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Information Note and Frequently Asked Questions for the Operators of Finfish Farms on the use of Acoustic Deterrent Devices and the Requirement for a European Protected Species Licence

This note has been developed by Marine Scotland in consultation with NatureScot. This note may be updated, particularly in terms of the assessment required, as our understanding develops concerning the use of Acoustic Deterrent Devices and their impacts on cetaceans.

1. Introduction

This document provides information for Scottish finfish farm operators who are using or planning to use Acoustic Deterrent Devices ("ADDs"). Where the term ADD is used in this document, this also includes any devices badged as Acoustic Startle Devices. In particular, this document is intended to help the reader assess:

a) The likelihood of an offence being committed under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the "Habitats Regulations");
b) Whether this can be avoided or minimised;
c) In circumstances where this cannot be avoided or minimised, whether the activity may be permissible under licence; and
d) The information which will be required in order to inform an European Protected Species ("EPS") licence application.

In Scottish inshore waters (within 12 nm of the coast), offences relating to the protection of marine EPS are provided for under the Habitats Regulations. These Regulations prohibit the deliberate and reckless capture, injury, killing and disturbance of marine EPS. This document relates to these Regulations.

What are European Protected Species?
These are species which are listed in Schedule 2 of the Habitats Regulations whose natural range includes any area in Scottish inshore waters. They include all species of cetaceans (whales, dolphins and porpoises), marine turtles and the Atlantic sturgeon.

2. Guidance for Scottish Inshore Waters

This document should be read alongside The Protection of Marine European Protected Species from Injury and Disturbance Guidance.

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The focus of this document is on cetacean species since these are the EPS considered to be most susceptible to the impacts of ADD use. As such, from this point forward the document will refer only to cetacean species.

Several species of cetaceans are known to be present in the seas around the west and north coasts of Scotland where finfish farms operate. Section 2.1 of The Protection of Marine European Protected Species from Injury and Disturbance Guidance provides links to a number of sources of information relating to cetacean distribution.

3. Legislation in Scottish Inshore Waters

Regulation 39(1)(a) of the Habitats Regulations sets out offences that relate to a number of specific circumstances in which EPS can be injured/disturbed. Furthermore, due to the differing strategies of cetaceans and our limited knowledge of them, Regulation 39(2) provides cetaceans with additional protection from disturbance by making it an offence to '*deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean).'*

4. ADDs and disturbance of cetaceans

Current scientific evidence shows that cetaceans may be disturbed by ADDs used at Scottish finfish farms. The potential for disturbance from ADDs will vary widely based on multiple factors including: the sound characteristics of ADDs and the manner in which they are deployed, the environment in which ADDs are used (factors affecting how far sound travels include bathymetry, sediment and sediment types), other noise sources and species' behavioural characteristics.

5. Do I need to apply for an EPS licence?

It is your responsibility as the fish farm operator to determine whether you need to apply for an EPS licence. However given current scientific advice, it is likely that an EPS licence will be required for all currently available ADDs unless you can demonstrate that the device(s) operating at your site will not cause disturbance to cetaceans.

If you are using or intend to use ADDs at your site and consider that the device(s) will not cause disturbance to cetaceans, evidence of this must be submitted to Marine Scotland - Licensing Operations Team ("MS-LOT") at MS.MarineLicensing@gov.scot. This evidence should include a robust assessment of the numbers of cetaceans likely to be disturbed using the best available estimates of cetacean abundance and distribution for the site, alongside underwater noise propagation modelling that accounts for local environmental conditions. If your assessment concludes that less than one individual of a cetacean species will be disturbed MS-LOT may be able to confirm that an EPS licence is not required following consultation with Marine Scotland Science ("MSS").

6. EPS Licences

EPS licence application forms are available here. The completed application should be sent to MS-LOT MS.MarineLicensing@gov.scot

If you determine that the ADDs you are using at your fish farm may cause disturbance to cetaceans and you wish to continue using them, then you will need to apply for an EPS licence. If you continue using the devices whilst your application is being determined you may be committing an offence under the Habitats Regulations.

EPS licences may be granted in certain specified circumstances, provided that the following tests are satisfied:

1. There is a licensable purpose;

2. There are no satisfactory alternatives;
3. The actions authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status in their natural range.

6.1 What is a licensable purpose?

The Habitats Regulations contain a list of licensable purposes which may be considered when applying for an EPS licence and your application will need to contain a detailed analysis of the licensable purpose. Those most relevant to the fish farm industry may be:

- Imperative reasons of over-riding public interest including those of a social or economic nature and beneficial consequences for the environment; or
- Preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries.

If you consider the most appropriate licensable purpose to be imperative reasons of over-riding public interest, **Annex B** of the application form must be completed and you must answer the following questions:

- What benefits will be provided by the use of ADDs? Include details of whether the benefits will be of a social, economic or environmental nature and whether these benefits are long or short term.
- What public interest will be served? Who will benefit from the use of ADDs? Does the use of ADDs address a need?
- Why is it imperative that ADDs are used?

Guidance on what could constitute 'imperative reasons of over-riding public interest' can be found at Section 1.3.2 of the Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC.

If you consider the most appropriate licensable purpose to be preventing serious damage to property or fisheries **Annex D** of the application form must be completed and include information on:

- What serious damage has occurred or will occur if the ADDs are not used; and
- How ADDs will prevent this damage, including any expert advice received.

6.2 What are satisfactory alternatives?

Marine Scotland is aware of various alternatives to ADDs which could be used to prevent seals from interacting with farmed fish and your application must include a **detailed analysis** of all alternatives previously tried or considered at your site and the reasons why they are not a satisfactory alternative. Reasons such as an increase in cost or inconvenience will not be considered satisfactory. If no satisfactory alternative is found then you will have to demonstrate why lower risk alternatives have been discounted. Generic information will not be sufficient, evidence must be provided which is site specific.

