

IAGC Guidance on the Use of Towed Passive Acoustic Monitoring during Geophysical Operations

Guidance Objectives

IAGC has been an early supporter of complementary monitoring techniques to visual observations. As a member of the OGP E&P Sound & Marine Life Joint Industry Program (JIP), IAGC has supported several mitigation and monitoring research projects, including the development of PAMGuard.

In order to maximise the performance of Passive Acoustic Monitoring (PAM) systems during geophysical surveys, the objectives of this guidance are to:

- determine minimum performance criteria for PAM
- describe what should be covered at the survey planning stage
- specify technical and operational requirements

This guidance will enable the geophysical industry to comply with confidence with the monitoring and mitigation measures stipulated by different regulatory agencies and/or clients.

PAM Definition

Passive Acoustic Monitoring (PAM) is a method to detect the presence of vocalizing marine mammals and estimate their location relative to a hydrophone array being towed from a vessel in operation. Marine mammal species are identified by the specific temporal and spectral characteristics of their vocalizations.

Background: PAM is a technology widely accepted yet showing variable levels of performance

PAM is increasingly considered by regulators as a qualified tool for conducting marine mammal monitoring at sea during night time or poor visibility conditions. Yet the performance of commercially available PAM systems is highly variable. Factors that contribute to determining the overall operational performance of PAM systems today include:

- The total listening time over the survey duration, depending on system reliability and redundancy.
- The technical specifications and capabilities of the PAM hardware and software system components relative to accurate detection and localization of vocalisations from various marine mammal species.
- The number of hydrophones and PAM arrays deployed and their geometry.
- The hydrophones arrays position with relation to the vessel's propulsion and to the energy sources.
- The availability of experienced PAM operators.
- The level of technical support available to PAM operators in the field.
- The cetacean groups targeted for detection.

Expected PAM System Performance

The PAM System should be capable of:

- Detecting the frequencies of the marine mammals of interest expected to be present in the survey area within the prescribed exclusion area around the energy sources.
- Detecting vocalizing marine mammals in a reasonable time.
- Identifying vocalizing marine mammals and establishing bearing and range in a reasonable time
- Immediately communicating relevant information to the party chief so appropriate and timely mitigation measures can be taken (i.e. delay soft start, power down or silence the energy source).
- Store the detection data so as to properly inform the final PAM report.

Pre-Planning specifications

The following should be clarified during the planning phase of a survey:

- Specifications fully demonstrating the system's capability to detect & classify the species of interest identified during the Environmental Risk Assessment, reflecting the species likely to be encountered in the survey area. Most importantly, the system's specifications must demonstrate their ability to provide a reasonable estimate for bearing and range of the detected marine mammal to the energy sources.
- Redundancy in hydrophones and spares so as to guarantee the PAM system's functionality throughout the survey.
- Intended mode of operation of the PAM system (dusk/night only or 24 hours) and hence the number of PAM operators.
- Details of the deployment and retrieval process with due consideration to vessel type, relation to the seismic spread (including minimization of received levels of background

noise) and back deck safety. This will be supported by load test certificates, risk assessments, procedures and job safety analysis. Early engagement with seismic Vessel Manager is therefore recommended.

- PAM operator's experience of marine seismic surveys, i.e. operational constraints and HSE expectations. PPE requirements will have been communicated for PAM operators to follow. A minimum of 10 weeks of experience is recommended for the lead operator.
- PAM operator's ability to troubleshoot PAM software, hardware, and handling equipment. **The completion of a PAM course is a must.**
- Availability of an onshore technical support to the PAM operator(s).
- Standard operating procedures for implementing PAM in conjunction with conventional visual observers or Marine Mammal Observers (MMOs).
- Communication pathways to be established between MMOs, PAM operators and crew.
- Choice of marine mammal observation reporting form. In countries not imposing a specific reporting form, it is recommended to use [IAGC's standard form](#).

Technical considerations

The PAM system should comprise:

- At least one hydrophone array section to listen for marine mammal vocalisations.
- A listening frequency range between 10'sHz – 180kHz dependent on hydrophone configuration in use. However the effective frequency range under operational conditions is determined by the presence and characteristics of ambient acoustic noise relative to animal vocalizations.
- A minimum of three hydrophones per bandwidth in order to determine the bearing and range to a detection signal. Additional hydrophones and hydrophone arrays may be utilized in order to improve both detection and localisation of marine mammals.
- A tow cable, deck cable and a data processing and monitoring system which processes, displays and stores selected data.
- A depth gauge fitted within the array in order to provide some positional information in the vertical plane.
- Input of GPS positioning from the object where the PAM cable is towed to enable the tracking of acoustic detections relative to the seismic source(s), the vessel, and the local area.
- Computer display with pre-loaded PAM software that has been designed to detect marine mammal vocalizations.