



## APPRAISING THE INTERACTION OF NERC MARINE SCIENCE WITH THE ENVIRONMENT

### MARINE ENVIRONMENT INTERACTION POLICY

#### DELIVERING A WORLD-LEADING, BENCHMARK APPROACH

Natural Environment Research Council (NERC) aims to be a world leader in environmental research. As such, NERC aims to be conscious of how the research it supports and promotes, interacts with the environment in which it is undertaken, so that its impact may be minimised. Embedded in this goal, NERC also aims to be a world leader in understanding environmental interaction and the driver of best appraisal and mitigation practice globally.

The objective of NERC's Marine Environment Interaction Policy (MEIP) is to assess the consequences for the environment of all marine research undertaken not only from its own vessels (regardless of funding stream within or external to NERC), but also by any research NERC funds on any vessel of opportunity or barter delivery. In parallel, NERC aims to promote and enable mitigation measures to minimise any environmental impact or interaction. Consequently, this MEIP is applicable to all research activities contained within the ship time programme, and includes the usage of equipment from the National Marine Equipment Pool (NMEP) provided as part of loan agreements.

The primary goal of this MEIP is to ensure that a uniform and standard approach to the appraisal of environmental impact or interaction is applied to all NERC-funded or facilitated marine research. Included in this goal is the aim that the appraisal approach and any identified mitigation measures either meet or exceed global best practice, and that they are delivered in both a time- and cost-effective manner.

#### BEST-PRACTICE APPROACH

The marine environment is diverse, and the research methodologies and technological approaches that may be adopted to better understand it are wide-ranging. Therefore, a flexible approach is required in which the environmental context, or sensitivity to impact or interaction, as well as the modes and intensities of interaction need to be appraised.

For the purposes of this policy, the **Definitions of Mode of Interaction** are outlined in Appendix 1, and the **Definitions of Mode of Appraisal** are outlined in Appendix 2. A single research cruise may involve multiple modes of interaction. Therefore, the appraisal approach to be undertaken should be defined by the highest rating interaction activity to be employed.

#### FACILITATION

NERC will facilitate the appraisal of the marine research it funds by means of a **Marine Environment Appraiser** (MEA). This Appraiser will undertake a first-pass review of each Ship time and Marine Equipment (SME) and Autonomous Deployment Form (ADF) submission at the point it is confirmed as funded by its Principal Investigator, to determine if a Standard or Enhanced approach to environmental interaction appraisal is required as defined in Appendix 2.

Principal Investigators are required to include in a SME or ADF any known sensitivities in timing or environmental considerations at the time of submission. For activities deemed as special cases in terms of this MEIP, outline equipment specifications should also be provided at the time of SME or ADF submission, for example, the initial design of a seismic source array.

## **APPROACH**

For SMEs or ADFs deemed to require the **Standard approach**, the Marine Environment Appraiser will undertake the Marine Environment Interaction Appraisal (MEIA) as part of the annual cruise programming cycle. No input from the Principal Investigator is envisaged in these cases, unless clarification of equipment specification or mode of usage is required.

For SMEs or ADFs deemed to require the **Enhanced approach**, the Marine Environment Appraiser will undertake the MEIA including, as appropriate, any modelling and quantification of the nature of the impact or interaction that any activity may have, for example, seismic source modelling. The Principal Investigator may be called upon to assist with this process and should supply any equipment specification and usage information requested by the Appraiser. If the appraisal concludes that a **species of concern** review is also required, this will be undertaken by the Marine Environment Appraiser and may be used to inform cruise scheduling, for example, to avoid times of the year where the proposed activities may have a greater impact.

## **MEIA TIMING**

The MEIA process should be completed within a time frame that enables it to be submitted with any necessary diplomatic clearance application as/when required. As part of the MEIA, the Marine Environment Appraiser will also identify and document any mitigation measures in the form of an **Marine Environment Mitigation Plan (MEMP)**.

## **EMBEDDING IN THE CRUISE PLANNING PROCESS**

The MEIA will be considered as part of cruise scheduling. The MEMP will be discussed as a standing agenda item at the cruise planning meeting. Any mitigation measures identified as part of the appraisal process will be discussed, agreed and enacted as part of the cruise planning and delivery process, and the MEMP updated accordingly. Principal Investigators are required to adhere to any mitigation measures agreed and documented in the MEMP, and are required to accommodate the delivery of the MEMP at sea within the research programme.