6.3 How is the maintenance of the population of the species concerned at favourable conservation status ("FCS") in their natural range determined?

MS-LOT consults with NatureScot (previously known as Scottish Natural Heritage) on all EPS licence applications within Scottish inshore waters. NatureScot provides advice on the favourable conservation of the different species, in light of the proposed activities (see Box 7 of the Protection of Marine European Protected Species from Injury and Disturbance Guidance). The assessment of FCS is at the scale of the relevant Marine Mammal Management Unit (JNCC report No. 547 NB – this report is currently being updated). Key

considerations will be whether the natural range of the species is reduced by the activity, and whether there is sufficiently large enough habitat to maintain the population on a long term basis. NatureScot makes this assessment based on the potential range of impacts, together with the estimate of the number of animals injured/disturbed and the likely duration of the activity. The Statutory Nature Conservation Body ("SNCB") joint position statement on FCS is available here.

To inform this advice, you will be required to complete an assessment of the potential impacts on cetaceans from the ADDs being used or proposed to be used at your fish farm (see Section 7.3 and Annex 1).

It should be noted that, for an EPS licence to be granted, all three tests above must be satisfied. It is not guaranteed that an application will be successful and the tests may be difficult to satisfy.

7. The assessment/EPS licence application must include the following information (Annex E of the EPS licence application form requests the information detailed in 7.1 and 7.2):

7.1 Details of the ADD model to be used, including

- The device name (and version if appropriate) for each type of proposed device;
- The number of devices to be used (if more than one device is to be used, provide numbers of each type of device);
- The indicative source level of each type of device (rms and SPLpeak);
- The typical frequency content of each type of ADD;
- Details of any triggering method;
- Details of the duty cycle to be used (or the settings available) including the system duty cycle;
- Duration of use of each type of device (e.g. hours use per 24 hour period);
- Time of use (e.g., are they used at a particular time of day or at a particular time of year); and
- The number and locations of ADDs to be deployed on the fish farm site.

7.2 How ADD use will be managed, including

- Detail of the cues/triggers and decision process to activate ADDs. The cues/triggers should be specific and measureable and relate to predation events by seals rather than presence of seals in the area;
- The manner in which ADD use would be reviewed;
- Criteria for deactivation or removal of ADDs (including if they do not appear to be effective); and
- Details of current ADD deployment plans and any relevant planning conditions relating to ADD use.

7.3 An estimate of the number of cetaceans (by species) likely to be disturbed or injured due to ADD use.

- The best available information on the cetacean species likely to be present in the area (see section 15.1), and their densities, should be used to inform the estimated number of cetaceans (by species) likely to be disturbed or injured due to ADD use;
- The assessment of impacts from ADDs being used at your site, and cumulative impacts from ADDs being used in the area must be completed using underwater noise propagation modelling or the approach detailed in Annex 1. Details of the assessment undertaken must be provided with the application. A worked example of the method

described in Annex 1 is provided in Annex 2.

- A quantitative assessment is required for all regularly occurring cetacean species;
- Marine Scotland and NatureScot are content to engage with the fish farm industry and its appointed consultants to provide any further advice on the assessment.

The Marine Noise Registry (MNR) records human activities in UK seas that produce loud, low to medium frequency impulsive noise. Whilst the majority of ADDs are non-impulsive and do not have to be reported, if a device is impulsive, where these are to be operating at low to medium frequency (10Hz – 10kHz) then it will be necessary for operators to complete MNR. The Technical Subgroup on Underwater Noise provides further information on this. Data input to the noise registry is via completion of two forms, the first a proposed activity form (detailing the planned activity) and second a close-out report (an accurate account of where and when the activity had occurred).

8. Can an EPS licence application cover more than one fish farm site?

A fish farm operator may complete an EPS application form covering more than one fish farm site. However, to ensure the EPS licence process can consider options for ADD management beyond the individual site level, applications should incorporate all geographically contiguous sites that are within the same disease management area ("DMA") under the control of the applicant. Annex E of the EPS application form should be completed for each of the individual fish farm sites within the geographically contiguous area.

9. Is there a cost associated with applying for an EPS licence?

MS-LOT does not currently charge a fee for processing EPS licence application(s), however fish farm operators will be responsible for covering the costs associated with an assessment required to accompany an application.

10. What are the timescales for processing an EPS licence application?

MS-LOT aim to determine applications within eight weeks, however this will be dependent on the quality of the application and the assessment undertaken. If you provide insufficient information, including in relation to satisfactory alternatives, the application will be returned requesting further detail. If it is not clear how the numbers of cetaceans being disturbed have been calculated again further information will be requested. The eight week time period for determination will start once MS-LOT has accepted an application as being complete and sufficient to allow a determination.

11. For what period will an EPS licence be granted if the application is successful?

MS-LOT intends to grant EPS licences for a period of 12-months following a successful application. Therefore, if ADDs are to be used following this period, a further EPS licence will be required and a new application should be submitted, allowing sufficient time for determination before the lapse of any existing EPS licence. This 12- month period, which may be reviewed in the future, is to allow consideration of the three EPS licensing tests on a regular basis as it is possible, for example, that new alternatives may become available during the licensing period.

12. Habitats Regulations Appraisal ("HRA")

It is possible that the use of ADDs at fish farm sites could also have an impact on European protected sites, in particular European sites designated for harbour porpoise, grey seals and harbour seals. This will depend amongst other things on the location of the fish farm relative to

the European protected sites. If there is likely to be a significant effect on a European site from the ADDs being used at your fish farm site, MS-LOT may be required to complete an appropriate assessment ("AA") prior to granting an EPS licence. MS-LOT may be able to rely on an AA completed by another competent authority (for example, by the local planning authority as part of the planning permission application) if considered appropriate. Therefore your application may also need to consider HRA. Further guidance on HRA is available on the NatureScot website here.

