in relation to areas of high levels of seal/fishery interactions.

### 3.4 Stakeholder workshop

A workshop on non-lethal seal deterrent options was held in London on 8<sup>th</sup> November 2018 with the intent to:

- Review the latest research and knowledge on seal-fishery interactions, the problem, and possible solutions;
- Consider the issues from different angles (fisheries/NGOs/regulators and policy makers); and
- Explore possible solutions and options for at-sea trials under the project.

The workshop was attended by expert stakeholders from the commercial fishing, regulatory, academic and NGO sectors. Stakeholder attendance was by invitation to ensure a balance and range of expertise.

To meet workshop objectives a range of presentations and discussion sessions addressed issues arising from seal-fishery interactions (including those found in survey results), recent seal-fishery research, seal deterrents and options/experimental design for at-sea trials. The agenda for the workshop is provided in [Annex E.1](#).

There were 19 participants, including the project team, representing the following organisations:

- ABPmer
- ACE Aquatech
- Cornwall Fish Producer's Organisation
- Cornwall Seal Group Research Trust
- Department for Environment, Food and Rural Affairs
- Eastern Inshore Fisheries and Conservation Authority
- Gael Force Seaguard
- Marine Management Organisation
- National Federation of Fishermen's Organisations
- Natural England
- Sea Mammal Research Unit / St Andrew's University
- Seal Protection Action Group
- University College, Cork
- Zoological Society London

A summary of the workshop is provided in [Section 6](#) Workshop Results.

## 4 Results of the Online Survey

The following section and sub-sections report on the anonymised responses from the online survey of fishermen in English waters. They reflect the problem of seal interactions as reported by fishermen, and their perception of it. Data are provided for all respondents, and also where appropriate broken down by responses by region. The following regions were used:

- North Sea and Eastern Channel (International Council for the Exploration of the Sea (ICES) divisions 4b, 4c and 7d);
- Irish Sea (ICES division 7a);
- Western Channel, Bristol Channel and Celtic Sea (ICES divisions 7e, 7f, 7g, 7h).

### 4.1 Response composition

Responses were received from fishermen that fish throughout English waters, with most responses from fishermen in 7e (Western Channel), 4b (Central North Sea) and 4c (Southern North Sea) (Figure 1).

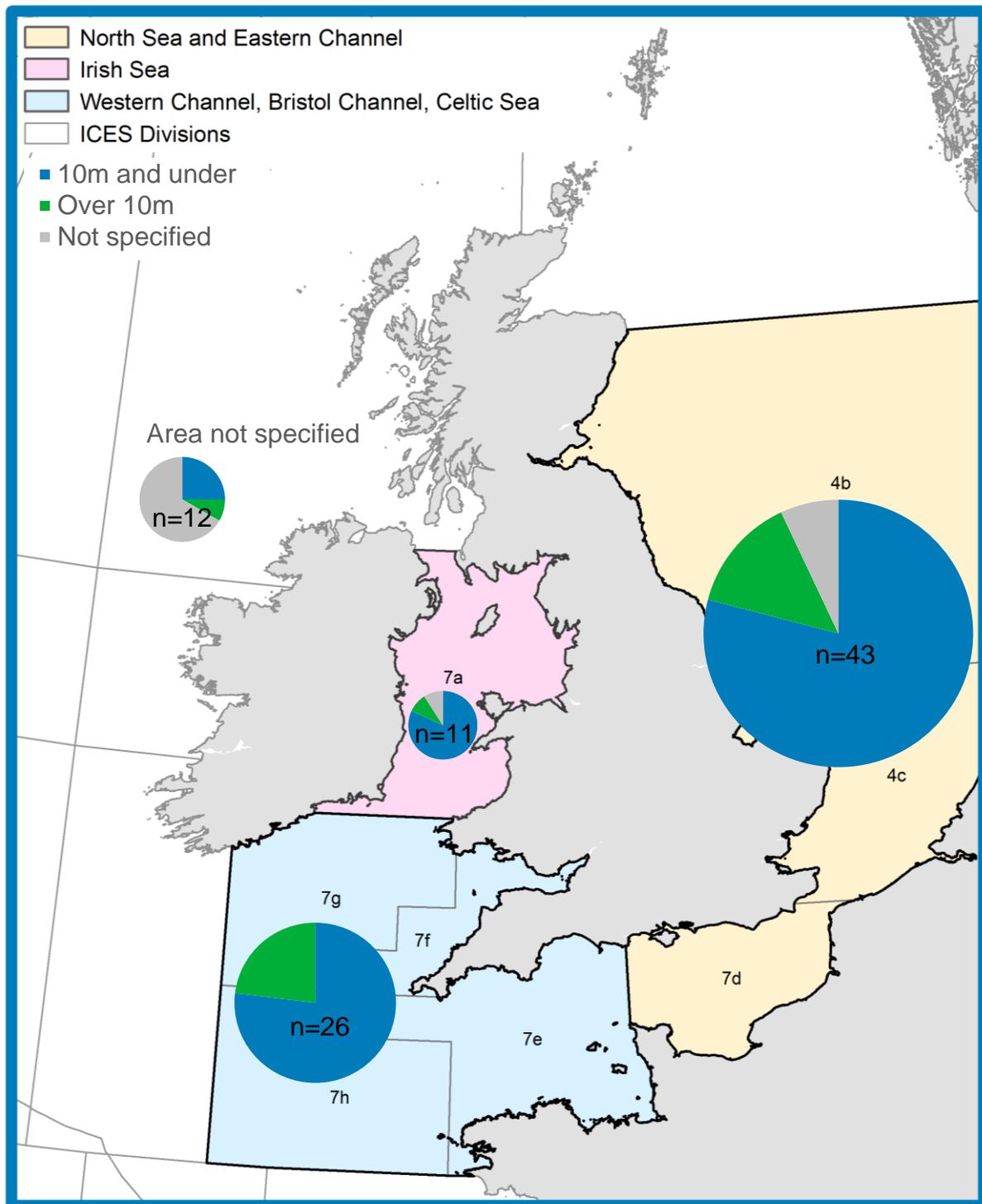
Most respondents (30) used static/fixed nets as a primary gear (Figure 2), with a further 25 using them as a secondary gear. Pots/traps was the next most widely used gear type. Lines, drift nets, otter trawl were used by between 11 and 22 respondents either as primary or secondary gear. Beam trawl was used by very few respondents. Five reported using 'other' gears including scallop dredge and rod and line.

The prevalence of nets as a gear type amongst respondents indicates the level of the problem experienced by fishermen using this gear, however problems were also reported for other gears including lines, pots and traps, and trawls.

Figure 3 shows the gears used by respondents by area. Static nets are the predominant gear used by respondents from the Western Channel, Bristol Channel and Celtic Sea area, with lines and pot/traps also used. All gears were more evenly represented in the North Sea and Eastern Channel area.

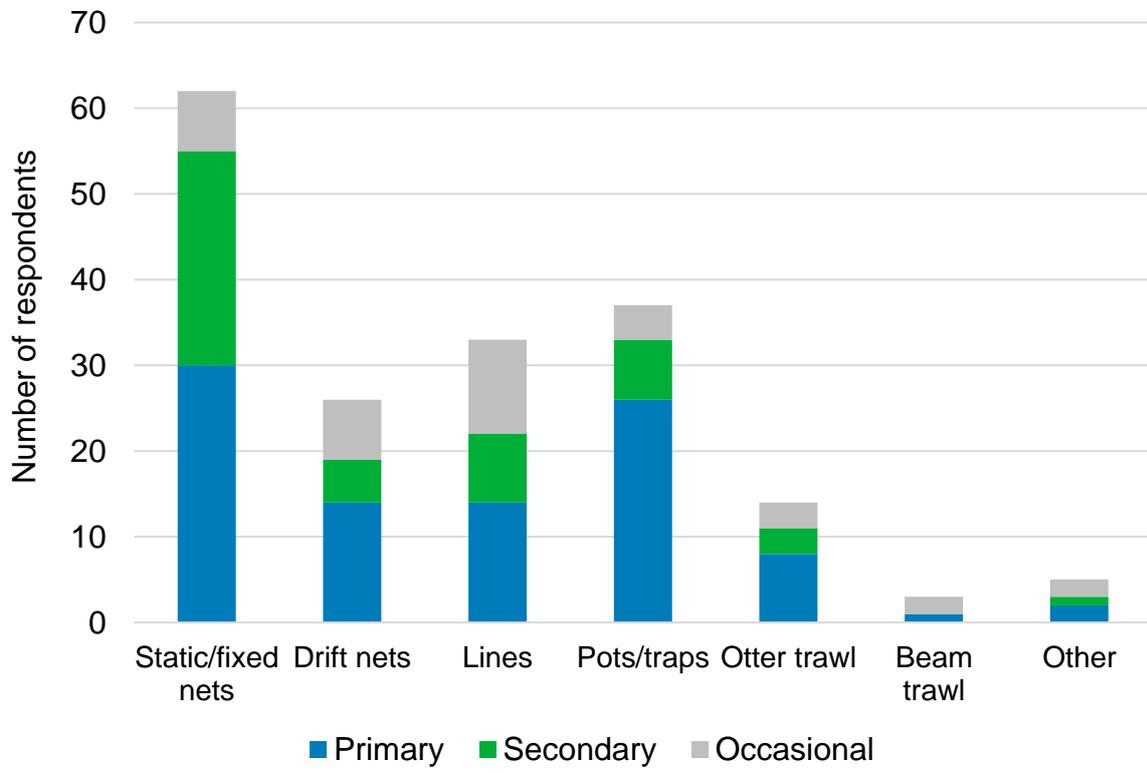
**Figure 1** Number of respondents that fish in each area.

Notes: 4b = Central North Sea; 4c = Southern North Sea; 7a = Irish Sea; 7d = Eastern Channel; 7e = Western Channel; 7f = Bristol Channel; 7g = Celtic Sea; 7h = Celtic Sea South / Little Sole Bank.



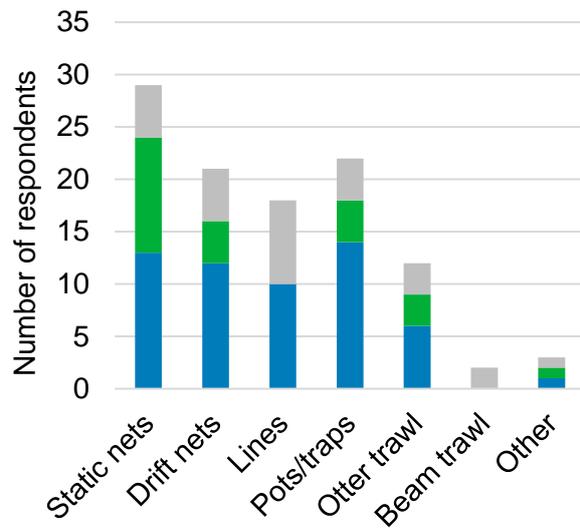
**Figure 2 Gear types used by respondents.**

Sample size = 83.

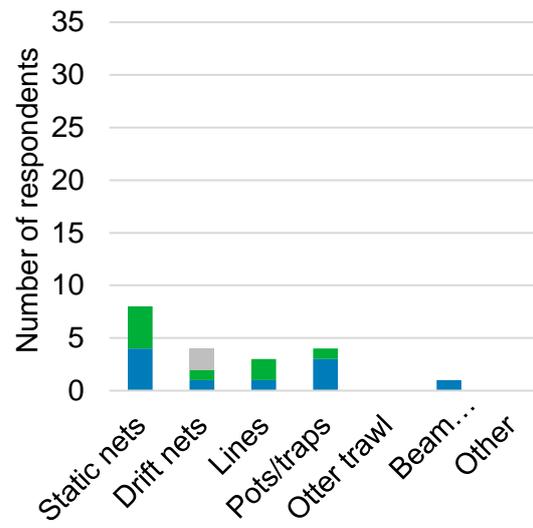


**Figure 3 Gear types used by respondents, by area.**

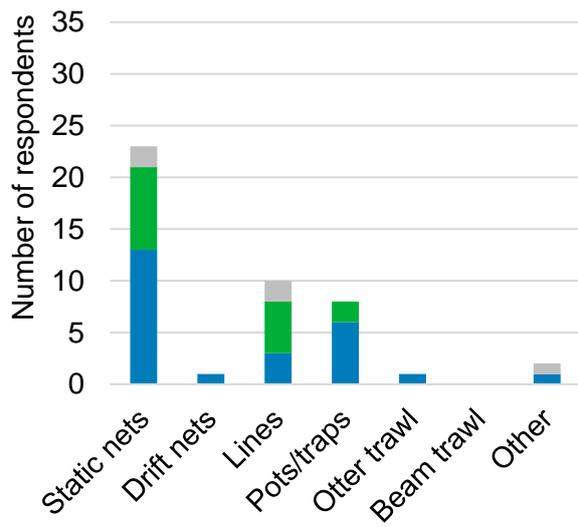
North Sea and Eastern Channel (n=40)



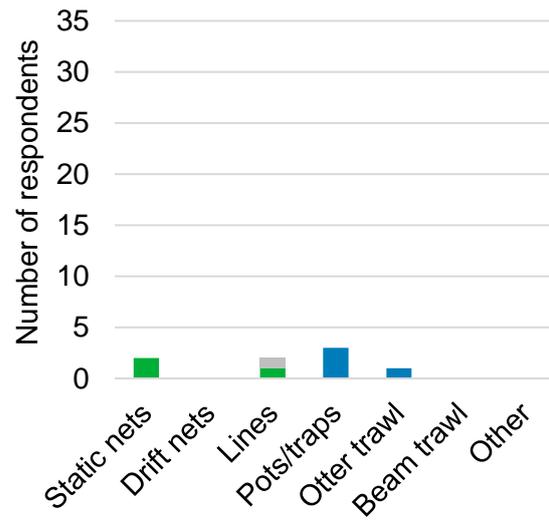
Irish Sea (n=10)



Western Channel, Bristol Channel, Celtic Sea (n=28)



Area not specified (n=5)



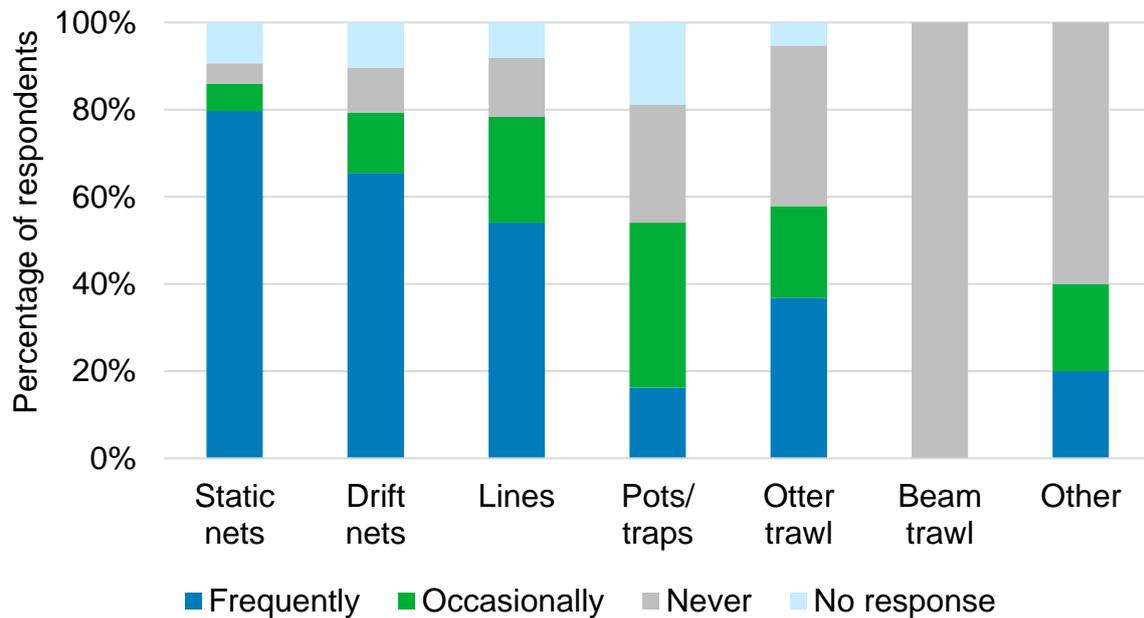
■ Primary ■ Secondary ■ Occasional

## 4.2 Frequency of interactions

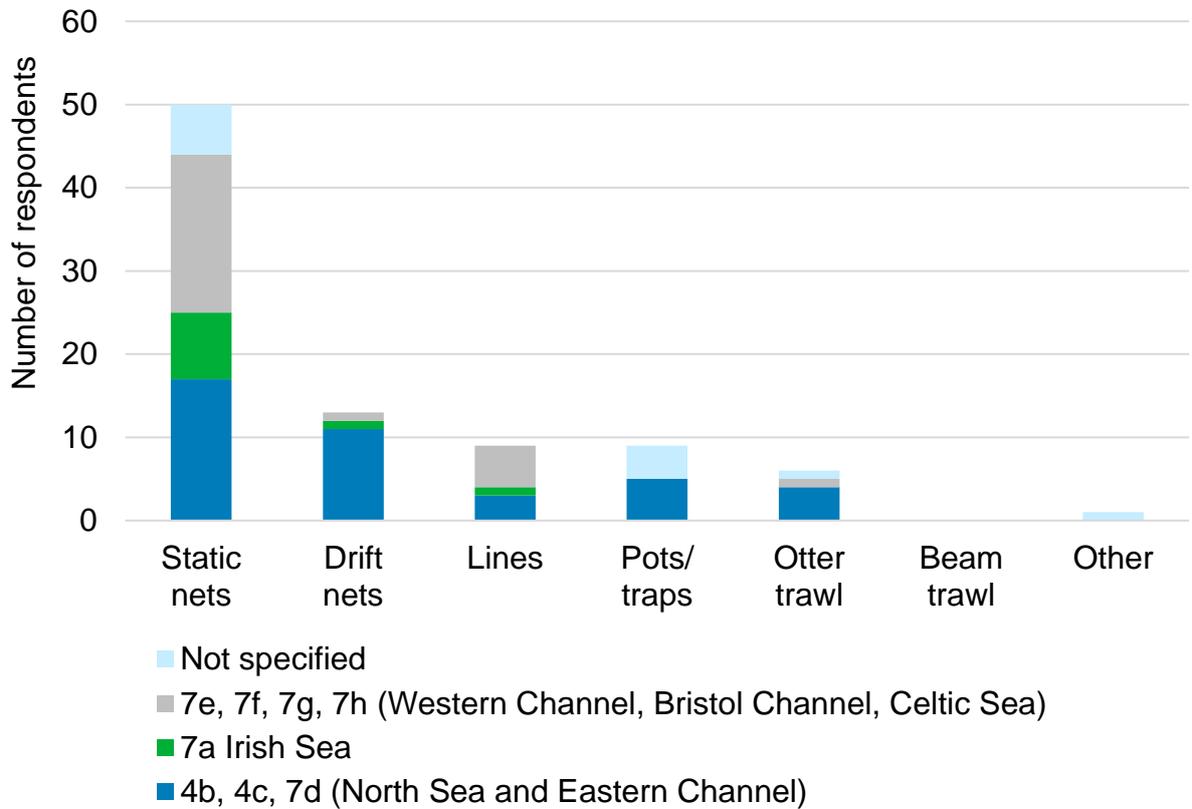
The majority of respondents reported frequent seal interactions with static nets (Figure 4). This is also reflected in static nets being reported overwhelmingly as the gear type that fishermen experience the biggest problem with seals (Figure 5). In the North Sea and Eastern Channel, drift nets and lines were also reported to be subject to frequent interactions (Figure 6). Interactions with pots/traps and trawls are of a more occasional nature.

**Figure 4 Frequency of interactions with seals by gear type (all areas combined).**

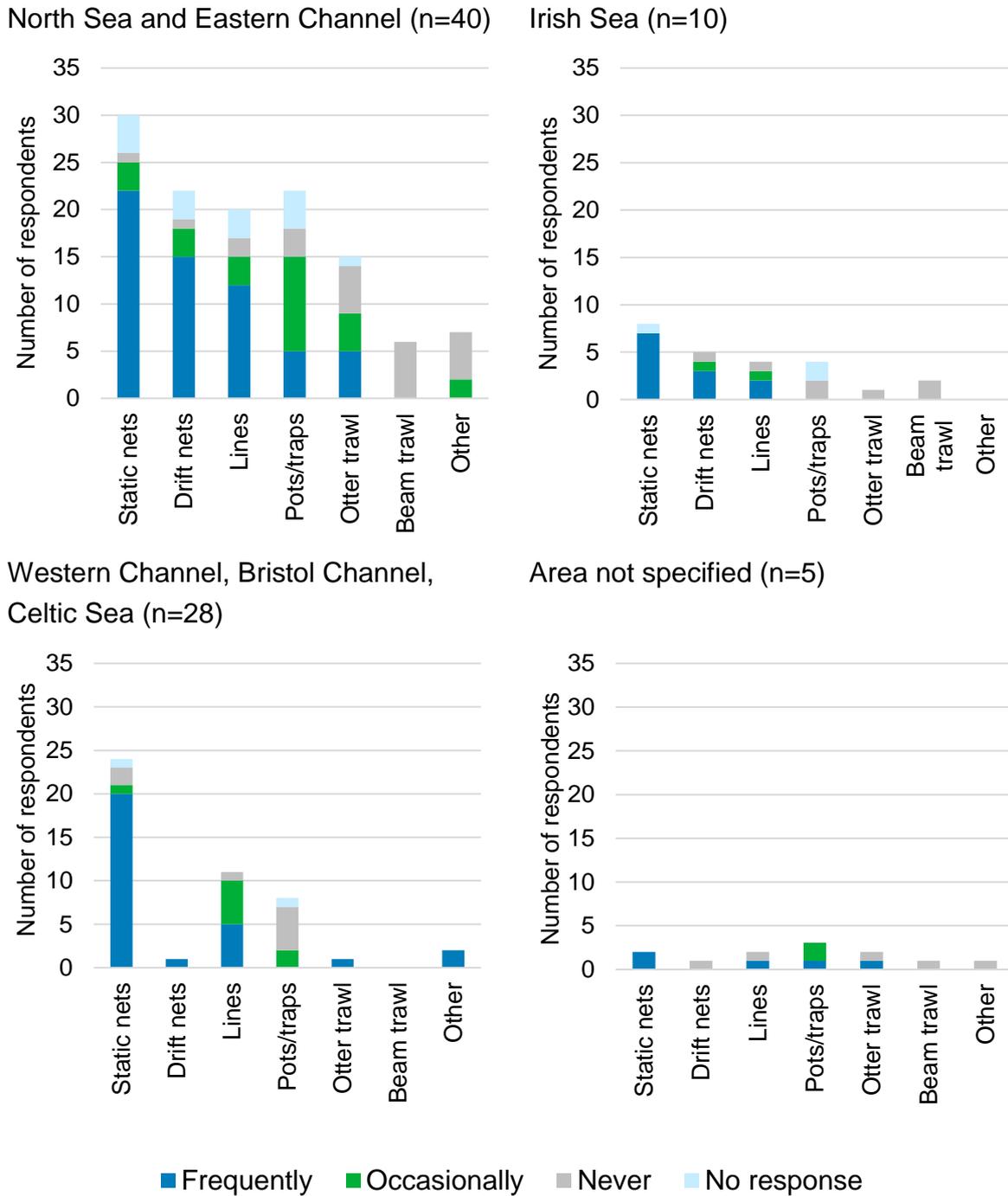
Sample sizes: static nets = 64; drift nets = 29; lines = 37; pots/traps = 37; otter trawl = 19; beam trawl = 9; other = 10.



