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

**UNDERWATER SOUND FORUM**

Minutes of the meeting held on Friday 20 April 2018 at

the National Oceanography Centre, (NOC), Southampton

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

**Attendees:**

Rachel Antill APEM

Sean Bell BAE Submarine Systems

Tom Benson HR Wallingford

Harriet Bolt UKHO

Tetrienne Box JNCC

Robin Burns Jasco

Sarah Canning JNCC

Pierre Cauchy UEA

Ken Collins University of Southampton

Julie Cook BEIS

Victoria Copley Natural England

Tarquin Dorrington Defra

Jon Downing MoD

Gaynor Evans BODC

Anthony Greening MoD

Ed Harland Chickerell BioAcoustics

David Hedgeland UKBP

Dick Hazelwood R & V Hazelwood Associates

Jackie Hill AECOM

Philip Hoare University of Southampton

David Hughes QinetiQ

Charlotte Johns University of Southampton

Phil Johnston Seiche

Kevin Linnane RPS Energy

Stephen Marsh BDMLR

Tim Mason Subacoustech

Francesca Marubini Hartley Anderson

Nathan Merchant Cefas

Fergus Midforth Subacoustech

Phil New GoBe Consultants

Denise Risch SAMS

Stephen Robinson NPL

Elena San Martin ABPmer

Graham Siggers HR Wallingford

Terry Sloan Planet Ocean

Gemma Starmore RHDHV

Adrian Tate Marine Scotland

Alex Thompson BEIS

Paul White ISVR

Duncan Williams Dstl

Russ Wynn NOC

**Secretariat:**

Anne Brazier NOC/MSCC

1. **Chair’s Welcome**

The Chair welcomed Members and guests to the Forum. The Chair expressed his pleasure at seeing so many attendees; the Forum’s membership now stands at 257 individuals and it was gratifying to see Members, both old and new, at this meeting. The Chair introduced Dr Duncan Williams of the UK Acoustic Network’s Special Interest Group in Underwater Acoustics (SIGUA). SIGUA are very keen to work with the Forum in the future.

1. **Host’s Welcome**

Professor Wynn welcomed attendees to the National Oceanography Centre (NOC). Professor Wynn has sat on many of the MSCC’s Working Groups so is very much aware of the research/policy interface of the Committee. Professor Wynn gave a precis of the National Oceanography Centre. Based over two centres (Southampton and Liverpool), co-located with the Universities of Southampton and Liverpool, the NOC employs 650 staff with 390 students and researchers at the Southampton building. In 2015 the Marine Robotics Innovation Centre opened which hosts a community of innovative companies developing technology for platforms, components and sub-systems. Additionally, the NOC operates the research ships the RRS *James Cook* and RRS *Discovery*. In 2017, the MASSMO 4[[1]](#footnote-1) mission saw up to 11 surface and submarine gliders deployed off the northern UK out to the Faroe-Shetland Channel. The mission, co-ordinated by the NOC, had a particular focus on passive acoustic monitoring of marine mammals and oceanographic features. Four terabytes of data was collected, the majority being acoustic. MASSMO 5 will see the operation of complex MAS fleets in high latitude regions whilst the 2019 – 20, MAS will be operated in ice-margin and under-ice environments. Anyone wishing for more information should contact Russ Wynn at rbw1@noc.ac.uk

1. **Apologies for absence**

Apologies had been received from The Wildlife Trust, Bae Systems, Dstl, Lloyds Register Consulting, MMO, OSC, The Carbon Trust, SMRU Consulting and Ultra.

1. **Minutes of the Previous Meeting**

The minutes of the previous meeting were agreed to be a true and accurate record and were therefore approved.

1. **Matters Arising**

There were no matters arising.

1. **Themed Presentations**

**NOAA vs Southall marine mammal noise exposure criteria**

*Nathan Merchant and Rebecca Faulkner, Cefas*

At the previous Forum meeting, Members received a presentation on the 2016 NOAA Marine Mammal Acoustic Technical Guidance Update, which provided acoustic thresholds for the onset of permanent threshold shifts (PTS) and temporary threshold shifts (TTS) in marine mammal hearing for all sound sources. Before this Technical Guidance was produced, the recognised standard criteria for such assessment were Southall *et al* (2007). At the time of the previous Forum meeting, there had been a preliminary comparison of the differences in risk assessments resulting from the application of one set of criteria over another which varied between being more or less conservative, depending on the marine mammal.