13. The Role of Marine Scotland Compliance ("MSC")

MSC will carry out routine monitoring of ADD use at fish farm sites. Inspections will be risk based and intelligence led, and may include site visits and document and data checks where an ADD is found to be present. Where evidence of ADDs are found and the operator does not hold an EPS licence, or is in breach of the conditions of a licence, MSC will investigate with a view to a prosecution under the Habitats Regulations. The powers to inspect and collect information is detailed in Part 7 of the Marine (Scotland) Act 2010, "Powers of marine enforcement officers". Reporting requirements for the use of ADDs at fish farms are detailed in the Aquaculture Code of Practice - Containment of and Prevention of Escape of Fish on Fish Farms in relation to Marine Mammal Interactions.

Further questions were received from industry which are answered below

14. How are Marine Scotland and NatureScot defining 'disturbance' in the context of the legislation?

Disturbance is not defined in the Habitats Regulations, EU law or case law. However, given current scientific advice, it is likely that all currently available ADDs could cause disturbance to cetaceans at the individual level.

Proximity of cetaceans to fish farms and maintaining conservation status

15. With regard to the first step of the assessment (are cetaceans in the area and subject to disturbance):

15.1 How is the area defined? Will areas be defined as being within a specific distance from a farm? Cetaceans are present throughout Scotland and are generally transient in nature.

The area would be the area that is known to be / or assessed to be within the ensonifed area of the ADD(s). Cetaceans are transient and are found throughout Scottish waters, as indicated by the recent report commissioned by Marine Scotland: Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters. Consideration of the maps provided for harbour porpoise alone (S3.3.3), for example, illustrates the prevalence of this species in all coastal waters likely to be relevant to fish farming. If a fish farm operator considers that cetaceans are not present in the ensonified area, this must be based on sufficient and robust evidence using the best available information on the cetacean species likely to be present at the site, and their densities (see Section 7.3). If this were the conclusion, then an EPS licence application would not be required, however the evidence to support this conclusion must be provided to MS-LOT.

15.2 Is it possible to scope out harbour porpoise / EPS at the risk assessment stage based on existing data, for example, in areas with no/low activity?

It is unlikely to be appropriate to scope out harbour porpoise from consideration in EPS licensing in certain areas unless robust evidence is available that they are not present in the

area for the same reasons as above. Similarly, if an applicant considers that their proposed device will not disturb harbour porpoise, sufficient robust evidence must be available to support this conclusion, and must be provided to MS-LOT.

15.3 Reference was made to cetacean data published by Marine Scotland in the Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters report.– Will MS provide this data in a useable format to streamline the data collation process (shapefiles/.shp preferred format)?

Marine Scotland do not have access to the shapefiles.

16. The third EPS licensing test refers to maintaining FCS; what is the situation if an EPS does not have a starting point of favourable? Will licensing be possible in those situations?

NatureScot provides advice in relation to the FCS test and the current status of any species will inform its consideration. However, absence of FCS alone will not necessarily preclude provision of an EPS licence. Provided that the licensed activity would not have a significant negative effect on the cetacean population concerned (or the future prospects of attaining FCS for this population), then licensing may still be permissible. Decisions are made on a case by case, site by site and species by species basis. Please refer to Section 6.3 of this document for more information.

Sound propagation

17. Will the proposed use of ADDs which operate at sound levels and frequencies which do not overlap with cetacean hearing ranges require an EPS licence? Will sound propagation modelling be required in support of an application and if so, what should be modelled, i.e. what thresholds should be used?

If, for example, by virtue of the sound levels and frequencies at which they operate, it can be shown that ADDs (or related systems) cannot disturb cetaceans, then an EPS licence is not required. However robust evidence to validate this claim must be provided to MS-LOT. In practice, the hearing ranges of seals and cetaceans overlap, so there may be limited scope for identification of deterrents to which only seals are sensitive.

If modelling is undertaken, an appropriate model should be used that considers all relevant environmental parameters. Preferably, this should be undertaken by underwater acoustic specialists. Modelling will be required for a realistic worst case scenario for each fish farm site and cumulatively, or using the approach outlined in Annex 1. Marine Scotland and NatureScot are content to engage with the fish farm industry and their appointed consultants to provide further advice on the modelling.

18. Definition of a "satisfactory alternative" to ADDs (in terms of the second EPS licensing test)

18.1 How can we best incorporate a hierarchy of predator control measures into an EPS licence application?

Rather than a hierarchy of predator control measures, details of all alternative methods considered prior to using ADDs should be provided as part of any EPS application (see Section 6.2). However, it is noted that ADDs are used as part of a suite of control methods, and the application should be focused on ADDs as the EPS licence is to allow disturbance as a result of their use. A description of the manner in which ADDs are used at your site(s) and the timing

and duration of this usage should be provided (as described in Section 7 of this document). This should include details of how their use is integrated with other predatorcontrol methods.

18.2 Will it be possible to argue that 'alternative' measures are not 'satisfactory alternatives' if they are not viewed as being 100% effective? Our position, backed up by evidence of losses to seals, is that ADDs are not 100% effective. A predator defence hierarchy is not about alternatives but relies on multiple lines of defence.

It is acknowledged that no single predator control measure may be 100% effective and therefore no method will have to be shown to be 100% effective to be considered satisfactory. Applicants should describe why available alternatives are not sufficient to remove the requirement for ADD use taking into account the licensable purpose. Details of alternatives tried should be provided as well as justification if other methods have not been considered or tested before using ADDs. The information provided should be site specific, generic information will not be sufficient.