**Figure 5 Gears for which respondents reported the greatest problems with seals (all areas combined).**  
 Sample size = 90.



**Figure 6 Frequency of reported interactions with seals by gear type, by area.**



### 4.3 Interactions over time

Fishermen overwhelmingly felt that there had been a large increase in the level of seal interactions over the last ten years (Figure 7). Only a few respondents felt that the level of interactions was stable or declining. The increase in seal populations is reflected in the following quotes from fishermen from free text questions in the survey:

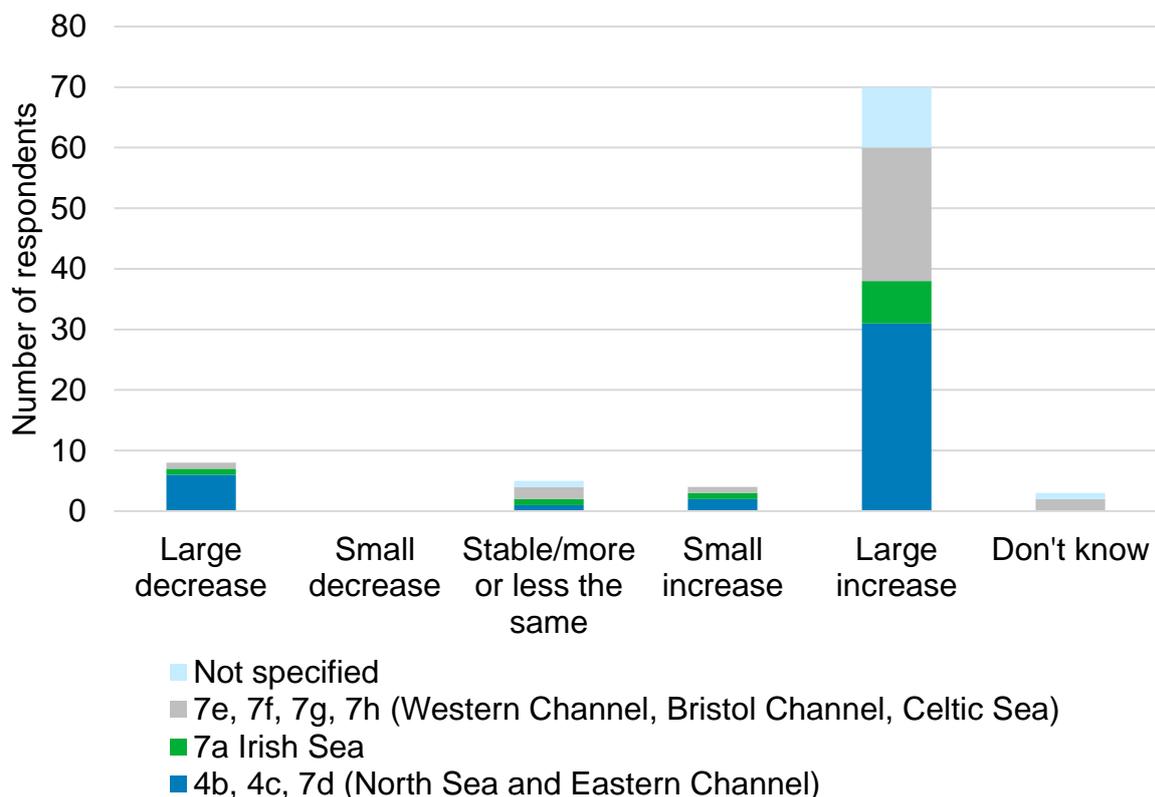
“Only ever used to see one or two seal a year in the eighties now see between six[ty] to seventy a day.”

“We used to see 1 a month now we see them every week”

“It’s difficult to be specific as to the amount seals take off the lines but it is certainly more common now then 20 years ago.”

**Figure 7 Fishermen’s opinions on trends in the level of seal interactions over the last ten years.**

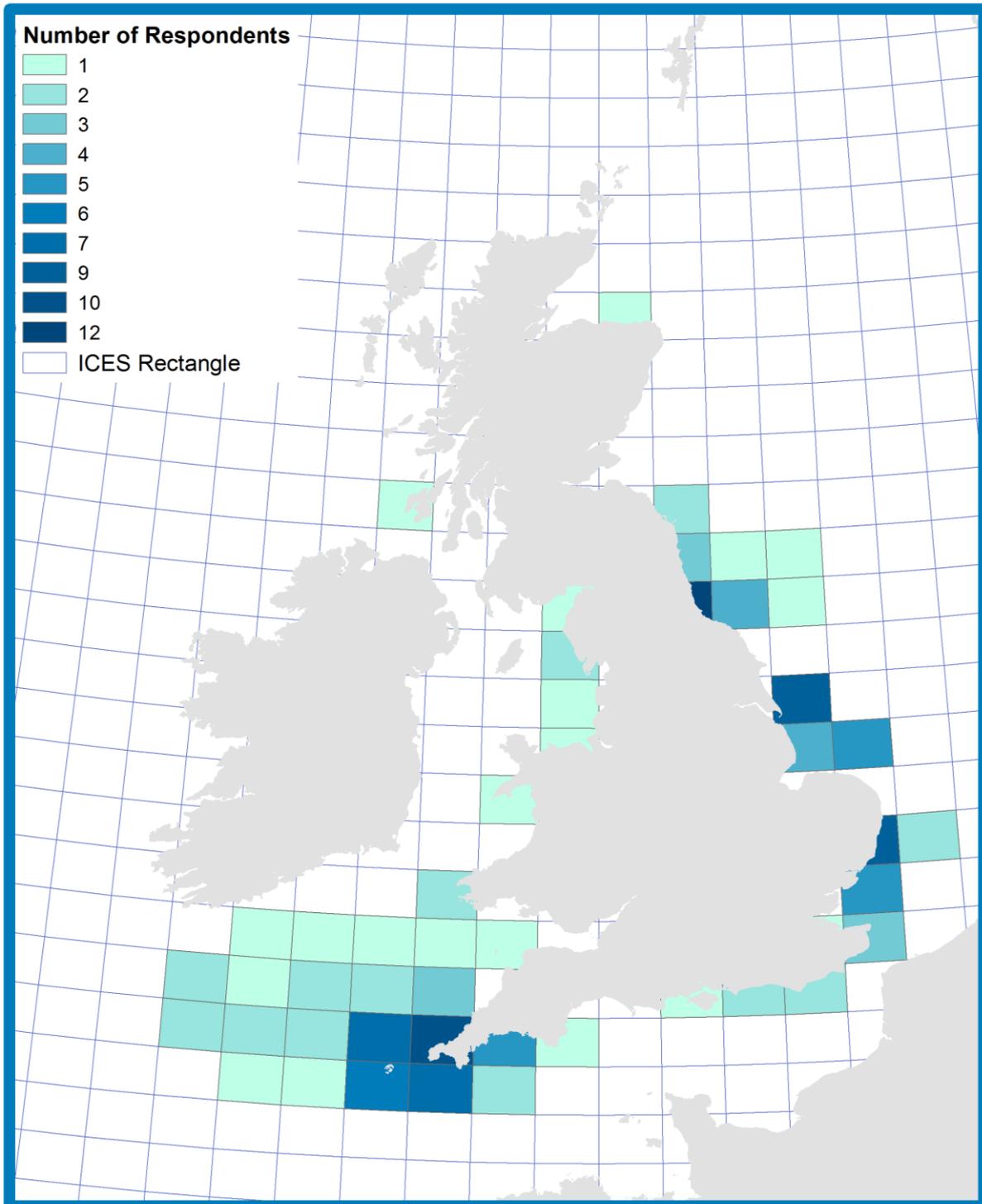
Sample size = 90.



### 4.4 Interactions by area

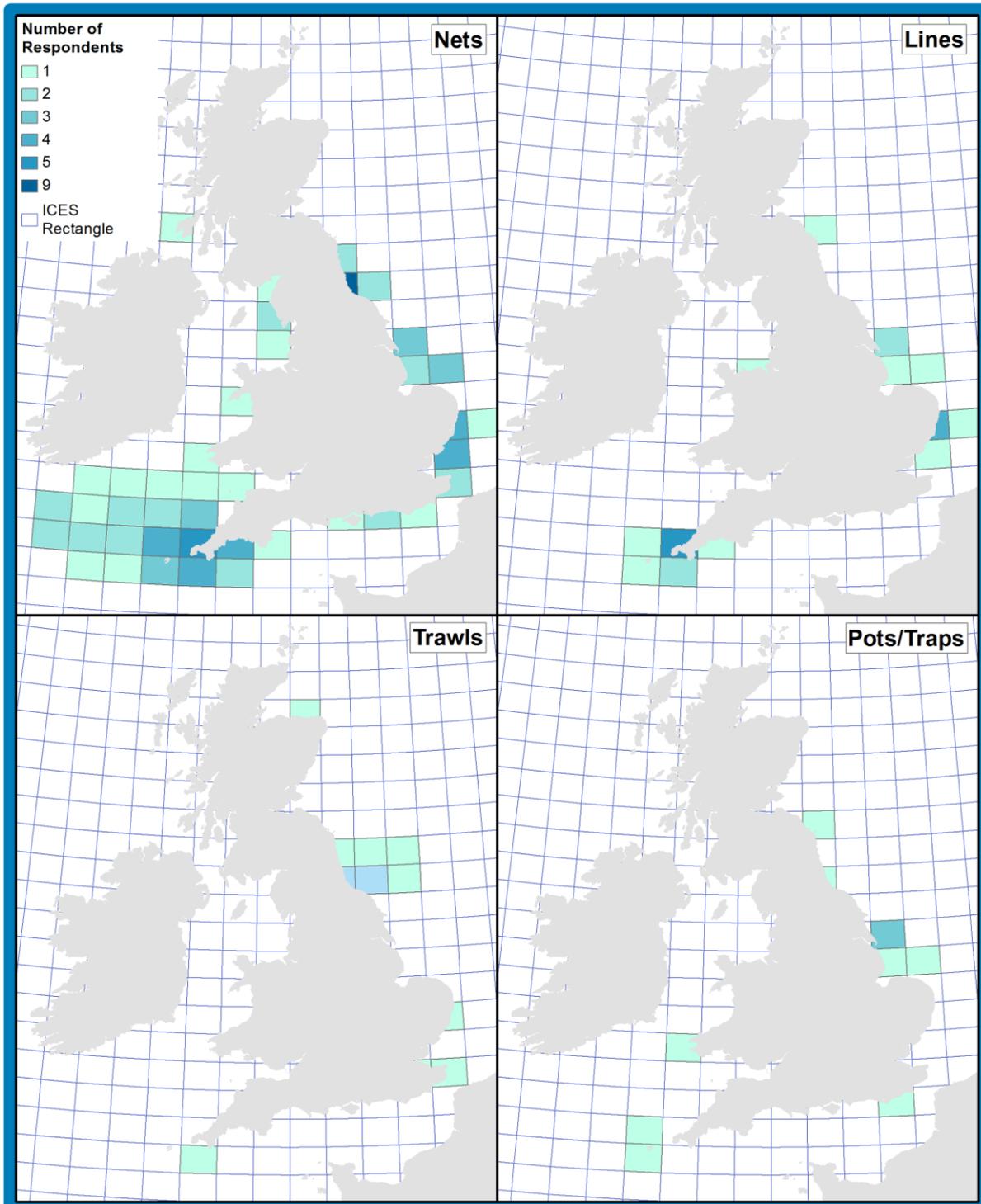
The survey asked respondents to specify in which ICES rectangles they experienced interactions with seals. The number of respondents that indicated each ICES rectangle is shown in Figure 8 for all gears combined, and in Figure 9 for individual gears.

**Figure 8 ICES rectangles where interactions with seals are reported to be a problem by fishermen (all gears).**  
 Sample size = 90.



© ABPmer, All rights reserved, 2018. Data source: ABPmer online survey on interactions between seals and fisheries, 2018.

**Figure 9 ICES rectangles where interactions with seals are reported to be a problem by fishermen (nets, lines, trawls and pots/traps).**  
 Sample size: Nets = 54; Lines = 18; Trawls = 7; Pots/traps = 9.



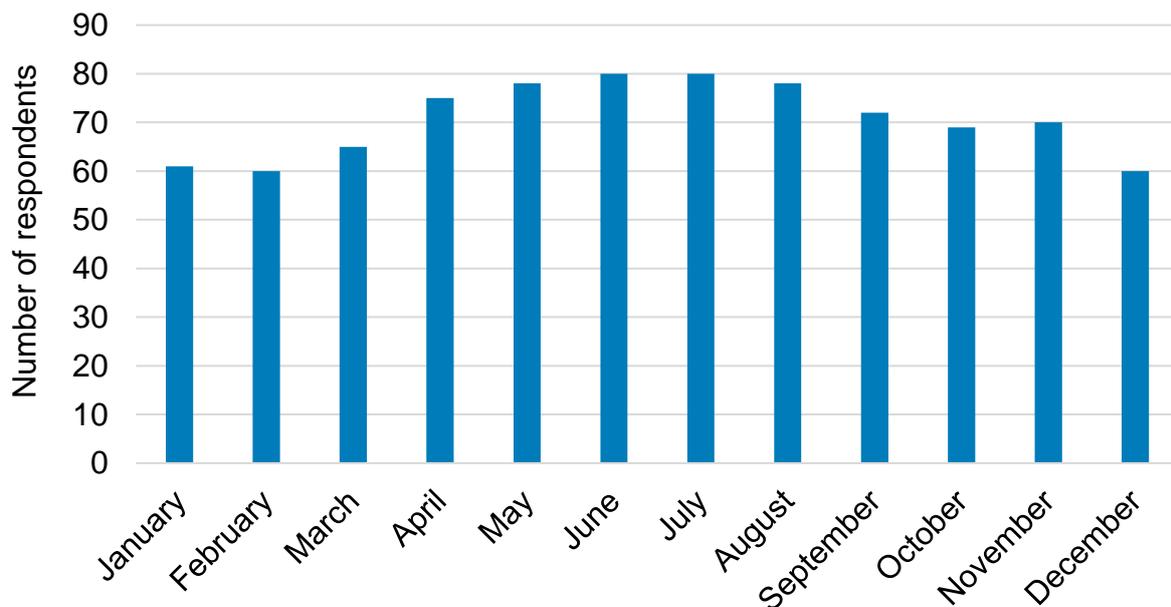
© ABPmer, All rights reserved, 2018. Data source: ABPmer online survey on interactions between seals and fisheries, 2018.

The areas that are highlighted by most respondents as having a problem with seal interactions are in line with the areas identified through the literature review (MMO, 2018) — the north-east around Berwick-upon-Tweed and North Shields; the east coast around Great Yarmouth to Southwold; the south-east around Felixstowe and Sheerness, the Greater Thames Estuary, to Dover; and the south-west particularly the Isles of Scilly, Land’s End and north Cornwall coast), with the addition of an area around the Humber estuary, in proximity to the seal colony at Donna Nook.

#### 4.5 Timing of interactions

Interactions with seals are reported to occur throughout the year, with a peak between April and August (with respect to the number of respondents that indicated that interactions occurred in each month) (Figure 10). A similar pattern is seen in the different individual areas (Figure 11), although with interactions in the North Sea and Eastern Channel being more continuous throughout the year, and a clearer seasonal peak in the Irish Sea.

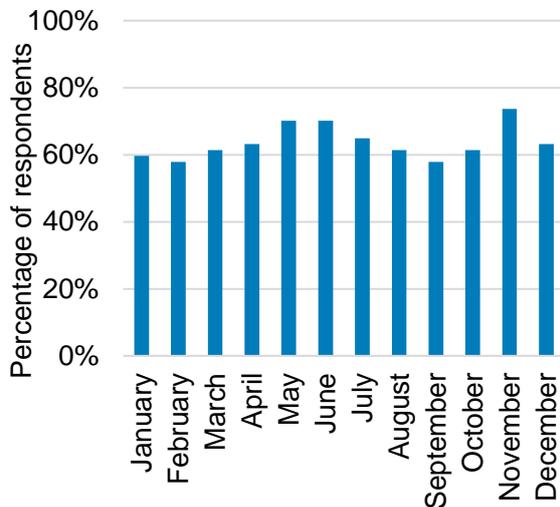
**Figure 10 Months in which interactions occur (all gears, all areas).**  
Sample size = 107. Each respondent may have provided information for more than one gear type.



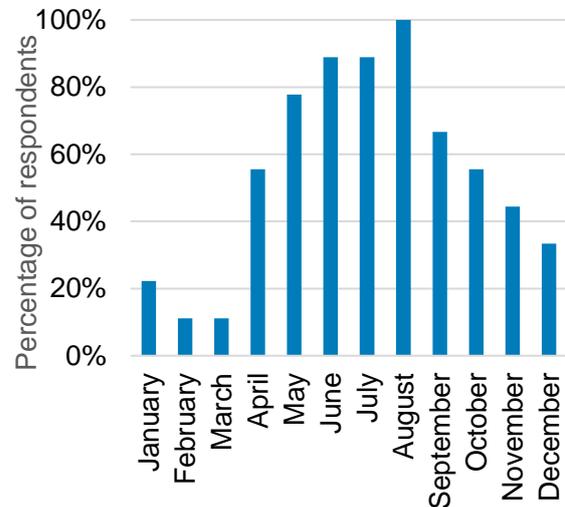
**Figure 11 Months in which interactions occur, by area (all gears).**

Notes: Graphs show the percentage of respondents (that responded to this question for each area), that cited each month as a problem for seal interactions.

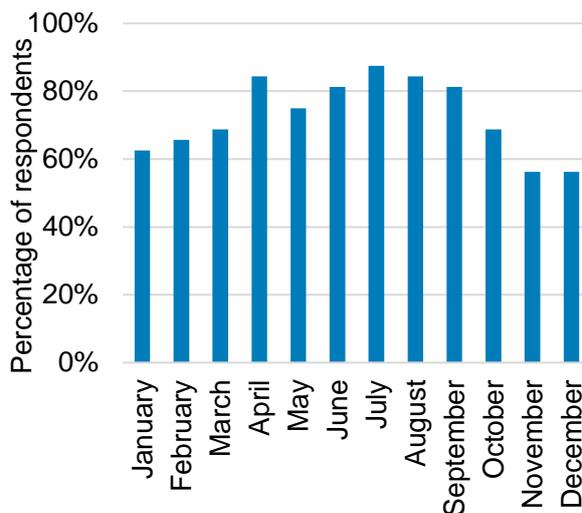
North Sea and Eastern Channel (n=57)



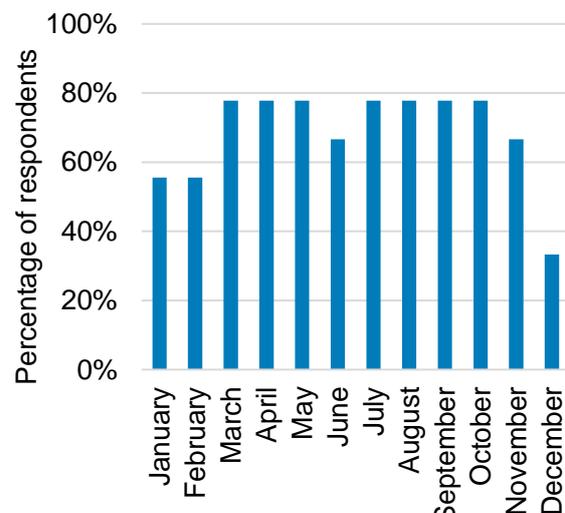
Irish Sea (n=9)



Western Channel, Bristol Channel, Celtic Sea (n=32)



Area not specified (n=9)



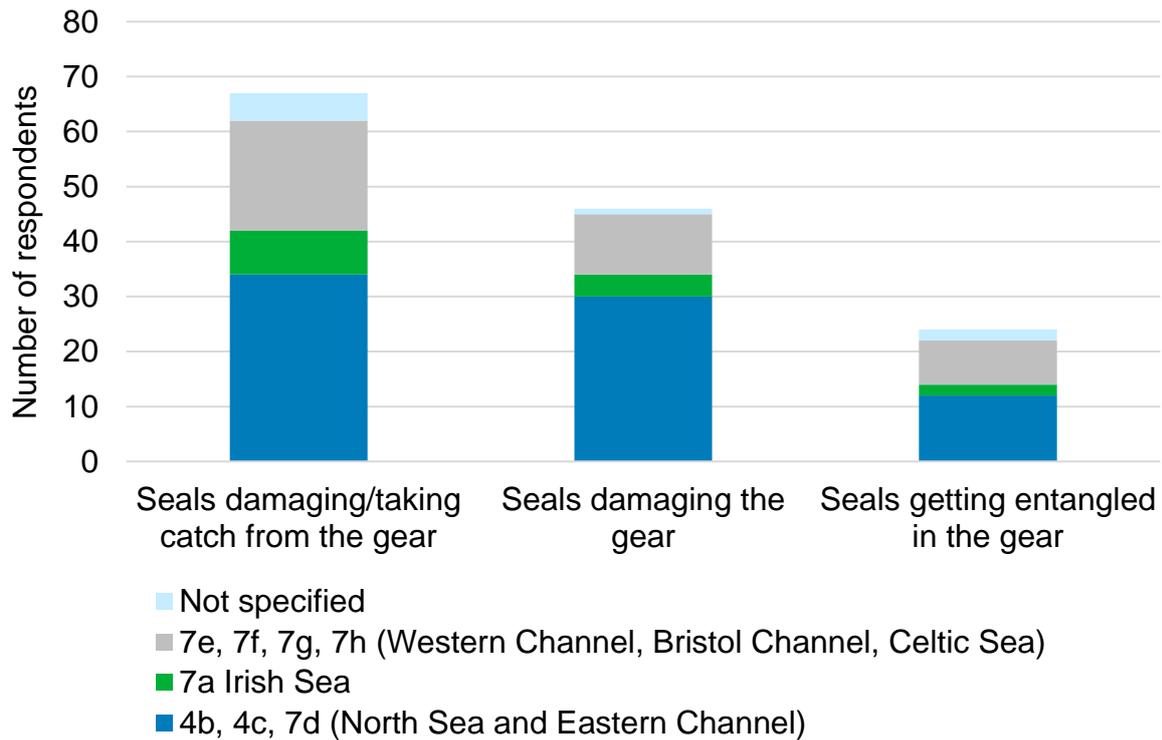
The peak over the summer months may be representative of the time of year when more inshore fishing activity takes place (with smaller boats' operations being restricted in more inclement weather). The late autumn peak in the North Sea and Eastern Channel area coincides with the grey seal pupping season (September to January). However, these factors require further investigation to determine any specific links between fishing seasons, pupping seasons and reported levels of interactions.

## 4.6 Interactions with nets

All fishermen that responded to the question about the type of interactions with nets cited seals damaging or taking catch from the gear as a problem (Figure 12). A smaller number (but still more than half) cited seals damaging the gear, and 24 (36% of those that responded to the question) cited seals getting entangled in the gear as a problem.