It is envisaged that a MEMP will evolve hand-in-hand with the cruise planning process, and take into account any requirements or special measures defined as part of any diplomatic clearance. Consequently, the Marine Environment Mitigation Plan will only become final at the point of departure from port. The environmental interaction appraisal and mitigation planning framework is summarised in Appendix 3.

## **BUY-IN AND CONFLICT OF INTEREST AVOIDANCE**

Best practice in environmental impact avoidance and mitigation is underpinned by the engagement of those interacting with the environment in a manner that might be deemed impacting. Delivering best practice in a cost-effective manner, encouraging buy-in to that best practice, is achieved in two ways: firstly, to plan activities such that they cause no more than the minimum impact or interaction necessary to achieve the scientific goals; and secondly, empowering delivery of the mitigation measures underpinned by adequate and appropriate training.

Scientists funded by NERC have an interest in the environment by definition and also have a requirement upon them to behave in an ethical manner and avoid conflicts of interest. On that basis, it is deemed appropriate that the scientific and technical members of the ship's crew and the Officers of the Watch on the vessel's bridge may be engaged in any mitigation process. All parties will be expected to act in accordance with the MEMP and behave in an ethical manner.

## **OPERATIONAL BEST PRACTICE**

Scientific and technical members of the ship's crew are required to adhere to best practice and avoid any unnecessary or gratuitous interaction or disturbance of the marine environment, even for activities deemed to be of low risk.

## **ENVIRONMENTAL CONTAMINATION AND POLLUTION**

Under international convention, vessels must adhere to strict waste disposal regulations. All NERC-funded research activities should comply with these regulations. However, NERC recognises that certain deployed equipment may inevitably introduce materials to the seabed, defined here as **inevitable waste**. In these cases, best practice is that such materials should be procured or designed to be environmentally degradable or inert wherever possible so that, even though these may have a short-term local impact on the environment, their medium-to-long-term impact will be negligible. The MEIP requires that the use of such materials be identified on a SME or ADF at point of submission to enable environmental interaction appraisal. NERC also recognises that despite best efforts not all seabed-deployed equipment can always be recovered, and often for reasons that will never be known. Such instances should also be regarded as inevitable waste. Unless a diplomatic clearance, international convention or other specific regional regulation requires it, NERC MEIP does not require such inevitable waste to be recovered if the best-practice approach has been adopted wherever possible or practicable.

## **HAZARDOUS MATERIALS**

Marine research may involve a number of materials that can be classified as hazardous. However, NERC recognises that certain deployed equipment or research activities may inevitably introduce such materials into the marine environment, defined here as **inevitable hazard**. In these cases, best practice is that the use of such materials is not excessive or gratuitous. In addition, wherever possible or practicable, such materials should be procured or designed to be environmentally degradable so that, even though these may have a short-term local impact on the environment, their medium-to-long-term impact will be negligible. The MEIP requires that the use of such materials be identified on a SME or ADF at point of submission to enable environmental interaction appraisal. As part of the cruise planning and delivery process and before use, an appropriate COSHH declaration should be provided, together with a risk of use assessment.

## **PROCUREMENT OF EQUIPMENT TO BE USED IN THE MARINE ENVIRONMENT**

Procurement of equipment to be used as part of NERC-funded science, whether that be as part of the vessel-fitted systems, temporarily affixed to a NERC vessel or used from any NERC vessel or NERC-funded vessel of opportunity or barter, should be specified in a manner that is environmentally aware and in adherence with the best-practice principles of this MEIP. For example, acoustic systems should have low power start-up/ramp-up capability wherever possible or practicable.

## **COSTS**

The costs associated with the appraisal process or the delivery of any identified mitigation measures will be borne by NERC. Such costs will be accommodated centrally and should not be included in the budgeting process for grant applications. The cost of any special mitigation measures required as part of any diplomatic clearance approval, which may be received at a very late stage in the cruise planning and delivery process, will also be borne by NERC for any NERC-funded cruise no matter the funding type. In non-NERC cases, such costs will be passed onto the funder. However, marine mammal observation and passive acoustic monitoring training costs for members of a scientific party should be included in any grant application, regardless of funding type.