18.3 If some ADDs are viewed as not requiring an EPS licence will these devices be automatically considered as a 'satisfactory alternative' and therefore prevent the granting of an EPS licence for an ADD which does overlap with the hearing range of cetaceans?

It would not be possible for an application to pass the no satisfactory alternative test if other methods that achieve the same purpose were available that result in less or no disturbance.

18.4 Will all ADDs be classed as a last resort in the hierarchy or will it be acknowledged that we require multiple deterrents to be effective? It is important to reference the different aims of the various management options – i.e. nets work as barriers to exclude seals from reaching fish, ADDs deter seals being in the vicinity of farms and causing stress on the fish.

The application should focus on the justification for the use of ADDs as part of a suite of measures. Information should include the consequences of not using ADDs and why ADDs are essential at the site(s) on the application. We are aware that there are a number of fish farms operating without ADDs in areas where ADD use is not permitted.

19. Licence details

19.1 Is an EPS licence specific to ADD type/model, or can multiple options be licensed? (NB the latter would be preferable, as sometimes ADDs may be amended mid-cycle in response to seal issues (as discussed, seal management requires continual review and relevant changes), and flexibility to make such changes swiftly is obviously key).

EPS licences, if granted, will specify particular models or their parameters and methods of use. Information regarding the model of ADD that you intend to utilise should be provided as part of any application (please refer to Section 7 of this document). If more than one ADD model is to be used, details of all of these models should be provided. This should include details of the manner in which different devices are to be used i.e. are they to be used in isolation, simultaneously, sequentially or in some other way.? If it is likely that multiple devices of different types will be used, then the realistic worst case combination of ADDs potentially to be used should be modelled (bearing in mind that applications for multiple devices may find the three tests more difficult to satisfy). ADD deployment plans can be referenced if relevant. If an EPS licence is issued it may contain conditions that limit or exclude the use of certain models in some circumstances. Please note that requests to update a licence with an ADD with operating parameters outwith those already assessed may necessitate the assessment, including the cumulative assessment, to be revised. Any such assessments will be the responsibility of the applicant.

19.2 What will be the duration of each licence? Most aquaculture sites are deemed to be long term developments and consequently it would be preferable to avoid

unnecessary renewals. For example, licences on an annual basis unless there have been changes to equipment or licensed conditions.

EPS licences will be issued for a period of 12 months. As technology advances and new control methods may become available, it would not be appropriate to issue licences for longer periods of time as the requirements of the satisfactory alternative test may no longer be met.

20. Cumulative impact

20.1 Will Marine Scotland identify specific management units for the consideration of cumulative impacts from multiple EPS applications or will existing management units in the recent report for the renewables industry stand?

Impacts will be assessed against existing marine mammal management units. The Marine Mammal Management Units, which are described in the Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters report, will form the basis for determining possible impacts upon FCS of the species concerned. Further information is provided in Annex 1.

20.2 In the case where ADD use at an individual farm meets all three EPS tests but when considered cumulatively with other applications within a defined management area, use at all farms cannot be approved, how will Marine Scotland determine which applications can be approved at a lower cumulative level?

Consideration will be given as to whether additional mitigation could be effective at ensuring that FCS is met, if so this may be included as a condition of an EPS licence. If additional mitigation is not an appropriate solution it is more likely that applications which are causing the most detriment to the FCS would be refused.

Contact

If you any queries regarding the guidance please direct them to:
Email: MS.MarineLicensing@gov.scot

Annex 1 - ADD disturbance and injury distances for use in EPS licence applications

Observed behavioural responses by cetaceans to noise can be used as evidence of disturbance. However, behavioural responses are often highly variable, and depend on a number of factors, including noise characteristics and context (e.g. body condition, location, age of individual, experience of individual etc.). It is worth considering that an inability to detect an overt response to a noise source does not necessarily mean there is no effect. Any observed behavioural response will therefore be a result of an individual's habituation to a stimuli in combination with sensitisation. Currently, there is no standard criterion for disturbance; therefore, a generic approach is taken here to provide guidance on disturbance distances to be assumed for ADDs, which can be used in the absence of site and/or device specific evidence.

Auditory injury is classed as a Permanent Threshold Shift (PTS) in hearing. This is a permanent increase in the level of a sound required for an animal to perceive it at a particular frequency. PTS can occur either instantly, or be accumulated over a period of time. Instantaneous PTS can occur through exposure to sudden onset loud noise (e.g. from pile driving or seismic surveys). Cumulative PTS is assessed using the cumulative Sound Exposure Level (SEL) metric, and considers the repeated exposure of sound over time (up to 24 hours). Cumulative PTS thresholds can be reached through a combination of how loud the noise is and how long the animal is exposed.

The risk of instantaneous injury due to ADD noise is unlikely, due to the source levels emitted by these devices; there is however, a potential risk of cumulative SEL PTS injury.

1. Input parameters and thresholds

The cumulative SEL PTS injury and disturbance thresholds which should be used for assessment are shown in Table 1.

1.1. Disturbance thresholds

The National Oceanic and Atmospheric Administration (NOAA) Fisheries in-water acoustic thresholds for behavioural disturbance (Level B criterion) are as follows, 120 dB re 1 µPa rms (flat) for non-impulsive signal type (continuous (NOAA)). We are aware that Southall et al. (2021) have recently published an update on as assessment of the severity of behavioural response to human noise for marine mammals. However, as there is not a clear category identified or threshold specifically for ADDs in the guidance we recommend that the NOAA behavioural disturbance threshold of 120 µPa rms (flat) is used in the assessments. If an applicant chooses to use an interpretation of the Southall et al. (2021) disturbance thresholds then robust justification should be provided. The NOAA Level B threshold is not frequency or species specific and represents a conservative approach to assessing disturbance distances.

