

Position Statement 1: Environmental Impact Assessments and Mitigation Plans

The Marine Mammal Observer Association (MMOA) considers that the production of a comprehensive and informative Environmental Impact Assessment (EIA) and the subsequent development of a site-specific, detailed Mitigation Plan (MP) for Species of Concern (SoC) are fundamental to effective mitigation programmes. It is important that these documents are produced well in advance of a mitigation survey and that both documents are made available to the mitigation team before or at the start of a survey so that the processes involved in developing the MP are clearly understood by the Marine Mammal Observers (MMOs)/Passive Acoustic Monitoring (PAM) Operators. Some key points are outlined below.

Environmental Impact Assessment (EIA)

In the context of this document, the purpose of an EIA is to identify, predict and evaluate the effects of anthropogenic sound on SoC prior to, and during, a survey using a sound source and identify mitigation measures to address these. Some regulators provide specific guidance for the development of EIAs relating to the potential environmental impacts of seismic surveys and the use of other anthropogenic sound sources (such as piling, geophysical and geotechnical site survey and explosives). The MMOA considers that the EIA content with respect to SoC and anthropogenic sound should include the following (as a minimum):

- Information on the potential and confirmed occurrence of SoC within the project area. This information should originate from comprehensive literature reviews of peer-reviewed scientific papers whenever possible. However, the MMOA recognises that published scientific information is lacking for many marine regions. In its absence, consideration should be given to additional supporting information; such as reports and datasets that may highlight species presence in an area. This should include information on species presence, density, seasonal and spatial distribution, breeding periods and behaviour, where these are available. Any species of particular sensitivity should be identified, for example through assessments of SoC global and regional conservation status (such as IUCN status), local protective legislation to identify locally-important conservation priorities, and compiled information on breeding, feeding or migratory habitat which may indicate the presence of critical habitats for SoC. Where existing information on species occurrence within a project area is scarce, the establishment of baseline characterisation surveys should be considered to provide initial information on SoC occurrence on which a mitigation plan can be based and subsequent impacts identified. Given the marked seasonal variation in occurrence of many SoC within particular areas, any baseline characterisation surveys carried out should occur at the same time of year as the planned use of the anthropogenic sound source.
- Details of any environmental legislation pertinent to the protection of SoC in the project area and its implications for the mitigation programme.
- Characteristics of the source being used during the survey. These should include equipment types, amplitude (sound level) and pressure, frequency characteristics and pulse duration. Duration of noise-generating activities and repetition rates for impulsive sources should be provided to allow characterisation of total acoustic emissions to which animals would be exposed.
- An assessment of transmission loss around the sound source. This is commonly modelled as simple geometric spreading, either spherical (intensity falls off with distance squared) or cylindrical (intensity falls linearly with distance). However, these methods are oversimplified in the case of loud sound sources in deeper waters, or depending on specific oceanographic conditions within a project area that often lead to substantial variability of transmission loss across different frequency bands. Consequently, the MMOA considers that transmission loss modelling should always be site-specific and should take into account the local topography and oceanography

of the project area at the time of the survey and also the geoacoustic nature of the seabed sediments and bedrock. In the absence of site-specific data it is recommended that databases such as the World Ocean Atlas for oceanography and ETOPO1 (NOAA) or Shuttle Radar Topography Mission (SRTM) for bathymetry, and the British Geological Survey (BGS) charts in UK waters for sediment and bedrock information be investigated for modelling purposes. For these reasons more sophisticated modelling techniques to those listed above should be carried out by suitably experienced (or expert) acoustic modellers. The correct model, or combinations of, should be used to cover the range and frequency of the source, for example, short range/high frequency sources require different models to long range/low frequency sources.

- Identification of, and predictions regarding, the potential impacts of the sound source on the SoC that occur in the area (bearing in mind that this will likely require separate evaluation for particular species groups, for example mysticetes, odontocetes, pinnipeds, sea turtles etc.), via a thorough literature review that includes consideration of specific hearing sensitivities. With regard to anthropogenic sound, consideration should be given to:
 - The potential impacts of anthropogenic sound on the SoC occurring within the survey area. This should include both direct (e.g. tissue damage, hearing loss) and indirect (e.g. displacement of SoC or their prey species) impacts.
 - The sound levels documented to cause hearing loss and other impacts in the specific SoC found within the survey area.
 - The current 'safe sound levels' (i.e. sound levels below which exposure is unlikely to result in disturbance or injurious impacts) documented for SoC.
 - Calculations of the radius of these safe levels around the proposed sound source (taking into account actual/expected sound transmission properties within the specific survey area and pulse emission rate). Also to be included should be a discussion of how the size of a given impact zone may change as a result of propagation in one direction or another. For instance, the beam pattern of a sound source combined with propagation over the local bathymetry might result in the distance over which an impact may occur being somewhat shorter in one direction than another.
 - Conclusions on the likely impacts on individual animals and at the population level (especially considering feeding, breeding and migratory areas), based on sound exposure and overall duration of the survey.
 - An assessment of cumulative impacts where more than one operation is active simultaneously or activity is over a long period of time. For example, some piling construction projects may last for 2-3 years. It should also be noted that an assessment of cumulative impacts is a requirement under some countries' EIA regulations.
- A review, identification and evaluation of other potential impacts of the survey work on SoC within the survey area, for example vessel strikes, pollution and entanglement in seismic gear.
- Information on how the potential impacts on SoC identified during the EIA will be mitigated during the survey. This may take the form of a Mitigation Plan (MP) for specific high-risk impacts (e.g. a MP for sound source mitigation as described below) and additional statements regarding other impacts (e.g. the use of 'turtle guards' on seismic tail buoys to mitigate against sea turtle entrapment).
- All relevant documentation should be made available to personnel implementing the mitigation plans.

Mitigation Plans (MPs) for anthropogenic sound sources

The MP should provide the specific details of how particular impacts on SoC identified during the EIA will be mitigated during the survey. The MMOA considers that a MP should be:

- Detailed, providing unambiguous instruction on the procedures to be followed under the various circumstances that may arise during a survey (flow charts of mitigation actions are often beneficial).
- Clear and using correct, consistent and well-defined terminology throughout, to avoid any misinterpretation.
- Produced by, and reviewed by, personnel who have sufficient expertise (indicated by qualifications and previous experience with marine fauna mitigation) to make these assessments and decisions.

Due to their first-hand experience in the practicalities of implementing MPs during surveys, the MMOA recommends that experienced MMOs/PAM Operators are shown the MP prior to a project in order to highlight any discrepancy or areas that need further clarification. The MP agreed prior to the survey should be followed rigorously as a minimum standard throughout the survey and should not be subject to changes once a survey has commenced. The only exceptions should be when ambiguities in the protocols require clarification, or when additional mitigation measures are added based on unexpected faunal encounters. These changes must be approved by the relevant authority or regulator.

The information below relates specifically to MPs which aim to mitigate the impacts from an anthropogenic sound source on SoC. **Some regional regulators have existing mitigation procedures that must be adopted as a legal requirement during surveys in their waters, and those procedures should always be followed when developing a MP.** The MP should clearly describe the recommended suite of mitigation measures to be implemented by the mitigation team, in order to minimise the potential impacts of the sound source on the SoC that were identified during the EIA. This should include the following (as a minimum):

- Establishment of a mitigation zone (MZ) around the sound source.
- Procedures for the monitoring of SoC within the MZ prior to and during operations.
- The importance of hiring suitably qualified MMOs and PAM Operators.
- Use of appropriate real-time mitigation measures should a SoC be detected inside the MZ prior to and during source operations. This should also include a list of SoC for which mitigation measures will apply.
- The incorporation of additional mitigation measures to minimise the likelihood that undetected SoC are exposed to injurious levels of source activity (e.g. due to night, poor weather or the limitations of monitoring techniques). This should include a detailed outline of source start-up procedures as well as clarification on what procedures should be followed after any breaks in source activity. In the case of seismic airgun arrays this should include information on whether the system will be automated or manually-operated, details of the order in which each gun of specified volume/sound level will be added-in and a graph showing cumulative volume/sound level of the array over time. This should expressly include procedures for the inclusion of 'spare guns' in the soft start without exceeding the normal operational volume during production and procedures for soft starts during gun tests.
- Procedures to ensure that the amount of source activity is minimised as much as possible during operations.
- Information on the communication links (and chain of command) between the mitigation team and the operators of the sound source, in order to ensure quick and well-implemented mitigation actions when animals are observed.
- Procedures for recording and reporting compliance to appropriate regulatory bodies.
- Documentation that is carefully worded to ensure that it is interpreted as mandatory rather than optional.