**Figure 12 Reported type of interaction with nets.**

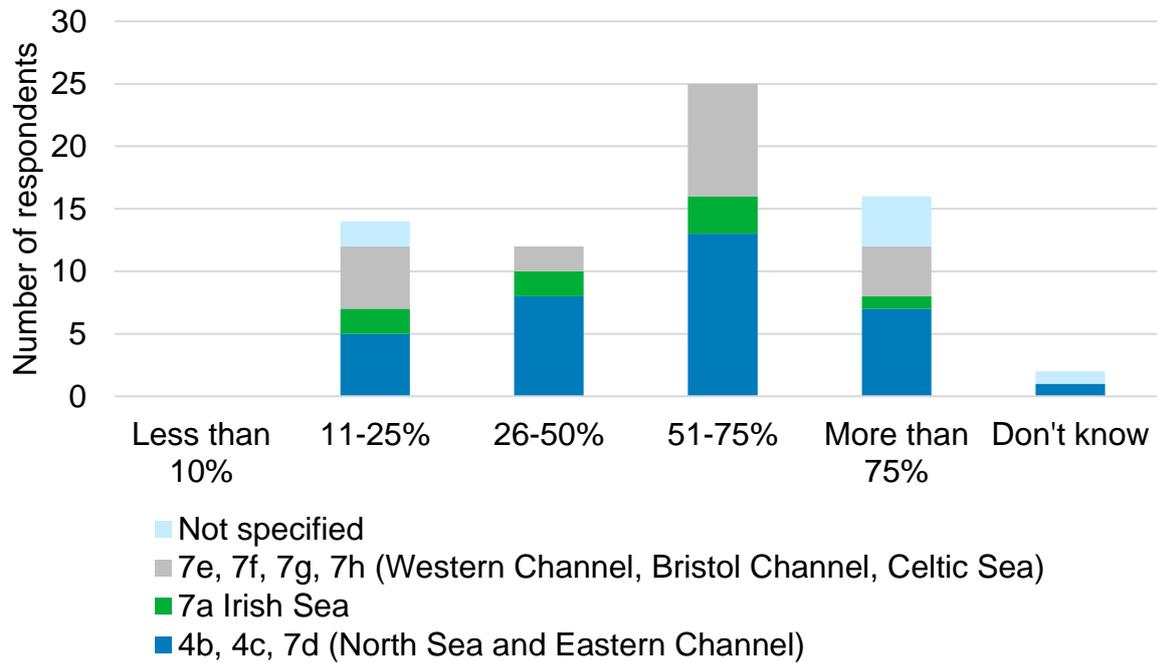
Sample size = 67. More than one response was possible.



The majority of respondents indicated that over half of tows/hauls were affected by seal damage in those months when interactions occur (Figure 13). When damage occurred, there was a wide spread of reported losses with most responses reporting between 'from 11-25%', and 'more than 75%' of the catch lost (Figure 14).

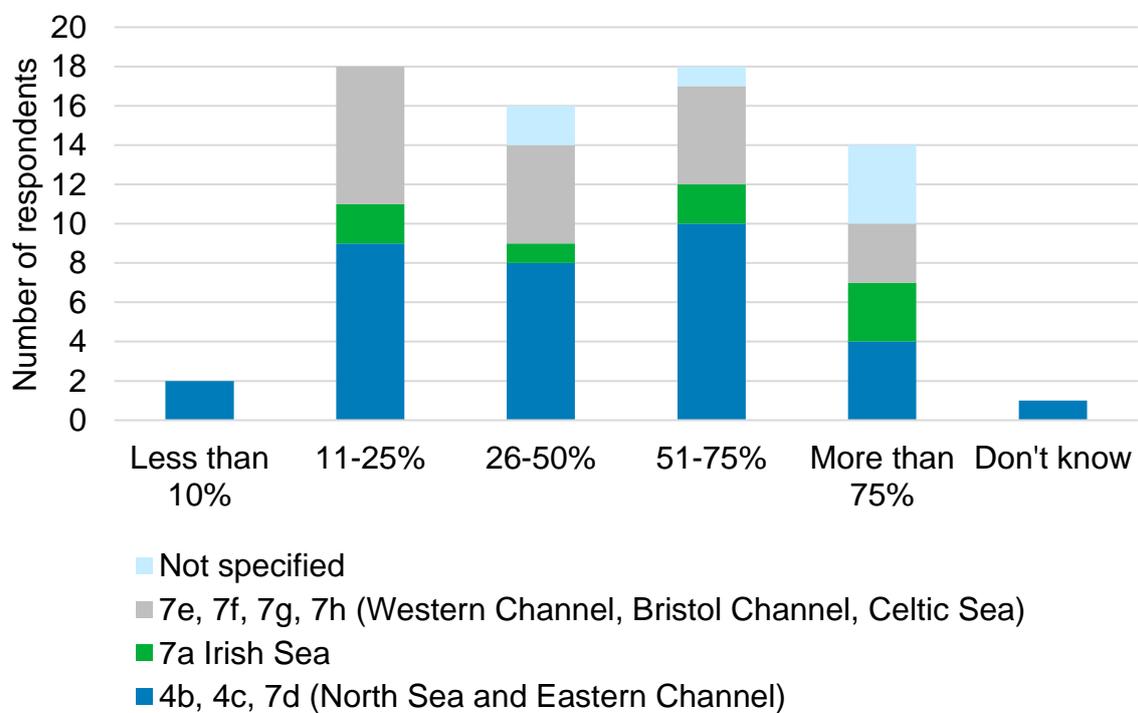
**Figure 13 Proportion of tows/sets/hauls reported to be affected by seal damage for nets (all areas).**

Sample size = 69. Responses relate to those months in which interactions occur.



**Figure 14 Proportion of catch value reported to be affected when seal damage occurs for nets (all areas).**

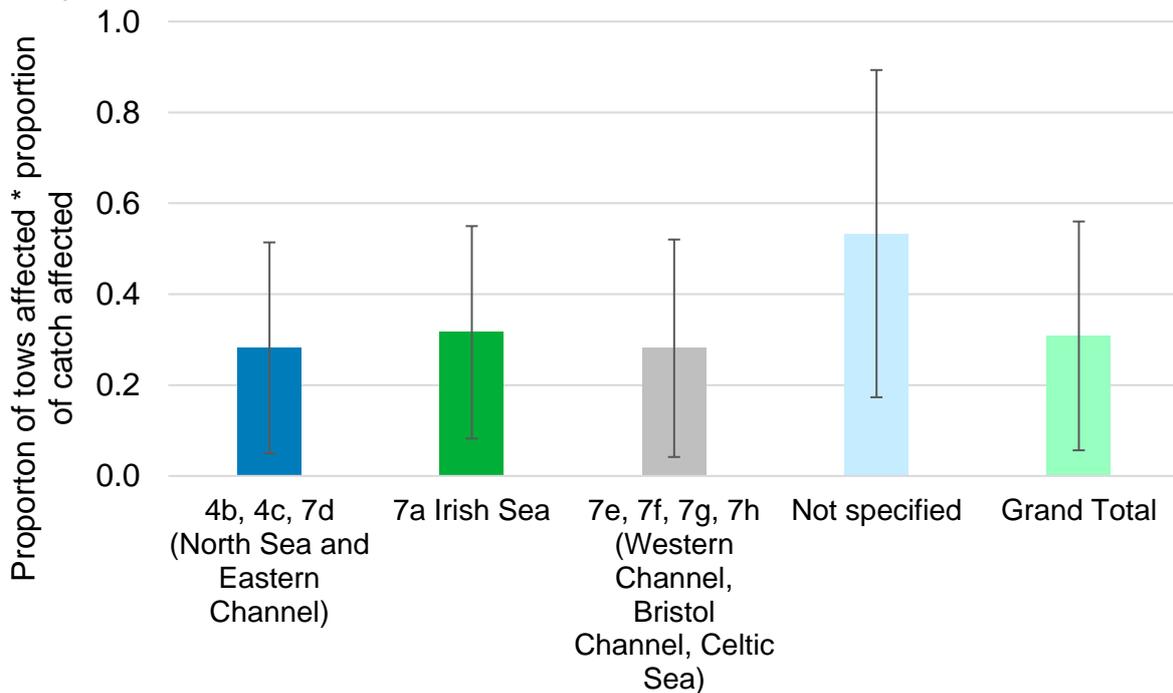
Sample size = 69.



There was a high variance in the proportion of the value of catches reported to be affected overall (taking into consideration the proportion of tows affected, in those months when interactions with seals occur). Around 30% of catches overall are affected, although reported rates can be considerably higher, up to 75% (Figure 15). The rate reported from the three different regions is similar, around 30%. Those respondents that did not specify which area they fish in reported higher rates of around 50%.

**Figure 15 Average (mean) reported proportion of catch value lost due to seals (nets, all areas).**

Sample size = 67. Error bars are mean  $\pm$  1 standard deviation.



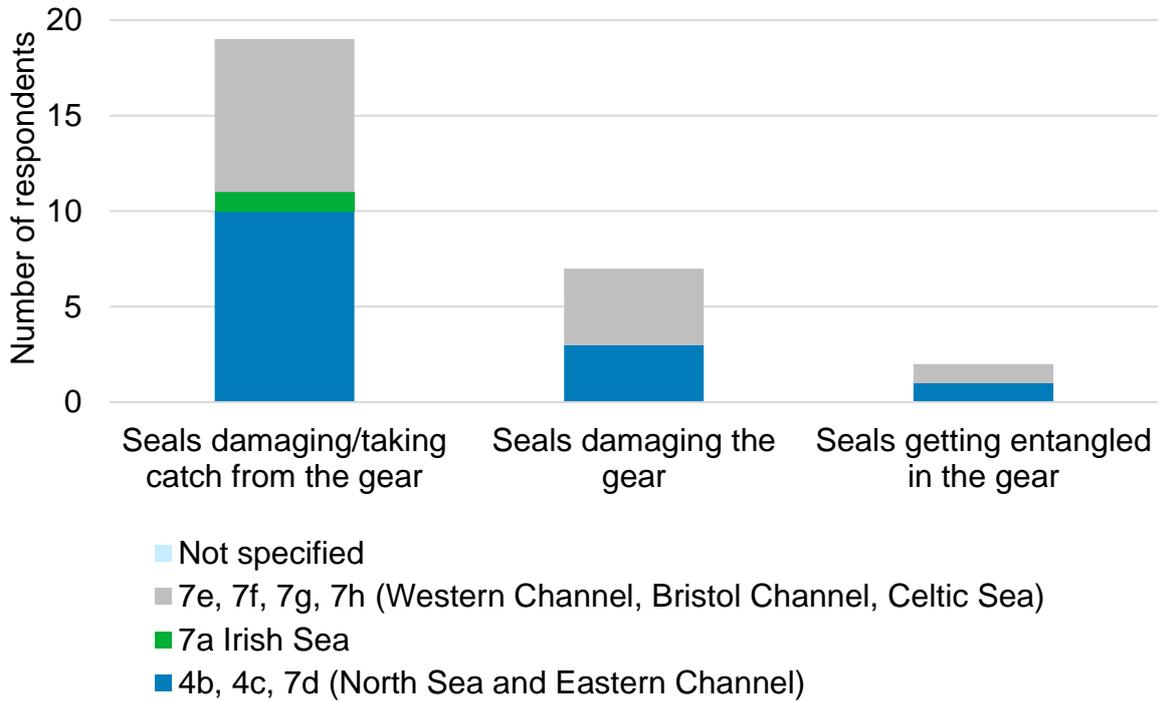
#### 4.7 Interactions with lines

All fishermen that responded to the question about the type of interaction with lines cited seals damaging or taking catch from the gear as a problem (Figure 16). A smaller number of them (less than half) cited seals damaging the gear. Seals getting tangled in the gear was a problem only for 2 respondents.

Around 15% of the total catch is reported to be affected (Figure 17), although reported rates can rise to around 55%. This is considerably less than the rates for nets.

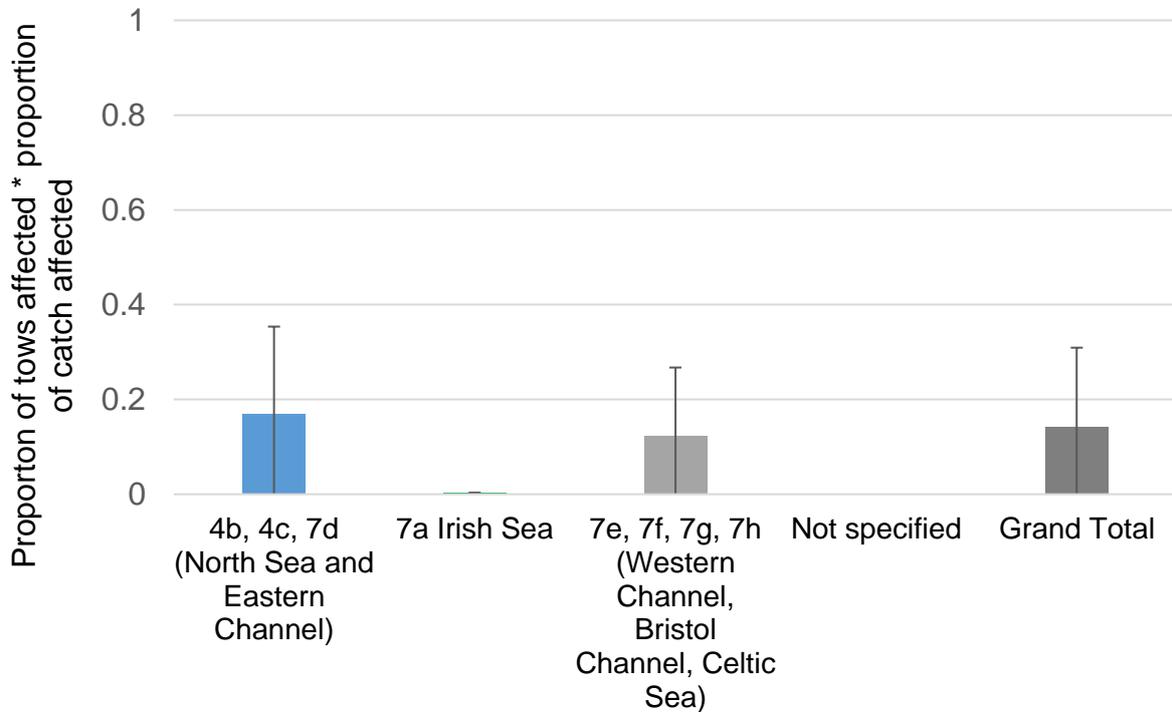
**Figure 16** Reported type of interaction with lines (all areas).

Sample size = 19.



**Figure 17** Average (mean) proportion of catch value reported to be lost due to seals (lines, all areas).

Sample size = 19. Error bars are mean  $\pm$  1 standard deviation.



## 4.8 Interactions with other gears

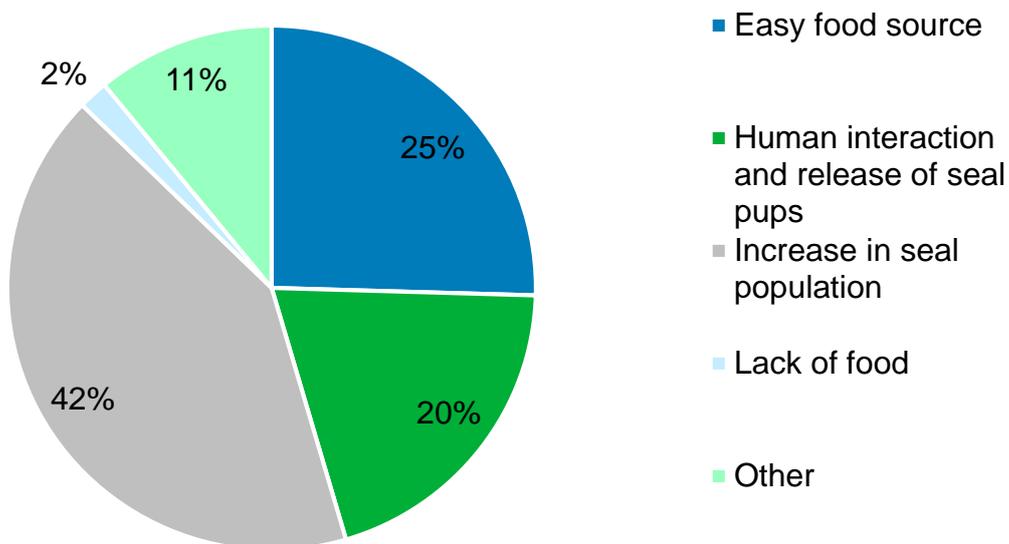
Similar information to that presented for nets and lines is available for pots/traps, trawls and other gear, however the number of respondents for each gear type is low. Results for these gears will be available in a complete anonymised version of the survey data available on request to MMO.

## 4.9 Perceptions of increasing seal populations

The factors that respondents attributed to the level of seal interactions are shown in Figure 18, with quotes to illustrate each issue selected below.

### Figure 18 Fishermen's opinions on the main factor affecting seal interactions with fisheries.

Sample size = 55. Responses were free text, and were then classified according to theme, with the themes being identified from the responses. Where more than one theme was mentioned in a response, it was attributed to the category that appeared to be the main theme.



Fishermen attributed interactions with seals mainly to the increasing seal populations around the English coast, resulting in more and more seals in search of food. Quotes from survey responses are provided below<sup>2</sup>:

“There are more seals and less fish and fishing nets are an easy target.”

“Seal colonies have been allowed to grow and the increased numbers mean that the seals are forced to feed further from their colony. As soon as the seals know that fish are available at a certain location they are there after two tides and will stay in that area until the food source is removed i.e. the nets are taken off.”

<sup>2</sup> Spelling and punctuation has been corrected whilst ensuring no changes to meaning.

Human interaction and the release of seal pups or rescued seals was also felt to contribute to this in two ways: first by contributing to population increase and not allowing natural selection to take its course with the weaker individuals, and second because the released seals were thought to be more accustomed to human presence, increasing the possibility of interactions (as they are not scared away by human presence).

“Seal sanctuary upsetting the natural order of things. Also wild adults teaching pups to follow boats and work the gear.”

“The national seal sanctuary is creating an unnaturally high seal population on the Cornish coast. Reviving seals that should have died naturally in the winter storms and bringing them from all over the country and releasing them in Cornwall.”

“When seals are fed by hand with lots of human interaction their natural instinct when released is to follow humans for food.”

“...it’s mainly to do with the human interaction and subsequent release of seal pups that would have naturally died through natural selection.”

A number of respondents also felt that taking fish from nets (or other gears) represented an easy meal for the seals, and that this trait may be passed down through the generations, exemplified by the quotes below:

“They take the fish out the nets because it’s easy pickings.”

“Our gear is an easy target they just sit on it and gorge this enables them to be more successful in rearing their pups so the problem is exponential.”

“They have adapted to easy fishing methods of not having to fend for themselves; they just look about, see a marker buoy, as they know its easy food.”

“They have learnt to follow the fishing boats and understand how to get an easy meal.”

“Seals are intelligent creatures, they have followed boats out from the beach in the past, and as soon as the dan buoy goes over they equate that with an easy meal. Once a line is located they will patrol up and down it for the duration of the soak.”

“They have learnt how to get an easy meal...and older ones do show younger ones how to fish.”

“Seals have trained themselves to target fishermen for easy food and are passing the trait to their young.”

## 4.10 Accounts of seal interactions

The survey contained fishermen's accounts of interactions with seals, evidencing that seals are responsible for at least part of the experienced damage to catch. Comments also included descriptions of the type of damage that seals cause to the fish (which differs from that of other known marine scavengers).

"We get heads returned on the hook and also the seal will surface close by with a fish to consume it."

"Seals tend to wait close to harbour then will follow a boat, follow the warps<sup>3</sup> down then continually dive on the net coming up with fish and eating on the surface with a voracious appetite!"

"Seals seem to behave like a fox with chickens, they eat what they want then skin the cod or rip out the bellies for fun."

"The seals do most of the damage to my monkfish, they seem to do most the damage in the evenings when the boats are not around and it is quiet."

## 4.11 Impact that seals are having on fisheries

Fishermen indicate that in many cases, seals can make fishing (particularly with nets) uneconomical and some claim to have stopped fishing as a result of the damage caused by seals.

"Seals have more [or] less killed off the cod net fishery in our area."

"Seals have become a very big problem in some areas and have been seen as far as 130 miles from the nearest point of land. Fish can be hard to find most of the time and when what you catch is damaged beyond sale it's really heart breaking. The seal will tend to only eat the liver of a fish which means it normally destroys the fish beyond sale."

"They put me out of fishing with nets. They would follow my boat and wait for me to shoot my nets."

"We used to tangle net for monk fish as well but not anymore; can't keep a whole one in the nets."

"Approx[imately] 10-12 years ago we were plagued by seals daily so much so that we could only fish our lobster pots and not our gill nets as it wasn't worth it as the seals were taking most of the catch and causing lots of damage to the nets ...."

"They have ruined a good fishery in our area. Sometimes we have up to 5 seals at our net at the same [time]."

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<sup>3</sup> In the case of a trawler.

“...sometimes you lose almost 100% and VERY VERY occasionally as little as a 5-0% loss.”

“Gave up fishing.”

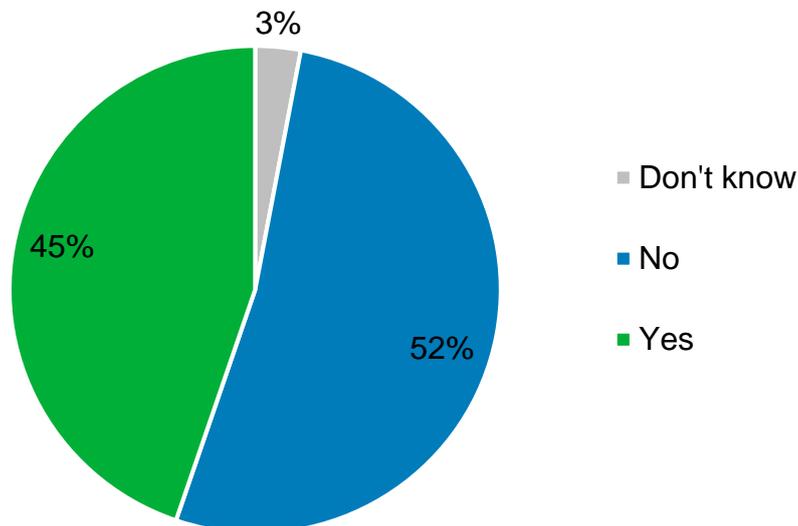
“I had gill netted for some 30 plus years and salmon netted for a similar time and in both cases seal predation was the main factor for stopping that type of fishing even when we patrolled the nets.”

#### 4.12 Actions taken to reduce seal interactions

Approximately half of respondents said that they currently do something to reduce the level or frequency of interactions with seals (Figure 19).

**Figure 19 Respondents that currently use any measures to reduce seal interactions.**

Sample size = 67.



Fishermen were divided about whether there was any point in trying to use deterrents or avoidance behaviour to reduce seal interactions, or whether there were some options that could help. Those that felt there was no point cited the following, including having tried various deterrent options:

“There is nothing I can do except to stay on land. And I am not willing to do that.”

“Put gear ashore in disgust. My winter fishery of 40 years has been destroyed.”

“They will take fish right under the boat and there is not a lot seems to deter them.”

“I have tried everything I can think of, nothing works, I can only fish inshore so can't get away from them.”

“Tried a seal pinger but no use. Tried a big mesh in funnel of net but no use as they are lying against it and eating the stuff easily as they don't use any energy they stay under the water longer.”

“We have tried shorter soak times on the gear but seems to make little or no difference and moving the gear around but that also makes no difference the seals seem to be everywhere.”

“Once the seals know the nets are there that's it, they have to be moved or change methods. Static nets have pretty much become unworkable so will trawl for soles instead.”

Options suggested, or already used by fishermen, for avoiding or reducing interactions with seals included reducing soak times, moving to a different area, attending gear, reducing noises that may attract seals, and adjusting rigging (for pots):

“Soak times are normally reduced but that then means the gear doesn't have a chance to fish properly. Not fishing in certain areas is also done but they seals will find your nets where ever you are.”

“We only give our gill nets 6 hours lay time now as opposed (sic) to overnight.”

“Only in respect of moving to a different fishing area.”