1.2. Injury thresholds

The Cumulative PTS SEL injury thresholds to be used are based on the most up to date guidance (Southall et al., 2019). These are weighted to each marine mammal hearing group based on weightings from NMFS (2018) (Table 1). Note that the names used for the hearing groups (low, high and very high frequency) conform to Southall et al. (2019), where as the National Marine Fisheries Service (NMFS) (2018) use different terminology (low, mid and high frequency).

Table 1. Marine mammal hearing groups and thresholds for disturbance and injury

Marine mammal hearing group	Example species	Hearing bandwidth (kHz)	Non-impulsive thresholds	
			Cumulative injury PTS onset - SEL (dB re 1 µPa²s) (weighted)	Disturbance onset (dB re 1 µPa rms) (flat)
Low frequency cetacean (LF)	Minke whale, humpback whale	7 Hz to 35 kHz	199	120
High frequency cetacean (HF)	Bottlenose dolphin, White-beaked dolphin	150 Hz to 160 kHz	198	
Very high frequency cetacean (VHF)	Harbour porpoise	275 Hz to 160 kHz	173	

To aid the industry to calculate disturbance and injury distances generalised ADD types have been generated based on available published information. The parameters such as source level and duty cycle have been generalised by using worst-case scenarios and therefore adopt a precautionary approach to the assessment (Table 2). For an EPS licence, the generalised ADD impact distances can be selected based on what aligns most closely with the applied for ADD system characteristics.

Table 2. Generalised ADD types

Parameter	ADD Type 1	ADD Type 2	ADD Type 3	ADD Type 4	ADD Type 5
Source Level (dB re 1 µPa @ 1 m rms)	195	198	198	189	165
Frequency Content (kHz)	1 - 5	8 – 12	8 – 12	8 - 11	8 – 11
Duty cycle (%)	8	50	100	32	9

It would be possible for an experienced underwater noise modeller to calculate non generalised ADD system specific disturbance and injury distances using the model presented below. Bespoke noise modelling techniques are welcome, however, if used we require the predictions to be accompanied with detailed supporting information, including assumptions made, methodology and evidence used.

Any document presented as an evidence base for consideration would ideally be peer-reviewed, for example, presented in a peer-reviewed scientific journal. If this is not possible, it must have gone through a robust Q&A process with an external body/individual that was not an employee either of the company undertaking the work, or of the ADD developer, and be publically available.

Documentation must outline a clear and complete methodology that would allow another person/organisation to replicate the study. As a minimum, where a field-based study has been undertaken, the document should report the:

- ADD type
- Noise levels, to include an estimate of the source level, and measured received levels
- Frequency content
- System duty cycle

If the evidence base supplied does not meet the standards above, it is unlikely that this will be accepted as the required evidence for the EPS licence application process.

2. Method and calculations

To inform this guidance, the marine mammal hearing group weightings from the National Marine Fisheries Service (NMFS, 2018) have been applied to the frequency range of the devices by assuming equal energy spread across the frequency content of the signal (Table 3). These auditory weightings take into account the hearing sensitivities of the marine mammal groups and scales the sound source to the hearing sensitivity.

The disturbance and injury distances have been estimated using a simple propagation model to calculate the received levels at distance, which were then compared to disturbance and cumulative SEL injury thresholds. The model used is from Götz and Janik, (2015); here, a logarithmic regression line was fitted to the measured sound pressure level (measured in dB re 1 µPa root mean square (rms)) received levels from the ADD sound source. These in-field measurements were made on the west coast of Scotland (Götz and Janik, 2015) and therefore provide a reasonable estimation of propagation loss in typical fish farm environments.

The received level (RL) is calculated by subtracting the propagation loss using 18.3Log(R) from the source level (SL), where R (in metres) is the distance from the sound source.

$$RL = SL - 18.3 \times \log(R)$$

The risk of PTS injury has been calculated as cumulative SEL for a stationary animal over 24 hours as a conservative estimate (e.g. the cumulative dose of energy an animal would receive over 24 hours).

Calculated distances for each generalised ADD type are provided in Table 3. (These can be used in-lieu of bespoke underwater noise modelling).

Table 3. Calculated distances of generalised ADD types for disturbance and injury thresholds

Generalised ADD type	Distance to threshold (m)			
	Disturbance	Cumulative SEL PTS injury		
	All cetacean hearing groups	LF	HF	VHF
ADD type 1	12,542	19	4	42
ADD type 2	18,293	543	604	10,243
ADD type 3	18,293	793	881	14,960
ADD type 4	5,895	76	77	1270
ADD type 5	288	2	2	27

2.1 Identifying cetacean species potentially impacted and calculating numbers

- Information on the cetacean species likely to be present in an area is available in the recently published Marine Scotland report Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters.
- Estimates of cetacean abundance in Scottish waters can be obtained from the most recent SCANS-III report European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys (Hammond et al., 2021); the data from these surveys are included in the regional baseline report above.
- These sources have been used in this example; however, for a specific site, there may be better, more suitable information on the cetacean species likely to be present and their densities.
- SCANS-III conducts surveys in blocks (Figure 1), the surface area (km^2) for each of the relevant blocks and cetacean species are provided in Table 6, below. If further information is required (e.g. other blocks or species), this can be found in Hammond et al. (2021).
- Assuming a uniform distribution of animals within the block, the information in the figure and the tables, coupled with the calculated disturbance and injury thresholds, can be used to provide a number for both of these potential impacts for the species occurring in

your location.

- For example, Mull falls within block G, which has a surface area of 15,122 km^2, and a harbour porpoise abundance estimate of 5,087. Table 4 and Table 5, below, provide an example of how to calculate the disturbance and injury, respectively for this species in that location across the five generalised ADD types.