Since that meeting, further analysis has taken place and acoustic modelling carried out to compare the two criteria using the scenarios of pile driving on an offshore wind farm, pile driving within an inshore port works, an unexploded ordnance detonation, and seismic survey. Again, there was variation in both source type and sound propagation. For example, the weightings differed substantially at low frequencies, the NOAA criteria are more precautionary for high-frequency cetaceans for both impulsive and non-impulsive sound and weightings differed for Phocid seals. This further analysis has therefore concluded that:

* NOAA guidelines are more precautionary than Southall for low-frequency and high-frequency cetaceans
* Phocid seals are either the same or less conservative
* Medium-frequency cetaceans are either the same or less conservative.

However, the meeting was asked to note that caution should be exercised to avoid applying these results too widely or with unwarranted precision: the absolute decibel differences reported for the criteria should be broadly similar for other similar environments and sources, but variability should be expected according to the specifics of any particular scenario assessed.

**Dealing with the Media: Lessons Learned**

*Kevin Linnane, RPS Energy*

Members were informed of the background to this presentation. In 2017 a story in the media described a ‘family’ of minke whales being washed up dead or injured after ‘becoming stressed by an offshore windfarm’. Members of a voluntary organisation were interviewed with one stating “I also believe that the wind turbines would have contributed to this…”. The emotive story was widely reported but was, in fact, inaccurate. The strandings were not related in any way, were not of the same species, the quoted volunteer did not have any expertise on marine mammals and was not in a position to claim that ‘environmentalists believe that offshore wind farms have contributed to whale deaths in the UK’. Dr Linnane took these inaccuracies to *The Daily Mirror,* with no effect and also submitted a complaint to the Independent Press Standards Organisation (IPSO) who found there had been no breach of the Editors’ Code of Practice.

Members discussed this, and other scenarios and considered options for going forward. The Forum concluded that early engagement with any publication is crucial and if a Member is offered the option of contributing to an article (no matter how long after the event) this offer should always be taken up as for subsequent similar stories individuals may then be consulted as their name will come up in ‘cuttings’ searches. It was agreed that a ‘Media’ page be added to the Underwater Sound Forum website, and any Member wishing to be added to this page (who can speak to the media under their own name, and not that of the Forum), to contact (AB) in first instance. **ACTION: Members**. Any ideas for a higher press profile for both the Forum and its Members to be sent to (AB) **ACTION: Members**.

**AutoNaut wave-propelled Unmanned Surface Vessel (USV) for Passive Acoustic Monitoring (PAM)**

*Phil Johnston, AutoNaut*

There are many options for PAM deployment methods, one of which is unmanned surface vessels such as AutoNaut. USVs have many advantages; they ensure the removal of personnel from the offshore environment, no fuel is required, their use means a reduction in costs and logistics, they have good manoeuvrability and very low self-noise. AutoNaut has actually been successfully deployed on 64 missions but there are still challenges to address such as reducing entanglement risk and ensuring the towed array has no negative impact on USV performance.

AutoNaut was part of the MASSMO 4 mission and picked up harbour porpoise sound through the use of PAM-Guard and was also used in the Unmanned Warrior 2016 mission where AutoNaut was covertly deployed as part of a major naval exercise for Anti-Submarine Warfare (ASW). Going forward, it is anticipated that AutoNaut will be of use in fisheries science by acting as a fish finding echo sounder. Members asked whether transducers were ever suspended from the base of foils. If not, perhaps this is something that can be investigated.

**Passive Acoustic Monitoring from Gliders**

*Pierre Cauchy, UEA*

Members were reminded that gliders have an advantage for passive acoustic monitoring as they have little noise emission and also no weather restrictions and can actually be utilised in hurricanes. Climate modellers require *in-situ* measurements to build accurate models and through the use of gliders the extent of measurements has grown considerably. For example, the seagrass *Posidonia oceanica* plays a key ecological role and is protected by a range of legislation. Standard *Posidonia* monitoring programmes generally focus on the plant at different spatial and short temporal scales, without considering the organisms dependent on the ecosystem. Passive acoustic monitoring can non‐intrusively monitor biological activities and biodiversity at high temporal resolution to assess ecosystem health. In a recent study, bottom‐moored hydrophones were deployed in nine Western Mediterranean meadows covering a distance of more than 200 km. Among eight identified fish sound categories, researchers found a single type of sound dominating the soundscape of the *Posidonia* meadows. This sound can be used as a potential indicator for ecosystem health in the Mediterranean Sea.