“Go out different time, go round so the seals don't follow, leave off dans [buoys] but they still find them“

“I am attending drift net every time they in water no more than 200 metres from them.”

“Keep depth sounder off as it seems to attract them whilst hauling.”

“Fitting hard eyes to pots i.e. rigging.”

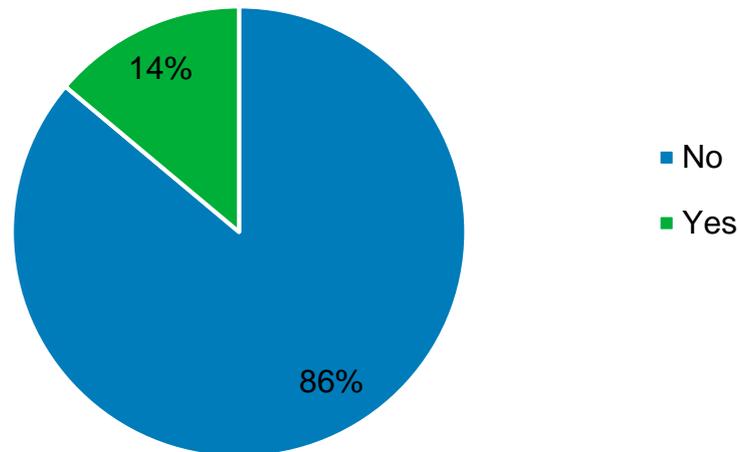
#### **4.13 Shooting of seals in the last 3 years**

Only 14% of respondents indicated that they had used the netsmen's defence<sup>4</sup> in the last three years in order to prevent damage to their nets and/or catch (Figure 20).

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<sup>4</sup> As laid out in the Conservation of Seals Act 1970.

**Figure 20** Respondents that have shot (“yes”), or not shot (“no”), any seals during last three years.  
Sample size = 65.



Many respondents were not aware of the netsmen’s defence or its application. A minority were happy to shoot at seals, whereas others were aware of the potential media implications.

“Thought it was illegal to carry a firearm on a licensed fishing vessel.”

“Frequently shoot at them. Difficult to hit.”

“It would be put on social media if anyone saw, and we would be condemned by the media and public.”

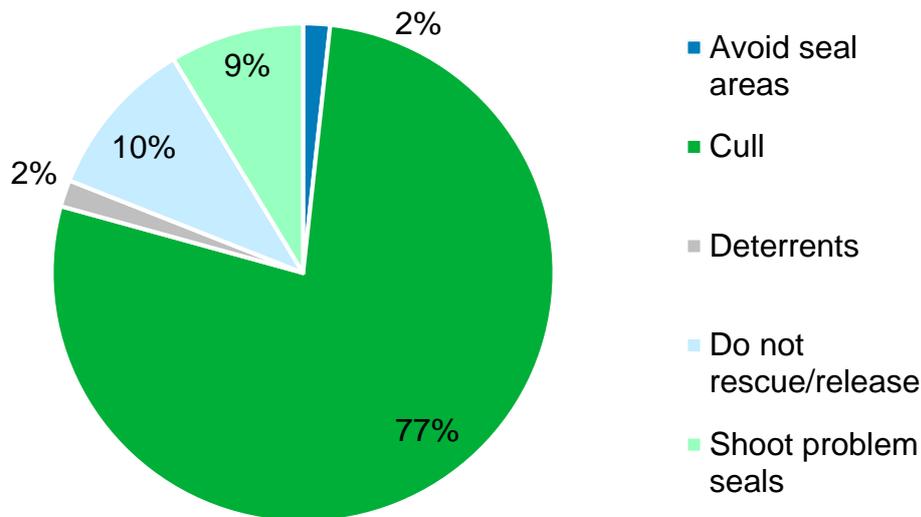
The media implications were recently felt in Cornwall when there was a case of shooting close to the shore in the bass gill net fishery that caused a local outcry and raised public safety concerns (key informant interview).

#### **4.14 Ways to reduce interactions**

The overwhelmingly most popular suggestion for how to reduce the level of interaction with seals was a cull (Figure 21), as is carried out in some areas for terrestrial species such as red deer. This links back to their perception of the increasing size of the seal population being the driving factor in the level of interactions experienced. Other means suggested for reducing the level of interactions indirectly relate to ways of reducing the size of the seal population (by not rescuing and releasing seals into the wild, and by shooting problem seals).

Only one respondent (2%) in each case suggested moving fishing area or using deterrents as ways of reducing interactions with seals.

**Figure 21 Suggestions of ways to reduce interactions with seals.**  
Sample size = 58.



## 5 Additional Information from Telephone Interviews

The information from the telephone interviews broadly supported the findings of the literature and data review and did not uncover any further additional research, information or data that had not already been incorporated in the review.

The outcomes of the online survey for fishermen is described in [Section 4](#), whilst the information obtained from telephone interviews with regulators, academic researchers and NGOs has been incorporated into this section.

The information from the key informant interviews is summarised by theme below.

### 5.1 Location and prevalence of seal-fishery interactions

All IFCA and MMO interviewees stressed that the information discussed had been relayed to them by fishermen and/or other stakeholders and hence they were not able to corroborate the information. All interviewees stressed the importance of speaking to fishermen and other key stakeholders to obtain further information and detail.

Information reported to the IFCA by fishermen indicated that seal interactions were a significant issue in the following locations:

- Suffolk - affecting fishers operating out of Harwich, Felixstowe, Orford, Aldeburgh beach, Southwold and Lowestoft;
- Cornwall - mostly along the south coast between Penzance and Plymouth with hotspots including Mevagissy and St Austell; and
- The north-east of England.

These areas corresponded with the areas which the MMO received the most reports of seal-fishery interactions from (the south-west, east and north-east of England).

In all of the areas, the fishing activity predominately affected is static nets (e.g. tangle nets set for monkfish), although in the east of England there were reports of all types of nets being affected (i.e. trawl, fixed or drift nets). In the north east of England, interactions were also reported to affect fishermen using T-nets and J-nets targeting sea trout in estuaries. The most common species targeted by the seals (that are reported to the MMO) are salmon, bass, pollack, flounder and monkfish.

The IFCA and MMO did not have any information or data relating to the prevalence of interactions, as this issue is not within their remit to monitor. However, in the Eastern IFCA and Cornwall IFCA Districts, fishermen have reported increases in seal numbers over the last couple of years and some fishers in Cornwall had commented that 2018 was probably the worst year any of them had seen for damage to catches. Fishermen have also reported to the IFCA and MMO that seals seem to be becoming 'more fearless', with very occasional reports of aggressive behaviour. The MMO noted they receive more reports of seal-fishery interactions in the south west of England in the summer. It was speculated that contributing factors to the increased in reported interactions during this season may include overlap with the breeding season and/or reports of some charter vessels (which are more prevalent in summer for wildlife watching or fishing) feeding seals, which may encourage interactions.

## 5.2 Impacts of seal-fishery interactions

Much of the evidence for seal depredation is anecdotal, largely from local fishermen. The main impact of the seal-fishery interactions reported to the IFCA and the MMO from fishermen is damage to commercial catches. For example, seals are reported to take part of the fish from the net, sometimes leaving only the head, or damaged fish which cannot be sold, with subsequent impacts on the fishermen's incomes.

Objective evidence of seal depredation is generally lacking, but there are established methods of attributing fish damage to seals, which have been used by academic researchers. This is based on the type of damage caused to fish, such as large v-shaped bite marks, lacerations, and what areas of the fish are targeted. This provides convincing evidence of seal depredation, as opposed to depredation by other species. However, direct observations (such as by video recordings) would provide objective evidence but this data has not been collected previously at static nets.

Estimates of the magnitude of impacts to the catch and economic valuation of the damage reported to IFCA included:

- Sometimes up to half of the catch is lost;
- Sometimes 70% of the catch is ruined;
- Loses of £5,000 worth of fish annually; and
- Hundreds of pounds of damage per day.

The impact was such that in the north-east of England it was considered by the regulator that the level of seal depredation, in conjunction with quota, was a significant factor limiting the amount of netting that could take place in the Northumberland IFCA district, such that the fishermen are almost completely reliant

on potting. This was also reflected in some of the responses to the online survey ([Section 4](#)).

Other impacts reported to the IFCA and MMO by fishermen included damage to equipment (e.g. 'shredded nets', although this seemed to be less of an issue than damage to catches, and was reported less in some Districts) and entanglement of seals in the nets. It was noted that in the south-west, reports of tagged seals entangled in nets has led to the suggestion that entanglement seemed to coincide with the release of rehabilitated seals pups from a local seal sanctuary.

Academic researchers reported on the prevalence of seal by-catch, particularly from the research undertaken in Ireland by Cosgrove *et al.* (2013, 2015, 2016), which is largely captured in the literature review. There is evidence to suggest nets with greater mesh sizes (such as trammel and tangle nets) have higher rates of by-catch (this does not seem to affect depredation rates). Furthermore, juvenile seals tend to be caught more often than adults. Juvenile seal entanglement could be attributed to a range of reasons, such as inexperience in taking fish from nets, greater entanglement due to juveniles panicking, or the fact large adults may be less likely to become entangled. A study by World Animal Protection (no date) was not able to establish whether entanglements in Cornwall were in discarded ghost gear or 'live' fishing gear.

It is not clear what the balance is between losses to the fishing industry from seals and benefits to local tourism industries from seals as a visitor attraction, and this is likely to vary between locations. An ecosystem services approach to analyse the costs and benefits, with potential for payments for ecosystem services to be implemented, might be an approach that could be explored.

### **5.3 Factors affecting depredation**

It is generally unknown if seals actively target nets and recognise them as a source of food, or if they happen on nets (and fish) accidentally. However, there is evidence to support the argument that individual, specialised seals that have learnt this behaviour are largely responsible for depredation. This is possibly further demonstrated by fishermen accounts of large adult males following fishing vessels and feeding on fish surrounding set nets that have been depredated.

Information provided by the IFCA included reports from fishermen that the seals are able to recognise individual fishing boats and have learned where and when the fishermen will undertake fishing activity. One IFCA respondent received reports of seals being present outside of the port and following fishing boats as they left the port and travelled to the fishing grounds. Fishermen have also reported to the IFCA that seals 'clearly learn' to find the marker [buoys] on the gear, swim down one rope, along the gear and ascend up the other rope, indicating they have learned where the fish will be. Fishermen have also reported to the MMO that it is when they are hauling the nets that they tend to see a lot of seals around.

Interviews with academic researchers supported the evidence provided in the literature review on factors that affect depredation. The interviews further highlighted that there is variation in the factors that affect depredation between studies, anecdotal accounts, and location. However, the predominant factors that seem to affect

depredation are: the amount of fish caught in nets as fish movement/thrashing may attract more seals; engine/boat noise or presence which may be having a 'dinner bell' effect; and hauling activity which seals may be targeting (though this is difficult to confirm and it is likely depredation also occurs when nets are set<sup>5</sup>). However, much of this evidence is anecdotal and it is difficult to decipher which of these factors is acting upon the rates of seal depredation.

In tourist areas, boats that feed seals may encourage seals to associate vessels with food. It was also reported that fishing vessels used to discard guts etc. overboard within harbour areas in Cornwall. Now that this has been banned, they may discard guts just outside the harbour, which encourages seals to wait and follow them.

#### 5.4 Deterrent methods/strategies

Most of the IFCA respondents confirmed that they were aware that some fishermen had licences to shoot seals, but that they did not have any information on the frequency with which this is done. The MMO stated that most of the enquiries they have received about shooting seals from fishermen (approximately 22 enquiries since 2010) come from east and south west England. The MMO do sometimes receive reports of seals being shot (approximately 16 reports since 2010), with some of these reports comprising witnessed incidents, whilst others were reports of loud bangs and/or seals washed up on beaches with shot wounds, although it was cautioned that the reporting of shot wounds could be erroneous as, unlike for stranded cetaceans, post mortems/examination of seal carcasses are not generally conducted.

The IFCAs and the MMO reported being aware of a number of devices and strategies that had been tried by fishermen to minimise seal-fishery interactions, which included bird scaring devices from agricultural trade outlets, fish scramblers, homemade thunderflashes and shooting over the heads of seals. The interviewees didn't have any data on the effectiveness of such deterrents, however, in general, the impression was that it did not take long for the seals to adapt to such deterrents even if they had initially worked. This caused some of these interviewees to question whether ultimately any such deterrent device may actually function as a dinner bell rather than a deterrent as intended.

In the North Eastern IFCA District, four Lofitech seal scarers were purchased in 2007, and deployed to three fishing vessels in the region during the salmon season (see NESFC, 2008). Comparison of the 2006 and 2007 monthly returns for June, July and August showed that the average revenue losses from seal damage to catches was lower in 2007 when the Lofitech devices were trialled. Furthermore, all participating fishermen believed the system had a positive impact on the quantity of undamaged fish landed and that the frequency of seal interactions with fishing gear had also been much reduced. However, it was noted that whilst the data indicated some positive trends when the Lofitech systems were deployed, the study design was not able to account for other factors, such as natural fluctuations in seal activity and/or increasing numbers of salmon and sea trout, which may have influenced the

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<sup>5</sup> In the online survey, some fishermen indicated that the damage did seem to occur overnight when nets were unattended.

results. However, since these trials, the devices have repeatedly malfunctioned, possibly due to the conditions exposed to in the marine environment, and for this reason the devices are no longer loaned to fishermen in the District.

The IFCAs and MMO were also aware that fishermen have varied aspects of equipment deployment and/or fishing patterns to try to reduce interactions, for example via shortening the soak time of nets, altering the distances between nets, deploying 'dummy nets' and hauling nets at different times. In general, these methods did not appear to have been successful in minimising seal-fishery interactions. There were also reports that increasing the distance between gill net tiers to around two metres has been successful in preventing seals following on from one tier to the next, but other interviewees disagreed.

Academic researchers that were interviewed agreed that currently available deterrents (which mainly comprise acoustic deterrent devices (ADDs)) were mostly ineffective at deterring seals. Most studies show evidence of habituation and sometimes a 'dinner bell' effect where seals are attracted to the noise of the ADD. However, 'dinner bell' effect evidence mainly comprises studies undertaken at aquaculture sites rather than capture fisheries. Habitat exclusion and effects to non-target species (namely cetaceans) are also a concern with current ADDs. A more pragmatic issue is that current devices require a large power supply and therefore fitting to nets is difficult, and may only be deployable from boats during hauling.

All academic researchers interviewed have worked together on a research project in Irish waters testing an early development of an ADD developed by Thomas Götz and Vincent Janik. Results from these studies were inconclusive primarily because rates of depredation were too low to detect the effectiveness of the ADD (Gosch *et al.*, 2017). However, all acknowledge the importance of a solution that is seal-specific (based on frequency), does not cause hearing damage to seals, and that seals are sensitive to over long periods. The ability for a device to be fixed to nets would also be an advantageous criterion, as seals may also take fish from nets during soaking. It was suggested that an early prototype developed in cooperation with Genuswave Ltd, which is submersible and can be attached to nets, currently shows the most promise as a seal deterrent. However, it was acknowledged that the relatively small effective range of ADDs, whilst also limiting wider effects, may hinder the ability for ADDs to protect long nets at sea.

## **5.5 Interviews with Fishermen**

The following sections summarise the information from the in-depth interviews with fishermen selected from responses to the online survey.

### **5.5.1 Experience of interactions with seals**

The interviews with fishermen re-emphasised that at the present time seals seem to be ever-present when they are fishing, in all areas covered in the questionnaire (north-east, south-east, south-west and north-west England).

It is generally held that seals recognise the sound of the engines: seals wait outside the harbour and then follow vessels to the fishing grounds. The seals tend to remain

within the inshore area, and appear to be able to differentiate among the different engines and the vessels, often not bothering to follow the offshore vessels because they know they will be fishing approximately 50 nm offshore.

There was a suggestion that the intensity of the seals' attention and their predation could be linked to the availability of other species. Although seals are opportunistic feeders, they appear to be particularly fond of mackerel (which has been late this year). Pressure on food stocks means that they are likely to start predating on "new" species, such as blonde rays in Cornwall this year.

#### **5.5.1.1 Identifying breeding colonies**

Apart from the south-west, in the other areas the fishermen could clearly identify the breeding colonies. In Cornwall the situation is less clear – the importance of seals released from sanctuaries was highlighted.

#### **5.5.1.2 Increase in level of predation**

Fishermen in all areas studied (see Figure 1) stressed the increase in the problem of depredation over the last decade, and particularly in the last few years when it is perceived to have at least doubled. The increase has not been constant, however. Rates of depredation did vary within fishing areas, perhaps due to the large areas covered.

Rates of depredation also varied in among regions. In the north-west, the breeding successes of the Walney Island reserve and possible movement southwards from Scotland of grey seals were held to be largely responsible for the increase. In the north-east, the increase of seal numbers on the Farne Islands and the southward colonisation to Coquet Island and St. Mary's are indicative of the change. In the East Anglia the impact of the increase in seal numbers on Scroby Sands and their southward extension are thought to underlie the increasing level of interactions.

The problem seems to be most acute in Cornwall where the presence of seal sanctuaries and the release of seals that are unafraid of humans is regarded as a major problem by fishermen although the same reservations about seals that are accustomed to humans is also expressed in other areas. This may also reflect the nature of fisheries in Cornwall, where there is higher levels of static gear fishing effort relative to other areas.

#### **5.5.1.3 Evidence that seals are responsible for predation**

The fishermen are in no doubt that the seals are responsible for the increase in predation. They have seen seals taking fish from the nets as they are hauled. In addition, they are familiar with the visual evidence of seal predation – heads left in the net, teeth marks, claw marks from their flippers as they hold the fish, livers or stomachs taken, etc.. They indicated that seal activity is easily differentiated from that of squid and cuttlefish.

### **5.5.2 Impacts of seal interactions**

#### **5.5.2.1 Damage to catch**

All the inshore fishermen reported substantial loss of income from seal predation, chiefly from lost or damaged catch, but also damaged gear. Precise details of the financial impact are difficult to establish since prices fluctuate. It is probably more

relevant to consider the percentage of catch damaged (where the whole fish is taken there will not necessarily be any evidence left other than possibly net damage).

Interviewees reported seabass and monkfish as the most widely predated species with damage percentages of around 50% on average. For ray, the damage is approximately 50% too. Salmon and sole, particularly valuable species, suffer higher predation rates. For salmon predation can vary from 10–99% during the short season. Sole, which has recently attracted more attention from the seals in the southern North Sea, is experiencing predation rates of up to 90%.

#### **5.5.2.2 Damage to gear**

Damage to gear is less important than damage to the catch. Panels or fleets of nets will require replacing more frequently and there will be a constant need for small repairs, but it is the “lost” catch that is of greater significance.

#### **5.5.2.3 Seal entanglement**

Seal entanglement occurs to some extent in all areas but was reported particularly from the south-west. Interviewees indicated that it is generally the pups or young seals that become entangled – older seals, especially ‘bull’ seals, have the power to force their way out of nets. It is rare for an adult seal to become entangled. It is usually the grey seal pups that become entangled in the early part of the year and it is felt that this is due to the fact that they are released from seal sanctuaries and have little sense of self-preservation. Seals are, on occasion, found dead in the nets but this is rare – which would indicate that they are present and become entangled when the fishermen are hauling their nets.

### **5.5.3 Methods for reducing seal interactions**

#### **5.5.3.1 Gear deployment**

The most commonly used method of reducing seal interactions is reducing the amount of time that nets are left in the water, particularly overnight. Fishermen will reduce the time nets are left from 3–4 days to 3 days or less. In some fisheries where the rate of predation is particularly high, they may not leave them in overnight at all. This reduces depredation losses but does not eliminate it.

The inshore fleet may have limited options for alternative fishing areas. Changing fisheries, particularly for fishermen who operate a range of gears, is to a certain extent an option but there are limitations imposed by the seasonality of some species and the difficulty of financing major changes in activity (vessel/gear/quotas).

There were some reports seals seem to be less active and less successful predators in the dark, so setting nets when it is still dark and only leaving them in a short time may offer a reduction in predation. However, if all fishermen adopted this tactic there is little doubt that the seals would adapt accordingly, and this would seem to contradict those responses where fishermen indicate they no longer leave their nets overnight.

Attending gear is a condition of salmon licences in the North East but, in itself, it is not a very effective strategy since the seals remain in the vicinity and can stay underwater for c.15 minutes, easily enough time to take the fish.

### **5.5.3.2 Shooting**

There was a general feeling that shooting seals was not really a viable option. In addition fishermen viewed shooting as ineffective (a very difficult shot in a bobbing vessel with a moving object some distance away). Only one fisherman interviewed had a licence and a gun to shoot seals and he used it more as a deterrent, shooting only one or two seals a year.

### **5.5.3.3 Deterrent devices**

Some of the fishermen have used a deterrent device, or have been involved in trials. Some of these have been crude bird-scarers to which the seals rapidly became accustomed. The trial of banana pingers has generally been inconclusive. In addition, problems arose because the pingers were on the same wavelength as the echosounders and therefore, once the seals became accustomed to the pingers, the echosounders began to attract the seals.

There were a number of practical problems that were cited attached to the use of ADDs. The equipment used to haul gear dislodged pingers from the gear; the battery life was relatively short; size is also a consideration in small (under-10 m) vessels.

Seals are very intelligent and rapidly work out evasive actions to deterrents. This habituation means that fishermen are somewhat sceptical about the long-term effectiveness of ADDs although they would welcome something that really worked at a reasonable price. Reactions varied as to the willingness to pay for an effective deterrent device. A common word used by fishermen was effective, and fishermen have become so accustomed to seals becoming habituated to deterrents. Fishermen's willingness to pay for deterrent devices included a range of responses but was generally "in the hundreds, not the thousands" of pounds from inshore vessels.

## **6 Workshop Results**

### **6.1 Setting the scene**

This section details engagement through the stakeholder workshop. The workshop was initiated by a presentation session, 'Setting the Scene', with an overview of the project provided by the MMO, the Authority who commissioned the project (slides in [Annex E.2](#)) providing the rationale for the work. Perspectives of the problem were given by a fishing industry representative and by an NGO representative.

This session highlighted that the increasing population of seals was problematic for fishermen, who are losing part of their catch to damage by seals, and fishermen feel that the rescuing and release of seals by sanctuaries is contributing to the problem. While seals impact on fisheries, fisheries also impact on seals through bycatch in operational fishing gear and entanglement in lost gear and use of lethal methods. All presenters agreed that the current situation was undesirable e.g. losses to fishermen and to seal populations suggesting a common interest to attempt change.

## 6.2 Key issues and visioning of potential solutions

In the first break-out session, groups representing different interests (seals, fishing, and marine regulation), explored key issues and visioning of potential solutions by considering the following questions (a record of break-out groups' outputs is provided in [Annex E.6](#)):

- What are the main issues/problems for you in relation to seal/fishery interactions?
- What would your ideal solution look like – What things do you consider essential in the solution, and what would be undesirable?

This session confirmed the perspectives in 'Setting the scene' and highlighted two particularly common themes, trust among parties and evidence needs. There is a need to engage, build trust and create dialogue between different parties to ensure different perspectives on the issue are integrated in any potential management solution or policy.

There is an ongoing need for further research, including into: seal diet, behaviour and population dynamics over time and among different areas, the extent, scale and type of interactions between seals and fisheries, the type of damage caused by seals, and differences between species (grey vs. harbour seals); and individual depredation behaviour, levels of depredation, and deterrent technology. The at-sea trials may contribute to the evidence on some of these issues.

## 6.3 Seal-fishery research and deterrents

Further presentations from project representatives and participants considered the results of the project survey, seal-fishery research, and deterrents (see [Section 4](#) and MMO, 2018). Copies of the presentations are provided in [Annex E.3-5](#). This either reinforced or expanded on conclusions in the literature and data review element of the project (MMO, 2018) such as local population trends, mobility, diet and recent deterrent research and provided further information for participants on acoustic deterrent device technology.