Table 4. Estimating the number of porpoise disturbed (from an abundance estimate of 5,087) in block G (15,122 km^2) across the five generalised ADD types

Generalised ADD type	Disturbance (m)	Area (km^2)	Percentage area of block G	Estimated number of porpoise disturbed
ADD type 1	12,542	494.2	3.27	167
ADD type 2	18,293	1,051.3	6.95	354
ADD type 3	18,293	1,051.3	6.95	354
ADD type 4	5,895	109.17	0.72	37
ADD type 5	288	0.261	0.002	0.1

Table 5. Estimating the number of porpoise injured (from an abundance estimate of 5,087) in block G (15,122 km^2) across the five generalised ADD types

Generalised ADD type	Cumulative SEL PTS injury (m)	Area (km^2)	Percentage area of block G	Estimated number of porpoise injured
ADD type 1	42	0.006	0.00004	0.002
ADD type 2	10,243	329.6	2.18	111
ADD type 3	14,960	703.1	4.65	237
ADD type 4	1270	5.1	0.03	2
ADD type 5	27	0.002	0.000007	0.0005

- These calculations are based on the entire area being ensonified, applicants can likely reduce this by mapping the location and impact zones, and calculating a more realistic total area (km^2) by removing landmass, for example. These maps and justifications should be provided with the application.
- A worked example is provided in Annex 2.

3. Cumulative impact assessment (CIA)

A cumulative impact assessment of ADD use by more than one company will be more efficient, cost- effective and consistent if undertaken collaboratively rather than independently. A collaborative approach to this exercise is therefore strongly recommend. The following approach could be delivered by companies individually or many from the same region working in partnership.

Set out below is a CIA method for this year's iteration of EPS licensing. It is likely that this advice will be revised for future years' EPS licences as more is learnt from this process and from emerging published evidence.

CIA is required under EPS licensing, because a judgment has to be made on whether the activity is "*detrimental to the maintenance of the population of the species concerned at a favourable conservation status (FCS)"* (Marine Scotland, 2020).

FCS is considered for each species within their natural ranges, which for mobile species, such as cetaceans, are large areas. Usually, Management Units (MU) (Inter-Agency Marine Mammal Working Group (IAMMWG), 2015) serve as the basis over which to assess FCS. However, for this current exercise we recommend that SCANS III block areas (Hammond et al., 2021) (Figure

1 & Table 6) be used instead. We have limited the assessment area to the Scottish west coast (SCANS blocks, G, H, I, J and K, cumulatively; see Table 6) and the Northern Isles (SCANS blocks S and T, cumulatively; see Table 6). Ideally, CIA should consider all other activities capable of causing disturbance or injury within these ranges. However, it is recognised this may be impractical to achieve, so for this year it is proposed that the following approach, which considers just the cumulative impact of multiple ADD use at fish farm sites, is adopted.

- The CIA must include all cetacean species identified in the EPS licence applications.
- Information on other fish farms operating ADDs may be available from MS-LOT upon request to inform the CIA.
- A series of maps using appropriate mapping software (GIS) should be presented; one for disturbance, and three for injury across the marine mammal hearing groups (Low Frequency (LF), High Frequency (HF), Very High Frequency (VHF)). Each of these maps should be at an appropriate spatial scale and resolution, identifying the locations of all fish farms applying to use ADDs, together with the predicted disturbance and injury impact zones.
- These maps may highlight overlapping impact zones due to the proximity of fish farm sites applying to use ADDs; in this instance we recommend the areas are merged to show the overall area, which will avoid double counting (i.e. animals in overlapping areas of impact should only be counted once in the CIA). Using GIS, the overall impacted area (km^2) can then be calculated to account for any overlap between fish farms, and landmass.
- SCANS block abundance estimates (Figure 1 and Table 6) should be used to calculate the number of impacted animals (following the methods as described in Section 2.1 above). The abundance estimates vary by SCANS block, if your predicted impacted area spans more than one block, the calculations should be undertaken and presented in table form separately for each block. The overall number of impacted animals can then be estimated by summing the blocks in the assessment area.
- Using the estimated number of animals impacted in the SCANS block, the percentage of animals impacted in that SCANS block can be calculated for the CIA and used to inform the FCS assessment.
- In the absence of a harbour porpoise population estimate for the Inner Hebrides and the Minches Special Area for Conservation (SAC), the population estimate from SCANS blocks G and I, collectively, should be used to estimate the proportion of the population impacted. For harbour porpoise, additional maps detailing the impacted area of blocks G and I, collectively, should be presented separately.
- If updated information becomes available on the densities of cetaceans in Scottish waters, it may be more appropriate for this updated information to be used in the assessment and you should contact MS-LOT to discuss further.