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Position Statement 2: Mitigation Measures Required in a Mitigation Plan

The Marine Mammal Observer Association (MMOA) has developed some generic advice and guiding principles to follow when drafting a Mitigation Plan (MP) for Species of Concern (SoC) during surveys using anthropogenic sound sources in the marine environment. This advice is based on the MMOA recognising that nominating single generic values for mitigation zones, delay durations and soft starts is inappropriate. Instead, the MMOA supports the establishment of survey and site-specific mitigation measures based on the water depths, oceanographic conditions, sound source and SoC likely to be encountered during a particular survey. **Please note that in some geographic areas the regulatory bodies have developed a set of formalised mitigation procedures and where that is the case those procedures must be strictly adhered to.** Before developing the appropriate MP, a full Environmental Impact Assessment (EIA) should be carried out.

The Principles of Establishing Mitigation Measures for SoC

The MMOA believes that the principle adopted at the EIA stage prior to the survey (hereafter the 'Planning Principle') should be:

“to minimise the likelihood of potential injury or disturbance to Species Of Concern (SoC), including potential displacement of SoC from critical habitat”

This planning principle will be achieved by identifying seasons/areas of particular importance for SoC (through the EIA and, where necessary, baseline survey work), and scheduling survey activities around those times/areas. The MMOA believes that avoidance of critical habitat is the single most important mitigation measure and should be considered early in the survey planning process.

The MMOA believes that the primary principle adopted during real-time mitigation activities during a survey (hereafter the 'Mitigation Principle') should be:

“to minimise the likelihood that all Species of Concern (SoC) are exposed to source levels that have the potential to cause injury or death”

This mitigation principle should then be consistently applied throughout the procedures adopted. The remainder of this document is concerned with the implementation of this mitigation principle. More detailed advice on mitigation measures are outlined below:

Mitigation Zones (MZs)

An acceptable ('safe') level of source activity should be determined i.e., a sound level which scientific studies indicate is unlikely to be injurious to the identified SoC. The MZ will then represent the radius around the sound source within which sound levels are higher than this predetermined 'safe' level. More than one MZ may be appropriate when different species groups are being mitigated for, e.g., sea turtles, mysticetes, odontocetes, pinnipeds and sirenians. Alternatively, simplification for monitoring purposes can be achieved by selecting a MZ for all SoC in an area that is based on the most precautionary zone from impact modelling. Cumulative exposure metrics (i.e., SEL) should be considered when SoC may be exposed over long durations or to multiple pulses of impulsive sources.

The MZ should be established by acoustic modelling to determine the zone of influence for a particular source and activity for each functional hearing group. The MZ should be determined for each source by applying modelled transmission loss to the corresponding frequency band source levels. Transmission loss modelling should consider in situ measurements of local

environmental conditions (e.g. water depth, seabed type, water temperature profiles) which affect the resulting sound propagation.

Where surveys are of long duration (> 1 month), MZ models should be updated regularly according to changes in localised oceanographic conditions within the site. For example, changes in water temperature and salinity are often measured regularly using T-S dips during seismic surveys and can be incorporated into updated models to calculate site-specific MZs over time.

If sound source modelling at the site of the actual project is not possible, the radius of the MZ should be determined by assuming that local conditions are optimal for sound propagation i.e. the worst case scenario which considers the hardest seabed sediment or substrate that is likely to be found in the area, the sound speed profile that is likely to give rise to the longest range propagation and the loudest noise likely to be generated by the sound source during the survey. In the case of seismic surveys, the firing of all guns simultaneously on the array but not including the spare guns should be considered i.e. the firing of spare guns should not be carried out unless other guns are dropped out first so that production volume is not exceeded).

Monitoring of SoC Within the Mitigation Zone Prior to and During Operations

Monitoring period prior to source activity – A minimum monitoring period should be adopted prior to the initiation of a sound source to detect any SoC in the area. The duration of the monitoring period can be determined by what is known about the surfacing rates and behaviour of SoC in the area. Various mitigation procedures worldwide recommend no less than a 30 minute watch period prior to source activation and the MMOA recognises this as an acceptable minimum period.

Monitoring during source activity – The MMOA recommends that monitoring for SoC continues throughout periods of source activity, in order to collect information on potential impacts. When shut-down procedures are part of the adopted mitigation protocol (as recommended by the MMOA for sound levels considered likely to cause injury/Permanent Threshold Shifts in hearing (PTS)) then monitoring will be required throughout periods of source activity in order to protect SoC.

Monitoring methods – Monitoring of the MZ may comprise visual monitoring during daylight hours, passive acoustic monitoring (PAM) during all hours and night vision/ infrared techniques during hours of darkness. The MMOA fully supports the development and use of novel detection technologies (remote PAM and thermal imaging ~~are promising developments~~ to improve detection and mitigation). All monitoring methods should be assessed for their efficiency and likelihood of detecting the SoC within a particular area. Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) Operators should be positioned as near to the source as possible for effective monitoring of the MZ. The MMOA considers that the MMOs/PAM Operators should always be located on the source platform^[1], unless an alternative platform has the potential to have a better view of the sound source. This would be essential if the distance of the sound source from the platform compromises the ability of the MMO/PAM Operator to effectively monitor the MZ for the relevant SoC. The relative detectability of each species group should be carefully considered, since some (e.g. sea turtles) may only be reliably detected within a few hundred metres of a visual observer. Consequently, a MMO located on a source platform from which the sound source is deployed several hundred metres astern (i.e., most 3D/4D seismic vessels) is unlikely to be able to reliably visually detect such fauna within the latter portion of a MZ. Where multiple sources are deployed from multiple survey platforms, a separate MZ and monitoring team are required for each source.

Use of Suitably Qualified Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) Operators

Monitoring should only be conducted by independent, experienced and dedicated MMOs and PAM Operators. The MMOA considers that, in this context, experience should reflect both field expertise with marine mammals (in order to develop detection and identification skills) and suitable accredited or regulator approved training courses (in order to develop proficiency with implementing mitigation procedures and completing data forms). Please see the MMOA Position Statements 4 & 5 – [Marine Mammal Observer \(MMO\) Qualifications](#) and [Passive Acoustic Monitoring \(PAM\) Operator Qualifications](#) - for further guidance.

There needs to be some quality assessment protocol to ensure that suitably qualified MMOs and PAM Operators are being employed before the project starts and the qualification of each should be outlined in the final MMO/PAM report. The regulatory body in place should ensure this and in the absence of a regulator, the Client should adopt this assessment protocol as “best practice”.

An assessment should be made of how many MMOs and PAM Operators are required to provide the necessary mitigation monitoring, allowing sufficient rest periods to avoid fatigue. As a rule, a MMO/PAM Operator should not be expected to work more than the standard 12 hr work per day of other seafarers – where observer duties include observations, data recording and reporting. Additionally, since visual observations require a high level of concentration, the MMOA recommends that a MMO team should be organised such that no MMO works for more than 2 hr continuously followed by a break of at least 1 hour.

Appropriate Real-time Mitigation Measures Should a SoC be Detected Inside the MZ Prior to and During Source Operations

Species of concern inside the mitigation Zone (MZ) - If a SoC is detected (visually or acoustically) within the MZ prior to source activation, commencement of the source should be delayed until such time that the animals depart the MZ. If it is unclear whether an animal has departed the MZ, an additional “buffer” time should be added to ensure a high likelihood that the animal is no longer in proximity to the sound source. Due to the limitations of passive acoustic monitoring (see Position Statement 3 – [Passive Acoustic Monitoring](#)) it is very unlikely that a PAM operator, during the hours of darkness, will be able to determine when SoC have left the MZ, unless experienced, (with the only possible exception being the ability, at times, to track vocalising sperm whales) and adding buffer times will be a standard procedure throughout night-time operations. Vessel speed, and the behaviour and swimming speeds of specific SoCs, should be considered to determine the likely length of time for a safe distance to be established. Different buffer times may be required according to the species groups being mitigated for, e.g. sea turtles, mysticetes, odontocetes, pinnipeds, or sirenians.

If a SoC is detected (visually or acoustically) within the MZ while a sound source is active, the source should be shut down until such time that the animals depart the MZ (see above for circumstances where it is unclear whether an animal has departed the MZ). The source should resume using a soft start procedure (see below).