Recent developments in ADD technology identified were promising; low frequency startle technology shows promise in reducing habituation, hearing damage and effects on non-target species such as odontocetes<sup>6</sup> while and lower source levels and duty cycles reduce underwater noise. It was also noted that technological readiness could be improved within months based on refinement of current technologies should there be an appropriate end market.

---

<sup>6</sup> Toothed whales - a suborder of cetaceans.

## 6.4 Constraints and benefits of different options and considerations for at sea-trials

The second set of break-out sessions encompassed three groups that mixed fisheries, NGOs and regulators in each group to inform the constraints and benefits of different options and considerations for at sea-trials by considered the following:

- What are the constraints and benefits (pros/cons) of each different approach to reducing seal-fishery interactions (deterrents, fishing tactics, avoidance measures and no action)?
- Which is the preferred option for your group and why? For the preferred option:
  - Where trials would be most critical?
  - What factors should be controlled for?
  - What parameters should be recorded?

Break-out groups' considerations are recorded in [Annex E](#). All groups had a preference for testing the ADDs in the at-sea trials. Fishing tactics and avoidance measures were not considered feasible, as all options have been tried by fishermen and not been successful in the long term. However, commonly-used fishing tactics could be collated and shared amongst industry.

It was noted that ADDs could be deployed in several ways (with options towards the end of the list requiring further research and development of devices):

- Deploy from vessels during steaming to prevent seals from following vessels to fishing areas;
- Deploy from vessels in vicinity of nets during fishing;
- Deploy from vessels during net hauling to deter depredation during hauling;
- Integrate in dhan buoys to deploy at either end of nets (often seals appear to follow the dhan line to find the net);
- Deploy on nets themselves (would need to be compact and integrated into one unit (control unit and transducer), and must not catch on the net as it goes through the hauler).

The break-out groups' recommendations for experimental design (location, fishery, parameters to record) will help to inform the project team's considerations for the at-sea trials. More detail is provided in [Annex E](#); key points that emerged to inform the design of the trials were:

- The importance of a transparent trial undertaken with involvement of the fishing industry;
- The most important factor is to test devices in areas of high depredation (to avoid inconclusive results – see Gosch *et al.*, 2017);
- Deterrent device could be 'net-integrated' on dhan buoys or deployed from the vessel – the latter could be activated whilst steaming to fishing grounds to prevent seals following fishing vessels;
- Photographic identification (Photo ID) of seals seen during the trials provides a possible opportunity to gather evidence on whether specific individuals are

responsible (if trials are carried out in the south-west, Cornwall Seal Group Research Trust, that has an extensive photo ID database, could support this);

- Device must be robust, not significantly interfere with fishing operations, and be tested on normal fishing operations (i.e. normal sized nets); and
- Important to control for environmental variables (i.e. carry out test and control hauls on the same days/times).

## 7 Conclusions

Through stakeholder engagement encompassing survey, interview and expert stakeholder workshop techniques, a body of work was conducted that supported the desk-based literature and data review. This encompassed wider stakeholder perceptions and expertise, generated awareness of the work undertaken

Fishermen's responses suggested seal interactions are increasing and they attribute this to increasing seal populations. Static nets were reported as the most impacted gear type with spatial patterns of interaction reflecting seal distributions at sea. Seasonal variation in interactions was reported although the strength of this varied among regions. Collectively this suggested deterrent trials with static nets in identified areas of high levels of seal interaction would encounter the greatest depredation pressure.

Fishermen reported using a wide range of deterrent options but did not have any data on the effectiveness of such deterrents and reported them all to become ineffective after a time. There was a consensus that if a non-technical solution was available e.g. through changing fishing behaviour, fishermen would have adopted it. In general, the impression was that seals did not take long to adapt to any deterrent. This supports the findings of the literature and data review and identified ADDs as the preferred approach to be trialled, with startle technology being promising.

Stakeholder engagement also generated insights that will support decisions on the geographic scope for the trials and on the key elements for trial design that key stakeholder groups see as being important to conducting a scientifically robust and supported sea trial in 2019.

## 8 References

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## Annex A. Poster for MMO and IFCA offices



**Do seals affect your commercial fishing activity?**

**Please take our survey to help us understand:**

- The extent of the problem
- The impact on the fishing industry
- Options for non-lethal deterrents

Photo by Andrew Pearson

### How to get involved:

- Take our online survey:  
[www.surveymonkey.co.uk/r/fishingandseals](http://www.surveymonkey.co.uk/r/fishingandseals)
- Participate in deterrent device field trials



### For more information please contact:

Suzannah Walmsley  
02380 711 858 / [swalmsley@abpmer.co.uk](mailto:swalmsley@abpmer.co.uk)



## Annex B. Press Coverage

Fishing News article, 2<sup>nd</sup> August 2018

**NEWS** THE VOICE OF THE INDUSTRY SINCE 1913

### Netting fishermen's knowledge on seals

A new project is underway to help improve advice on ways to prevent seals from taking fish catches, which is costly to the industry, both in terms of loss of catch and also in damaged gear.

ABPmer, a marine consultancy based on the south coast, is working with the National Federation of Fishermen's Organisations (NFFO) to gain an up-to-date understanding of the issue, and to identify and trial possible seal deterrents with the fishing industry.

Project manager Suzannah Walmsley said: "Current government advice is that other deterrents must be tried before shooting. However, when you're on a fishing vessel in open water, alternative viable options are limited.

"We would like as many fishermen as possible to complete our online survey about their experiences of interactions with seals, whether they experience an issue or not.

"We want to know about the extent of the problem, the impact on the fishing industry, and any experiences with, or ideas about, possible seal deterrent options. There is even the chance to win a £50 Amazon voucher for completing the survey!"

Following the data-gathering exercise, ABPmer will review non-lethal measures, gear modifications and fishing tactics currently available to reduce seal interactions. Field tests of the most promising non-lethal deterrent options will then be undertaken within one or more of the fisheries where seal interactions are a significant issue.

The project is being implemented by ABPmer and NFFO for DEFRA and the Marine Management Organisation.

An online survey is available at: [bit.ly/2ms0gts](http://bit.ly/2ms0gts) or Suzannah Walmsley can be contacted at: [swalmsley@abpmer.co.uk](mailto:swalmsley@abpmer.co.uk) or on: 02380 711 858.



Seals continue to be an increasing problem for inshore fishermen.

# NFFO news article, 17<sup>th</sup> July 2018

Not secure | nffo.org.uk/news/netting-fishermens-knowledge-on-seals.html

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## NETTING FISHERMEN'S KNOWLEDGE ON SEALS

17TH JULY 2018 IN INDUSTRY SCIENCE PARTNERSHIPS

A new project is underway to help improve advice on ways to prevent seals from taking fish catches.

Seals eat catches from fishing gear in areas throughout English waters, particularly in the south west, north east and east. This is costly to the industry both in terms of loss of catch but also in damaged gear.

ABPmer, a marine consultancy based on the south coast, is working with the National Federation of Fishermen's Organisations (NFFO) to gain an up-to-date understanding of the issue, and to identify and trial possible seal deterrents with the fishing industry.

Suzannah Walmsley, project manager, said; "Current government advice is that other deterrents must be tried before shooting. However, when you're on a fishing vessel in open water, alternative viable options are limited."

"We would like as many fishermen as possible to complete our [online survey](#) about their experiences of interactions with seals, whether they experience an issue or not.

We want to know about the extent of the problem, the impact on the fishing industry, and any experiences with or ideas about possible seal deterrent options. There is even the chance to win a £50 Amazon voucher for completing the survey!"

Following the data gathering exercise, ABPmer will review non-lethal measures, gear modifications and fishing tactics currently available to reduce seal interactions. Field tests of the most promising non-lethal deterrent options will then be undertaken within one or more of the fisheries where seal interactions are a significant issue.

The project is being implemented by ABPmer and NFFO for Defra and the Marine Management Organisation.

To get involved please take our [online survey](#).

Or to register your interest, email or call Suzannah Walmsley on [swalmsley@abpmer.co.uk](mailto:swalmsley@abpmer.co.uk) or 02380 711 858.



Credit/copyright: Andrew Pearson

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[www.abpmer.co.uk/news-desk/news-archive/abpmer-to-assess-options-for-non-lethal-seal-deterrents/](http://www.abpmer.co.uk/news-desk/news-archive/abpmer-to-assess-options-for-non-lethal-seal-deterrents/)



### ABPmer TO ASSESS OPTIONS FOR NON-LETHAL SEAL DETERRENTS

17/07/2018

To help improve regulatory advice, ABPmer has been appointed by Defra and the Marine Management Organisation (MMO) to improve understanding of how seals interact with commercial fisheries and review options for non-lethal measures to deter seals from taking catches.

Depredation is an issue for static net fisheries throughout English waters, and particularly the south west, north east and east. This leads to significant economic costs from loss of commercial catch, increased gear handling or gear damage.

Suzannah Walmsley, Principal Fisheries Consultant at ABPmer said "Current regulatory advice is that prior to shooting, all non-lethal deterrent methods should be tried, but effective non-lethal seal deterrent alternatives to shooting do not currently exist for application from fishing vessels in open water".

"This study will help extend regulator knowledge and understanding of the seal depredation issue in English fisheries and will allow the MMO to provide fishermen with robust practical advice on how to deter seals using non-lethal methods".

ABPmer is working with the National Federation of Fishermen's Organisations (NFFO) and will be asking commercial fisherman to share their experiences on interactions with seals including the gear types, the fish species taken, the proportion of catches that have been affected and whether the problem occurs more frequently in particular locations or at certain times of the year.

Following the data gathering exercise, ABPmer will review non-lethal measures, gear modifications and fishing tactics currently available to reduce seal depredation and bycatch for static net fisheries. Field tests of the most promising non-lethal deterrent options will then be undertaken within one or more of the fisheries where seal interactions are a significant issue.

ABPmer is a recognised specialist in fisheries and marine conservation, policy and management, socio-economic impact assessment, planning and licensing for aquaculture, and seafood trade and value-chain analysis.

It regularly undertakes fisheries and aquaculture research, data analysis and offers advice to a range of clients including government departments, statutory bodies, industry, Fisheries Local Action Groups (FLAGs) and NGOs.

The online survey for commercial fishermen can be accessed here:  
[www.surveymonkey.co.uk/r/fishingandseals](http://www.surveymonkey.co.uk/r/fishingandseals)

#### Contact

Rupert Malins  
Communications  
+44 (0) 2380 711 840



#### Resources

## MMO Facebook posts



**Marine Management Organisation - MMO** 7 August · 🌐

Do seals affect your commercial fishing activity?

The MMO has commissioned research, including work with the National Federation of Fishermen's Organisations (NFFO), to improve understanding of how seals interact with commercial fisheries. Please help us understand the extent of the problem, impacts and find options and solutions for non-lethal deterrents.

We need to know about interactions with seals including the gear types, the fish species taken, the proportion of catches that have been affected and whether the problem occurs more frequently in particular locations or at certain times of the year. Let us know via this survey [[www.surveymonkey.co.uk/r/fishingandseals](http://www.surveymonkey.co.uk/r/fishingandseals)] by 17 August.

Thanks



SURVEYMONKEY.CO.UK  
**Survey on interactions between seals and fisheries**  
Web survey powered by SurveyMonkey.com.  
Create your own online survey now with SurveyMonkey's expert certified FREE templates.

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Marine Management Organisation - MMO shared a post.



14 August at 14:02 · 🌐

If seals affect your fishing activity we'd appreciate hearing your experiences via the survey we've commissioned as the first phase of research. It closes this Friday, 17 August, link in the original post.



Marine Management Organisation - MMO

7 August · 🌐

Do seals affect your commercial fishing activity?

The MMO has commissioned research, including work with the National Federation of Fishermen's Organisations (NFFO), to improve understanding of how seals interact with commercial fisheries. Please help us understand the extent of the problem, impacts and find options and solutions for non-lethal deterrents.

We need to know about interactions with seals including the gear types, the fish species taken, the proportion of catches that have been affected and whether the problem occurs more frequently in particular locations or at certain times of the year. Let us know via this survey [[www.surveymonkey.co.uk/r/fishingandseals](http://www.surveymonkey.co.uk/r/fishingandseals)] by 17 August.

Thanks



SURVEYMONKEY.CO.UK

**Survey on interactions between seals and fisheries**

Web survey powered by SurveyMonkey.com. Create your own online...



2

9 Shares

## Annex C. Online Survey

### Survey on interactions between seals and fisheries

#### Background:

This survey is for commercial fishermen in England about their experiences of interactions with seals (seals feeding on catches, damage to gears and entanglement). Your responses will help us better understand the extent of seal–fishery interactions around the country and identify options for non-lethal measures to reduce these interactions. Participation in the survey is voluntary.

This survey is being carried out as part of a wider study, which is implemented by ABPmer Ltd and the National Federation of Fishermen’s Organisations (NFFO) on behalf of the Marine Management Organisation and Defra. The study aims to identify fisheries in English waters where such interactions are a significant issue and to field test the most promising deterrent option(s) within one or more of those fisheries. This will help with the identification of viable and effective options for reducing seal–fishery interactions, with benefits for both fisheries (reduction of damaged catches or time lost) and seal populations (reduced impacts from fisheries).

**Win a £50 Amazon voucher!** By taking part in the survey, you will have the chance to win a £50 Amazon voucher. Terms and conditions apply.

**Time to complete the survey:** The survey should take no more than 15 minutes to complete.

**Queries:** If you have any questions about completing the survey, prefer to complete it offline, or wish to discuss anything further, please contact Suzannah Walmsley, ABPmer (Email: [swalmsley@abpmer.co.uk](mailto:swalmsley@abpmer.co.uk); Tel: 02380 711 858).

#### Data processing:

The survey collects personal data (name, contact details, vessel details). You do not have to provide your name or contact details to complete the survey, but it would be helpful to allow us to follow up any queries if necessary. Your data will be held securely and in accordance with ABPmer’s privacy policy<sup>7</sup>. It will only be shared with members of the project team where necessary for the purposes of analysing survey responses. Data will be processed in line with the objectives of the survey and will not be used for any other purpose. Your personal data will not be published; survey results will be published in anonymised or aggregated form, such that the personal details are not identifiable. Any personal data collected will be destroyed at the end of the project, and only anonymised data will be passed to MMO for longer term storage.

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<sup>7</sup> <http://www.abpmer.co.uk/media/1913/abpmer-customer-privacy-notice18jun18.pdf>

## A. Fishing Details

1. Vessel Identification (PLN number)

2. Vessel length (m)

3. Home Port

4. Main fishing area(s):

- 4b / IVb (Central North Sea)
- 4c / IVc (Southern North Sea)
- 7a / VIIa (Irish Sea)
- 7d / VIId (Eastern Channel)
- 7e / VIIe (Western Channel)
- 7f / VIIf (Bristol Channel)
- 7g / VIIg (Celtic Sea)
- 7h / VIIh (Celtic Sea South / Little Sole Bank)

## 5. Gear types and seal interactions

	How frequently do you use this gear	Of the gears you use, how often do you experience problems with seals?
Static/fixed nets	<input type="text"/>	<input type="text"/>
Drift nets	<input type="text"/>	<input type="text"/>
Lines	<input type="text"/>	<input type="text"/>
Pots/traps	<input type="text"/>	<input type="text"/>
Otter trawl	<input type="text"/>	<input type="text"/>
Beam trawl	<input type="text"/>	<input type="text"/>
Other (please specify below)	<input type="text"/>	<input type="text"/>
Other gear type - description	<input type="text"/>	

\*6. If you have been fishing for ten years or more, how has the level of seal interactions changed over the past ten years, in your experience?

- Large decrease
- Small decrease
- Stable/more or less the same
- Small increase
- Large increase
- Don't know

\*7. Of the gears you use, which do you experience the biggest problem with seals? (tick one only)

You will have the option to provide details about seal interactions for two further gear types in the survey.

- Static/fixed nets
- Drift nets
- Lines
- Pots/traps
- Otter trawl
- Beam trawl
- Other
- None

## B. Experience with Seals – GEAR 1

The following questions relate to your experience of interactions between **seals and the gear type you indicated in Question 7 above**

8. Type of interaction (tick all that apply):

- Seals damaging/taking catch from the gear
- Seals damaging the gear
- Seals getting entangled in the gear

9. In which ICES rectangles do these interactions take place? Use this [ICES map](#) to help identify the correct rectangles and free type all that apply, e.g. 36F0, 29E3

10. In which months of the year do you experience interactions with seals with this gear? (tick all that apply):

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> January  | <input type="checkbox"/> August     |
| <input type="checkbox"/> February | <input type="checkbox"/> September  |
| <input type="checkbox"/> March    | <input type="checkbox"/> October    |
| <input type="checkbox"/> April    | <input type="checkbox"/> November   |
| <input type="checkbox"/> May      | <input type="checkbox"/> December   |
| <input type="checkbox"/> June     | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> July     |                                     |

\*11. In those months when interactions occur, what proportion of your hauls/sets/tows are affected?

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| <input type="radio"/> Less than 10% | <input type="radio"/> 51-75%        |
| <input type="radio"/> 11-25%        | <input type="radio"/> More than 75% |
| <input type="radio"/> 26-50%        | <input type="radio"/> Don't know    |

\*12. When seals take or damage fish, what proportion of your catch (value) is affected, on average?

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| <input type="radio"/> Less than 10% | <input type="radio"/> 51-75%        |
| <input type="radio"/> 11-25%        | <input type="radio"/> More than 75% |
| <input type="radio"/> 26-50%        | <input type="radio"/> Don't know    |

13. Which species of fish or shellfish in your catch do the seals target most?

14. Please provide details about your gear (answer only the questions for the relevant gear type identified in Question 7):

**Nets:**

Average length of net (in metres)

Number of nets set per trip

Average soak time (in hours)

Average water depth at which nets are set (in metres)

Average number of trips per month

(in those months when you experience interactions with seals)

**Lines:**

Average length of line (in metres)

Number of lines set per trip

Average soak time (in hours)

Average water depth at which lines are set (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

**Pots/traps:**

Number of pots per string

Average number of strings per trip

Average soak time (in days)

Average water depth in which pots are set (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

**Trawls:**

Average number of tows per trip

Average duration of each tow

Overall width of trawl (in metres) (i.e. if beam trawl, width of both trawls; if twin or triple rigs, sum of width of all trawls)

Average depth of tows (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

Other gear type:

**8.1.1.1 Please provide details of gear configuration (size, number of components), tow or soak time, average number of trips per month (in those months when you experience interactions with seals), and fishing depth:**

15. If you have any other comments about seal interactions with this gear type, enter them here:

\*16. Do you want to tell us about seal interactions with another gear type? (You can tell us about up to two more gear types)

Yes – please complete questions 8-15 again. Copies of the questions are available on pages 10 and 13.

No

**8.1.1.2 17. What factors do you think affect seal interactions with fisheries?**

**8.1.1.3 \*18. Do you currently do anything to reduce the level or frequency of interactions with seals (e.g. timing/location of fishing, type of gear, rigging of gear, attending gear, use of deterrent devices)?**

Yes

No

Don't know

Please give details:

**8.1.1.4 19. In the past three years, have you shot any seals using the netsman's defence (laid out in the Conservation of Seals Act 1970) in order to prevent damage to your nets and/or catch?**

Yes

No

Don't know

Please give details

**8.1.1.5 20. Do you have any thoughts on ways of reducing seal interactions?  
Please give details.**

**8.1.1.6 21. Please provide any further comments that would help to inform the  
issues in your area:**

**8.1.1.7 22. Thank you for taking the time to complete the survey.**

***If you would like us to send you further information about the project, or if you would be willing for us to follow up with you if necessary to discuss any issues in more detail over the phone (approx. 15 minutes), and/or if you might be interested in taking part in the field trials, please provide your contact details:***

Name

Email Address

Phone Number

**8.1.1.8 23. Tick all that apply**

I would like to receive further information about the project

I would be willing to discuss further on the phone

I am interested in taking part in the field trials

#### **T&C for Prize Draw for £50 Amazon voucher**

- To be eligible for the Prize Draw you must be a commercial fisherman in English waters and complete the online survey, including full contact details.
- Only one entry per person. Entries on behalf of other people will not be accepted.
- Entries to the Prize Draw close at 23:59 on 17 August 2018. Entries received after this time will not be considered.

- The winner will be chosen at random in accordance with the Terms and Conditions. The winner will be notified no later than 30 August 2018 using the contact details provided. If the winner cannot be contacted by 30 September 2018, another winner will be chosen.
- The prize is non-exchangeable, non-transferable and non-redeemable for cash or any other prizes.

## B. Experience with Seals – GEAR 2

The following questions relate to your experience of interactions between seals and the 2<sup>nd</sup> gear type you would like to provide details on.

Please specify gear type here:

8. Type of interaction (tick all that apply):

- Seals damaging/taking catch from the gear
- Seals damaging the gear
- Seals getting entangled in the gear

9. In which ICES rectangles do these interactions take place? Use this [ICES map](#) to help identify the correct rectangles and free type all that apply, e.g. 36F0, 29E3

10. In which months of the year do you experience interactions with seals with this gear? (tick all that apply):

- |                                   |                                     |
|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> January  | <input type="checkbox"/> August     |
| <input type="checkbox"/> February | <input type="checkbox"/> September  |
| <input type="checkbox"/> March    | <input type="checkbox"/> October    |
| <input type="checkbox"/> April    | <input type="checkbox"/> November   |
| <input type="checkbox"/> May      | <input type="checkbox"/> December   |
| <input type="checkbox"/> June     | <input type="checkbox"/> Don't know |
| <input type="checkbox"/> July     |                                     |

\*11. In those months when interactions occur, what proportion of your hauls/sets/tows are affected?

- |  |  |
|--|--|
| <input type="checkbox"/> Less than 10% | <input type="checkbox"/> 51-75%        |
| <input type="checkbox"/> 11-25%        | <input type="checkbox"/> More than 75% |
| <input type="checkbox"/> 26-50%        | <input type="checkbox"/> Don't know    |

\*12. When seals take or damage fish, what proportion of your catch (value) is affected, on average?

- |  |                                 |
|--|---------------------------------|
| <input type="checkbox"/> Less than 10% | <input type="checkbox"/> 26-50% |
| <input type="checkbox"/> 11-25%        | <input type="checkbox"/> 51-75% |

More than 75%

Don't know

### 13. Which species of fish or shellfish in your catch do the seals target most?

### 14. Please provide details about your gear (answer only the questions for the relevant gear type identified above):

#### Nets:

Average length of net (in metres)

Number of nets set per trip

Average soak time (in hours)

Average water depth at which nets are set (in metres)

Average number of trips per month  
(in those months when you experience interactions with seals)

#### Lines:

Average length of line (in metres)

Number of lines set per trip

Average soak time (in hours)

Average water depth at which lines are set (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

#### Pots/traps:

Number of pots per string

Average number of strings per trip

Average soak time (in days)

Average water depth in which pots are set (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

#### Trawls:

Average number of tows per trip

Average duration of each tow

Overall width of trawl (in metres) (i.e. if beam trawl, width of both trawls; if twin or triple rigs, sum of width of all trawls)

Average depth of tows (in metres)

Average number of trips per month (in those months when you experience interactions with seals)

Other gear type:

**8.1.1.9 Please provide details of gear configuration (size, number of components), tow or soak time, average number of trips per month (in those months when you experience interactions with seals), and fishing depth:**

15. If you have any other comments about seal interactions with this gear type, enter them here:

\*16. Do you want to tell us about seal interactions with another gear type? (You can tell us about one more gear types)

Yes – go to the questions for ‘GEAR 3’ on the next page

No

## B. Experience with Seals – GEAR 3

The following questions relate to your experience of interactions between seals and the 3<sup>rd</sup> gear type you would like to provide details on.