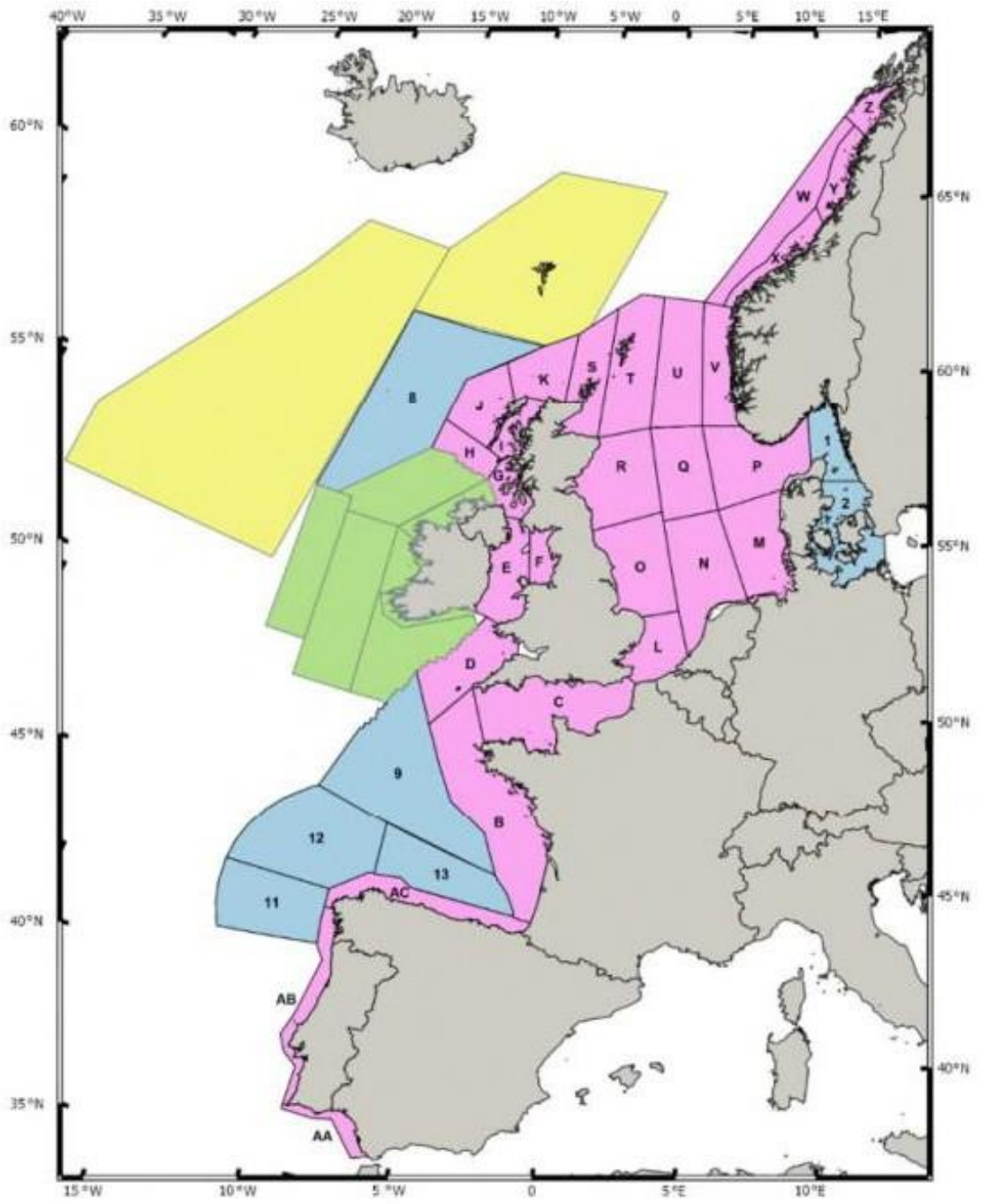

Figure 1 Area covered by SCANS-III and adjacent surveys. SCANS-III pink (surveyed by air) and blue (surveyed by ship) Green blocks surveyed by the ObSERVE project and yellow by the Faroe Islands. SCANS-III blocks relevant to this assessment are pink (G, H, I, J, K, S, T) see https://synergy.st-andrews.ac.uk/scans3/files/2017/04/Shapefiles-for-SCANS-website.zip for shapefiles that can be imported in to GIS to assist with your assessment.

Table 6. SCANS III assessment blocks, area, density and abundance for key cetacean species (Hammond et al., 2021)

Minke whale (LF)	Assessment block	Area (km²)	Density (animals/ km²)	Abundance
West coast	G	15,122	0.027	410
	H	18,634	0.008	149
	I	13,979	0.020	285
	J	35,099	0.018	647
	K	32,505	0.009	295
North coast	S	40,383	0.010	383
	T	65,417	0.032	2,068
Harbour porpoise (VHF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**
West coast	G	15,122	0.336	5,087
	H	18,634	0.090	1,682
	I	13,979	0.397	5,556
	J	35,099	0.058	2,045
	K	32,505	0.308	9,999
North coast	S	40,383	0.152	6,147
	T	65,417	0.402	26,309
HP SAC	G	15,122	0.336	5,087
	I	13,979	0.397	5,556
Bottlenose dolphin (HF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**
West coast	G	15,122	0.121	1,824
	H	18,634	0.003	59
	I	13,979	0.000	0
	J	35,099	0.000	0
	K	32,505	0.000	0
North coast	S	40,383	0.004	151
	T	65,417	0.000	0
Risso Dolphin (HF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**
West coast	G	15,122	0.000	0
	H	18,634	0.029	538
	I	13,979	0.000	0
	J	35,099	0.192	6,750
	K	32,505	0.014	440
North coast	S	40,383	0.000	0
	T	65,417	0.000	0
Common dolphin (HF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**
West coast	G	15,122	0.000	0
	H	18,634	0.000	0
	I	13,979	0.000	0
	J	35,099	0.133	4,679
	K	32,505	0.000	0
North coast	S	40,383	0.000	0
	T	65,417	0.000	0
White-sided dolphin (HF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**
West coast	G	15,122	0.000	0
	H	18,634	0.000	0
	I	13,979	0.000	0
	J	35,099	0.00	0
	K	32,505	0.000	0
North coast	S	40,383	0.000	0
	T	65,417	0.021	1,366
White-beaked dolphin (HF)	**Assessment block**	**Area (km²)**	**Density (animals/ km²)**	**Abundance**

West coast	G	15,122	0.000	0
	H	18,634	0.316	5,881
	I	13,979	0.000	0
	J	35,099	0.053	1,871
	K	32,505	0.217	7,055
North coast	S	40,383	0.021	868
	T	65,417	0.037	2,417

Annex 2 – Worked example of the methodology described in Annex 1

Annex 2 provides a description of the methods used in Annex 1 to calculate disturbance and cumulative sound exposure level (SEL) permanent threshold shift (PTS) distance predictions, using a worked example. The calculations for the number of individuals of each marine mammal species (referred to as "animals" in this document) experiencing PTS or disturbance using these estimates are also shown through a worked example using the disturbance distance predicted. The thresholds, criteria and input parameters used in these worked examples are described in more detail in Annex 1. Table 1 provides the parameters of the ADD in the worked example below.