Some regulators worldwide do not adopt shut down procedures, based on an unproven ‘common sense’ assumption that animals opting to approach a sound source voluntarily are indicative of a lack of discomfort and consequently do not require mitigation. This principle has also been adopted as ‘best practice’ in the mitigation plans for surveys in some geographic areas where no formal regulator guidance is in place. However, there is no scientific basis for the assumption that animals entering a mitigation zone (which has previously been defined as an injurious zone) ‘voluntarily’ while a source is active, are somehow less susceptible to

impacts. This may particularly be the case when young, sensitive animals are accompanying adults and are involuntarily exposed to high sound levels. This would also apply to feeding animals where the drive for food means that the animals show greater levels of tolerance e.g. bowhead whales. Finally, some SoC, for example sea turtles basking at the surface for metabolic purposes, may not have sufficient mobility to move away appropriately from an approaching sound source. The MMOA believes that mitigation plans should aim to “**minimise the likelihood that all species of concern are exposed to source levels that have the potential to cause injury**” and therefore supports shutting down a sound source whenever a SoC enters the MZ for whatever reason.

The Incorporation of Additional Mitigation Measures to Minimise the Likelihood that Undetected SoCs are Exposed to Injurious Levels of Source Activity (e.g. due to night, poor weather or the limitations of monitoring techniques).

Adopt a ramp-up or soft start procedure^[2] – The aim of the soft start is to initiate the source at the lowest possible sound level and gradually increase power over a pre-defined time period to reach the operational sound level. This procedure is intended to allow animals to depart the immediate vicinity of a sound source prior to being exposed to potentially injurious levels of sound. The soft start must commence at a sound level which does not have the potential to cause injury. If the source cannot be started at a sufficiently low (i.e. ‘safe’) power level, then an alternative method, such as deploying specially designed acoustic alarms, should be adopted. Acoustic alarms or pingers should be designed to cover the frequency ranges of all SoC and should also be activated gradually.

The duration of a soft start should be sufficient to allow an animal to move to a safe distance before full power is achieved. The behaviour and swimming speeds of the SoC should be considered to determine the length of time that it takes for an animal to move to a safe distance. Consideration should be given to situations when full soft starts might not be necessary – for example when testing low-power single airguns at source levels below those that are considered injurious.

In the case of seismic airgun arrays, the airgun soft start procedure should be automated wherever possible to avoid operator inconsistencies in start-up techniques. Seismic contractors should have, and follow, detailed protocols for the order in which each gun of specified volume/sound level is added-in over time and a graph showing cumulative volume/sound level of the array over time. This should expressly include procedures for the inclusion of ‘spare guns’ in the soft start (without exceeding normal operational volume during production) and procedures for soft starts during gun tests.

For other operations utilising sound sources, such as pile driving, military sonars and explosives, it is important to have pre-determined and detailed soft start procedures in place for all equipment that produces high-amplitude sound with the potential to cause injury to SoC.

Breaks in Source activity – Technical issues with equipment sometimes result in a “break in source activity” during surveys, where the sound source is temporarily shut down for maintenance. Various regional guidelines stipulate permitted short lengths of time within which a source can resume at full power following such a break in activity provided no SoC have been detected in the MZ during the break. If the source does not resume within that period of time, a soft start (with monitoring beforehand) must be carried out prior to resuming the survey. Determining an appropriate length of time for a permitted break in source activity (i.e. where a soft start is not required on source resumption) should take account of:

- Whether the MMOs and PAM Operators can be certain that the MZ was free of SoC (i.e. whether they were on watch, whether it was night or day, the detectability and mobility of the SoC).
- The speed of the platform and how far it has moved since shutting down.

The MMOA believes that, in most cases, a precautionary approach to mitigation should not permit breaks in source of activity of more than 5 minutes without requiring a soft start. This is particularly the case for SoC of low detectability such as sea turtles. The MMOA does not support resuming at full volume following a break in source activity if no visual watch for SoC was being maintained throughout the break by a MMO (i.e. at night or in poor visibility). This procedure should only be utilised during occasional, unexpected incidences of technical issues with source activity; it should not be a routine method of avoiding a subsequent soft start.

Noise records – The MMOA is aware that noise records of (usually) 1 or 2 minutes duration are routinely carried out during seismic surveys, prior to the start of each line. This involves shutting down the source and then resuming at full power. The routine occurrence of noise records should be acknowledged and specifically included within Mitigation Plans. The mitigation team should maintain a watch for SoC throughout the duration of noise records in case animals are observed within the MZ during the break in firing and mitigating actions are required. The duration of noise records should be kept to the minimum possible, and these should not be carried out and included within the duration of the soft start.

Use of a mitigation source - The practice of keeping sound sources active at reduced power in-between operations (for example during seismic survey line changes) is sometimes adopted by regulators or included in mitigation plans where no formal regulations are in place. This is called the “minimum source” or “mitigation source”, and is intended as a ‘common sense’ approach to warn animals of the location of a sound source. There is no currently-available scientific evidence that “mitigation sources” are effective at deterring animals from the vicinity of an active source (indeed, there is equally the potential for attraction of animals towards low power sound sources). Consequently, the MMOA recommends that careful consideration should be given before adopting this unproven technique, particularly given the significant amount of additional sound that will be emitted into the marine environment as a result.

Minimising Source Use and Levels

Best practice should include both minimising overall use of the sound source throughout the survey and using the lowest practicable sound levels. The sound source should be switched off whenever the survey is not in production mode. Testing of sound sources should be kept to an absolute minimum. Start-up of the sound source (including soft start) should be run as close to the start of operations as is possible. The use of a mitigation source in between operations is discouraged until scientific evidence is available to support the procedure. Barkaszi and Kelly (2019) tested the effectiveness of mitigation methods and found mixed results between odontocetes and mysticetes, there is still research to be done.

Communication Links

It is important to clarify the communication links (and chain of command) between the mitigation team and the operators of the sound source, in order to ensure quick, clear and well-implemented mitigation actions when animals are observed.

The mitigation team should have direct contact with personnel operating source equipment so that delays and shutdowns are executed immediately. The MMOA recommends that the use of handheld radios (as opposed to intercom systems) is vital (especially for MMOs, who are

likely to be outside on deck during pre-shoot watches) to ensure that mitigation guidance is swiftly conveyed to the operations crew whilst allowing the observer to continue to monitor the animals. A sufficient number of handheld radios should therefore be made available to the MMOs and PAM Operators at all times.

Recording and Reporting Compliance to Appropriate Authorities

Prior to any project it should be determined how compliance with mitigation measures is to be reported to the appropriate authorities. This should include the provision to maintain the independence of the MMO/PAM reports from Client, Operators and MMO/PAM Provider companies and how this review and assessment of compliance and data quality is to be conducted. There should be a clear system for how non-compliance is dealt with. This could be achieved by allowing independent dialogue between MMOs and PAM operators and any regulatory body involved. Reports should also be available for public viewing.

What data are to be collected and how this is to be recorded should be determined from the outset. The data recording protocol will then need to be passed onto any appropriate authority for assessment.

The MMOA recommends that data collection during mitigation surveys should be standardised according to established protocols. For example, a set of standardised electronic MMO and PAM data forms have been developed by the E&P Sound and Marine Life Joint Industry Programme (JIP) (www.soundandmarinelife.org), a body affiliated with the International Association of Oil and Gas Producers (IOGP). The data forms have been frequently revised following extensive feedback from MMOs and PAM Operators working in the field, and are recommended for a global standard. These forms have been adopted by the Joint Nature Conservation Committee in the United Kingdom (and by other bodies in some other regions) and can be found online at: <https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4>.

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^[1] Platform is defined throughout this document as any mobile or static base on which MMOs are located in order to carry out marine mammal mitigation duties. This potentially includes vessels, rigs, shore and airplanes, but most commonly refers to vessels.

^[2] The terms 'ramp-up' and 'soft start' refer to the same operational procedure where a sound source is initiated at its lowest sound level and gradually increases in sound level over time to reach the desired operational level. The terms are used by different regulatory bodies worldwide and are inter-changeable. We use 'soft start' in the remainder of this document.

