**MARINE SCIENCE CO-ORDINATION COMMITTEE (MSCC)**

**UNDERWATER SOUND FORUM**

Minutes of the meeting held on Thursday 30 November 2017 at

Hotel Victoria, Lowestoft

**Meeting Chair:** Professor Peter Liss **University of East Anglia**

**Attendees:**

Helen Baron Intertek Energy and Water

Oliver Boisseau Marine Conservation Research

Lindsey Booth-Huggins MMO

Tetrienne Box JNCC

John Campbell IOGP

Jo Collins BDMLR

Ken Collins University of Southampton

Julie Cook BEIS

Tania Davey Living Seas, Wildlife Trust

Ian Davies Marine Scotland Science

Jonathan Downing Maritime Warfare Centre

Phil Durrant Marine Industries Liaison Group

Adrian Farcas Cefas

Rebecca Faulkner Cefas

Phil Gibbs Swale Technologies

David Hedgeland UKBP

Jackie Hill AECOM

Julia Hunt Defra

Alice Jamieson MMO

Rod Jones MoD

Sally Kazar GOBE Consultants

Paul Kirk MMO

Richard McLanaghan Marine Conservation Research

Stephen Marsh BDMLR

Nathan Merchant Cefas

Tina Nenadovic Gardline

Laura Opel MMO

Laura Palmer Gardline

Stephen Robinson NPL

Gemma Starmore Royal Haskoning DHV

Simon Stephenson RPS

Davy Still BEIS

Alex Thompson BEIS

Conor Tickner AECOM

Emma Toogood MMO

Corentin Troussard RTSys

Nienke van Geel SAMS

Rebecca Walker Natural England

Ed Willsteed Cranfield University

**Secretariat:**

Anne Brazier MSCC/NOC

1. **Chair’s Welcome**

The Chair welcomed attendees to meeting, in a very snowy Lowestoft, and thanked Cefas for organising the meeting. The Chair reminded Members that the Forum had now been in existence for over ten years and it was testimony to its success that new faces continue to join the Forum and attend meetings.

1. **Host’s Welcome**

Dr Merchant, on behalf of Cefas, welcomed Members to Lowestoft. The meeting was held in the Hotel Victoria as the Cefas headquarters were undergoing redevelopment. Members were informed the new office building is planned to open in January 2018 and it is hoped will make Cefas sustainable in Lowestoft for the next 50 years.

1. **Apologies for absence**

Apologies were received from: Jasco, Scottish Natural Heritage, Atlas Elektronik, Sonardyne, GMX, IoA, APEM, University of Exeter, Ultra, Loughine, HR Wallingford, Chickerell BioAcoustics, Natural Resources Wales, The Marine Connection, BODC, Seiche, ISVR, SMRU Consulting, OSC, SEA, BAE Submarines.

1. **Minutes of previous meeting and matter arising**

The minutes of the previous meeting were agreed to be a true and accurate record and are therefore approved. There were no matters arising.

1. **Themed Presentations**

**The work of Cefas, including underwater sound, scientific advice to regulators and underwater noise modelling**

*Nathan Merchant, Rebecca Faulkner, Adrian Farcas, Cefas*

The Centre for Environment, Fisheries and Aquaculture Science (Cefas), was established in 1902 by the Marine Biological Association to research the fishing industry as part of the UK contribution to the newly-created International Council for the Exploration of the Sea. Today Cefas collects, manages and interprets data on the aquatic environment, biodiversity and fisheries.

The Cefas Noise and Bioacoustics Team are recognised experts in impact assessment of underwater noise, with capabilities ranging from marine biology and bioacoustics to sound propagation and modelling. They are a leading voice on policy and regulatory issues, provide scientific advice on underwater noise to Defra, the Marine Management Organisation (MMO), and Natural Resources Wales (NRW), and represent the UK in international fora such as OSPAR and the EU Technical Group on noise for the Marine Strategy Framework Directive (MSFD).

The Team, in conjunction with Marine Scotland Science and the University of Exeter, have analysed underwater noise data from subsea sound recorders located around the UK coast to make an initial assessment of underwater noise pollution. This was used to inform UK policy on underwater noise pollution and to form the basis of the UK assessment on underwater noise under the EU Marine Strategy Framework Directive.