## **SPECIAL CASE MITIGATION MEASURES – THE BEST PRACTICE APPROACH**

Inevitably, certain marine research activities are more environmentally invasive than others. Such special cases warrant the definition of explicit best practice mitigation measures that Principle Investigators and the leaders of any equivalent equipment trials or testing processes should follow.

These mitigation measures adhere to the principles defined by the Joint Nature Conservation Committee's (JNCC) guidelines (issue 2017) for geophysical survey operations on the UK continental shelf, that have been adopted globally as best practice by the hydrocarbon exploration, offshore engineering and renewable energy industries, with extensions developed independently for particularly sensitive areas, e.g. the Gulf of Mexico, the coral reefs of Australasia etc.. In the absence of any special mitigation

measures being defined as part of any diplomatic clearance, international treaty or special regional regulation, the principles of the JNCC guidelines should be followed as best practice regardless of geographic location of survey.

In adhering to the principles of the JNCC guidelines, the following definitions and approaches should be adopted.

**Marine Mammal Observers** should be certified to JNCC standards via a JNCC-approved training course. MMOs should produce their certificate of competency for inspection at the start of any research cruise, trials or testing activity. If special mitigation measures are defined as part of any diplomatic clearance, international treaty or special regional regulation, at least one MMO should be trained in the applicable extensions or additions as appropriate to act as the point of reference. MMOs may be drawn from the scientific or technical members of the vessel's crew and, if the case, should sign a declaration of conflict of interest and adherence to best ethical behaviour. The Duty MMO should have the final say on the commencement or cessation of seismic activities in the presence of species of concern, and should not be subject to undue pressure or influence.

**Passive Acoustic Monitoring Operators** should have a certificate of competency issued by a recognised provider, which should be produced for inspection at the start of any cruise. PAM Operators may be drawn from the scientific or technical members of the vessel's crew and, if the case, should sign a declaration of conflict of interest and adherence to best ethical behaviour.

In **special cases**, such as terms and conditions of diplomatic clearance, international treaty or special regional regulation, which require mitigation measures to be delivered or overseen by an entirely impartial and independent MMO and/or PAM Operator, these services shall be sub-contracted by the National Marine Facility (NMF). The cost of this sub-contracted service will be included in the cruise delivery charge made to NERC or other external funding body.

The **location of the survey area** in relation to known breeding and rearing zones and migration paths should be considered, and surveys appropriately located and/or scheduled to avoid the most sensitive times of year.

The **mitigation zone** is defined as a 500m radius from the centre of the source of disturbance.

### *The active-source seismic special case*

For any seismic survey, all mammals (marine and coastal) and turtles should be considered as a **species of concern** by default for which mitigation is expected.

For any **equipment testing, training or trials** activity, at least one Marine Mammal Observer (MMO) should be part of the sea-going party and take responsibility for delivery of the seismic mitigation measures.

For any **research cruise**, at least three MMOs should be part of the sea-going party to enable delivery of the seismic mitigation measures 24/7. One of these MMOs (the Lead MMO) should also be trained in passive acoustic monitoring (PAM) and should take overall responsibility for delivery of the seismic mitigation measures.

The expected best practice seismic survey mitigation measures are summarised in Appendix 4.

### ***The acoustic source special case***

This case is primarily directed towards sub-bottom profiling and chirp sources, but the need for environmental consideration also applies, in principle, to all uses of acoustic transducers.

For any acoustic sub-bottom survey, all mammals (marine and coastal) and turtles should be considered as a **species of concern** by default for which mitigation is expected.

For any **equipment testing, training or trials** activity, at least one Marine Mammal Observer (MMO) should be part of the sea-going party and take responsibility for delivery of the acoustic mitigation measures during pre-start and start-up.

For any **research cruise**, at least one MMO (the Lead MMO) should be part of the sea-going party to enable delivery of the acoustic mitigation measures, and should take overall responsibility for their delivery. A General Lookout or the Officer of the Watch may assist the Lead MMO during surveying.

The expected best practice acoustic sub-seabed survey mitigation measures are summarised in Appendix 5.

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### ***Swath bathymetry surveying***

This case covers all uses of swath bathymetry systems, regardless of water depth.

For any swath bathymetry survey, any mammals (marine and coastal) sensitive to acoustic signals of <100 kHz should be considered as a **species of concern** by default.