Position Statement 3: Passive Acoustic Monitoring

The Marine Mammal Observer Association (MMOA) recommends that Passive Acoustic Monitoring (PAM) equipment and/or services, supplied for marine mammal mitigation purposes should comprise of the following (as a minimum);

- An appropriate length of cable to deploy the hydrophone(s) at a suitable distance and depth from the survey vessel and/or platform.
- Hydrophone elements with the correct frequency range for the expected species within the projects' geographical location, especially those species that may result in delays and/or shutdowns of the project. This may mean multiple elements with differing frequency sensitivities.
- Appropriate sound cards (and back up drivers) with the appropriate sampling rate for and Species of Concern (SoC) and full instructions on their configuration.
- If using multiple hydrophone elements; full details of separation distances of each pair of elements for determination of bearing.
- GPS integration
- Calibrated depth sensor and full instructions on configuration.
- Filtering system for unwanted noise and full instructions on configuration.
- Professional noise cancelling headphones (with battery charger and/or spare batteries).
- Appropriate software for real time monitoring
- Full detailed manufacturers manual of assembly and calibration.
- Full inventory list of contents.
- Properly labeled shipping containers and reels.
- Timely and regular support from the PAM equipment provider for technical problems and configuration advice.

Additional recommendations for best practice:

- Incorporation of multiple (minimum of 2) hydrophone elements for each frequency range needed in order to provide bearing information for tracking animals.
- A backup of each component of the PAM equipment (including the smallest connectors) in case of equipment failures.

Using PAM alongside visual monitoring by Marine Mammal Observers (MMOs) greatly improves the possibility of marine mammal species being detected, however, clients, regulators and PAM Operator provider companies should be aware of several inherent limitations with the use of PAM for mitigation purposes. These points are important to understand when considering whether PAM is suitable for use as a sole monitoring method during darkness or other periods of limited visibility (i.e. whether it has a reasonable likelihood of reliably detecting the SoC present within a site).

Limitations of Passive Acoustic Monitoring (PAM):

- Many potential SoC will not be detected using PAM equipment because they do not produce vocalisations, or vocalise infrequently, for example sea turtles, sirenians, baleen whales, basking sharks, and many species of pinnipeds. If an animal is not vocalizing it may pass close to a PAM system but remain undetected.
- Limited ability to detect baleen whale vocalisations as typical PAM equipment used for mitigation purposes is usually deployed astern of large commercial vessels and in proximity to continuous low frequency engine noise. Propeller noise (together with water noise and the low frequency sound emitted by the airguns (or other sound source) themselves) can mask low frequency biological signals.

- Determining range in cases where baleen whales are occasionally detected can be difficult. For example, singing humpback whales can produce vocalisations, which travel over many kilometres, make it difficult to determine range and a PAM Operator may be unable to determine with any level of reliability whether an animal is within a mitigation zone.
- Species that vocalise at high frequencies will not be detected beyond short distances. For example, the reliable detection range for harbour porpoise signals is approximately 200-300m. These animals may be present within the MZ before being detected by PAM equipment. Therefore, a harbour porpoise may be present in the outer region of a MZ (e.g. 300-500m from the source) but not detected by a PAM system; however, high frequency vocalizations can be assumed to be within the mitigation zone.
- The vocal repertoires of some marine mammal species are poorly-described or unknown.
- Many marine mammal vocalisations, particularly the echolocation click trains produced by odontocetes, are directional in nature and may not be easily detected by PAM equipment if the animals are facing away from the hydrophone. For example harbour porpoises (which often show avoidance reactions to platforms) will not be detected when swimming away from a vessel's track line.
- Range determination is only possible for some species through the tracking of bearing information over time, using the timing of signals arriving at pairs of hydrophone elements deployed at known distances from the ship's stern and the ship's GPS position. PAM systems with linear pairs of hydrophones are sometimes inadequate at providing suitable bearing information over a sufficient time, for accurate range determination.
- Range determination is not possible for a towed array deployed vertically from a static platform and in such situations all detections could be regarded as within the mitigation zone. Additionally several individual hydrophones not linked to form an array cannot localize on an acoustic signal and all detections could be regarded as within the mitigation zone.

The MMOA believes that the use of PAM equipment for mitigation purposes for many SoC should not be considered to represent a reliable sole method but rather should be used to enhance other mitigation measures. However, PAM is the only reliable method that allows detection and identification of animals underwater and can be used in darkness, fog and periods of reduced visibility, as well as most weather conditions. Effective operation is dependent on capable equipment, good deployment and competent operators.

PAM Detections and Noise Samples

The MMOA recommends that the use of PAM during a mitigation project should be objectively assessed for detection rates. This may be achieved with PAM recordings made during other mitigation surveys, or sound sample records for quality assessments (i.e. to gauge water noise and masking and determine how effective the PAM system was likely to be at detecting marine mammals in practice). The effectiveness of PAM for marine mammal mitigation purposes cannot be assessed without understanding the acoustic environment that the systems are being deployed in and the corresponding likelihood of detecting an animal. Modelling should be completed during any assessment phase of the project or programme.

Submission of PAM Data to Regulatory Bodies

The requirement for recordings of PAM detections to be submitted to a regulatory body is changing across jurisdictions. Should a project require submission and regulatory processes are in place to submit PAM recordings - it is necessary to follow the requirements of the

regulator. Many jurisdictions do not yet require these types of submissions. The MMOA considers this best practice in order to:

- Assess the likelihood of acoustic detection for different SoC.
- Provide a means of assessing and validating the species identification of recorded acoustic detections.
- Provide a means of assessing the mitigation decisions made based on particular acoustic detections
- Provide opportunities for acoustic analysis research.

PAM data can be checked or verified for its effectiveness in mitigation surveys (in terms of equipment functioning properly, adequate ambient noise levels for making detections, the species and number of detections made, the provision of adequate range and bearing information and the consequent implementation of mitigation decisions).

Training for PAM Operators

Please see the MMOA's Position Statement 5 - [Passive Acoustic Monitoring \(PAM\) Operator Qualifications](#) for a comprehensive list of (minimum) qualifications for PAM Operators.

The MMOA emphasises that the skills required to work effectively as a PAM Operator are difficult to acquire through short training courses, and require practical time at sea. Consequently, the MMOA recommends that organisations hiring PAM Operators for mitigation surveys seek to use personnel with proven previous field expertise with marine mammal acoustics. The MMOA does not promote the use of inexperienced PAM personnel as trainees offshore. The Association recommends that persons seeking acoustic monitoring experience achieve this by joining dedicated research projects (paid or otherwise) and through mentoring opportunities.

It is recommended that projects introducing anthropogenic noise into the marine environment should have a marine mammal or fauna mitigation plan with a description of all mammal acoustics of species commonly encountered in the project area. It is the responsibility of the PAM operator to ensure they are familiar with the likely range of species and subsequently the vocalisations likely to be encountered.

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^[1] Blackwell, S.B., Nations, C.S., McDonald, T.L., Thode, A.M., Mathias, D., Kim, K.H., Greene Jr, C.R., Macrander, A.M. (2015). Effects of airgun sounds on bowhead whale calling rates: evidence for two behavioral thresholds. PLoS ONE 10(6): e0125720. Doi: 10.1371/journal.pone.0125720

Position Statement 4: Marine Mammal Observer (MMO) / Protected Species Observer (PSO) Qualifications

The Marine Mammal Observer Association (MMOA) emphasises that a Marine Mammal Observer (MMO) or Protected Species Observer (PSO) mitigation training certificate should *not* be the only requirement to qualify a person as a MMO/PSO on a mitigation survey. A MMO/PSO requires *all* of the following skills to be able to complete their job professionally and competently:

- **A good attitude to conducting watches of concentrated effort, often for long days and several consecutive weeks** – evidence of work experience where this has been proven such as previous surveys at sea or long periods in the field conducting surveys or monitoring work. Attitude/enthusiasm may also be determined via feedback from previous employers or colleagues.
- **Ability and experience to identify the specific SoC known to occur within the region of the survey and for which mitigation measures apply** – evidence of previous experience, for example researching marine mammals at sea, working as a naturalist guide at sea, conducting cetacean surveys or time spent at sea where marine mammal experience has been achieved. This experience should be of an appropriate length of time to have gained the skills to be competent at identifying marine mammal species.
- **Ability to make accurate estimates of range at sea** – through prior at-sea experience during at sea surveys or theoretical training through appropriate training courses. This experience must include the use of appropriate equipment such as reticle binoculars, clinometers, range sticks or other proven equipment to obtain such estimates of range.
- **A thorough understanding of the mitigation requirements of the area or project** – through appropriate training from a regulator approved training course or from client/employer created training courses (where regulator approved courses are not available) and from the provision of a detailed Mitigation Plan (MP) and project EIA for every project.
- **Ability to make decisions quickly and to convey the necessary mitigation information to the crew concisely, politely, objectively and firmly** – personnel working as an MMO/PSO should be independent and should have the character and confidence to make correct mitigating decisions under pressure. Such characteristics might be gauged via feedback from previous employers or colleagues.
- **Experience of recording data in a scientific and accurate manner** – through a formal academic qualification or through work experience where this was achieved (in the latter case references should be sought).
- **Experience of assimilating data, basic data analysis and writing reports** – through a formal academic qualification or through work experience where this was achieved (in the latter case references should be sought). A good command of the common language (usually English) in use on the project is essential for this purpose.
- **Ability to work in a team and communicate well** – such characteristics might be gauged via feedback from previous employers or colleagues.
- **Aspire to improve their skills as an MMO/PSO and to further their knowledge** – belong to a professional body such as the MMOA or other appropriate professional body where information and code of practice is promoted. Attend training courses and refreshers to improve knowledge and skill through continuing professional development programmes.