The Team also conduct field surveys of underwater noise, carry out offshore monitoring, environmental impact assessments and advise on the UK’s regulatory processes and legislative requirements. Additionally, their in-house expertise in acoustic propagation modelling, and 3D modelling suite for noise assessment under varying oceanographic conditions, underpins their environmental impact assessments, and is able to account for seasonal effects and wave conditions which can substantially affect predictions of risk to marine life. The Noise and Bioacoustics Team are also active in research, working with researchers both within the UK and internationally.

**The Joint Industry Programme (JIP) ‘Sound and Marine Life’ – update**

*John Campbell, International Association of Oil & Gas Producers*

Joint Industry Programmes (JIPs) ensure that effective policy stems from good, independent science. In 2005 a wide group of international oil companies and the International Association of Geophysical Contractors committed to found a JIP, under the auspices of the International Association of Oil and Gas Producers. The aim was to identify and conduct a research programme that would improve the understanding of the potential impact of Exploration and Production (E&P) sound on marine life and contribute to scientific debate. In order to advance the understanding of the interaction between sound from oil and gas operations and marine life, this JIP identified and commissioned research to support planning of E&P projects and risk assessments, to provide the basis for appropriate operational measures that are protective of marine life and to inform policy and regulatory development.

To date, $60 million has funded a range of research into (i) sound source characterisation, (ii) physical, psychological and hearing, (iii) behavioural responses and their biological significance, (iv) mitigation and monitoring, and (v) technology development which together have resulted in > 80 peer-reviewed publications and major research accomplishments.[[1]](#footnote-1) Examples include research on hearing for Ringed, Spotted and Bearded seals, using behavioural means the creation of a standardised and open source software (PAMGuard) that runs several vocalisation detectors that allow multiple species to be identified and potentially tracked at the same time, day or night and in low visibility; the behavioural responses of Australian Humpback whales to seismic surveys which found that whilst migrating there was no evidence of orientation of the whales towards, or away from, the source vessel towing the acoustic source (in fact sometimes the whales seem to be reacting to the vessel itself and not to the vessel noise); and research on dolphin hearing which showed that the potential for seismic air sources to cause temporary hearing loss in dolphins is lower than previously predicted.

The JIP is now in the final stage of three, and Phase III research studies are likely to continue until 2020, with a review meeting taking place in 2018. A Phase IV research programme is under review. Factsheets are planned for publication by the end of 2018 and data should be available via the IOPG. Reports and publications linked to JIP-sponsored research, including details on research focus areas and funding opportunities which can all be accessed via the JIP website (see footnote 1).

**Summary of the Offshore Renewables Joint Industry Programme (ORJIP) Project on the use of Acoustic Deterrent Devices (ADDs) and Improvements to Standard Mitigation Measure during piling: Understanding the Effectiveness of ADDs on Minke Whales**

*Simon Stephenson, RPS Planning and Development*

The ORJIP Ocean Energy is a UK-wide collaborative programme of environmental research with the aim of reducing consenting risks for wave, tidal stream and tidal range projects.   A priority consenting risk to the offshore wind farm (OWF) industry is the potential effects of subsea noise (primarily produced during pile-driving) on marine mammal receptors.  To address this risk ORJIP proposed a project to investigate the efficacy of ADDs to deter marine mammals from an offshore wind construction site which could enable exclusion zones to be created around the turbine.  Phase 1 of the ORJIP study identified and reviewed 34 ADDs as part of a comprehensive desk top study.  This led to a second phase of work where the focus was to carry out in-field testing on the efficacy of ADDs to deter minke whale (a low frequency cetacean) and to provide recommendations on their use during construction and which, in turn, will inform government guidance on mitigating injury to marine mammals.

The study site chosen for the Phase 2 field study was Faxaflói, a large bay in the southwest of Iceland approximately 50 km long and 90 km wide with an average depth of 38 metres.   The Lofitech ADD was selected, as this was proven to be effective for other marine mammals (pinnipeds and harbour porpoise).  46 whales were successfully tracked over a six-week period. A pre-exposure period of 30 minutes would be followed by a 15-minute control period (engine cut) and then the ADD was deployed for 15 minutes at a distance of 1,000 metres from the animal.  This was followed by a 30-minute post-exposure period.  It became clear that the whales were responding to the ADD as their swim speed almost doubled and there was a significant change in their directional path. For example, if the whales were foraging before deployment, they would move in an erratic way, after deployment this became a straight line.  The whales continued to move away 30 minutes after the ADD was turned off and even after 45 minutes, the whales were still moving away but their speed had slowed.