Table 1: Parameters of ADD used in the worked example

Parameter	
Source Level (dB re 1 µPa @ 1 m (rms))	187
Frequency range (kHz)	2-6
Duty cycle (%)	10
Pulse duration (seconds)	2

Disturbance distance calculation

The disturbance calculation used is:

$$Disturbance\ distance\ = 10\ \hat{}\ \frac{(source\ level - disturbance\ threshold)}{transmission\ loss\ factor}$$

In this example the parameters are:

- source level: An unweighted sound pressure level (SPL) of 187 dB re 1 µPa (rms) @ 1 m has been used for the signal
- disturbance threshold: 120 dB re 1 µPa (rms), for non-impulsive signal type sounds as the potential onset of disturbance (NOAA, 2021).
- transmission loss factor: 18.3 (Götz and Janik, 2015). This factor should be used for all ADD types.

$$Disturbance\ distance\ = 10\ \hat{}\ \frac{(187\ -\ 120)}{18.3}$$
$$= 4{,}584\ metres$$

Cumulative SEL PTS distance calculations

An example calculation to estimate cumulative SEL over 24 hours for one device is provided below. As for the disturbance example, the cumulative SEL example uses the properties of, but cumulative SEL thresholds require hearing group frequency weighting. In this worked example, weightings for very high frequency cetaceans have been used. The weighting calculations are not provided here but are available in Section 2.2 of NMFS (2018).

There are three steps in the process to generate cumulative SEL PTS distances.

Step 1. Using the frequency weightings for very high frequency cetaceans from NMFS (2018) with the frequency characteristics of the example ADD (Table 1) gives a weighted SPL of 171.5 dB re 1 µPa (rms).

The weighted rms SPL is integrated over the duration of a single ADD emission (Table 1).

The weighted SEL calculation used is:

$$Weighted\ SEL = \ weighted\ rms\ SPL\ +\ 10\ Log(T)$$

In this example, the parameters are:
- Weighted rms SPL: 171.5 dB re 1 µPa (as calculated above using NMFS, 2018)
- T (duration of a single ADD emission): 2 seconds

$$Weighted\ SEL\ =\ 171.53\ +\ 10\ Log(2)$$
$$=\ 174.5\ dB\ re\ 1\ \mu Pa^2 s$$

Step 2. The cumulative SEL (SEL_{cum}) is then calculated over 24 hours using the weighted SEL and the specific percentage duty cycle of the device, which is converted into the number of seconds throughout a 24 hour period that the ADD is emitting sound.

The cumulative SEL calculation used is:

$$SEL_{cum} = Weighted\ SEL\ +\ 10Log((duty\ cycle/100)\ x\ 60\ x\ 60\ x\ 24)$$

In this example, the parameters are:
- Weighted SEL (as calculated above): 174.5 dB re 1 µPa²s
- duty cycle: 10% (i.e. 8,640 seconds)

$$SEL_{cum} =\ 174.5\ +\ 10\ Log(0.1\ x\ 86400)$$
$$=\ 213.85\ dB\ re\ 1\ \mu Pa^2 s$$

Step 3. Simple noise propagation modelling is then used to calculate the distance at which the SEL PTS injury threshold will be reached.

The calculation of distance to SEL PTS threshold is:

$$Distance\ to\ \ SEL\ PTS\ threshold\ \ = 10\ \hat{}\ \frac{(SEL_{cum} -\ SEL\ PTS\ threshold)}{transmission\ loss\ factor}$$

In this example, the parameters are:
- SEL_{cum} (as calculated above): 213.85 dB re 1 µPa²s
- SEL PTS threshold: 173 dB re 1 µPa²s (Table ES3, NMFS, 2018), for very high frequency cetaceans
- transmission loss factor: 18.3 (Götz and Janik, 2015)

$$Distance\ to\ SEL\ PTS\ threshold\ =\ 10\ \hat{}\ \frac{(213.85\ -\ 173)}{18.3}$$
$$=\ 171\ metres$$

<u>Calculations for estimating number of animals injured and disturbed</u>

A worked example to calculate the number of animals injured and disturbed is provided below.

Using the distance of injury (0.171 km) as the radius, an area of injury can be calculated:

$$Area = \pi\ x\ radius^2$$
$$=\ \pi\ x\ (0.1717)^2$$
$$=\ 0.09\ km^2$$

To calculate the number of animals potentially injured, this predicted area of injury is then multiplied by the density of animals. For example, the density for harbour porpoise from SCANS-III block I, available here. is 0.397 (animals/km²). Assuming uniform distribution over the area, this gives:

$$Number\ of\ animals\ injured = 0.09\ x\ 0.397$$
$$= 0.03$$

Using the distance of disturbance calculated above (4,583 m) as the radius, an area of disturbance can be calculated:

$$Area = \pi\ x\ radius^2$$
$$= \pi\ x\ (4{,}583)^2$$
$$= 66\ km^2$$

To calculate the number of animals potentially disturbed, this predicted area of disturbance is then multiplied by the density of animals. For example, the density for harbour porpoise from SCANS-III block I, available here, is 0.397 (animals/km^2). Assuming uniform distribution over the area, this gives:

$$Number\ of\ animals\ disturbed = 66\ x\ 0.397$$
$$= 26\ individuals$$

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