A Client hiring MMOs for a mitigation survey through a MMO/PSO provider company (personnel agency) should request this standard of MMO/PSO qualification in order to promote a professional standard in their environmental objectives.

Benefits of hiring professional MMO/PSOs with all of the above skills

The MMOA emphasises that the use of MMO/PSOs who meet the above professional standards is likely to confer a number of benefits for the clients of mitigation surveys, both in terms of proving compliance with mitigation requirements and maintaining a positive environment on-board the platform. These potential benefits include:

- Client confidence in meeting environmental requirements.
- A professional working attitude by the MMO/PSO on board the platform, ensuring courteous interactions with crew, appropriate chains of command are followed and good cooperation is achieved when mitigation measures are required.
- Accurate identification of SoC to species level (where possible) which ensures that species-specific mitigation measures are implemented correctly and potentially avoids erroneous mitigation measures that may be costly to the survey.
- Ability (based on previous experience and correct use of field equipment) to make accurate distance estimates, which may avoid unnecessary disruption to the survey.
- Collection of standardised, high-quality data that serves to prove compliance with mitigation requirements and may additionally contribute to robust scientific analysis.
- Knowledge and experience to answer questions that arise during the survey, and to guide the crew through the required mitigation measures clearly and concisely to avoid error and confusion.

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Position Statement 5: Passive Acoustic Monitoring (PAM) Operator qualifications

The Marine Mammal Observer Association (MMOA) emphasises that a Passive Acoustic Monitoring (PAM) training certificate should *not* be the only requirement to qualify a person as a PAM Operator. A PAM Operator requires *all* of the following skills to be able to complete their job professionally and competently:

- **A good attitude to conducting monitoring periods of concentrated effort, often for long days and several consecutive weeks** – evidence of work experience where this has been proven such as previous surveys at sea or long periods in the field conducting surveys or monitoring work. Attitude/enthusiasm may also be determined via feedback from previous employers or colleagues
- **Ability and experience to identify a range of marine mammal acoustic signals** – previous experience of PAM for marine mammals at sea. This experience should be of an appropriate length of time to have gained the skills to be competent at identifying marine mammal acoustic signals and interpreting acoustic software – the MMOA recommends this to be at least 20 weeks during which time a range of marine mammal species should have been encountered.
- **Ability to assemble, deploy and configure PAM equipment to optimise signal-to-noise ratio** – previous experience of PAM for marine mammals at sea. Attendance of appropriate training courses with instruction on assembly and deployment of specific PAM equipment/software.
- **Ability to interpret acoustic software for detection and range estimation (where possible)** – Previous experience as described above. Attendance on a course to be instructed on PAMGUARD or other suitable software.
- **An understanding of the mitigation requirements of the area or project** – through appropriate training from a regulator approved training course or from client/employer created training course (where regulator approved courses are not available) and from the provision of a detailed Mitigation Plan (MP) and project EIA for every project.
- **Ability to make decisions quickly and to convey the necessary mitigation information to the crew concisely, politely, objectively, and firmly** – personnel working as a PAM operator should be independent and should have the character and confidence to make correct mitigating decisions under pressure. Such characteristics might be gauged via feedback from previous employers or colleagues.
- **Experience of recording data in a scientific and accurate manner** – through a formal academic qualification or through work experience where this was achieved (in the latter case references should be sought).
- **Experience of assimilating data, basic acoustic data analysis (i.e., familiarity with producing and interpreting spectrograms) and writing reports** – through a formal academic qualification or through work experience where this was achieved (in the latter case references should be sought).
- **Ability to work in a team and communicate well** – such characteristics might be gauged via feedback from previous employers or colleagues.
- **Aspire to improve their skills as a PAM Operator and to further their knowledge** – belong to a professional body such as the MMOA or other appropriate professional body where information and code of practice is promoted. Attend training courses and refreshers to improve knowledge and skill through continuing professional development programmes.

A client hiring PAM Operators through a MMO, and PAM provider company (personnel agency) should request this standard of PAM qualification in order to promote a professional standard in their environmental objectives.

Benefits of hiring professional PAM Operators with all of the above skills

The MMOA emphasises that the use of PAM Operators who meet the above professional standards is likely to confer a number of benefits for the clients of mitigation surveys, both in terms of proving compliance with mitigation requirements and maintaining a positive environment on-board the platform. These potential benefits include:

- Client confidence in meeting environmental requirements.
- A professional working attitude by the PAM Operator on board the platform, ensuring courteous interactions with crew, appropriate chains of command are followed, and good cooperation is achieved in the event that mitigation measures are required.
- Accurate identification of SoC acoustic signals which ensures that species-specific mitigation measures are implemented correctly (for detections that can be positively-identified to species level using acoustic methods) and potentially avoids erroneous mitigation measures that may be costly to the survey.
- Ability (based on previous experience and correct calibration of acoustic equipment) to make good distance estimates to acoustic signals (where equipment permits), which may avoid unnecessary disruption to the survey.
- Collection of standardised, high-quality acoustic data that serves to prove compliance with mitigation requirements and may additionally contribute to robust scientific analysis.
- Knowledge and experience to answer questions that arise during the survey, and to guide the crew through the required mitigation measures clearly and concisely to avoid error and confusion.

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Position Statement 6. Marine Mammal Observer (MMO) and Passive Acoustic Monitoring (PAM) Mitigation Training Standards

The Marine Mammal Observer Association (MMOA) considers that mitigation training courses are a crucial component of implementing effective mitigation measures at sea and allows both MMOs and PAM Operators to work safely and to collect data in a consistent way. The MMOA has the following advice regarding the content and provision of training courses for MMOs and PAM Operators.

MMO and PAM Mitigation training courses

A MMO or PAM mitigation training certificate should not be the only requirement to qualify a person as a MMO or PAM Operator. MMO and PAM mitigation training courses should only act as a supplementary qualification for a person who already has the appropriate academic and/or marine mammal field experience to work as a MMO or PAM Operator. The MMOA note that mitigation training course providers should not advertise their courses to be the only qualification needed to become a MMO or PAM Operator, and nor should regulators, clients or MMO and PAM Operator providers consider mitigation training certificates to be such.

MMO and PAM mitigation training courses should serve to provide new MMOs and PAM Operators with the necessary knowledge to enable them to perform appropriately in a mitigation role and to be aware of their duties and responsibilities while implementing mitigation measures.

MMO and PAM Mitigation training course content (generic components)

In some countries regulatory bodies have formalised training requirements and where that is the case those requirements must be strictly adhered to. Additionally, the MMOA recommends that all mitigation training courses worldwide should include the following generic components:

- The importance of sound to marine mammals.
- The potential effects of anthropogenic sound on marine mammals and other SoC (if applicable) including acoustic criteria used to define zones of disturbance and injury.
- Visual monitoring techniques, including methods for range estimation (in MMO courses).
- Field identification (visual or acoustic) of marine mammal and other SoC (if applicable) – noting that course attendees should already have some practical experience with marine mammal identifications or seek to gain this after attending the course and prior to mitigation work.
- The mitigation procedures being used in the geographic region.
- Soft start principles, procedures and monitoring.
- Mitigation Zones.
- An understanding of the industry operations that require MMOs.
- The role of the MMO:
 - Attending project start-up meetings.
 - Monitoring for marine mammals and other SoC (if applicable).
 - Monitoring of compliance with mitigation procedures (i.e. compliant source operations).
 - Mitigating for SoC inside mitigation zones prior to operations, during soft start (if applicable) and during full power operations (if applicable).
 - Scenarios that may arise and how to deal with these.
 - Interaction with industry personnel and procedures in place, in particular, QHSE requirements.
 - Recording MMO and/or PAM data and compliance reporting.
 - Chains of command on-board industrial platforms.
- Conduct of MMOs and PAM Operators
- Life on board and personal safety

Additional MMO and PAM Mitigation training course content (specific to geographic area)

Where regulatory bodies have formalised training requirements, those requirements must be strictly adhered to. Elsewhere, the MMOA recommends that mitigation training courses for specific geographic areas should include the following components:

- Understanding the background and development of the adopted mitigation procedures and their legislative framework.
- Consent and permitting process of the procedures prior to projects.
- Specific explanation of the mitigation procedures for the geographic area.
- Identifying species likely to be in the geographic area and which of these should be regarded as SoC.
- Discussing specific project data collection if applicable.

