

Mitigating measures for acoustic surveys

Introduction

Irish Marine Mammals

There are currently eighty-six recognised species of cetacean in the world. Twenty-four species have been identified in Irish waters from sighting or stranding records. Of these six are large baleen whales (mysticeti) and eighteen smaller toothed- whale species (odontoceti). The status of many of the world's cetacean populations is threatened by commercial fishing by-catch, targeted fisheries, pollution, habitat destruction, anthropogenic noise, disturbance, over-fishing and climate change. There are two species of seal which breed in Irish waters.

Effects of Acoustic Surveys on Marine Mammals

Hearing is the most important sense for cetaceans, and the ability to hear well is vital in all key aspects of their lives including finding food, navigating and social interactions. Any reduction in hearing ability, whether by physical damage or masking by other sound, may seriously compromise the viability of individuals and, therefore, populations. Whilst at an extreme level noise can lead to cetacean mortality from barotrauma, sub-lethal effects may also have a significant impact. Sub-lethal effects could include threshold shift or complete hearing loss, which would seriously compromise the viability of individuals or entire populations. Displacement of cetaceans from important feeding, migration or reproductive sites could also lead to a change in population dynamics.

Seals may also be affected by noise particularly during periods when they are pupping or moulting. However, these areas are unlikely to form the major component of a survey and would be covered through the protection afforded by designated special areas of conservation.

Marine Acoustic Surveys

Marine geophysical surveys are conducted to study geological processes and structures and to locate geological structures of types often associated with petroleum deposits. These surveys often use high-energy sources of sound or vibration to create seismic waves in the earth's crust beneath the sea. High-energy, low frequency sounds, usually in the form of short-duration pulses, are created along survey grids. Sound pulses from marine seismic surveys are often detectable in the water column tens or even hundreds of kilometres from the source.

Many surveys use various mapping techniques to assess the bottom contours or the nature of underlying rock formations. Methods used range from towed side-scan sonar to elucidate bottom contours, hull-mounted multi-beam bathymetric echo-sounders to form an accurate map with detail of the nature of sea floor and seismic surveys that use an array of airguns to

form an image of underlying rock and sediment beneath the sea floor. In addition concerns over the effects of electromagnetic (EM) surveys on cetacean navigation mean that these guidelines should also be implemented during EM surveys in Irish waters. The survey of offshore waters and continental shelf areas has a very significant consequence for the future socio-economic sustainability of Ireland.

Mitigation Measures

To facilitate surveys a list of mitigating measures has been designed by National Parks & Wildlife Service of the Department of the Environment, Heritage and Local Government. This list was formed in consultation with the Irish Whale and Dolphin Group, Coastal Marine Resource Centre (University College Cork), Geological Survey of Ireland, Marine Institute and Petroleum Affairs Division (Department of Communications, Marine and Natural Resources).

1. SECTION 1: Outline of Procedures for Implementing Acoustic Survey mitigating measures

1.1. Survey Planning & Risk Matrix Analysis

At the survey planning stage consideration should be given to the marine mammal species present in the survey area. Conservation issues to be considered include:

1. The proportion of the population of each species contained within the survey area.
2. The geographical range of the species involved.
3. Whether the survey area contains high value habitat for marine mammal species (e.g. known or potentially important feeding grounds or calving areas).
4. Where marine mammals with migratory habits occur:
 - a. Are migrations likely to be affected by the timing of the survey.
 - b. Is the survey likely to represent an acoustic barrier to the movement of cetaceans along a bathymetric feature or across the entrance a feature such as a bay or estuary?
5. Consideration must be given to the cumulative effects of conducting more than one seismic/acoustic survey in the same area, at the same time.

Data on cetacean distribution and relative abundance in Irish waters may be sourced from the publications and websites listed in Appendix I..

Exploration managers need to consult with relevant marine mammal experts and a risk matrix (example in Appendix II) must be completed during the planning phase and submitted to PAD for an exploration licence or other authorisation.

1.2. Sound Source Levels and Frequencies.

The minimum source level required to achieve results should be used and frequencies chosen to minimise impacts on marine mammals. Continuous noise is likely to be more damaging to marine mammals than pulsed sounds and should be avoided where possible. Available methods should be used to reduce and/or baffle unnecessary high frequency noise produced by airguns or other acoustic energy sources during the survey.