As a general rule, where equipment capability allows, a ramp-up in output power start-up process should be enacted.

A general lookout should be kept for species of concern prior to and during the start-up process, and suitable avoidance measures enacted, e.g. vessel manoeuvring or delay, if a species of concern enters the mitigation zone.

Such an approach is regarded as best practice and no other mitigation measures are prescribed.

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## **GOAL**

NERC's Marine Environment Interaction Policy will ensure that:

- existing practise is clearly defined, documented and standardised across all marine research activities;
- all stakeholders are aware of their environmental responsibilities in planning and delivering research activities at sea;
- a standardised and uniform approach to environmental impact or interaction appraisal is defined and applied that reflects best practice;
- a clear and consistent approach to environmental impact or interaction mitigation is defined and applied that reflects best practise; and
- any process or procedure is compliant with diplomatic clearance, international convention or other specific regulation, and adheres to promoted best practice.

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On behalf of: NERC and the National Marine Facility, National Oceanography Centre

**APPENDIX 1: DEFINITIONS OF MODE OF INTERACTION**

Mode of Interaction	Definition
sub-seabed imaging	all towed active-source, sub-seabed imaging operations, regardless of source type or frequency  (e.g. seismic, chirping, electromagnetic)
seabed imaging	all towed or vessel-mounted seabed imaging operations  (e.g. swath bathymetry, single beam echo sounder, sub-seabed profiler)
seabed sampling	all operations that directly take samples from the seabed or near-seabed/sub-surface  (e.g. dredging, coring, drilling, biological sampling, seabed trawling)
seabed instrumentation and moorings	all operations that involve statically installing instrumentation on the seabed on a temporary or permanent basis  (e.g. sensed moorings, seabed navigation systems, seabed sensed platforms, seabed observatories, photographic platforms)
water-column imaging	all passive sensing operations, or active-source operations that emit acoustic “pings” into the water-column, regardless of source type or frequency  (e.g. ADCP, fish shoal mapping, sound velocity profiling, CTD profiling, USBL locating)
water-column sampling	all operations that take samples from or add to the water column  (e.g. water sampling, particulate sampling, tracers)
autonomous and remotely operated vehicles	all operations that involve remote vehicle operations, either tethered or untethered  (e.g. Autosub, ROV, gliders, tow-yo vehicles)

## APPENDIX 2: DEFINITIONS OF MODE OF APPRAISAL

Region	Sensitivity to impact	Activity	Mode of Appraisal	
			Standard	Enhanced
Marine protected area Special area of conservation Marine conservation zone	High	sub-seabed imaging		X
		seabed imaging		X
		seabed sampling		X
		seabed instrumentation and moorings		X
		water-column imaging		X
		water-column sampling		X
		autonomous and remotely operated vehicles		X
High latitude defined as: 1. within the Arctic Circle (>66.67°N) 2. within the Antarctic Treaty bound region (>60°S)	Medium-High	sub-seabed imaging		X
		seabed imaging	X	
		seabed sampling		X
		seabed instrumentation and moorings		X
		water-column imaging	X	
		water-column sampling	X	
		autonomous and remotely operated vehicles		X
Continental shelf and slope	Medium	sub-seabed imaging		X
		seabed imaging	X	
		seabed sampling		X
		seabed instrumentation and moorings		X
		water-column imaging	X	
		water-column sampling	X	
		autonomous and remotely operated vehicles	X	
Ocean	Low	sub-seabed imaging		X
		seabed imaging	X	
		seabed sampling		X
		seabed instrumentation and moorings	X	
		water-column imaging	X	
		water-column sampling	X	
		autonomous and remotely operated vehicles	X	

NOTE: The above definitions include consideration of potential to introduce *inevitable hazard* and *inevitable waste* into the marine environment, together with the *risk vs. likelihood of equipment loss* such that it is irretrievably introduced into the marine environment.