**Please specify gear type here:**

8. Type of interaction (tick all that apply):

Seals damaging/taking catch from the gear

Seals damaging the gear

Seals getting entangled in the gear

9. In which ICES rectangles do these interactions take place? Use this [ICES map](#) to help identify the correct rectangles and free type all that apply, e.g. 36F0, 29E3

10. In which months of the year do you experience interactions with seals with this gear? (tick all that apply):

- January
- February
- March
- April
- May
- June
- July

- August
- September
- October
- November
- December
- Don't know

\*11. In those months when interactions occur, what proportion of your hauls/sets/tows are affected?

- Less than 10%
- 11-25%
- 26-50%

- 51-75%
- More than 75%
- Don't know

\*12. When seals take or damage fish, what proportion of your catch (value) is affected, on average?

- Less than 10%
- 11-25%
- 26-50%
- 51-75%
- More than 75%
- Don't know



Average number of trips per month (in those months when you experience interactions with seals)

Other gear type:

**8.1.1.10** Please provide details of gear configuration (size, number of components), tow or soak time, average number of trips per month (in those months when you experience interactions with seals), and fishing depth:

15. If you have any other comments about seal interactions with this gear type, enter them here:

\*16. Do you want to tell us about seal interactions with another gear type? (You can tell us about up to two more gear types)

- Yes  
 No

## Annex D. Telephone Interview Topics

### Fishermen

Use the response to the survey to help inform the following line of questioning – depending on their responses to the survey, not all questions may be relevant.

Provide a general introduction to the study and its aims (see page 1), and inform them of data processing and recording (if relevant).

### Experience of interactions with seals

1. We would like to better understand how seals go about taking fish from fishing gears and what factors influence it (e.g. time of day, weather conditions, temperature, particular individuals or groups, visual or sound cues) [prompt]. Could you explain your experiences and observations?
2. Do you know from which breeding colony the seals come from? [If yes] Whereabouts?
3. You stated in the questionnaire that there had been XXXX change in the problem over the last 10 years? How big has the change been? Why do you think that is? Has the trend been constant or varying during that time?
4. There are some people that question whether it is seals that are taking/damaging the fish rather than other animals. How can you tell that it is seals causing the damage rather than other animals such as crabs or dogfish etc.?
5. What have been the impacts of seal damage on your business, resulting from gear damage and/or lost catch? Can you estimate the tonnage or value of any losses? Has it stopped you from using any particular gears or fishing particular areas? If so, what/where? Do you think the problem has had any significant effects on seafood supply chain businesses or support services in the area? If so, how?
6. [Only ask where indicated] You indicated that seals have been entangled in your gear. How frequently has that happened?

### Methods for reducing seal interactions

7. [If they stated that they have used methods to reduce interactions] You stated in the survey that you XXXX to reduce seal damages [refer to answers to survey where relevant, otherwise ask what methods e.g. timing/location of fishing, type of gear, rigging of gear, attending gear]. How effective have these methods been? Are there particular issues you need to take into account when using them? Have you noticed any adaptation (i.e. changes in behaviour) from seals that may have reduced the effectiveness of the measures taken?
8. [If they stated they have used a deterrent device] You indicated that you had tried XXXX deterrent device, how effective has it been? Was there a reduction in damage to your catch (ask for estimates of tonnage or value of any losses with device)? What was the purchase cost or hire cost of the device? Were there any issues or problems to be overcome in terms of installing it and using it? Have you

noticed any habituation or adaptation (i.e. changes in behaviour) from the seals that may have reduced the effectiveness of the deterrent device?

9. [If they said that they have shot seals] You stated in the survey that you have had to shoot seals before. How often (in a typical year)?
10. How much would you be prepared to pay for a device that successfully deterred seals from your gear?

### **Deterrent trials**

We are planning to trial some deterrent options in one or two fisheries. This might be either some kind of seal scarer, or modifications to fishing tactics. Do you think your fishery would be appropriate for a trial, and would you be interested in participating? Are there any logistical, safety or financial aspects/conditions that would need to be considered?

### **Regulators Interview (IFCAs, MMO)**

Provide a general introduction to the study and its aims (see page 1), and inform them of data processing and recording (if relevant).

We would like to know about any information or evidence (quantitative, qualitative or anecdotal) regarding:

1. Is there a problem with seal interactions with fisheries in your region? If so, for which gears/fleet segments is this most prevalent? Is there any data/information on the magnitude/frequency of interactions (e.g. observed or reported by fishermen) (for MMO ask about the level of interactions reported from different regions)?
2. What problems do the interactions cause (seal entanglement in specific types of fishing gears; damage to fishermen's catches; damage to fishermen's gears)? And is there any information on the frequency/prevalence (quantitative data or anecdotal) of these?
3. Have you carried out any research, or are you aware of any research in your region, into seal-fishery interactions and possible deterrents?
4. Do you know what cues seals use and factors that may influence levels of depredation (e.g. time of day, weather conditions, temperature, particular individuals or groups, visual or sound cues, particular fishing gear types, preferred prey species)?
5. Is there any information on the impacts of interactions on the fishing industry (e.g. with respect to gear damage, reported losses (volumes of catches and/or financial)?
6. Is there any information (anecdotal or otherwise) about the frequency of lethal deterrent methods used by fishermen (i.e. shooting) in your region?
7. Do fishermen in your region use any seal deterrent devices or fishing strategies to minimise seal interactions (and efficacies if known)?
8. Any new or emerging deterrents technologies that you are aware of?
9. Do you think the fishermen in your District would be interested in taking part in a trial of deterrent methods?

We would also be interested to know:

10. If there are other experts that you think may have relevant information/data that we should contact?
11. Any other comments or information that you feel is relevant to the study?

## **Academics/researchers**

Questions should be tailored to the academic/research group and their research – might be most appropriate for Jamie to progress these interviews.

Provide a general introduction to the study and its aims (see page 1), and inform them of data processing and recording (if relevant).

We would like to know about any previous, current or future planned research you have undertaken on:

1. Is there any data on the frequency or prevalence (quantitative data or anecdotal) of seal entanglement in specific types of fishing gears, in different areas?
2. Is there any data on the frequency or prevalence (quantitative data or anecdotal) of seal entanglement in specific types of fishing gears, in different areas?
3. What objective evidence is there that damage is caused by seals rather than by other marine animals such as crabs or elasmobranchs?
4. What are the predominant factors that affect seal depredation behaviour in relation to fisheries (e.g. time of day, weather conditions, temperature, particular individuals or groups, visual or sound cues, particular fishing gear types, preferred prey species)?
5. How effective are existing seal deterrent devices, and which make/model is most effective and appropriate for static net fisheries?
6. Are there any new or emerging deterrent technologies that might be appropriate for use on static nets?

We would also be interested to know:

7. If there are other experts that you think may have relevant information/data, that we should contact?
8. Any other comments or information that you feel is relevant to the study?

## **NGOs**

Questions should be tailored according to the type of NGO and their focus.

Provide a general introduction to the study and its aims (see page 1), and inform them of data processing and recording (if relevant).

We would like to know about any information or evidence (quantitative, qualitative or anecdotal) relating to:

1. Are seal-fishery interactions an issue (in the area where your NGO operates / in which areas are they the biggest issue?), and what are the main consequences?
2. Why seal-fishery interactions occur in your area (i.e. the cause of this issue);
3. How frequently interactions occur (quantitative data or anecdotal) in your area?
4. Are you aware of any research into seal deterrent options that might help reduce the level of interactions, and how effective are they?

We would also be interested to know:

5. If there are other experts that you think may have relevant information/data, that we should contact?
6. Any other comments or information that you feel is relevant to the study?

## Annex E. Workshop Materials

### E.1 Agenda

#### Workshop on Non-Lethal Seal Deterrent Options

### Agenda

ABP Head Office, 2<sup>nd</sup> Floor, 25 Bedford Street, London WC2E 9ES  
8<sup>th</sup> November 2018, 10.00–16.30

#### 9.30-10.00 – Registration and coffee

Time	Agenda item
10.00	1) Welcome and Introductions
	2) Background and Context (MMO)
	3) Setting the scene: <ul style="list-style-type: none"> <li>a. A fisherman's experience (Andrew Pascoe, fisherman) – the problem and its escalation in recent years</li> <li>b. NGO perspective (Sue Sayer, Cornwall Seal Group Research Trust)</li> </ul>
10.30	4) Key issues and visioning potential solutions
11.00	5) Summary of the project's literature and data review, and results of the online fishermen's survey (ABPmer).
11.30	COFFEE BREAK
11.45	6) Updates on seal-fishery research <ul style="list-style-type: none"> <li>a. Thea Cox (ZSL) – Seal Conservation in the Thames Estuary</li> <li>b. Dr Martha Gosch (University College Cork) – Seal diet in Ireland and interactions with fisheries</li> <li>c. Dr Thomas Goetz (SMRU) – A new reflex-based approach to non-lethal management of pinniped predation: mitigating adverse effects on target and non-target species</li> </ul>
12.45	LUNCH
13.30	7) Seal deterrents – presentations and discussion <ul style="list-style-type: none"> <li>a. Dr Jamie Oaten (ABPmer) – introduction/summary of review of deterrents</li> <li>b. Mike Forbes – Ace Aquatech</li> <li>c. Jamie Young – Gael Force</li> <li>d. Dr Thomas Goetz (SMRU) – The targeted acoustic startle technology (TAST) and its implementation by Genuswave</li> </ul>
14.30	8) Constraints and benefits of different options, considerations for at-sea trials and experimental design.
16.00	9) Conclusions
16.30	CLOSE



## E.2 Presentations on 'Setting the Scene'

### Assessing Non-Lethal Seal Deterrent Options: Chris Sweeting, MMO



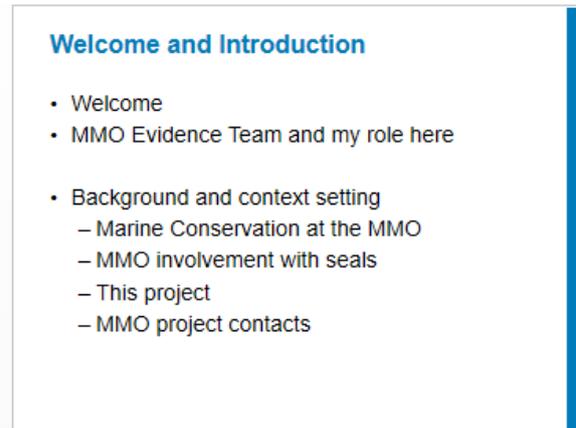
Marine Management Organisation

**Assessing Non-Lethal Seal Deterrent Options**  
MMO1131 Technical Workshop (08/11/18)

ENVIRONMENT ISO 14001 CERTIFIED  
QUALITY ISO 9001 CERTIFIED



1



**Welcome and Introduction**

- Welcome
- MMO Evidence Team and my role here
- Background and context setting
  - Marine Conservation at the MMO
  - MMO involvement with seals
  - This project
  - MMO project contacts

2

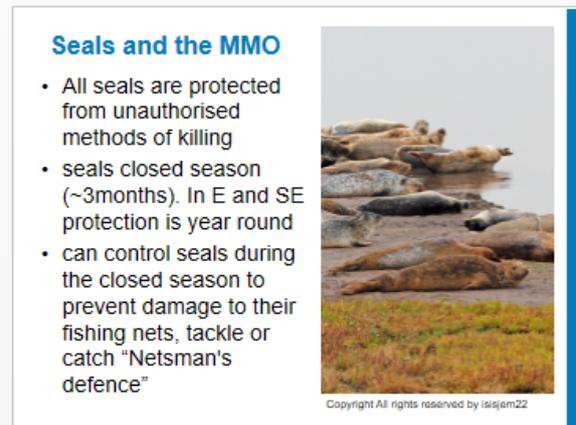


**MMO and Marine Conservation**

- MMO responsible for the management of England's marine area
- wildlife licensing and enforcement function to protect marine species and habitats
- MPA management and oil spill treatment



3



**Seals and the MMO**

- All seals are protected from unauthorised methods of killing
- seals closed season (~3months). In E and SE protection is year round
- can control seals during the closed season to prevent damage to their fishing nets, tackle or catch "Netsman's defence"



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4

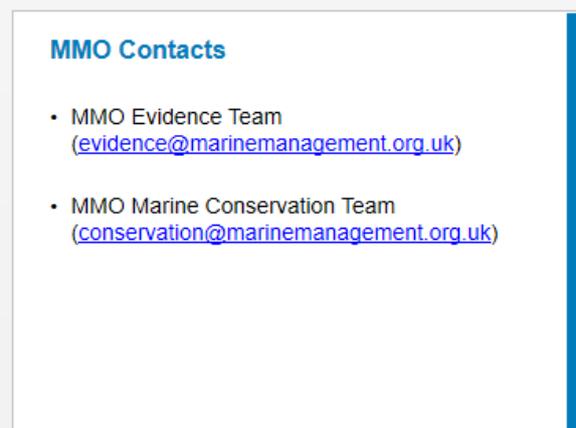


**This project**


- MMO to provide advice on interactions between seals and fishing gears
- prior to shooting, non-lethal methods should be tried and shown to be ineffective,
- effective non-lethal alternatives limited for application **from fishing vessels in open water**
- project to identify and test **non-lethal** alternatives

5



**MMO Contacts**

- MMO Evidence Team ([evidence@marinemanagement.org.uk](mailto:evidence@marinemanagement.org.uk))
- MMO Marine Conservation Team ([conservation@marinemanagement.org.uk](mailto:conservation@marinemanagement.org.uk))

6

### **Fishermen's perspective: Andrew Pascoe, CFPO**

The perspective of the fishing industry was given by an industry representative, who highlighted that in the mid-1980s it was unusual to see seals. From the late 1980s, more seals started to be seen, and monkfish started being damaged (eaten) in their fishing nets; this appeared to coincide with the rescuing and release of seals from sanctuaries. Fishermen feel that the release of rescued seals has contributed to the population increase, and that these seals have not learnt how to hunt and are therefore more likely to take fish from nets. Now around 75% of monkfish caught in nets is being eaten by seals. These fish are not landed and therefore are not accounted for in fish stock assessments. For the industry, a good first step would be to stop the rescue and release of seals.

# NGO perspective: Sue Sayer, Cornwall Seal Group Research Trust

## Oceans, ecosystems and seals





1

## Cornwall Seal Group Research Trust (CSGRT)

- An evidence based conservation charity (1162936)
- Foundation CIO – trustees
- Research: Communicate: Inspire: Engage: Conserve
  - Passionately protecting Cornwall's precious marine life
  - Identifying and monitoring local seals across the SW
  - Researching, report on and spreading the word on lessons learned
  - Putting seals on everyone's agenda and giving seals a voice in policy and planning




2

## International

International reputation and influence

- World Animal Protection (OSPAR, San Francisco and Halifax Nova Scotia)
- Global Ghost Gear Initiative (Webinar)
- Pinniped Entanglement Group (Conference calls and newsletters)
- 5 Gyres Trawfishare



3

## Our funders



4

## Third party affirmation

### Future generations

Patron Gillian Burke

Cornwall Mammal Group Award

'Certificate of recognition for the study, understanding and promotion of mammals in Cornwall'

Media coverage

My first wild seal sighting Francesco



5

## Volunteer driven

### 2017 alone

- 3945 seal records (11 every day)
- 101,017 photos
- 285 volunteers (including 45 individual systematic surveyors)
- 4 systematic team surveys
- 271 locations across Cornwall, Devon and the Isles of Scilly



6

## Our grey seals are very special!

Globally rare seal species

**WORLD:**

- IUCN Red List
- Bern Convention
- EU Habitats Directive (UK special responsibility)

**UK:** 34/38% of world's grey seals (on basis of pup production)

More red squirrels 161K (PTES) in UK and grey seals 141K (SCOS)

Protected by CSA, SACs & SSSIs (criminal offence to disturb)

Conservation of Habitats & Species Regulations (2017)



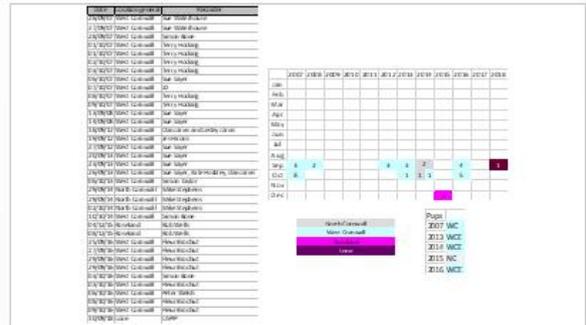
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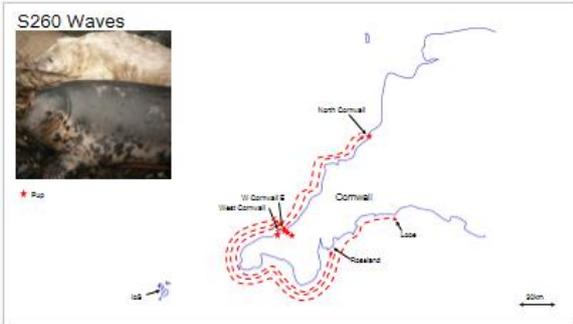
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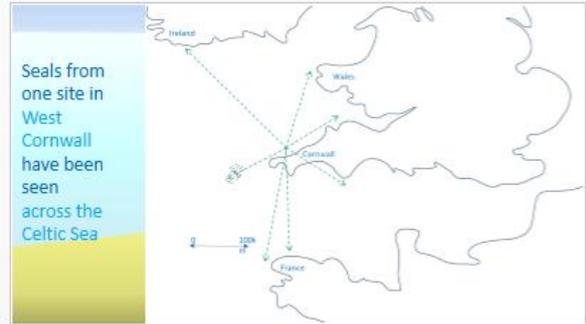
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10



11



12

### Oceans, ecosystems and seals

- Publicly owned global asset
- Relationship with sea evolved
  - Resource
  - Competition
  - Service asset
- Healthy ecosystem
  - Thriving seals
  - Thriving fish
  - Thriving fisheries
- Sentinel species

13



### Fishery/seal interactions

- Catch damage
  - Seals
  - Fish
  - Shellfish
  - Cetaceans
  - Birds (Kiely et al 2000)
- Shooting
  - Inhumane welfare issue (moving platform and target)
  - Effectiveness (analogy and predator vacuum)
  - DEFRA guidelines (last resort)
- Accidental
  - Bycatch
  - Entanglement
  - Identification and panic response

14



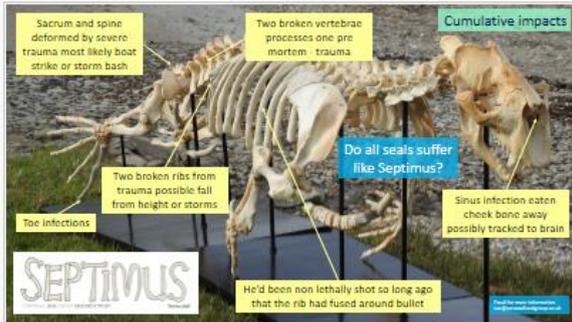
### Fisheries and other cumulative impacts

- Prey depletion
- Shooting
- Bycatch
- Entanglement
- Habitat loss
- Extreme weather
- Noise
- Recreational disturbance
- Marine pollution
  - Chemical
  - Rubbish
- Microplastics

15



16



17



## Our shared solutions focussed future

- Working relationship
  - 'No blame' culture
  - Confidential trust
- Share information to build up knowledge
  - CSGRT sessions on seal behaviour
  - Fisher reporting of bycatch; entanglement
- Collaborate on effective solution design
  - Statutory agencies
  - NGOs
  - Fishers
  - Seal scientists and
  - Creative entrepreneurs
- Benefits for fishers - to avoid:
  - economic losses
  - questions over sustainability
  - risking premium pricing of ethically sourced fish and
  - the PR nightmare of shooting seals



18

## Outcomes of future research

- Quantifying what; where; when and how (both ways)
- Economics: Lost income balanced against
  - Landings takings
  - Wildlife jobs and companies' income
  - Tourist income generation
  - Health and wellbeing benefits
- Best practice guides to minimise impacts
  - Fisheries on seals
  - Seals on fisheries



19



Globally rare  
UK special responsibility species

**Thank you!**

For listening!

Conservation  
**SEAL**  
Research  
Trust





20

## E.3 Presentations Summarising the Project's Work to Date

### Summary of the project's literature and data review: Dr Jamie Oaten, ABPmer

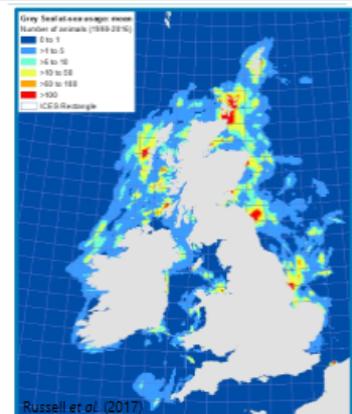
Literature and Data Review

Dr Jamie Oaten, ABPmer



10

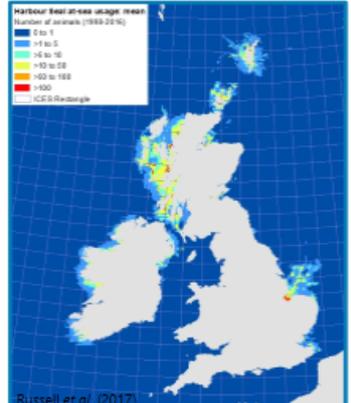
Seal populations



- Grey seal colonies concentrated on north and east coasts and the south west
  - Farne Islands
  - Donna Nook and on the Norfolk coast including the Wash
  - Isles of Scilly and Lundy
- UK population ~139,800 in 2015 (SCOS, 2017)

11

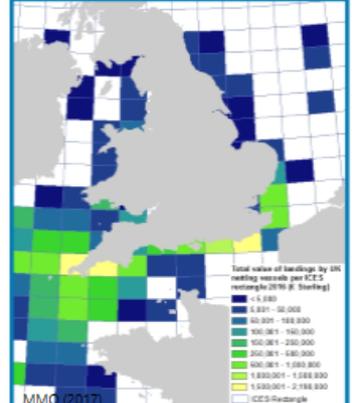
Seal populations



- Harbour seal colonies concentrated around the Wash and Thames
- UK population ~43,500 in 2016 (SCOS, 2017)
- Unlikely to be primary species involved in seal-fishery interactions (Cosgrove *et al.*, 2013)

12

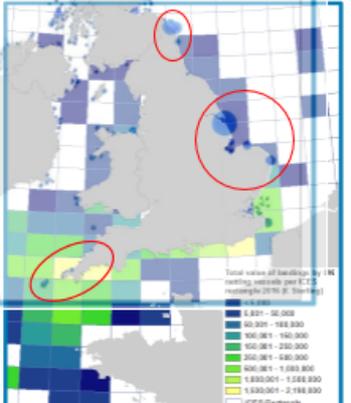
Net fisheries



- High value net fisheries:
  - North and south of Cornwall
  - South coast of Devon
  - West and east Sussex
  - Greater Thames Estuary and Suffolk

13

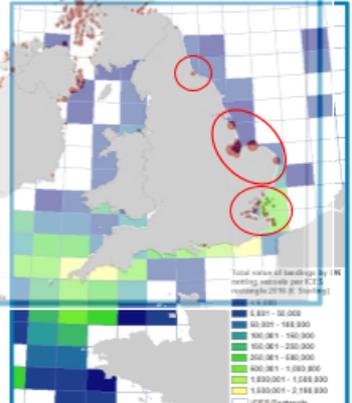
Seal-fishery overlap



- Grey seals:
  - the north east – specifically around Alnmouth;
  - the east coast – around Great Yarmouth/ Lowestoft and Southwold;
  - the south west – particularly the Isles of Scilly, Lands End and north Cornwall coast.