1.3. Marine Mammal Observers

Qualified and experienced Marine Mammal Observers (MMOs) must be present on board the vessel containing the sound source at all times during the survey. An experienced MMO is a person who has undergone marine mammal observation training and has spent a minimum of 6 months at sea over a 3 year period.

1.4. Guideline Implementation

During the survey it is the responsibility of operators to work with the MMO(s) to ensure that:

1. The soft start must occur in daylight hours with sufficient light to allow for a the pre 'soft start' scan.
2. The correct pre 'soft start' scan is conducted for the water depth in which the vessel is operating.
3. Soft start is delayed for the appropriate time period when marine mammals are recorded within the 'exclusion zone'.
4. The correct 'soft start' procedure is followed for the water depth in which the vessel is operating.
5. There should be no shooting apart from that necessary for the normal operation of a seismic survey or for a 'soft start'. (Protracted shooting which is not part of a survey line is discouraged).

1.5. Post-Survey Report

A report from the MMO detailing the marine mammals sighted, the methods used to detect them, mitigation actions taken during the survey (such data must be entered on standard forms provided), problems encountered and any other comments must

be submitted within 30 days of completion of the survey to PAD. This information will be made available to DoEHLG. In National interest Operators are requested that this data be made publicly available.

Such reports must include:

1. The survey reference number supplied by the PAD or other statutory body.
2. Date and location of the survey.
3. Number and volume of each airgun used and a calculated total volume of the array.
4. Nature of airgun array discharge frequency (in Hz), intensity (in dB re. 1 μ Pa or bar metres) and firing interval (seconds), or details of other acoustic or electromagnetic sources used.
5. Number and types of vessels involved in the survey.
6. A record of all occasions when the airguns or other sound sources were used, including details of the pre soft start scan and the duration of the soft start (using standard forms).
7. Details of any problems encountered during marine mammal detection procedures, or during the survey
8. Marine mammal sightings (using standard forms).
9. Details of watches made for marine mammals and the seismic activity during watches (using standard forms)
10. Reports from any observers on board.

SECTION 2: Marine Mammal Observers

The following conditions apply to the allocation of MMOs:

1. For deep sea (200m +) areas to the west of Ireland, for surveys within areas of conservation significance (e.g. SACs) and for areas off the south coast from June - February, the MMO must be an experienced cetacean biologist or an MMO with at least three seasons worth of experience.
2. MMOs must be engaged solely in monitoring the operator's implementation of these guidelines and conducting visual/acoustic observation of mammals during the survey.
3. The MMO should be onboard the vessel carrying the sound source. If a survey involves time sharing, then MMOs should be placed on all source vessels.

SECTION 3: Guidelines for carrying out soft starts.

In the following guidelines the term 'sound source' refers to seismic, side-scan sonar, multi-beam, and other acoustic and electromagnetic energy sources.

3.1 Pre Soft Start Scan for Marine Mammals

1. Waters up to 200m depth

MMOs should survey the area for presence of cetaceans **30 minutes** before the onset of the soft start. A minimum distance of **1000 meters** is required between the centre of the array/sound source and the nearest cetacean before soft start can commence.

2. Waters deeper than 200m

MMOs should survey the area for presence of cetaceans **60 minutes** before the onset of the soft start. A minimum distance of **2000 meters** is required between the centre of the array/sound source and the nearest cetacean before soft start can commence.

The longer survey time and wider exclusion zone in waters deeper than 200m are:

1. In acknowledgement of the fact that the 'footprint' of an acoustic source covers a much wider area in deep waters and so animals at a greater distance from the vessel will be affected.
2. To allow cetaceans feeding at greater depth time to re-surface and leave the area affected.

3.2 Soft Start Delay

1. Waters up to 200m depth

If marine mammals are seen within **1000 metres** of the centre of the sound source the start of the sound source(s) should be delayed until they have moved away, allowing adequate time after the last sighting for the animals to move leave the area (**30 minutes**). If the cetaceans do not leave the area it is recommended that the survey vessel alters course to ensure that the animals are outside the **1000 meter** exclusion zone when soft start commences.

2. Waters deeper than 200m

If marine mammals are seen within **2000 meters** of the centre of the sound source the start of the sound source(s) should be delayed until they have

moved away, allowing adequate time after the last sighting for the animals to leave the area (**60 minutes**). If the cetaceans do not leave the area it is recommended that the survey vessel alters course to ensure that the animals are outside the **2000 meter** exclusion zone when soft start commences.