**APPENDIX 3: ENVIRONMENTAL INTERACTION APPRAISAL AND MITIGATION PLANNING FRAMEWORK**

MEA = Marine Environment Appraiser; PI = Principal Investigator; CM = Cruise Manager; M = vessel Master;  
STO = Senior Technical Officer of cruise

Stage point	Activity	Owner
<b>Initiation</b>		
	SME or ADF creation Inclusion of: <ul style="list-style-type: none"> <li>• equipment specifications</li> <li>• environmental sensitivities</li> <li>• timing considerations</li> <li>• inevitable waste declaration</li> <li>• inevitable hazard declaration</li> <li>• design and specification seismic source array (where applicable)</li> </ul>	PI
<b>Funded</b>		
	First-pass environmental interaction appraisal, including: <ul style="list-style-type: none"> <li>• determination of approach to appraisal</li> <li>• determination of cruise scheduling considerations</li> </ul>	MEA
<b>Approach</b>		
	<u>Standard</u> Undertake environmental interaction appraisal Create outline environmental mitigation plan	MEA
	<u>Enhanced</u> Undertake environmental interaction appraisal Define nature of enhanced environmental interaction Create outline environmental mitigation plan defining any mitigation measures	MEA / PI
<b>Cruise planning to delivery</b>		
	Review environmental interaction appraisal and environmental mitigation plan at cruise planning meeting	CM / MEA / PI
	Determine mitigation measures required and mode of facilitation and delivery at sea	CM / MEA / PI
	Sub-contract personnel and equipment services as required	CM
<b>Diplomatic clearance</b>		
	Review terms and conditions of any diplomatic clearance and determine implications for environmental mitigation plan	MEA
	Modify environmental mitigation plan as required	MEA
	Review mitigation measures	CM / MEA / PI
	Sub-contract personnel and equipment services as required	CM
<b>Departure from port</b>		
	Finalise environmental mitigation plan	PI / M / STO
	Deliver environmental mitigation plan	PI / M / STO
<b>Pre-arrival in port</b>		
	Review environmental mitigation plan and compliance	PI / M / STO
<b>Post-cruise review</b>		
	Identify any examples of good and bad practice	CM / MEA
	Address issues of concern	CM



#### APPENDIX 4: DEFINITION OF BEST PRACTICE SEISMIC SURVEY MITIGATION MEASURES

For the purposes of seismic surveys, regardless of source type, volume or signal frequency of operation, mitigation measures are expected for all species of concern. If, as part of an observational procedure, a species of concern is observed or detected, the approach outlined below should be adopted.

**Monitoring:** As best practice passive acoustic monitoring (PAM) as well as visual observations should be undertaken as part of any pre-start and start-up procedure. If a PAM system is available, survey start-up and repair and maintenance cycles are permitted during the hours of darkness as well as daylight. In the absence of a PAM system, pre-start and start-up procedures should be restricted to daylight hours, when visual observations can be made to a distance of greater than 500m from the vessel.

**Mitigation zone:** A mitigation zone should be established with a 500m radius centred on the seismic source, which defines the action to be undertaken in the presence of species of concern.

**Observation:** One MMO, the Duty MMO, should be available on any watch, and should co-ordinate the observations during pre-start and soft-starts. Additional crew or members of the scientific or technical parties may be utilised as extra pairs of eyes as/when required. During surveying, the Bridge Officer of the Watch may be available to keep a general lookout for species of concern and should report any sightings to the Duty MMO. The Duty MMO should then co-ordinate any necessary response to the observation, and log the observation.

**Pre-start:** During pre-start, 60 minutes of observation focusing on the mitigation zone around the seismic source should be undertaken. If no species of concern are observed in the mitigation zone during this period, the soft-start may commence. If species of concern are observed within the mitigation zone during this period, the observation period may recommence once 20 minutes have elapsed since the last observation, the soft-start being delayed accordingly.

**Soft-start:** The soft-start process should be enacted to take at least 20 minutes and no longer than 40 minutes, starting with the smallest volume component in the seismic source array, and proceed by increasing source component volume. Although there is no requirement to stop firing once the soft-start has commenced, if a species of concern moves into the mitigation zone, best practice dictates that the soft-start should be stopped, if practical and feasible to do so, with the soft-start recommencing after the species of concern leaves the mitigation zone, or after 30 minutes have elapsed since it was last observed.

**Transit between survey lines:** Normally, the seismic source should not be fired during transits between distinct and separate survey lines and a full pre-start and soft-start procedure should be enacted. However, where these shots provide full azimuthal coverage to create a 3D image of the sub-seabed, as recorded by contemporaneously deployed ocean-bottom seismographs, or where multiple survey lines comprise a closely-spaced grid where a linear transit or turn between lines take less time than a combined pre-start and soft-start procedure, then transit and turn shots may be fired.