Conclusions from this study are that: 1) ADDs are effective at invoking a deterrence response in minke whales without the risk of inducing injurious effects even if deployed over longer durations (1-2 hours); 2) minke whales are responsive to ADD activation; 3) it is considered unlikely that higher ambient noise conditions on wind farm sites would significantly affect the effectiveness of ADDs as a mitigation measure; and 4) the ADD deployment, in the context of the duration of pile driving, is not considered likely to induce temporary or permanent hearing damage, nor result in any long-term behavioural effect.   Members asked if there were any changes in behaviour to individual whales affected by the ADD more than once.  Since the study did not focus on identifying individual minke whales this is not known.

## Calibration of marine autonomous acoustic recorders (EMPIR UNAC-LOW project)

## *Stephen Robinson, NPL*

## The expansion of offshore activities has raised concerns about the environmental impact of man-made noise on marine life. In response, the EU has introduced legislation designed to limit the impact of such noise. The UNAC-LOW project addresses this need for traceable calibration through the development of a European Metrological Capacity in underwater calibration for acoustic frequencies below 1kHz. It aims to achieve this by providing traceable measurement capabilities to meet the need for calibration of hydrophones between 20 Hz and 1 kHz (Work Package 1) and autonomous underwater acoustic noise recording systems at frequencies between 20 Hz and 1 kHz (Work Package 2).

## The project’s consortium members are: UK (NPL), Turkey (Tubitak), Denmark (DFM), Sweden (FOI), and Italy (CNR & ISPRA). Emerging from the project, NPL have already launched a calibration service for low frequencies.

## Recorders may need to be treated as ‘black-boxes’, but different procedures are needed depending on if hydrophone can be separated from the recorder body. For hydrophones attached rigidly to the body, scattering from the body causes perturbations of the frequency response and directional response at kilohertz frequencies. In the 500 Hz to 2 kHz range, the recorder body can have resonances. In addition, at very low frequencies the recorder body (and protective cage) can increase flow noise. Work has begun to standardise calibration methods - a new work item in ISO TC43 SC3 has been proposed by Canada and additionally, there probably will be joint work with IEC TC87.

## Members questioned the robustness of autonomous recorders but recorders are now far more robust than earlier models. Stephen mentioned that clamping the body rigidly can reduce the effect of body resonances, and using a hydrophone on an extension cable alleviates the effect of the scattered sound at kilohertz frequencies.

## Passive Acoustic Monitoring and environmental regulation compliance

## *Coretin Troussard, RTsys*

## RTsys specialises in the design and manufacture of advanced underwater acoustics systems which allow the measurement of different types of underwater noise such as mammal, ship and boat noise, pile driving and air guns and other anthropogenic noise. Two case studies were covered in more detail within the presentation. RTsys recorders are qualified as being suitable for submarine measurements within the framework of the Marine Strategy Framework Directive (MSFD). The measurements are made at low frequencies, concentrating on two one-third octave bands at 63 and 125 Hz – at these frequencies, maritime traffic noise predominates over all over noise sources. Pre-calculation software directly supplies the indicators required by the MSFD such as acoustic pressure, the exposure level and the third-octaves. Recorders can also emit alarms in real time should noise exceed the thresholds determined in advance, with the raw data being saved. RT’s Quick Report post-processing software can produce a detailed report on sound exposure levels, sound pressure levels, one-third octave bands as well as other descriptors making it easy for those who wish to develop their own cycles, or identify area of interest. This software is available free, on request, with RTsys recorders.

## Case Two referred to offshore installation monitoring where rugged remote buoys can record underwater noise and simultaneously send and display real-time noise information such as the Sound Exposure Level (SEL) and Sound Pressure Level (SPL) over a 10km distance (when 750m away from the offshore installation) so as to ensure the regulation threshold for noise is not exceeded. Additionally, a network of buoys around an offshore installation can also be coupled with a deterrent device. A prototype was deployed during summer 2017 in the Mediterranean and successfully detected boats, dolphins and specific fish. Further deployments in 2018 will test the system’s success in picking up harbour porpoise.