14

Seal-fishery overlap



- Harbour seals:
  - the north-east – specifically off Tynemouth;
  - the east coast – around Great Yarmouth/ Lowestoft;
  - the south-east – around Felixstowe and Sheerness, the Greater Thames Estuary, to Dover.

15

### Seal feeding behaviour

Important foraging mechanisms:

- **Visual cues** evidenced by seals having eyes primarily suited to vision in water rather than air (Schusterman *et al.*, 2000);
- Use **vibrissae (whiskers)** to detect vibrations from hydrodynamic trails/wakes (Murphy *et al.*, 2017);
- **Passive acoustics** listening for prey species that may be swimming, struggling or foraging (Myrberg, 1981).



16

### Seal feeding behaviour

Important foraging mechanisms:

- **Visual cues** evidenced by seals having eyes primarily suited to vision in water rather than air (Schusterman *et al.*, 2000);
- Use **vibrissae (whiskers)** to detect vibrations from hydrodynamic trails/wakes (Murphy *et al.*, 2017);
- **Passive acoustics** listening for prey species that may be swimming, struggling or foraging (Myrberg, 1981).



17

★

### Seal feeding behaviour

- Net-foraging behaviour appears a learnt behaviour and 'specialised' seals repeatedly return to depredate from nets
  - (Scottish Salmon Growers Association, 1990; Morris *et al.*, 1996; Graham *et al.*, 2011; Cronin *et al.*, 2016).



Königson (2011); Königson *et al.* (2013)



18

★

### Factors that affect depredateion

- Investigated by Cosgrove *et al.* (2013):
  - Soak time;
  - Depth;
  - Hauling and haul speeds;
  - Fishing activity (haul sequence and amount of gear deployed) and noise;
  - Location;
  - Season;
  - Day/night deployment;
  - Net type.



19

★

### Possible solutions?

- Non-lethal deterrents
  - Acoustic deterrent devices (ADDs)?
  - Electrified netting?
  - Visual deterrents?
- Avoidance measures
  - Fishing tactics?
  - Alternative gear types?



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# Results of the online fishermen's survey: Suzannah Walmsley, ABPmer

## Results of the Fishermen's Survey

Suzannah Walmsley, ABPmer

22

## Online survey

- Survey Monkey
- 17 July – 17 August 2018
- 92 responses
  - North Sea and Eastern Channel: 43
  - Irish Sea: 11
  - Western Channel, Bristol Channel, Celtic Sea: 26
  - Not specified: 12
- Predominantly from under-10m vessels

Number of respondents that fish in each area

23

## Fishermen report greatest problems with static nets

### Gears for which respondents reported the greatest problems with seals

Gear	Number of respondents
Static nets	50
Drift nets	12
Lines	8
Pots/traps	10
Other trawl	5
Beam trawl	1
Other	1

24

## Fishermen perceive a large increase in the level of interactions with seals

### Fishermen's opinions on trends in the level of seal interactions over the last ten years (sample size=90)

Trend	Number of respondents
Large decrease	5
Small decrease	2
Stable/more or less the same	3
Small increase	3
Large increase	70
Don't know	1

25

## Areas

### ICES rectangles where interactions with seals are reported to be a problem by fishermen (all gears).

- Areas mostly close to the coast
  - Northumberland
  - Humber-side
  - East Anglia/Thames Estuary
  - South West
- Areas further offshore in SW reflect activity of larger vessels that responded

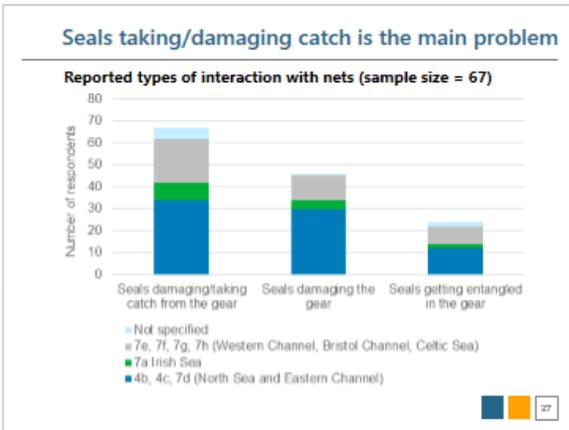
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## Interactions occur throughout the year

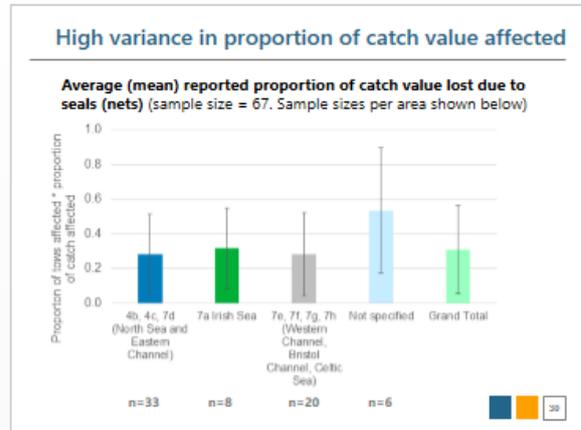
### Months in which interactions occur (all gears, all areas)

Month	Number of respondents
January	60
February	60
March	65
April	75
May	80
June	80
July	80
August	80
September	75
October	70
November	70
December	60

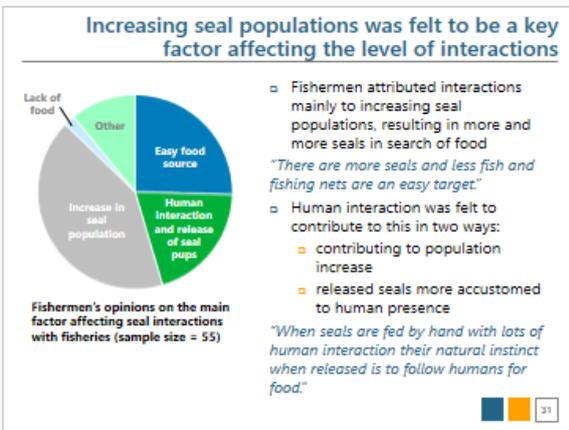
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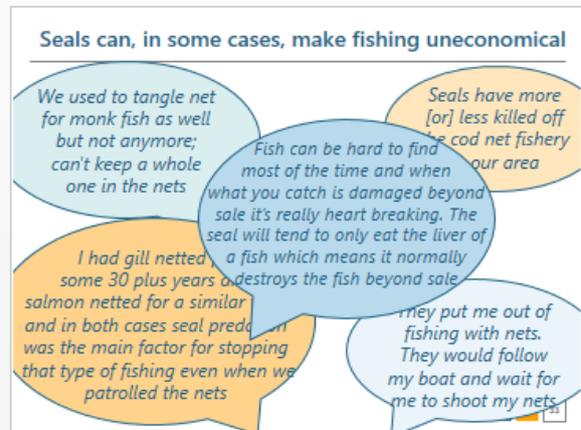
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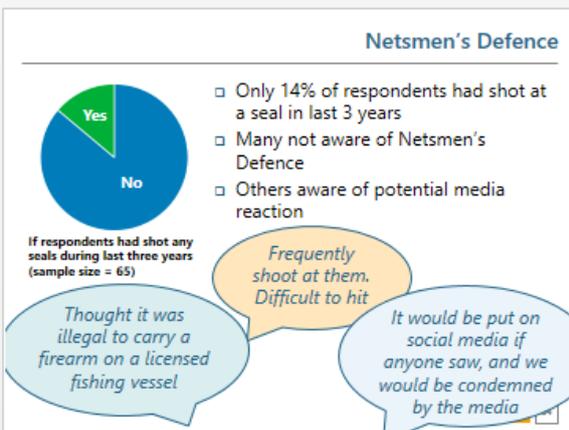
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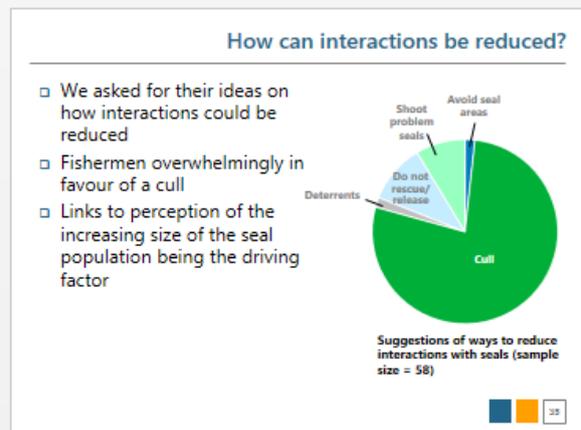
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33

### A few options...

- Options suggested, or already used included:
  - reducing soak times
  - moving to a different area
  - attending gear
  - reducing noises that may attract seals (depth sounder)
  - adjusting rigging (for pots)



## E.4 Presentations on Updates on Seal-Fishery Research

### Seal Conservation in the Thames Estuary: Thea Cox, ZSL

**Seal conservation in the Greater Thames Estuary**  
Research, citizen science & stakeholder engagement

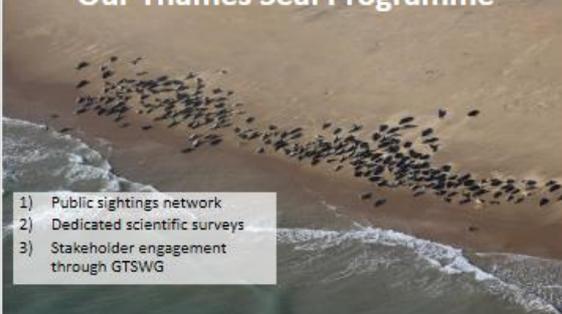


© Russ Miles

Thea Cox: Estuaries and Wetlands Conservation Biologist  
thea.cox@zsl.org @ZSLMarine / #inthethames

1

**Our Thames Seal Programme**



- 1) Public sightings network
- 2) Dedicated scientific surveys
- 3) Stakeholder engagement through GTSWG

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2

**Public Sighting network** zsl.org/inthethames



Over 2,300 sightings since it began in 2004, with more than 388 seals so far this year

3

**Seal Surveys**

- Population survey during harbour seal moult (August)
- Breeding survey late June/early July
- 3 x aerial, 1 x boat transect, 1 x land
- 2 hours either side of low tide



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4

**Comparison of seal survey results**

	2013	2014	2015	2016	2017
Harbour Seal Count	482	489	451	694	795
Harbour Seal Population Estimate*	669 (548-893)	679 (556-906)	626 (513-835)	964 (789-1285)	1104 (903-1472)
Grey Seal Count	203	449	454	481	575
Grey Seal Population Estimate**	849 (710-1057)	1879 (1570-2339)	1900 (1587-2365)	2013 (1682-2505)	2406 (2010-2995)

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**Harbour and grey seal haul out locations 2017**



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6



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### Greater Thames Seal Working Group

- Established in 2013
- Aim: to ensure informed management of seal populations in Greater Thames Estuary (GTE)
- Representative of wide range of stakeholders in the GTE
- Facilitates dialogue and information sharing
- Working towards Greater Thames Seal Action Plan

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9

### Quantifying seal-fisher interactions in Thames estuary

- How and why?**
  - Questionnaires and interviews
  - Map extent of interactions, gear types, species affected, etc.
  - Baseline data
- Headline results**
  - Only 18 questionnaires returned
  - 100% participants state that seals have an impact on fishing
  - High instances of depredation for white fish (bass, cod)
  - Perception as highly intelligent animals

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10



### Next steps:

- Fundraising for 2019 seal population survey
- 2019 Greater Thames Seal Working Group meeting – end of 5 year action plan, update and draft new edition
- Seal-fisher interactions – what to do next in the Thames?

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11

### Any Questions?

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12

# Seal diet in Ireland and interactions with fisheries: Dr Martha Gosch, University College Cork

## Seal diet in Ireland and interactions with fisheries

Dr Martha Gosch  
Postdoctoral Researcher (FishKOSM)  
m.gosch@ucc.ie

MaREI  
Marine Renewable Energy Ireland

SFI  
Science Foundation Ireland For what's next

1

## Research in the MaREI Centre

MaREI  
Marine Renewable Energy Ireland

Ocean Renewable Energy Technologies

Marine Governance  
Climate Change & Adaptation  
Earth Observation & GIS Application

Marine Ecology  
Jellyfish  
Seabirds  
Dolphins  
Whales  
Seals

Email: [marei@ucc.ie](mailto:marei@ucc.ie)  
Twitter: @MaREIcentre

2

★

## Seal-fishery interactions in Ireland

- Overall numbers of both seal species on the rise
- Reported increase in seal-fisheries interactions
- Frequent calls to introduce a cull

3

★

## Operational interactions

- Federation of Irish Fishermen reported rates of 20-30%
- Bottom-set gillnets and entangling net fisheries
- Interactions year round – highest during spring (Crumin *et al.* 2014)
- Approximately 59% across monkfish fisheries (Cosgrove *et al.* 2013)

Crumin M, Cosgrove M, Hinch D, and Reid P. (2014) Policy and implementation in Irish waters: Current gear-related seal losses and possible prevention. *Ocean Policy*, 44, 499-511. <https://doi.org/10.1016/j.oceanpol.2014.02.010>

4

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## Spatial overlap

Crumin, M., O'Leary, H., Reid, P. and Cosgrove, M. (2016) Spatial overlap of grey seals and fisheries in Irish waters, using new techniques using telemetry technology and VMS. *ICES J. Mar. Sci.*, in press.

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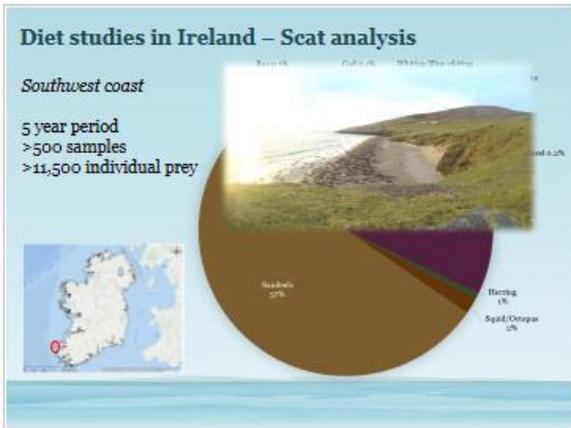
## Diet studies in Ireland – Scat analysis

Southwest coast  
5 year period  
>500 samples  
>11,500 individual prey

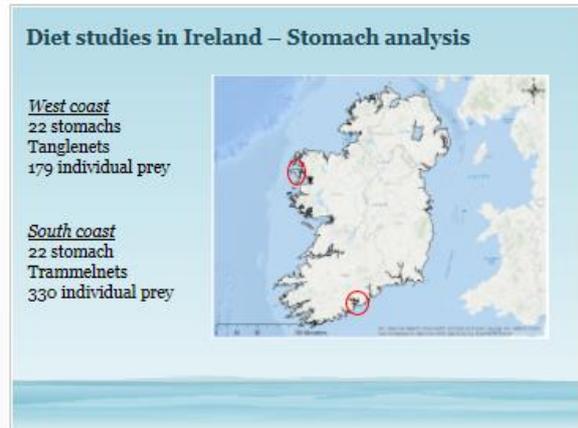
Prey Item	Percentage
Headfish	27%
Trout/Salmon	15%
Herring	8%
Spotted Octopus	2%
Monkfish	0.2%
Flatfish	6%
Hake	0.2%
Lang	1%
Whiting/Blue whiting	0%
Haddock/Pollock/Seahe	1%
Cod	0.2%
Ray	0.1%

6

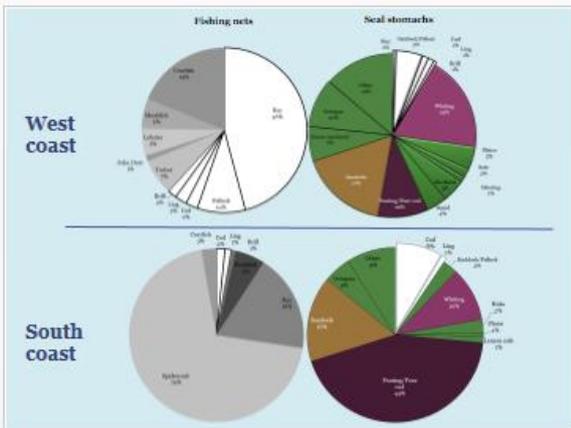
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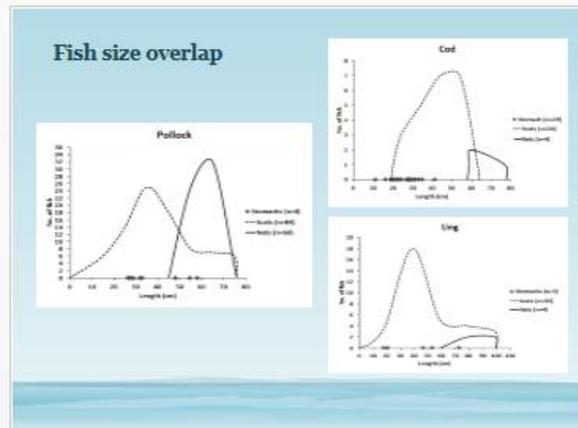
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### Potential solutions: previous experiments using the startle technology

**Scotland**  
Fish farms: target specific deterrents of seals (Gitz & Jamil, 2015)  
94% to 97% reduction in predation (Gitz & Jamil, 2016).

**California**  
Bait docks: Sea lions move away from dock during playback (Schukner et al. 2017)

Party boat fisheries: 83% reduction in sea lion bait foraging during the startle pulse treatment (Schukner et al. 2017)

GITZ, T. and JAMIL, V.M., 2015. Target specific acoustic predator deterrence in the marine environment. *Animal Conservation*, 18(1), pp. 104-111.  
GITZ, T. and JAMIL, V.M., 2016. Seal-fish management of salmonine production longlines using an acoustic pulse-based deterrent with a fish-bait. *Animal Conservation*, 19(2), pp. 112-120.  
Schukner, S.A., Gitz, T., Jamil, V.M. and Hildebrand, D.T., 2017. Can free-roaming, wild California sea lions learn from fishing activities? *Animal Conservation*, 19(2), pp. 407-420.

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## Seal-fisheries mitigation

- Harnesses mammalian acoustic startle reflex
- Sensitization of avoidance responses, interruption of foraging behavior and flight responses (Götz & Janik 2011)
- Low duty cycle (i.e. time during which sound is emitted)
- Low frequency pulses
- Minimum impact on odontocetes (Götz & Janik, 2015, 2016)



Götz, T. and Janik, V.M., 2011. Response of dolphins of the acoustic startle reflex leads to modifications in subsequent position behaviour and behavior bias conditioning. BMC neuroscience, 12(1), p.36.

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## Sea trials

	Jigger	Gillnetter
Start/End date	June 2016 - October 2016	August 2016 - April 2017
No. of vessels	2	1
No. days effort	10	4 trips (19 days)



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## Jigging fishery

- Two vessels; "Treatment" and "Control"
- Targeting pollock at shallow depths up to 90m
- Loudspeakers on opposite side to jiggers
- Different playback files used in consecutive drifts
- Signal deployment alternated on/off over consecutive days



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## Gillnet fishery

- 1 offshore vessel
- Targeting hake at deep depths up to 232m
- Each set approximately 4km long
- Loudspeakers on opposite side of hauler
- Signal deployment alternated on/off over consecutive hauls



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## Seal observations



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## Other marine mammal observations



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### Jigger – Analysis

Playback	Total fish	Mean (± se) fish per drift	Total fish depredated	% total fish depredated	Mean (± se) fish depredated per drift
On	902	9.49 (± 1.20)	0	0.00	0.00 (± 0.00)
Off	1712	12.14 (± 1.62)	12	0.70	0.09 (± 0.04)

**Fisher's exact test – 2x2 contingency table**

Playback	Drifts depredated	Drifts not depredated
On	0	86
Off	7	128

• P = 0.0442 two-tailed test...Significant reduction

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### Gillnetter - Analysis

- Negative binomial generalized linear model (GLM)
- Model selection

Response variable	Explanatory variable	Offset
No. depredated fish	No. fish caught Distance to Elasket Islands Playback (+ Depth)	Effort (km net + soak time)

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### Gillnetter - Results

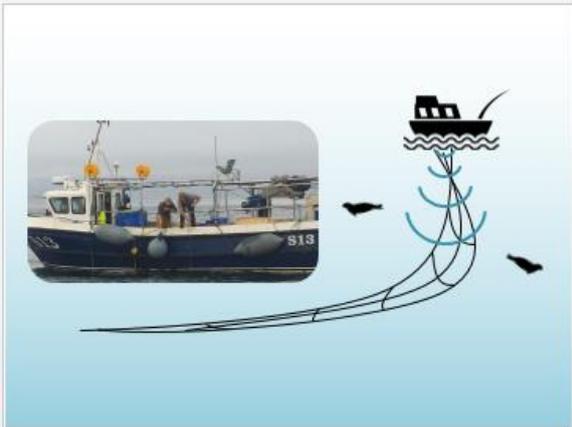
Drivers of depredation Model without interaction term	Drivers of depredation Model with interaction term
No. fish caught ↑ Distance Elasket Islands ↓ Playback ↓	No. fish caught ↑ Distance to Elasket Islands ↓ Playback + Depth ↓ -> Playback more efficient in reducing predation in shallow water

Only significant variables (p < 0.05) are shown.

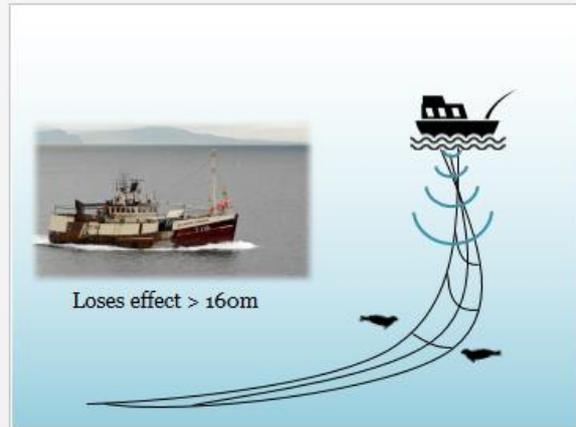
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## Total fish catches

- Jigger & Gillnetter
- Startle pulses had no significant effect on overall catch



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## Conclusions

- Startle-eliciting noise pulses have potential to reduce depredation
- Small sample sizes – results are preliminary with associated uncertainties



- No adverse effects on catch
- No discernable impact on other marine mammals
- Jigging fishery – pulses appear to deter seals
- Gillnetting fishery – pulses appears to reduce depredation in **shallow waters**

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## Future work

- Jigging fishery preliminary results encouraging – further trials necessary
- Deep set-net fisheries – Where, When, Why depredation occurs?
- Device modifications for extended deterrence ranges have partly been implemented
- Independent at sea deployment (multiple units)
- Study has highlighted potential.
- Continued experimentation required



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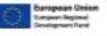
### Thank you

We would like to thank the designers and crew of the vessels participating in the study, John O'Leary (owner of Jigging vessels), Brendan Johnson, Gordon O'Leary, Michael Keenan, Aislinn Flanagan, Marie Healy, Tara Kennedy (owner of set-net vessels), and John O'Leary (jigger). The work was funded by Food Catcher (MaREI).