In situations where seals are congregating immediately around a drilling or production platform, it is recommended that commencement of the seismic sources begin at least **1000 meters** from the platform.

3.3 Soft Start Procedure

1. Waters up to 200m depth

Soft start should commence after a **1000 meter** area around the vessel has been confirmed clear of cetaceans for **30 minutes**. Soft starts should achieve maximum (or desired) output after **20 to 40 minutes**.

Power should be built up slowly from a low energy start-up (e.g. starting with the smallest airgun in the array and gradually adding in others) over at least **20 minutes** to give adequate time for marine mammals to leave the vicinity. This build up of power should occur in uniform stages to provide a constant increase in output from the sound source.

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There should be a 'soft start' every time the sound source(s) is used, **even if no marine mammals have been seen.**

Summary of Soft Start Up Procedure

	Time in Minutes	
	< 200m depth	> 200m depth

Pre start up scan	30	60
Zone free of cetaceans	30	60
Soft start up	20-40	20- 40

The following conditions apply to Soft Starts:

1. Soft starts must occur during daylight hours when MMO's can carry out the required pre soft start scan.
2. To minimise additional noise in the marine environment, a 'soft start' (from commencement of soft start to commencement of the line) should take no longer than 40 minutes.
3. The 'soft start' procedure should be followed at all times including before test firing of the sound source.
4. If, for any reason, firing of the sound source has stopped and not restarted for at least 5 minutes a full 'soft start' for the appropriate depth should be carried out.
5. After any break in firing of any duration a visual check should be made for marine mammals within the 'exclusion zone' for that depth. If a marine mammal is present then re-commencement of shooting should be delayed as per the instructions above.
6. When time-sharing, where two or more vessels operate in adjacent areas and take turns to shoot to avoid causing seismic interference to each other, all vessels shooting should follow the full 'soft start' procedure for each line started.
7. Once the sound source has achieved its maximum output (post soft start) the survey need not be halted should cetaceans approach the vessel.

If a 'soft start' is not possible this should be identified at the time of application to PAD and measures identified as to how the operator proposes to deal with this issue.

When submitting their report, MMOs should indicate how the soft start was achieved

3.4 Line Change

Line change is the term used to describe the time it takes for a vessel to turn from the end of one survey line to the start of the next. Depending upon the type of acoustic survey being undertaken, the time for a line change can vary (e.g. between five and ten minutes for site surveys to two to three hours for 3D exploration surveys). In the

past this has caused some confusion as to when a soft start will be required. In order to standardise approaches the following guidance is provided:

1. If a break in output greater than 5 minutes occurs at any time whilst sampling then a full soft start (including pre soft start scan) for the appropriate water depth should be used prior to recommencing use of the sound source.
2. With the sound source running if turn-around time between sample lines or stations is greater than the time required to conduct a soft start (including pre soft start scan) for the appropriate water depth, then the sound source should be stopped and a soft start for the appropriate water depth should be used prior to commencing the new line.
3. For line change which take less time than that required to undertake a soft start, the sound source (e.g. full array of airguns) should continue firing during the line turn (e.g. for a site survey line turn of 5 minutes continue firing at full power).
4. For high resolution site surveys line changes it is also permissible to reduce airgun output at the end of each line to an output of 150dB. The increase from 150 dB to full power, prior to the start of the next line, should be undertaken in a stepped manner similar to a full soft start.

3.5 Undershoot Operations

During an undershoot operation a second vessel is employed to tow a seismic source or airguns although the main vessel will still tow the streamer array. This is to allow shooting under platforms or around any other obstructions at sea. This operation can sometimes lead to difficulties when, as a term of the consent, a dedicated MMO has been requested. The following guidance is provided:

1. The MMO should always be onboard the source vessel.
2. In some cases this guidance may be difficult to implement and therefore operators who foresee a problem placing an MMO onboard a vessel undertaking an undershoot operation must notify PAD during the application process.

Appendix I: Sources of data on Marine Mammal distribution and abundance in Ireland.