## 

## NOAA Marine Mammal Acoustic Technical Guidance Update

## *Nathan Merchant, Rebecca Faulkner, Cefas*

## This 2016 Technical Guidance provides acoustic thresholds for the onset of permanent threshold shifts (PTS) and temporary threshold shift (TTS) in marine mammal hearing for all sound sources and can be used to help evaluate the risk of proposed activities having these effects on marine mammals.

## Before this Technical Guidance was produced, the recognised standard criteria for such assessments were the Southall et al (2007) criteria. The purpose of this talk was to consider the differences in risk assessments resulting from the application of one set of criteria over the other.

## Both sets of criteria apply the following terminology:

## Dividing sound sources into two groups based on their potential to affect hearing sensitivity:

## Impulsive sound sources (e.g. airguns, impact pile drivers): are transient, brief (less than 1 second), broadband, and typically consist of high peak pressure with rapid rise time and rapid decay, and based on these physical characteristics have a greater potential to affect hearing sensitivity.

## Non-impulsive sound sources (e.g. sonar, vibratory pile drivers): can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak pressure with rapid rise time (typically only small fluctuations in dB level) that impulsive signals do.

## Choosing two metrics (duel exposure criteria) that address the impacts of noise on hearing sensitivity:

## Peak sound pressure level: better reflects the physical properties of many sound sources, especially impulsive sources, to affect hearing sensitivity.

## Cumulative sound exposure level: accounts for not only level of exposure but also duration of exposure.

## Dividing marine mammals into functional hearing groups and developing auditory weighting functions based on the supporting science indicates that not all marine mammals hear and use sound in the same manner (For reference, humans hear from 20 Hz to 20 kHz):

Low-frequency cetaceans (hearing range 7 Hz to 35 kHz): large, baleen whale species.

Mid-frequency cetaceans (hearing range 150 Hz to 160 kHz): dolphin species.

High-frequency cetaceans (hearing range 275 Hz to 160 kHz): porpoise species.

**Southall only:**

Pinnipeds (hearing range: 75 Hz to 75 kHz).

**NOAA only:**

Otariid pinnipeds (hearing range: 60 Hz to 39 kHz): eared seals (e.g., sea lions).

Phocid pinnipeds (hearing range 50 Hz to 86 kHz): true/ earless seals (e.g., harbour seals).

## However, the weightings and sound exposure thresholds for PTS and TTS differ between the two sets of criteria, meaning that these effects will be predicted at different distances from a sound source depending on which criteria are used. Examples were shown demonstrating the differences for each functional hearing group using a benchmark scenario of a generic pile-driving operation. The NOAA criteria were found to be more conservative than Southall (i.e. predicted larger effect zones) for low-and high-frequency cetaceans, while the remaining hearing groups were either the same (mid-frequency cetaceans and phocid seals for the peak SPL criterion) or less conservative than the Southall criteria. Further analysis will be needed to confirm how consistent these findings are for different sound sources and propagation distances.

1. **Recent developments in specification standards and the UK Acoustics Network (UKAN)**

*Stephen Robinson, NPL*

The International Standards Organisation’s (ISO) Technical Committee 43, Sub Committee 3 on Underwater Acoustics has four current working groups: Ship noise measurement, definitions and terminology, marine pile driving, and active sonar calibration using standard targets. Potential new work includes standards for measurement of particle velocity and standards for the measurement of seabed vibration. Experts are required for both. The International Electrotechnical Commission’s (IEC)Technical Committee 87 covers ultrasound, but of interest to Members will be Working Group 15 which looks at the calibration of underwater electroacoustic devices. Potential new work items include the calibration of vector sensors. A joint ISO/IEC Technical Committee 1 Working Group 7 deals with sensor networks. Reference architecture was published in 2017 with the UK providing a large number of comments. The British Standards Institution (BSI) Expert panel EH/1/7 on underwater acoustics already contains many Members of the Forum. Any Member interested in joining can contact the Chair, Stephen Robinson, at [stephen.robinson@npl.co.uk](mailto:stephn.robinson@npl.co.uk)

The newly-formed UK Acoustics Network aims to bring together the internationally leading, but disparate UK acoustics research community, to promote acoustics in the UK both nationally and internationally and to provide a coherent single point of access to acoustics research for industry and governmental agencies. The main aim of acoustics.ac.uk is to bring together researchers working in different areas of acoustics to enhance communication between groups, provide a focus for collaboration and innovation, and to maximise the future impact of acoustics based research in the UK.