Specific PAM Operator mitigation training (theory and software training)

- Basic theoretical principles of sound.
- Recognition of different types of SoC vocalisations.
- Discussion of types of unwanted ambient noise and masking problems.
- Components of PAM equipment – cables, hydrophone elements, sound cards, filtering systems, depth sensors, laptops and software – assembly, deployment and calibration.
- Discussion of deployment scenarios and examples.
- Principle components of PAM software – displays and the need for project-specific configuration.
- Specific software training – e.g. PAMGuard – practical instruction in creating configurations and basic settings relating to hardware used and method of deployment.
- Discussion of bearing determination and the problem of ranging acoustic signals.

Specific PAM Operator mitigation training (assembly and deployment)

PAM training is only complete when a person has learnt how to assemble PAM equipment and deploy it in a safe and sufficient way to maximise the detection of vocalising animals. Experience of at-sea deployment is hard to gain as there is a lack of practical training courses worldwide offering this facility. No PAM Operator should take sole responsibility on an offshore mitigation job without having some prior deployment experience. They could gain such experience from joining research groups who carry out acoustic monitoring work, attend a PAM training course offering at sea deployment experience or work on an offshore mitigation project alongside an experienced PAM Operator for a probationary period.

MMO and PAM Mitigation training course instructors

The responsibility for determining who provides MMO and PAM mitigation training courses falls with the regulator for the geographic region in question. However, the MMOA believes that the following criteria should be met by people wishing to act as MMO or PAM mitigation training course providers:

- Must demonstrate that an instructor has good presentation and teaching skills.
- Be able to compile clear, interesting and professional training material such as PowerPoint presentations, training manuals, supporting reading material and practical interactive sessions.
- Have an extensive background in visual and/or acoustic marine mammal survey techniques and species identification.
- Be knowledgeable with respect to the effects of anthropogenic sound on marine mammals.
- Have experience of responsibility as a lead MMO in a wide range of offshore industrial operations. If the course is aimed at mitigation during seismic surveys, then the Instructor should have first-hand experience of working on several survey types such as site surveys, VSP, OBC, 2D/3D and 4D surveys. If the course covers additional

operations such as pile driving or explosive work then the instructor should also have had the experience of working as a MMO on such projects.

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Position Statement 7: Marine Mammal Observer (MMO) and Passive Acoustic Monitoring (PAM) Operator Providers

The Marine Mammal Observer Association (MMOA) is of the belief that companies providing MMO and PAM Operator personnel should abide by the following:

- Provide only suitably qualified, experienced, and appropriately referenced personnel
- The ability to recognise the skills needed to be competent and professional in the field of marine animal mitigation
- Have a comprehensive understanding of [worldwide] mitigation requirements.
- Have the appropriate knowledge of passive acoustic monitoring and understand its limitations in the field (and the ability to make potential clients aware of these limitations from the outset). This is only applicable to those companies providing PAM equipment and/or PAM Operators
- The ability and internal company systems to provide appropriate legal contracts to marine animal mitigation personnel, including the timing and duration of each project and/or rotation, day rates, payment schedule, travel, visa arrangements and all other applicable logistical and contractual considerations
- Cover all insurance required for any marine animal mitigation personnel to work on industry projects. The company should make clear any gaps in insurance provided.
- Provide MMOs and PAM Operators with appropriate documentation prior to the beginning of the project (e.g., Environmental Impact Assessment, appropriate consent/permit/license, Environmental Management Protocols, templates for daily, weekly, project reports, etc).
- Recommend sufficient numbers of marine animal mitigation personnel to Client(s) to ensure compliance with project mitigation regulations.
- Provide a Quality Assurance system for all marine animal mitigation data
- Provide guidance, autonomy and clear means of communication to marine animal mitigation personnel when offshore
- The ability to quality assure marine animal mitigation final reports, provide guidance on requirements and clear expectations on timelines and submission

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Position Statement 8: Marine Mammal Observer (MMO) and Passive Acoustic Monitoring (PAM) data collection and analysis

Using suitably qualified MMOs and thorough methodology

The Marine Mammal Observer Association (MMOA) maintains that to maximise the value of data collected during mitigation surveys, it is essential for MMOs and PAM Operators to be suitably qualified, experienced and dedicated. Any data that are to be scientifically analysed need to have been collected using a structured, standardised methodology and then should be fully assessed for data quality before analysis can begin. Meaningful analyses should only include data collected by people with proven species identification skills, an appreciation for the necessity for correctly recording effort status and weather conditions, and good distance estimation skills. Using inexperienced persons and individualised data collection methodologies will lessen scientific credibility.

Data recording by MMOs and PAM operators

Data recording should be diligent and accurate. The use of standardised forms (see below) is encouraged. MMOs and PAM operators should liaise with the crew to record accurate and complete operational data. They should ensure that effort records accurately reflect the times of monitoring and weather conditions throughout. Records of sightings or acoustic detections should include as much detail as can confidently be given (e.g. identifications should only be to species level if there is confidence in the identification). The MMOA encourages MMOs and PAM operators to check their data thoroughly prior to submission for use, including cross-referencing between forms (e.g. checking that times of source activity agree between operations, effort and sightings forms).

Use of photographs to improve MMO data quality

MMO data quality may be improved if photographs of sightings are collected when possible and stored (bearing in mind that it is not possible to photograph every sighting because animals are often seen briefly or at distance or in inclement weather conditions). The collection of supporting images allows later independent verification of the sightings, especially in terms of species identification. This is particularly important in areas or for species where little information exists on marine mammal distribution, or for species where identification is challenging. However, obtaining photographs of animals should never be at the expense of data collection. Where photographs are taken these should be submitted with MMO reports, noting that file size should not be excessive, to enable their use for scientific purposes.

Collating PAM detection recordings and noise samples

Retaining and collating recordings of PAM detections and samples of sound is not a widespread requirement with regulators. The MMOA encourages Clients to specifically request that recordings of every PAM detection are made and stored during a survey, so that independent verification of the data can occur at a later time and the use of the data be maximised. This process will also facilitate assessment of the signal-to-noise ratio and other recording parameters experienced during PAM surveys with a view to assessing the likely potential for detections to have occurred on the system.

MMO and PAM data analysis

Analysis of the data collected during mitigation surveys should be carried out by individuals/organisations that have a full understanding of the limitations of current MMO and

PAM datasets. Datasets collected by multiple personnel of varying skill levels are inherently subject to wide variation in standards. Although this variation can be minimised to some extent through the use of standardised data collection methods and data forms, bias in detection rates and identification skills between observers is an acknowledged and fundamental issue for all large marine mammal surveys, and will be especially the case in large MMO/PAM datasets where data may originate from several hundred observers. Meaningful analyses are reliant on having an understanding of the varying quality of MMOs and PAM Operators being hired on projects and the limitations this creates (for example, the ability to account for inter-observer variation during analysis). An assessment of which data are of scientific value can only be achieved if the data are accompanied by detailed descriptions of the methodology used, by supporting information allowing independent verification where appropriate (i.e. photographs or acoustic recordings) and an indication of whether the data were collected by dedicated, experienced and qualified MMOs and PAM Operators. All data, including that of experienced personnel, should be thoroughly checked using a rigorous quality control process prior to analysis and only good quality data should be used. Analysis should not be performed on data that has not undergone quality control.