Gliders can also be used to monitor the population of whales, (whales are not concerned by gliders) and research is looking at the detection of sperm whales in the Mediterranean and will also be deployed at the Porcupine Abyssal Plain to help detect explosions and ship noise. Members were advised however that some gliders are sold with propellers and researchers should ask whether they actually need this facility and whether speed is required over a lack of sound.

**ORJIP Project – impacts on herring from piling at offshore wind farms**

*Phil New, GoBe Consultants*

Members were advised this talk presents the results of a recent ORJIP project on the impacts of underwater noise on herring. The purpose of the study was to provide a reference for the industry to use in the assessing of the impacts of piling on herring and to also undertake a re-analysis of the distribution of spawning herring around the UK.

The assessment of the impacts of offshore wind farms on the development of fish should be included in all EIAs, including underwater noise. However, in many cases detailed site-specific surveys of fish populations, and in particular fish larvae are not undertaken prior to the consenting process, which can lead to highly conservative assessments and the imposition of restrictions. This study looked at alternative data sources for herring spawning indicators at the EIA stage and a new methodology for the analysis of data. Herring were chosen due to the species being recognised as particularly sensitive to anthropogenic underwater noise. Spawning grounds are not fixed and consequently EIA impacts may be being assessed on the basis of 20-year-old data (for example Coull *et al* (1998)) and may be under or over-estimating impacts.

Heatmaps derived from International Herring Larval Survey (IHLS) data over the previous ten years were created. These clearly showed the location of the four main autumn spawning herring stocks within the North Sea and which revealed changes in the distribution of herring larvae compared to that of the Coull *et al* spawning grounds. For example, the IHLS data shows that the historic spawning ground at Dogger Bank has not recolonised since the stock collapse of the 1980s. Therefore heatmaps can be used to aid in assessing the impacts on active spawning grounds by informing the current distribution of spawning herring within each spawning ground to prevent unnecessary restrictions on OWF that have no ecological benefit.

**Intense water particle motion localised near seabed vibrations**

*Dick Hazelwood, R & V Hazelwood Associates*

Work on seabed vibrational waves began in 2010 and arose from concerns over piling and dredging, which both impact the seabed and add to natural seismic noise. This motion is significant to aquatic life which is dependent on inertial sensors (otoliths, etc.) to respond to the environment. For much seabed wild life, ocean noise may be dominated by seabed seismic waves and their associated water motion. They are more sensitive to vibration than pressure.

Seabed measurements show sediment waves forming ground roll where both solid and fluid motions follow an elliptical path, unlike the linear water particle velocities associated with plane pressure waves. Finite element (FE) modelling has shown how these waves do not radiate energy into the water above or the sediment below, but create evanescent pressures, largely confined to the bottom 1 metre of water. This has potential significance to aquatic life. In 2017, an experiment was conducted at Wraysbury reservoir by NPL. This helped confirm theoretical studies on seabed vibrations and their effect on nearby water.

There are five types of water waves: sound pressure, ocean rolling, channel impulse, seabed ground roll and morphing Mexican hat (MMH). It is this final impulse form that has been predicted by a new model. Despite strong spectral dispersion, the MMH impulse wave retains its intensity, creating disturbance at long range in some seabed types. Members are encouraged to access ‘Modelling water motion near seismic waves’ which is available at <http://www.mdpi.com/2077-1312/4/3/47/pdf>

**The characterisation of humpback whale song vocalisations in Southern Mozambique**

*Charlotte Johns, University of Southampton*

The Mozambique Channel contains ‘breeding stock C’ which is composed of three sub stocks, C1, C2 and C3. To date there is a restricted range of data available on humpback whale song patterns for this breeding stock. Little to no small-scale studies have been undertaken as the majority of studies focus on alternate breeding stocks migrating around Australia, Alaska, Antarctica and Hawaii. Data was collected from C1 and C3, which reside off north-east Madagascar, which helped to provide a baseline for this area.