The UKAN has a number of Specialist Interest Groups (SIGs). The Special Interest Group (SIG) for Underwater Acoustics (SIGUA) is concerned with the generation, transmission, and reception of sound in the underwater environment including the interaction between sound and underwater surfaces and structures. The principal function of the SIGUA is to provide a forum for researchers, practitioners and users of underwater acoustics, covering analysis, modelling, synthesis, and measurement, across all possible underwater applications.

Historically, the UK has held a strong position internationally in underwater acoustics, and underwater acoustics has been represented at senior levels in industry and government, with considerable influence on national research priorities including funding. This has been eroded in recent years and the SIGUA will take steps to: (i) increase the national profile and importance of underwater acoustics; (ii) increase the level of senior representation in underwater acoustics; (iii) increase the number of early career researchers in underwater acoustics; and (iv) to increase the number of contributions to journals and international conference in underwater acoustics. The main way this is expected to be achieved is by demonstrating the value of research in underwater acoustics to national challenges and strategic areas for research development. The SIGUA should also develop ways to capture different stakeholder valuations of research in underwater acoustics and to demonstrate the wider value to public life and its impact on society and the economy. The SIGUA will divide its efforts between a series of workshops, conferences, and other scientific events to exchange ideas and promote discussion between researchers, practitioners and users and a set of specific objectives. The Group Coordinator for the SIGUA is Dr Duncan Williams of DSTL. Any Member interested in participating in the activities of the UKAN SIGUA, please visit <https://acoustics.ac.uk/> to register interest. It was agreed to see whether a joint Forum/SIGUA meeting could be held in 2018 **ACTION: Stephen Robinson/Anne Brazier**.

1. **The remit of the MSCC’s Marine Industries Liaison Group (MILG)**

*Phil Durrant, MILG and MarineSpace*

The Marine Industries Liaison Committee was formed in 2010 and is one of the sub-groups of the Marine Science Co-ordination Committee (MSCC). The Committee is composed of representatives from the main marine and maritime industry sectors, who meet in person twice per years although email correspondence is ongoing. The MILG provides advice and guidance to the MSCC on matters relating to marine and marine science industries and therefore allows industry to talk to policy makers about what is important to it and to also learn about what is happening which may impact on industry. Spending cuts have forced the private and public sectors to work together and MILG is actively seeking to promote ‘UK plc’, a combination of private and public sectors working together to promote the UK.

The recommendations in the 2013 report ‘A review of private and public sector marine science and evidence needs, the capability of the UK’s private sector marine science and technology sector to meet or support the meeting of those needs, and opportunities for growth’ recommendations led to a work programme for MILG over the next 18 – 24 months in three areas: strategic actions, collaboration to support efficient delivery of marine science, removing barriers for growth. Activities continue with MILG taking on new projects including input into the refreshed MSCC Marine Science Strategy, the updating of MILG factsheets and seafood production and processing.

# MILG members have also been instrumental in populating the NOC Association’s *UK Marine Science and Technology Compendium* database, which reflects the vibrant nature of the UK’s marine science community and also contains information from the UK marine industry sector, Government, marine societies and marine NGO contacts. Forum Members were asked to access the database via <http://naqbase.noc.ac.uk> and contact Jackie Pearson, NOC Association Secretariat (jfpea@noc.ac.uk), if they wished to appear within the Compendium.

1. **Any other business**

Members were provided with a brief update by Jon Downing on his MSc project ‘Securing diverse stakeholders engagement in studies of the effects of sonar transmission on marine animals’.

Members were informed that Ed Harland of Chickerell BioAcoustics has obtained his doctorate.

1. **Date of next meeting**

The next Forum meeting will be held on Friday 20 April 2018 at the National Oceanography Centre, Southampton. The Autumn meeting will be held at NPL on Wednesday 21 November 2018. Any Member wishing to present at either meeting, or who would like to suggest an agenda topic, should contact Anne Brazier.

1. www.soundandmarinelife.org

   [↑](#footnote-ref-1)