Collating MMO and PAM datasets worldwide

The MMOA supports the standardisation of data collection methods and the data forms used to record data worldwide, in order to improve the value of global datasets. MMO and PAM data forms in an electronic version have been developed by the E&P Sound and Marine Life Joint Industry Programme (JIP) (www.soundandmarinelife.org), a body affiliated with the International Association of Oil and Gas Producers (IOGP). These forms have been adopted by, amongst others, the Joint Nature Conservation Committee (JNCC) in the United Kingdom. The data forms have been revised by JNCC following feedback from MMOs and PAM Operators working in the field. The MMOA encourages the adoption of these forms with their guidance notes, where appropriate, to improve the standardisation of MMO data worldwide. The forms can be found online at: <https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4>. To improve standardisation the forms should be used in their existing format and not altered.

In summary to maximise the value of MMO data for scientific purposes the data must be:

- Collected by suitably qualified and experienced MMOs and PAM Operators;
- Collected using a standardised methodology (e.g. through the use of the JNCC Marine Mammal Recording Forms);
- Checked for accuracy prior to submission;
- Quality-controlled by independent experienced personnel with an understanding of the data;
- Accompanied by photographs and acoustic recordings whenever possible for each visual or acoustic detection;
- Analysed by individuals/organisations that have a full understanding of how MMO and PAM data are collected, have been collected in the past and what the limitations are.

The potential uses of MMO data for scientific research purposes have resulted in some MMOs seeking permission from the Client to publish their own data from work on projects. The MMOA encourages this practice. Please refer to *Position Statement 9 - The Use of Marine Mammal Observer (MMO) data for Scientific Publications* – for further information.

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Position Statement 9: The Use of Marine Mammal Observer (MMO) or PSO Data for Scientific Publications

Potential Scientific Uses of MMO Data

Offshore activities can occur in areas where little is known about the occurrence of marine mammals and other marine wildlife of conservation concern (e.g., sea turtles, whale and basking sharks, seabirds). This includes some large geographic regions where little scientific research has been carried out (e.g., the eastern tropical Atlantic off the west coast of Africa and large parts of the Indo-Pacific region), but also includes the deep, offshore waters around many continents (since for logistical reasons most marine mammal research worldwide has been focussed on coastal species inhabiting near shore, easily-accessible waters). Consequently, survey vessels and installations can potentially operate as a 'platform of opportunity' from which to collect valuable data on the occurrence of marine mammals (and other fauna) for scientific research purposes.

The potential uses of MMO data for scientific research purposes (including specific examples of peer-reviewed scientific papers published by MMOs from their own work on survey vessels and/or installations and having undergone a data permission process with the Client) may include, this is not an exhaustive list:

- Documenting new ranges for species, e.g., common dolphin range extension (Farías-Curtidor et al., 2017).
- Documenting unusual sightings/behaviours, e.g., fur-seals (Lalas and McConnell, 2016), and broad behaviour responses (Harris et al., 2018; Southall et al., 2021)
- Analysing the potential impacts on species, e.g., species with high site-fidelity (Forney, 2017), and harbour porpoise responses to pile driving (Graham et al., 2019)
- Describing new recommendations, e.g., PAM during pile-driving (Van Parijs et al., 2021)

Suitability of MMO Data for Scientific Analysis

The collection of data that is suitable for scientific analysis is reliant on the use of experienced and dedicated MMOs and PAM operators who are meticulous about the collection of field data and have sufficient expertise with the fauna in question to correctly identify animals in the field. The MMOA strongly recommends that MMOs and PAM operators hired for a mitigation role have appropriate experience where they are familiar with species identification and behaviour and follow rigorous data collection protocols. Please see the MMOA's Position Statements 4 and 5 – Marine Mammal Observer (MMO) Qualifications and Passive Acoustic Monitoring (PAM) Operator Qualifications - for more information on this subject. For data to be useful in a scientific context, the following are usually required:

- The use of a MMO/ PAM operator who is experienced, dedicated, motivated and understands the importance of accurate data collection and data entry
- The use of a MMO/ PAM operator with proven experience in reliable field identification of the species of interest within the study area
- The routine collection of additional data to support the species identifications recorded in the field, so that independent verification of the data can be performed when necessary. This might include acoustic recordings of the species, or photographs of sightings. It should be noted that many species (for example, dolphins of the *Stenella* genus, and whales of the genus *Mesoplodon*) are very similar in external appearance and behaviour, and observers require significant levels of field experience to reliably distinguish between such species in the field.

- Depending on the analyses being carried out, the collection of high-quality supporting effort data. This requires (as a minimum):
 - The collection of GPS positions at sufficiently-small intervals (≤ 1 hr intervals on most surveys; every few minutes where turns between lines are acute, i.e. on site surveys) to reliably recreate the track of a seismic vessel (i.e. through turns) to show the location of survey effort.
 - Accurate logging of airgun use and related effort data
 - Accurate logging of environmental data, especially Beaufort sea state (which is known to be a very important factor influencing the detection rate of marine fauna). It is recommended that where less precise sea state codes are the requirement on mitigation data forms (e.g. the JNCC forms) that precise Beaufort sea state data are collected additionally by the MMO for scientific use (this may also apply to visibility and swell height).

Benefits of Publishing MMO Data

Currently, there are large amounts of potentially useful data being collected by MMOs worldwide that are not being made accessible to researchers and consequently amount to 'lost data'. The MMOA seeks to encourage publication of appropriate MMO datasets (see above conditions) so that data are available to scientists and, ultimately, feedback into the conservation of marine fauna worldwide.

For the MMO - Using the data collected during seismic surveys is a method of contributing to science and, in the long-term, to the potential conservation of marine species. Scientific publications are also a great addition to a CV, illustrating enthusiasm, dedication, competence and a genuine interest in the topic.

For the Client - Making MMO data accessible for scientific purposes demonstrates Client interest and support for the environment and furthering scientific knowledge, and releasing such data is likely to be of benefit to species conservation. There are no obvious disadvantages to releasing data, assuming protocols are established and followed (see below).

For Protection - Species conservation is reliant on knowledge of when and where a species occurs. This basic information is often lacking, particularly for mobile marine species, and in deep-offshore and poorly-studied regions (where seismic survey vessels may provide a unique opportunity for data collection). The example scientific publications provided above demonstrate how basic data on species occurrence, distribution, taxonomy, behaviour, density and habitat preferences can be provided by MMO data, with obvious conservation implications.

Protocols for Releasing MMO Data

It is important for all parties concerned that protocols relating to the release, and subsequent use, of MMO data are established at an early stage in discussions. The publication of MMO datasets is still relatively rare, and there are no predefined standardised protocols in place to follow. The procedure will be survey-specific, requiring direct discussions between Client and MMO, and in some cases also the personnel agency providing the MMO to the Client. Ultimately, the MMO is contractually bound to the Client, and it is essential that a MMO receives the Client's express permission before releasing/publishing any data. This may otherwise violate client confidentiality and result in a breach of contract.

Clients should establish from the outset exactly what their data will be used for, which data will be used, what the intended output will be (e.g. conference presentation, scientific paper) and how they will be acknowledged. Clients should be aware that any published data (e.g. a journal paper) will subsequently be in the public domain, and may be referred to in other scientific papers and used elsewhere. Consequently, the Client should have the opportunity to view and comment on both a draft paper (prior to submission to a journal) and the final version of the paper (if accepted for publication). Permission to use the data should include clauses to this effect, so that Client approval is expressly required prior to submission and final publication. This eliminates any risk of information being published that the Client deems to be confidential or otherwise sensitive. A MMO wishing to publish data from seismic surveys should appreciate that environmental datasets are often considered sensitive and should seek to ensure that the process is carried out courteously and as transparently as possible. This will particularly be the case for data concerning potential impacts of airgun activity on marine fauna, and a MMO should clearly state whether or not airgun impacts will be considered within the proposed paper. The MMOA recommends that (as a minimum) a MMO should inform the Client of:

- The aims/objectives of using the data (providing a working title and a synopsis of likely content).
- Exactly which data will be included.
- Where they intend to publish the data.
- How the Client will be acknowledged.
- At which stages the Client will be contacted to approve the paper content.

The MMOA also emphasises that in instances where permission to publish is refused then a MMO should remain courteous, professional and accept that decision.