The project adhered to two main null hypotheses: no differences in vocal phrase patterns of C1 and no differences between C1 and C3. Sampling took place over a three-month period via a hydrophone deployed over a diving boat twice daily. Comparative analysis showed no significant differences within C1 and also between C1 and C3.

**Ecological stressors from a fish’s viewpoint – Developments in Agent Based Modelling at HR Wallingford**

*Tom Benson, HR Wallingford*

This presentation highlighted HR Wallingford’s work in developing agent-based models for Environmental Impact Assessments (EIAs) to foresee the impacts of underwater sound and other ecological stressors on marine life. EIAs are required for pile driving, dredging, deep sea mining and seismic surveys. Through the development of an Agent Based Model for EIAs (*HydroBoids*) HR Wallingford can experiment to assess reactions to noise. Members were shown a presentation which included modelled samples (agents) of fish, cetaceans and pinnipeds reaction to sound.

Agents were shown making decisions at each model time step interval: for example, schooling, predator/prey interactions, migratory pathways, response to environmental stressors such as sound, temperature, salinity, light and chemical pollutants. Individuals are assigned a swim speed, (with some randomness in direction), carried by the flow field and can modify their behaviour due to local flow fields. *HydroBoids* is therefore better at predicting impacts, although some information is required in advance such as detailed information on the physical environment. Further information can be accessed at <http://eprints.hrwallingford.co.uk/1448/1/HRPP764-Putting-fish-in-the-tank-T-Benson.pdf>

1. **Updates**

**UK Marine Noise Registry**

*Tetrienne Box, JNCC*

The Marine Noise Registry provides a temporal and spatial record of loud, low to mid frequency impulsive noise from 10 Hz to 10 kHz. Understanding when and where noisy activities take place help define a baseline level for impulsive noise in UK waters and quantify the pressure on the environment by making available an overview of relevant impulsive low and mid-frequency sound sources, throughout the year.

Maps produced annually show the spread of activities in ‘pulse block days’ (the number of days within a set period of time that impulsive noise has been generated within each UK oil and gas licensing block). Data in the Registry are also fed into a Europe-wide registry through OSPAR (the Oslo and Paris Convention for the Protection of the North-East Atlantic). Pulse block day maps have now been produced for 2015 and 2016 and are available from: [https://data.gov.uk/](http://data.gov.uk/).

**Royal Navy/MoD**

*Jon Downing, Maritime Warfare School, HMS Collingwood*

Members were advised there was nothing of significance to report at this time. The Royal Navy is currently looking at the UK’s national infrastructure, especially in the light of fears over national security, such as the cutting of undersea communications cables, and there is intelligence that Russia has converted an old ballistic submarine to carry smaller submarines that are designed to work on the ocean floor.

In the next ten years it is anticipated that the Royal Navy will change but its numbers will not increase. For example, eight Type 26 frigates will replace eight Type 23 ships. The Royal Navy plan to procure a new family of frigates, the Type 31e, with the first of this class expected to be in service by 2023. Additionally, helicopter numbers will not change. Nine new Boing P8 Maritime Patrol Aircraft will be utilised to protect the new aircraft carriers from submarine threats. Over the next 20 years there will be more unmanned vehicles used but these will not necessarily put more noise into the water.

**Standards**

*Stephen Robinson, NPL*

The International Standards Organisation’s (ISO) Technical Committee (TC) 43, Sub Committee (SC) 3 on Underwater Acoustics has four current working groups; Ship noise measurement (WG1), Definitions and terminology (WG2), Marine pile driving (WG3) and Active sonar calibration using standard targets (WG4). The Technical Committee last met in the USA in October 2017 and will next meet in October 2018 in China. The ISO TC43 SC3 standards programme will be of interest to Members and is available from the ISO.

**Published Standards:**

ISO 17208 – 1 Ship Noise requirements for deep water measurements used for comparison purposes

ISO 18405 Underwater acoustics

ISO 18406 Measurement of marine pile driving noise.

**In progress:**

ISO 17208-2 Determination of source levels in deep water

ISO 17208-3 Ship Noise requirements for shallow water measurements

ISO 20073 Standard-target calibration of active sonars.