Web: [www.marei.ie](http://www.marei.ie)  
Twitter: @MaREI\_Centre  
Facebook: MaREI\_Centre

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**A new reflex-based approach to non-lethal management of pinniped predation — mitigating adverse effects on target and non-target species: Dr Thomas Goetz, SMRU**

Readers are referred to the following papers which provide relevant information:

- Götz, T. and Janik, V.M. 2010. Aversiveness of sounds in phocid seals: psycho-physiological factors, learning processes and motivation. *The Journal of Experimental Biology* 213: 1536–1548.
- Götz, T. and Janik, V.M. 2011. Repeated elicitation of the acoustic startle reflex leads to sensitisation in subsequent avoidance behaviour and induces fear conditioning. *BMC Neuroscience* 12:30.  
<http://www.biomedcentral.com/1471-2202/12/30> (13 April 2011).
- Götz, T. and Janik, V.M. 2013. Acoustic deterrent devices to prevent pinniped depredation: efficiency, conservation concerns and possible solutions. *Marine Ecology Progress Series* 492: 285–302.
- Götz, T. and Janik, V.M. 2015. Target-specific acoustic predator deterrence in the marine environment. *Animal Conservation* 18: 102–111.
- Götz, T. and Janik, V.M. 2016. Non-lethal management of carnivore predation: long-term tests with a startle reflex-based deterrence system on a fish farm. *Animal Conservation* 19: 212–221.

Copies of the papers can be requested from Thomas Götz (tg45@st-andrews.ac.uk).

## E.5 Presentations on Seal Deterrents

### Introduction/summary of review of deterrents: Dr Jamie Oaten, ABPmer

### Overview of Non-Lethal Options

Dr Jamie Oaten, ABPmer



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### Non-lethal deterrents

- Aversive stimuli to prevent animals using human resources
  - Stimuli are required to be aversive, harmful, fearful, or noxious, eliciting a defensive response (Götz and Janik, 2010)
- Acoustic Deterrent Devices (ADDs)
- Electrified netting
- Visual and olfactory deterrents

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### ADDs

Manufacturer	Model	Source Level (deciBel (dB) re 1 micropascal (µPa) m)	Frequency (kilohertz (kHz))	Pulse durations (millisecond (ms))	Duty cycle
Airmar	601 Plus 8	182 (root mean square) at 10.3kHz	10 (tonal - with harmonics)	1.4ms at 40ms intervals	50% to almost continuous during typical operation with >1 transducer
Loftech	Universal Scanner	182 (root mean square) at 14.9kHz	14 (tonal - with harmonics)	~500ms over variable length blocks	10 to 25%
Ace Aquatics	Universal Scrammer 3	193 (root mean square) at 10kHz	10 - 60 (broadband)	3.3 to 14ms with 33.2 to 48.5ms intervals	50%
Tereos Ltd	USMS-4	178 (root mean square) at 4.9kHz	2 - 70 (broadband)	Variable (~8ms to 8 or 10ms sequences)	Variable
Fernald-Thomson	4X	200 (unspecified) at 28kHz	7 - 95 (broadband)	20ms repeated every 40ms	3% max.
Geacoseaw	SeismicSafe™	180 (root mean square) at 18kHz	1 (central band)	200ms	0.8 to 1%

Adapted from Götz and Janik (2013, 2015, 2016); Coram et al. (2014); Sparling et al. (2015) (and references cited therein)

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### ADD effectiveness

- Some studies report effective use of ADDs
  - Increased catches over three years (Fjälling et al., 2006)
  - Reduced seal movements upstream by approximately 50% (Graham et al., 2009)
  - Prevented seals feeding within 50m radius of foraging site (Yurk and Trites, 2000)
- Some studies report ineffective use of ADDs
  - Seals moved past ADD to reach a well-known seal foraging site (Olesiuk et al., 1996)
  - Did not significantly affect seal abundance in area - limited effective range of the ADD due to the shallow depths and constrained nature of a river environment (Graham et al., 2009)

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### ADD issues

- Habituation
  - Reduced effectiveness over time (Jacobs and Terhune, 2002; Mate and Harvey, 1987)
  - Deafness and swimming with head above water (Götz and Janik, 2013; Harris et al., 2014; Gosch et al., 2017)
  - 'Dinner bell effect'
- Hearing damage
  - Sensitive marine mammals may be very vulnerable (Götz and Janik, 2013; Lucke et al., 2009)
  - Weak hearing loss in seals could affect population levels
- Habitat exclusion
  - Reduced detections of marine mammals in vicinity of ADDs (Northridge et al., 2010; Johnston 2002; Morton and Symonds, 2002; Mikkelsen et al., 2017)

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### Other non-lethal deterrents

- Electrified netting
  - Limited empirical evidence of effectiveness
  - Freshwater study showed deterrence of seal (Forrest et al., 2009)
  - Preliminary trials in seawater show some promise (Milne et al., 2012)
- Visual and olfactory deterrents
  - No modern studies
  - Past studies showed habituation and little promise

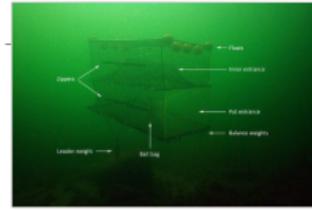
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### Avoidance measures

- Gear modifications and alternative gear types
  - Barrier nets (Sepúlveda and Oliva, 2005; Lehtonen and Suuronen, 2004)
    - Practicality problems for net fisheries (Northridge *et al.*, 2013)
  - Pots or fish traps as an alternative
    - Norway cod (Bjordal and Furevik, 1988; Furevik and Løkkeborg, 1994; Westerberg, 2010)
    - Irish crawfish (Cosgrove *et al.*, 2013)
    - BUT requires evidence of effectiveness AND requires significant reinvestment (Cosgrove *et al.*, 2013)



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### Avoidance measures

- Gear modifications and alternative gear types
  - Barrier nets (Sepúlveda and Oliva, 2005; Lehtonen and Suuronen, 2004)
    - Practicality problems for net fisheries (Northridge *et al.*, 2013)
  - Pots or fish traps as an alternative
    - Norway cod (Bjordal and Furevik, 1988; Furevik and Løkkeborg, 1994; Westerberg, 2010)
    - Irish crawfish (Cosgrove *et al.*, 2013)
    - BUT requires evidence of effectiveness AND requires significant reinvestment (Cosgrove *et al.*, 2013)



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### Avoidance measures

- Fishing tactics (derived from Cosgrove *et al.*, 2013)
  - Faster hauling speeds
  - Reduce soak times
  - Night setting



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### Implementation of possible solutions for static nets

Disturbance or fishing tactic	Pros	Cons
<b> vessel deployed ADC nets:</b>		
Vessel deployed ADC	<ul style="list-style-type: none"> <li>Practical implementation in terms of power supply</li> <li>Low frequency, short rise times, low duty cycles may help limit harmful effects to seals and non-target species</li> <li>Early evidence suggests good effectiveness</li> </ul>	<ul style="list-style-type: none"> <li>May only be effective at reducing seal-depensation during hauling – will not be effective if seal depensation is taking place whilst nets are set</li> <li>Relatively high initial costs compared to fishing tactics</li> </ul>
Multiple net-deployed ADCs	<ul style="list-style-type: none"> <li>May increase effective range of ADCs along sections of net</li> <li>May reduce the effect of soak time and depth on seal depensation</li> <li>Early evidence suggests good effectiveness</li> <li>Low frequency, short rise times, low duty cycles may help limit harmful effects to seals and non-target species</li> </ul>	<ul style="list-style-type: none"> <li>Expensive</li> <li>Difficulties in fixing multiple devices to net</li> <li>Modification/development of ADCs required to be sustainable and have reliable, small power sources</li> </ul>
Faster haul speeds	<ul style="list-style-type: none"> <li>Evidence suggests may be effective for deeper-net nets that are beyond the diving range of seals whilst set</li> <li>Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>May be difficult to implement on small vessels</li> </ul>
Shorter soak times	<ul style="list-style-type: none"> <li>Ease of implementation</li> <li>Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>May limit catch potential</li> </ul>
Night setting	<ul style="list-style-type: none"> <li>Ease of implementation</li> <li>Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>Little evidence of reduced depensation – likely to be site specific</li> <li>May be impractical for fishermen or have safety issues to consider</li> </ul>



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# Ace Aquatech deterrents: Mike Forbes, Ace Aquatech

<p>Rethinking technology to drive forward <b>sustainable farming</b>.</p> <p>ACE AQUATEC</p> <p>Mike Forbes Food of Gates &amp; Marketing Innovation &amp; Research Centre</p>	<p>Rethinking technology to drive forward <b>sustainable farming</b>.</p> <p>ACE AQUATEC</p> <p>Scottish Sea Farms   Cooke   New Zealand King Salmon   marineharvest   Grieg   SARGOS   NIBELS   Loch Duart</p>
<p>1</p> <p>2</p> <p>Awards</p> <p>WINNER OF INNOVATION AWARD 2016 Aquaculture UK</p> <p>WINNER OF INNOVATION AWARD 2017</p> <p>Partners</p> <p>NEPTUNE SONAR</p> <p>University of St Andrews</p> <p>UNIVERSITY OF STIRLING</p> <p>University of BRISTOL</p> <p>Sea Mammal Research Unit</p>	<p>Predators are clever and determined. <b>So are we.</b></p> <p>ACE AQUATEC</p>
<p>3</p> <p>4</p> <p>Acoustic deterrents</p> <ol style="list-style-type: none"> <li>1 Acoustic Deterrents</li> <li>2 Remote Monitoring</li> <li>3 Electric Net</li> <li>4 Electric Fish</li> <li>5 Sonar Triggers</li> </ol>	<p>1 Acoustic Deterrents US3</p> <ul style="list-style-type: none"> <li>• Mid frequency deterrent (10-20kHz)</li> <li>• 195dB volume</li> <li>• Randomised sound patterns designed to avoid habituation</li> </ul>
<p>5</p>	<p>6</p>

## 1 Acoustic Deterrents RT1

- Low frequency deterrent (1-2kHz)
- Outside the sensitive hearing range of porpoises
- 195dB volume
- Randomised sound patterns designed to avoid habituation



## Sound designed to avoid habituation



Wide frequency range, complex tone bursts

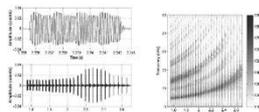


Fig. 1. White Sturgeon ACE 195 dB SPL. Upper panel: single tone burst (200-300 Hz); lower panel: sequence of complex tone bursts.

## Competing deterrents

Narrow frequency range, single tone bursts

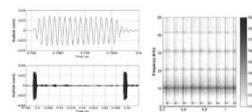
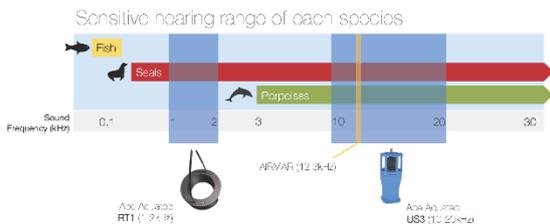


Fig. 2. ADDEAL deterrent. Upper panel: 10 Hz single tone burst; lower panel: sequence of tone bursts.

Data source: Lepper et al (2004)

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## Hitting the right hearing thresholds



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## New sound patterns



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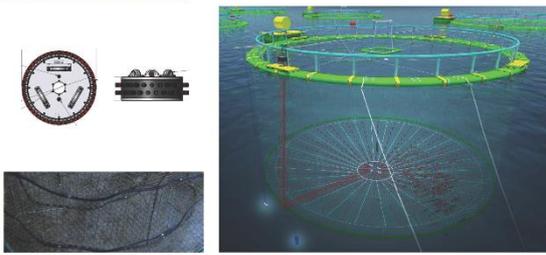
## 2 Remote Monitoring

ID	Software	Status	Name	Mode	ScreenRate	TimeCycling	Active/Power	Screens	FallScreens	Remove
102	T-4.05 T-3903 P-4802	STARTING OK	CHIEF 1	Screening	24	PerScreen	11	11	104	11
103	T-4.05 T-3903 P-3801	STARTING OK	CHIEF 2	Screening	24	PerScreen	11	11	103	11
104	T-4.06 T-3902 P-3801	DISCONNECTED	BATTERY PAIR	CHIEF 3	Screening	48	PerScreen	11	104	11
105	T-4.05 T-3904 P-3802	STARTING OK	CHIEF 4	Screening	24	PerScreen	11	11	102	11

11

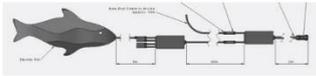
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## 3 Electric Net

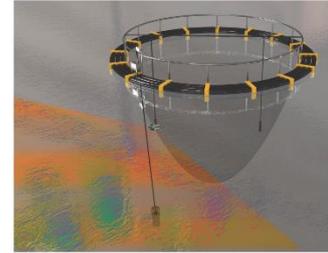


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4 Electric Fish



5 Sonar Triggers

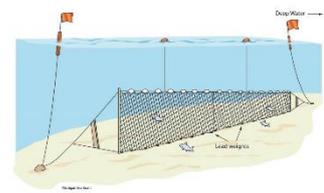
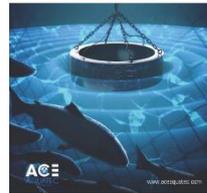


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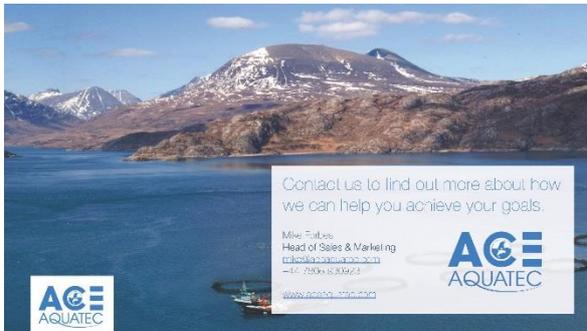


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Partnering with capture fisheries



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17

# Gael Force deterrents: Jamie Young, Gael Force Group



### Workshop on Non-Lethal Seal Deterrent Options





### THEN AND NOW

- Began in 1983 as a one-man start-up in Stornoway, repairing and manufacturing fishing creels for fishermen on the Island.
- 35 years later, the Group is involved in supplying 4 key markets, employing 200 people across the UK and targeting a turnover of £35m in 2018, and £50m by end of 2021.



### MARKETS

- Commercial Fishing & Marine
- Aquaculture
- Marinas & Pontoons
- Leisure Marine



### Quality

Gael Force Group is committed to consistently meeting or exceeding our customers' requirements for products and services, and is pledged to continuous improvement.




**Really Why we are here:-**

To understand the Interactions between seals and fishing gear taking place around the English coast, and particularly in the south-west, north-east and east, that can lead to significant economic costs from loss of or damage to catches, increased gear handling or gear damage.

AND WHAT WE CAN DO ABOUT IT.



**The Problem ...  
(Ok Maybe Not!)**



**The solution ...  
(or at least a solution, more socially acceptable!!)**



- Proven 10khz output projectors
- Simple and reliable system design
- Projector status monitoring
- Cetaceans friendly
- COST EFFECTIVE!!



**Mackerel Fisherman - Moray Firth**

"During the summer I used the 2 channel unit which was fitted in the bow locker. 24 V DC Power was supplied via a 12/24 volt power supply. Vittron Energy Orion Tr 12/24V 120W purchased .

The unit was used solely whilst mackerel fishing using 2 x DNG electric jiggling reels with 30 hook traces about 9 meters long, fishing sikes placed in depths from 10 to around 25 meters with out occasion of 40 meters.

During the 2017 summer mackerel season we experienced numerous incidents with seals getting caught in the line whilst trying to get the mackerel from the hooks, we also noted that the presence of the seals around the boat scattered the mackerel and affected the fishing. Basically we had to move and find the mackerel again, catching as much as possible before the seals again turned up."



We would be delighted to discuss further with anyone more details and ways we can support the industry

Thank you.



## **The targeted acoustic startle technology (TAST) and its implementation by Genuswave: Dr Thomas Goetz, SMRU**

Readers are referred to the following papers which provide relevant information:

- Götz, T. and Janik, V.M. 2010. Aversiveness of sounds in phocid seals: psycho-physiological factors, learning processes and motivation. *The Journal of Experimental Biology* 213: 1536–1548.
- Götz, T. and Janik, V.M. 2011. Repeated elicitation of the acoustic startle reflex leads to sensitisation in subsequent avoidance behaviour and induces fear conditioning. *BMC Neuroscience* 12:30.  
<http://www.biomedcentral.com/1471-2202/12/30> (13 April 2011).
- Götz, T. and Janik, V.M. 2013. Acoustic deterrent devices to prevent pinniped depredation: efficiency, conservation concerns and possible solutions. *Marine Ecology Progress Series* 492: 285–302.
- Götz, T. and Janik, V.M. 2015. Target-specific acoustic predator deterrence in the marine environment. *Animal Conservation* 18: 102–111.
- Götz, T. and Janik, V.M. 2016. Non-lethal management of carnivore predation: long-term tests with a startle reflex-based deterrence system on a fish farm. *Animal Conservation* 19: 212–221.

Copies of the papers can be requested from Thomas Götz ([tg45@st-andrews.ac.uk](mailto:tg45@st-andrews.ac.uk)).

## E.7 Group Work

### Break-out session 1

- What are the main issues/problems for you in relation to seal/fishery interactions?
- What would your ideal solution look like – What things do you consider essential in the solution, and what would be undesirable?

### Fishing group

#### Problems:

- Seal predation causing stock loss – balance of nature (on the stock as a whole);
- Economic loss
  - Loss of catch – wasted catch, seals behave like a 'fox in the hen house', just consuming part of the fish, not the whole thing
  - Damage to fishing gear
- Feeling that population is increasing, distribution becoming wider
  - There are more interactions with seals (being caught), but as a percentage of the population, this might be declining; what level is acceptable?
  - Carrying capacity / density dependence
- Larger vessels changing fishing areas, but inshore fleet cannot necessarily do this
- Learned behaviour from human interaction – seals no longer see humans as a threat; and group behaviour (learning from each other)
- Lack of action from regulators

#### Solutions:

- Manage the release of rescued seals
- Need more up-to-date science (population dynamics)
- Lack of practical policy – what is the 'right' level of the population, effect of seal population on other species and fish stocks; when is too much too much?
- Population management vs. welfare issue – matter for policy
- Need to agree on what the problems are

### Seals group

#### Problems:

- Complex, wider issues
- Public relations – shooting seals not good for fisheries
- Lack of evidence from fisheries
- Tails being returned to the sea, may encourage greater interactions
- Environmental change – it is happening
- Seals get the blame, particularly during challenging time for fishermen
- Lack of reporting

#### Solutions:

- Listening
- No shooting
- Open minds
- Holistic understanding of all sides and complexity of the issue
- Scientific evidence from trials
- Shared solutions, fishermen are part of the solution
- Provenance of fish, sustainability
- Fishermen have mandatory training for safety etc, but not ecosystems/how to be stewards of the environment

#### **Regulators group**

##### Issues:

- Evidencing non-lethal efforts
- Compliance with existing legislation
- Proving seals are responsible for damage
- Mitigations have potential impacts
- Trust (to gather data)

##### Solutions

- Building networks, building trust
- Sea trials (joint) – want strong fishing sector input
- Mitigation – engineering solutions to address side effects
- Evidence – how much certainty do you need to act? Assessing whether individual seals are the problem
- Compliance with legislation – education and visibility

#### **Break- out session 2**

- For the different approaches:
  - Deterrents
  - Fishing tactics
  - Avoidance
  - No action
- What are the constraints and benefits (pros/cons) of each?
- Which is the preferred option for your group and why?

## Red group

<b>Deterrents</b> ✗ Potential licence required ✗ Noise pollution – contribution to background noise, damage ✗ Investment (£000s) ✓ Does deter seals (evidence)	<b>Fishing Tactics</b> ✓ Expected cheaper ✓ Quicker ✗ Limited viable tactics ✗ MPAs?
<b>Avoidance</b> ✗ Effectiveness against intelligent species ✓ Work on individuals? ✗ Fishery specific ✗ MPAs ✓ Contraception	<b>No Action</b> ✓ Dependent on cost/benefit

- Preference for deterrents:
  - Struggling to identify tactics that we have any confidence in (all have been tried by fishermen and not been effective in the long term).
  - Deterrent – if cost-benefit profile favourable, otherwise no action
  - Could re-do whole process for each fishery – cost-benefit profile would change

## Blue group

Option	Pros	Cons
Deterrents	Potential to also decrease porpoise bycatch Financial incentive/commercial aspect (market demand for a solution) – could better drive innovation <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">Potential to combine</div>	Still to work out practical deployment Needs to last Power Need multiple units
Fishing tactics	Multi-treatment experiments Possible to do with nets	Limited possibilities
Avoidance		Limited possibilities – Tried and tested but not worked – not a new problem Seals follow boats

		Harder for inshore fleet – where to go?
No action		

- Fishing tactics and avoidance – everything has been done/tried – if there was something possible, would have tried it. Potential to put best practice / various options for avoiding interactions) in a document, capture retiring fishers' expertise.
- Deterrent is the preferred option. Deterrents are looking promising.
- Possibility to combine fishing tactics and deterrents – e.g. use deterrent on vessel to stop seals following boats out. Patrolling net with boat using device. May be possible to try deterrents on dhan bouys, then later develop technology further to deploy on nets. Start with smaller nets (gillnets tend to be 300-400m but can deploy 200m). Monk nets 1km-1.5km.

### Yellow group

Option	Pros	Cons
Deterrents	Startle device promising	Practicality Cost? Power source
Fishing tactics	Already happening	Economic risk
Alternative gear	Potential conservation benefits	Regulatory issues
No action	Let nature take its course	Compensate for losses

- Explore other options?
  - Predator sounds, emetics (taste aversion)

### Break-out session 3

- For your preferred option:
  - Where trials would be most critical?
  - What factors should be controlled for?
  - What parameters should be recorded?

### Red group

- ADDs, startle device?
- Use in depredation hotspots (maximise potential for significant difference to be detected in trials).

- Use on nets, in shallow water, small fleets of nets, e.g. slack water bass short deployment.
- Use photo ID to identify age, sex of seals. Cornwall Seal Group Research Trust happy to help with identification of seals.
- Record:
  - Depredation rates (catch, amount of damage, species composition, size composition, recent damage vs older damage, bite)
  - Seal species/proximity
  - Rigorous scientific designs
- Fisherman need to be involved in the trials – believability, transparency.
- Logistics – if small vessel, can extra people go on board? Task load for data activity vs what can be done from the vessel.
- Fit with regular fishing.
- Scientifically rigorous design – control/impact; before and after, control and impact design (BACI) if possible. However this is costly.
- Focus effort – show categorically in one area whether it works or not.
- On board or monitor.
- Explore possibility of scientific dispensation to land damaged catch (bite marks etc)

### Blue group

	<b>Hand lines</b>	<b>Inshore gill nets</b>	<b>Tangle nets</b>
Trials	Replicate Martha's experiment (jigging) in a high predation area, calm seas - St Ives Bay mackerel fishery?	West Cornwall? Thames?	
Controls?	Pair – control and playback boat	200m nets – easier to manage for a trial 2 units – either end Replicates with and without (x6) devices (if enough devices) Don't want playback to affect control if done on same day but if different days, could environmental variables affect results?	Early deterrents (several times on way out to fishing ground, lose early) Control Device 3 treatments (applies to all net scenarios)
Record?	Total catch Total depredation events		

	Seal observations (photo ID)		
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- Consider time/cost to fishers of participation in trials, e.g. if reduce nets to 200m

### Yellow group

- Preferred option: ADDs
- Location: in predation 'hotspots'
- Factors:
- Parameters:
- While ADDs are promising, should also explore other options.