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References

Graham Isla M., Merchant Nathan D., Farcas Adrian, Barton Tim R., Cheney Barbara, Bono Saliza and Thompson Paul M. 2019. Harbour porpoise responses to pile-driving diminish over time. *Soc. open sci.* 6:190335190335

Harris, CM, Thomas, L, Falcone, EA, et al. Marine mammals and sonar: Dose–response studies, the risk-disturbance hypothesis and the role of exposure context. *J Appl Ecol.* 2018; 55: 396– 404. <https://doi.org/10.1111/1365-2664.12955>

Fariás-Curtidor N, Barragán-Barrera DC, Chávez-Carreño PA, Jiménez-Pinedo C, Palacios DM, Caicedo D, et al. (2017) Range extension for the common dolphin (*Delphinus* sp.) to the Colombian Caribbean, with taxonomic implications from genetic barcoding and phylogenetic analyses. *PLoS ONE* 12(2): e0171000. <https://doi.org/10.1371/journal.pone.0171000>

Forney, K. A., B.L. Southall, E. Slooten, S. Dawson, A.J. Read, R.W. Baird, and R. L. Brownell Jr. 2017. Nowhere to go: noise impact assessments for marine mammal populations with high site fidelity. *Endangered Species Research* DOI: 10.3354/esr00820

Lalas, C. and McConnell, H. (2016), Effects of seismic surveys on New Zealand fur seals during daylight hours: Do fur seals respond to obstacles rather than airgun noise?. *Mar Mam Sci*, 32: 643-663. <https://doi.org/10.1111/mms.12293>

Van Parijs, S., Baker, K., Carduner, J., Daly, J., Davis, G., Esch, C., Guan, S., Scholik-Schlomer, A., Sisson, N. and Staaterman, E., 2021. NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening

Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs. *Frontiers in Marine Science*, 8.

Position Statement 10: The Conduct of Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) Operators during Offshore Operations

This section is aimed at providing guidance to MMOs and PAM Operators (hereafter referred to as the 'mitigation team') on their conduct during offshore operations. It is also aimed at providing guidance to MMO/PAM providers and Clients regarding the representatives they contract to fulfill these roles.

Knowledge of Regulatory Requirements

The mitigation team has a duty to ensure they are familiar with all documentation outlining mitigation procedures (including regulatory guidelines specific to the survey area but also the project specific conditions outlined in project licenses and permits) prior to the project commencing. They should ensure that they have a thorough understanding of this documentation and always have it to hand to provide advice to the client / contractors when required. On arrival on the platform/ vessel or during the start up meeting, the mitigation team should provide a detailed summary of the mitigation requirements to key project personnel but also ensure that all operational contractors are aware of the expectations. They should be able to answer questions confidently about the mitigation procedures in place and also have an understanding of the rationale for the procedures. Producing and presenting a very brief summary of procedures which also highlights the recommended lines of communication to each department onboard is often a useful means of making project documentation more digestible in the field.

Diligent Observation/Monitoring

The mitigation team should always ensure they will be on time for their watches and build a good relationship with the operations team so you are given plenty of warning to commence watches and prevent delays. They should perform their observation and monitoring duties to the best of their abilities and remain diligent throughout the duration of the watch. Leading by example in this regard tends to encourage much greater cooperation with the operational contractors. MMOs should have professional binoculars (good light gathering ability, waterproof, suitable magnification for scanning at sea, wide field of view and range estimation ability is recommended) which they should use to scan the mitigation zone, and adjacent waters, regularly. It is the MMO's responsibility to ensure that they are aware of any specific requirements with regard to what type of binoculars are required for the country they are working in (for example, some countries require the use of reticulated binoculars). Data recording should be prompt and efficient allowing for observations to be resumed as soon as possible with minimal disruption. PAM Operators should remain at their station and remain wholly focused on monitoring PAM software and listening to acoustic signals. Take breaks to minimize fatigue but time these breaks around operations wherever possible and where available, seek cover whilst you are away from your observation platform or workstation.

Recording Data and Species Identification

The mitigation team should be diligent in the recording of data and make sure data is checked on a regular basis. All entries should be as accurate as possible and without subjectivity. They should have appropriate identification books/cameras if applicable to aid them with species determination. The MMOA emphasises that species identifications should *never* be guessed and personnel are encouraged to raise identification to a higher taxonomic level where confidence in species is not high. Assuming species identification is considered bad practice, reduces the reliability of the dataset and may render it unfit for data analysis. The lowest definite category of identification should be adopted as the formally reported species

identification at all times. In other words 'definite dolphin species' is more appropriate than 'possible bottlenose dolphin', although the latter can also be noted in a comments section of the reporting forms. The MMOA stresses that no pressure should be placed on the mitigation team to make a positive species identification. On the contrary, this is often not possible due to the nature of marine fauna and the often challenging viewing conditions at sea.

Accurate Range Determination

The mitigation team should estimate range as accurately as is possible given the prevailing conditions. MMOs should have suitable equipment (reticulated binoculars, inclinometers or range sticks) to determine range and PAM Operators should have sufficient knowledge to interpret PAM software to determine range (when the software permits). Take the opportunity to test your ranging capabilities against objects at known distances by using the vessel's radar / AIS system.

Use of Handheld Radios

The mitigation team should use handheld radios in accordance with the platform / vessels protocol and operational language (i.e. using the platform's working channel and following good radio practice). They should remember that communications must be kept to a minimum and that instructions must be clear and decisive. The mitigation team should make sure they test the communications prior to the first pre-watch and regularly during the project to avoid any issues when a radio call is required. They should always check that their radios are charged and on the correct channel, and should not compromise communication by listening to loud music. They should not have disputes over the radio.

Taking Mitigating Actions

The mitigation team should remain professional and adhere strictly to the mitigation procedures determined for the project. They should advise on mitigation actions in a clear, concise and polite manner to the platform's crew, and ensure that measures are implemented swiftly. At all times, it must be remembered that they are there to advise on mitigation actions in line with the project licenses and should never consider their role to be enforcement. Advice should be unambiguous, non-subjective and firm.

Non-compliance

In any cases of non-compliance the mitigation team should adhere to the communication protocol established by the Client. They will remain calm, professional and respectful in these situations. For transparency the mitigation team should log in detail the sequence of events of any non compliance in case future disputes arise. Non-compliance should be discussed onboard and documented in daily progress reports to provide an opportunity for the operations team to acknowledge, understand and prevent reoccurrence.

Reporting

The mitigation team should report honestly and concisely the details of their observation/monitoring effort, weather conditions, sound source activity, sightings/acoustic detections and adherence to the mitigation procedures. Avoid documenting opinion in the technical report and provide an unbiased, factual account of the survey programme to include all supporting data (e.g. recording forms provided as an appendix to the report for ease of access). Reports should be checked thoroughly for technical content and grammar and submitted within the agreed timeframe which should be outlined from the onset. Utilise

weather downtime to work on reports and ensure thorough handovers are undertaken between rotations.

Respect Data Confidentiality

The mitigation team should be aware that they are working for an operation with sensitive data and will respect this. No information should be distributed without following the correct reporting protocol determined prior to the project. Project confidentiality must also be upheld when using social media and client internet safety procedures adhered to at all times.

Respecting Safety Policies

During certain operations or exercises on the platform/ vessel the mitigation team should be aware that they may be required to wear Personal Protective Equipment (PPE) or be excluded from certain work areas. They should select their work area within appropriate safety boundaries and receive formal approval for workstations from the client. If they are unsure about any activity or workspace they should ask the Captain, Chief Officer or Party Manager first. The mitigation team should be aware that they are expected to attend safety drills and any safety meetings when requested. If they need to be exempt from these because they must be on watch, they will seek prior approval for this first with the Captain or Chief Officer.

Appropriate Dress

The mitigation team should dress appropriately for their role. This means in cold climates they should have appropriate warm and waterproof clothing for observation outside. In warm climates they should wear suitable clothing and sunscreen to avoid sunburn. Follow the project specific risk assessment for working in extreme weather conditions.

Remain Professional at all Times

Even when mitigation team members are off watch they will act professionally. They will consider the close working environment on-board the platform and respect the roles and responsibilities of others. They will not distract other crew members from their duties and will be aware that people may be asleep during the day and that they may need to be quiet in certain areas of the platform/ vessel. All personnel should behave accordingly and refrain from entering inappropriate discussions which may cause offence to others and/ or have damaging consequences to the project. Where necessary, inappropriate behavior should be reported at the soonest and any appropriate action taken to ensure all personnel feel comfortable in their work environment.

Being Part of a Team

The mitigation team may comprise several MMO and PAM Operators who will be expected to work as a team. The mitigation team members will respect the person who has been assigned to lead this team and the duties they have to perform. They will be supportive at all times. The mitigation team should also be aware that for the period of time they are on the platform/ vessel they are also part of the wider on board community.

This is one of ten position statements produced by the MMOA. All of the MMOA Position Statements are available for download in a single document in addition to viewing on this website. To download this document please click [here](#)