**Potential new work:**

Standard for ambient noise measurement

Standard for calibration of recorders and digital hydrophones

Standard for testing effectiveness of barrier mitigation in piling noise

Standards for measurement of particle velocity

Standards for measurement of seabed vibration.

The International Electrotechnical Commission’s (IEC) Technical Committee 87 covers ultrasound. Of interest to Members is Working Group 15 which looks at the calibration of underwater electroacoustic devices.

**Published:**

IEC 60500 Properties of hydrophones

**In progress:**

IEC60050-8-1-32 International Electrotechnical Vocabulary. Part 32, underwater acoustics, under revision

IEC 60565 Calibration of hydrophones, free-field and low frequency (under revision).

Technical Committee 114 covers marine Renewable Energy Devices. In progress is IEC 62600-40 Marine energy – wave, tidal and other water current converters and part 40 focusses on the acoustic characterisation of marine energy converters. In collaboration with the ISO is the joint technical committee, Working Group 7 on Sensor networks. Reference Architecture, (Part 2), has now been published.

The British Standards Institution (BSI) Expert Panel EH1/7 on underwater acoustics already contains many Members of the Forum. To join them please contact Stephen Robinson at stephen.robinson@npl.co.uk

The Institute of Acoustics Underwater Acoustics Group covers a wide range of topics including natural and anthropogenic sound and its generation underwater; sonar transducers; sonar signal processing; sonar performance predictions; multi-beam and bathymetry sonar systems; underwater communication; the propagation, reflection and scattering of sound in the underwater environment including the seabed and the sea surface; and bioacoustics. If anyone would like to be involved in bioacoustics please contact Paul Lepper at [p.a.lepper@lboro.ac.uk](mailto:p.a.lepper@lboro.ac.uk)

**UK Acoustics Network**

*Stephen Robinson, NPL*

The UK Acoustics Network was launched in November 2017. Its Underwater Acoustics Specialist Interest Group (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 Group is to provide a forum for researchers, practitioners and users of underwater acoustics, covering analysis, modelling, synthesis and measurement across all possible underwater applications. Members were urged to register at [www.acoustics.ac.uk](http://www.acoustics.ac.uk) and it is hoped to hold joint meetings between the Forum and the UASIG and the Specialist Interest Group on Noise (SIGN) in due course.

The SIGUA will take steps to increase the national profile and importance of underwater acoustics, increase the level of senior representation in underwater acoustics, increase the number of early career researchers in underwater acoustics and increase the number of contributions to journals and international conferences in underwater acoustics. Some funding is available and the Forum were asked for ideas as to how this can be used to increase the profile of underwater acoustics. Ideas already considered are a competition for early career researchers and students, workshops and greater international co-operation.

Members suggested that as the Forum was a broad church, it would be helpful to have SIG meetings on a specific theme, and also requested a follow-up meeting on particle motion. Members also asked if Southall and Popper’s expenses could be covered, thus allowing them to attend the IoA Acoustics Conference. Any Member wishing to make a further suggestion should contact Duncan at [DPWILLIAMS@mail.dstl.gov.uk](mailto:DPWILLIAMS@mail.dstl.gov.uk)

1. **Any Other Business**

The Marine Environmental Data and Information Network (MEDIN) would like the help of Forum Members to redevelop their data guidelines and asked if any Members would be interested in volunteering for a small technical group. Anyone wishing to volunteer to please contact Gaynor Evans at [gaev@bodc.ac.uk](mailto:gaev@bodc.ac.uk)

The 5th international conference and exhibition on Underwater Acoustics will take place in Hersonissos, Crete from June 30 to July 5 2019.

The Chair and Members thanked Anne Brazier for her continued support to the Forum in her role of MSCC Secretariat.

1. **Date and Venue of next Forum Meeting**

The next Forum meeting will take place on the 21 November 2018 at NPL, Teddington. Grateful thanks to Stephen Robinson for provision of venue. Agenda items to (AB).

The May 2019 meeting is currently scheduled to take place at the University of Exeter and the November 2019 meeting at the Scottish Government, Leith.

1. Marine Autonomous Systems in Support of Marine Observations (MASSMO) [↑](#footnote-ref-1)