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<http://www.iwdg.ie/downloads/CelticExplorerReport2004.PDF>

IWDG (2004). Cetacean Distribution and Relative Abundance Survey during Blue Whiting Survey 2004. *Unpublished survey report, Marine Institute, Galway*.
<http://www.iwdg.ie/downloads/CelticExplorerReport2004b.PDF>

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Appendix II: Example of proposed risk matrix (following SCAR report on marine acoustic technology and the Antarctic environment 2001).

Effect on Marine Mammals

<i>Level</i>	<i>Detailed description</i>
1	Individual show no response, or only a temporary (minutes) behaviour change. No change to environment or populations
2	Individuals show short-term (hours) behaviour change. Temporary displacement of a small proportion of a population; small proportion of habitat affected; no impact on ecosystem function.
3	Longer term (days) simultaneous displacement of a higher proportion of a population; disruption to behaviour; interference with feeding.
4	Simultaneous displacement and disruption over a period of weeks to behaviour and feeding of a large part of a population, a few injuries, some interference with breeding success.
5	Long-term displacement (months) of much of a population, injuries common, substantial interference in a season's breeding success, fatalities rare.
6	Injuries very common, fatalities, population jeopardised, long-term displacement from a large or important area.

Likelihood of Occurrence

<i>Level</i>	<i>Description</i>
A	Expected in almost all instances
B	Will probably occur in most cases
C	Could occur in a some cases
D	Could occur in a few cases
E	May occur in exceptional circumstances
F	Cannot see how it could happen

Example Risk evaluation:

Output 185-190 dB re 1µPa @ 1m.

Omni-directional.

Pings of millisecond length over 15 minutes during recovery.

Consequences

<i>Likelihood</i>	1	2	3	4	5	6
A	X					
B						

C						
D						
E		X				
F			X	X	X	X

Appendix III: List of cetacean species recorded in Irish waters.

Atlantic White-Sided Dolphin	<i>Lagenorhynchus actus</i>	co / os / br
Beluga	<i>Delphinapterus leucas</i>	va / arc /
Blue Whale	<i>Balaenoptera musculus</i>	uc / os / se
Bottlenose Dolphin	<i>Tursiops truncatus</i>	co / br
Common Dolphin	<i>Delphis delphis</i>	co / br
Cuvier's Beaked Whale	<i>Ziphius cavirostris</i>	uc / os
False Killer Whale	<i>Pseudorca crassidens</i>	uc / os
Fin Whale	<i>Balaenoptera physalus</i>	co / se
Gervais' Beaked Whale	<i>Mesoplodon europaeus</i>	va / st
Harbour Porpoise	<i>Phocoena phocoena</i>	co / br
Humpback Whale	<i>Megaptera novaeangliae</i>	ra / se
Killer Whale	<i>Orcinus orca</i>	sp / br [?]
Minke Whale	<i>Balaenoptera acutorostrata</i>	co / br [?]
Northern Bottlenose Whale	<i>Hyperoodon ampullatus</i>	uc / os
Northern Right Whale	<i>Eubalaena glacialis</i>	va / os
Pilot Whale (long-finned)	<i>Globicephala melas</i>	co / os / br
Pygmy Sperm Whale	<i>Kogia breviceps</i>	uc / os
Risso's Dolphin	<i>Grampus griseus</i>	co / br
Sei Whale	<i>Balaenoptera borealis</i>	uc
Sowerby's Beaked Whale	<i>Mesoplodon bidens</i>	uc / os
Sperm Whale	<i>Physeter macrocephalus</i>	co / os / br [?]
Striped Dolphin	<i>Stenella coeruleoalba</i>	uc / os
True's Beaked Whale	<i>Mesoplodon mirus</i>	uc / os
White-Beaked Dolphin	<i>Lagenorhynchus albirostris</i>	uc / os

co – common; *os* – offshore species; *br* – breeds in Irish waters; *va* – vagrant; *arc* – arctic species; *uc* – uncommon; *se* – seasonal; *st* – known only from strandings; *sp* – sporadic.

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These guidelines were prepared following consultation with the Irish Whale and Dolphin Group, Coastal Marine Resource Centre (University College Cork), Geological Survey of Ireland, Marine Institute, Petroleum Affairs Division (Department of Communications, Marine and Natural Resources) and Irish Offshore Operators Association. The text of these guidelines was based on the text of the Joint Nature Conservation Committee (JNCC) 'Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Surveys'.