**Full operations:** Once full power has been achieved, full seismic operations should continue until each distinct line, or all related lines have been acquired, or unless a period of repair and maintenance is required. Restarts following periods of repair or maintenance should follow the start of survey procedure. As the firing of a seismic source is regarded as a deterrent to species of concern, shooting may continue if a species of concern is observed, even if it is deemed likely that the species of concern may enter the seismic source mitigation zone. Although there is no requirement to stop firing, assuming the vessel is unable to manoeuvre an avoidance course, best practice dictates that shooting should be temporarily suspended until the species of concern moves out of the mitigation zone. If this process takes more than 10 min, a soft-start procedure should be enacted.

**Reporting:** During surveying all species of concern observations should be recorded on the forms provided by the JNCC. The Duty MMO is responsible for completing the effort form on each watch. Any observation made should be reported to and recorded by the Duty MMO.

**APPENDIX 5: DEFINITION OF BEST PRACTICE ACOUSTIC SUB-SEABED SURVEY MITIGATION MEASURES**

For the purposes of acoustic sub-seabed surveys, regardless of source type, power or signal frequency of operation, mitigation measures are expected for all species of concern. If, as part of an observational procedure, a species of concern is observed or detected, the approach outlined below should be adopted.

**Monitoring:** As best practice visual observations should be undertaken as part of any pre-start and start-up procedure, and survey start-up and repair and maintenance cycles should only be undertaken during the hours of daylight. Visual observations should be made to a distance of greater than 500m from the vessel.

**Mitigation zone:** A mitigation zone should be established with a 500m radius centred on the acoustic source, which defines the action to be undertaken in the presence of species of concern.

**Observation:** At least one member of the scientific or technical parties should be trained as an MMO (the Lead MMO), and should be available to co-ordinate the observations during pre-start and start-up. The Bridge Officer of the Watch or other members of the scientific or technical parties may be utilised as General Lookouts at all other times. During surveying, any sightings of species of concern should be reported to the Lead MMO. The Lead MMO should then co-ordinate any necessary response to the observation, and log the observation.

**Pre-start:** During pre-start, 60 minutes of observation focusing on the mitigation zone around the acoustic source should be undertaken. If no species of concern are observed in the mitigation zone during this period, the start-up may commence, adopting a progressive and uniform ramp-up in power approach if instrumentation allows. If species of concern are observed within the mitigation zone during this period, the observation period may recommence once 20 minutes have elapsed since the last observation, the start-up being delayed accordingly.

**Start-up:** The start-up process should be enacted to take at least 20 minutes and no longer than 40 minutes, starting at the lowest possible power setting if instrumentation allows. Although there is no requirement to stop surveying once the start-up has commenced, if a species of concern moves into the mitigation zone, best practice dictates that the start-up should be stopped, if practical and feasible to do so. Start-up should recommence either after the species of concern leaves the mitigation zone, after the vessel manoeuvres to place the species of concern outside the mitigation zone, or after 30 minutes have elapsed since it was last observed.

**Transit between survey lines:** Normally, the acoustic source should not be operated during transits between distinct and separate survey lines and a full pre-start and start-up procedure should be enacted for each line in the survey. However, where transits between survey lines will take less than 40 min, source operation may continue but power levels should be reduced if instrumentation allows.

**Full operations:** Once full power has been achieved, full acoustic sub-seabed survey operations should continue until each distinct line, or all related lines have been acquired, or unless a period of repair and maintenance is required. Restarts following periods of repair or maintenance should follow the start of survey procedure. As the operation of an acoustic source may be regarded as a deterrent to species of concern, surveying may continue if a species of concern is observed, even if it is deemed likely that the species of concern may enter the acoustic source mitigation zone. Although there is no requirement to stop surveying, if the vessel is unable to manoeuvre off-line such that the species of concern is out of the mitigation zone, best practice dictates that surveying should be temporarily suspended until the species of concern moves out of the mitigation zone. If this process takes more than 10 min, a start-up procedure should be enacted.

**Reporting:** During surveying all species of concern observations should be recorded on the forms provided by the JNCC. The Lead MMO is responsible for completing the effort form. Any observation made should be reported to and recorded by the Lead MMO.