Marine Science Coordination Committee:
Underwater Sound Forum
November 24th 2021: 13:00 – 15:45, Online Meeting

Chair: Professor Peter Liss, University of East Anglia

Agenda

1) Welcome and Apologies

2) Previous Minutes and Actions

3) Presentations
   - 3.1 Floating offshore wind (FLOW): assessing the risks of underwater noise, Rosalyn (Ros) Putland (RP), Cefas Bioacoustician
   - 3.2 Shelter from the storm**,** Dick Hazelwood, R & V Hazelwood Associates, Guildford UK
   - 3.3 Measurements of high-order explosions for disposal of Unexploded Ordnance in the North Sea, Sei-Him Cheong, NPL
   - 3.4 Deep ocean noise during COVID, Stephen Robinson, NPL
   - 3.5 EMB Future Science Brief: Addressing underwater noise in Europe, Sónia Mendes, JNCC / European Marine Board
   - 3.6 Measuring Ambient Noise (PAM) from Autonomous Platforms, John Maloney, JASCO

4) International Standards Update

5) Any other business

Meeting Summary

1. Welcome & Apologies

Peter Liss (PL) opened the virtual meeting, noting that most attendees would prefer a face-to-face experience, and Harriet Bolt from the UK Hydrographic Office still willing to host a future in person meeting when this becomes possible. Each speaker will have 15 minutes. Requested that questions go in the chat, and that these will be dealt with first.

2. Previous Minutes & Actions

PL asked if members had any feedback or changes to the minutes from the remote USF meeting in 18 May 2021. No feedback provided, so minutes agreed to be true and accurate reflection.

USF members still encouraged, following point 5 ("USF and the UK Acoustics Network, with Stephen Robinson, SPL) of May 2021 minutes, to reach out to PL with ideas on how to engage with the UK Acoustics Network.

3. General Presentations

3.1. Floating offshore wind (FLOW): assessing the risks of underwater noise

Rosalyn (Ros) Putland (RP), Cefas Bioacoustician

Presentation captured work completed by the Cefas Noise & Bioacoustics Team. Objective of this Defra funded project: *Review the different installation/anchoring methods used for FLOW and operational regimes, to understand what the main sources of noise would be and likely noise levels.* One initial recommendation following literature review is for more standardised in situ measurements. Next steps for Cefas Teams are to build a noise model to ascertain if underwater noise from FLOW likely to be an issue compared to fixed turbines, followed up with GIS analysis to identify priority areas for noise in UK waters.

Selected from Discussion

- Simon Stephenson asked of FP had come across cable snapping/strumming sounds from floating turbines. RP said yes, from tension leg mooring as they are taut cables under the platform itself, so any platform movement would reverberate down cables. But this is strumming rather than snapping.
- Conversation amongst participants about cable strumming models. Suggestion that fairing cables may minimise strumming, and potential relevant of FPSO (Floating Production Storage and Offloading) data as they are on similar tension cables.
- Peter Liss's question: presumably deep-water turbines are done for other reasons than lowering noise, but do you think from a noise perspective that offshore turbines have an advantage over one set in concrete?
    - RP: Yes, deep-water turbines done for a number of reasons, e.g. to mitigate objections to the view. We have a lot of knowledge gaps when it comes to answering your question. It appears operational noise levels for floating wind farms is manageable. During construction, similar noise levels if not lower due to different techniques used. However, we don't know is impact of larger arrays.

3.2. Shelter from the storm

Dick Hazelwood, R & V Hazelwood Associates, Guildford UK

Mid-ocean submarines and pelagic fish will be sheltered from a storm generating surface waves as the water particle motions decrease rapidly (e.g. an evanescent mechanism) with greater depths. Same thing happens at bottom of the sea. The mid-ocean will provide shelter from a "seismic storm" originating on the seabed, but lots of effects near the source. A pile driven into the seabed generates, among other kinds of waves, seismic interface waves. Evanescent water waves get smaller and smaller as they drift up from the source.

Geophones are a low-cost way to measure seismic activity on the seabed. Can use them as set to measure x, y a and z axes. Much less expensive than other water particle velocity instruments currently on the market.

Joint paper documenting their findings, entitled “Substrate vibrations and their potential effects upon fishes and invertebrates” by Hawkins, Hazelwood, Popper and Macey published April 2021 in The Journal of the Acoustical Society of America, 149(4). Measurements were insufficient to fully assess the size of any problem. However, hopes that theory and modelling results may help in design of future experiments.

Another useful resource is “Best Practice Guide for Underwater Particle Motion Measurement for Biological Applications” published October 2021 with Sophie L Nedelec (University of Exeter) as a lead author.

Tony Hawkins has worked for years on researching sensitivity of pelagic vs benthic fish to pressure waves. Fish are sensitive to water particle motion, but we don’t know yet how much it bothers them.

New predictions to be tested set out in article entitled “Noise waveforms within seabed vibrations and their associated evanescent fields” by Hazelwood & Macey in Journal of Marine Science and Engineering July 2021 (Volume 9, 733). Key issue: relationship between acoustic sound pressures and water particle velocity. We have theoretical results based on models which don’t necessarily reflect real conditions.

Laboratory testing took place at Exeter University using geophones to measure crab sensitivity to being shaken. Relevant paper entitled “Anthropogenic underwater vibrations are sensed and stressful for the short crab *Carcinus maneas*” by Aimon, Simpson, Hazelwood, Bruintjes and Urbina in Environmental Pollution September 2021 (Volume 285). Technique could easily be reproduced.

Conclusion: Measurements sparse and theory constrained by model simplifications, but concentration on water motion rather than solid motion should help. Attention to deployment still important to minimise disturbance imposed on the seabed. With time modelling of more complex seabed types (beyond simple sediments) may be possible.

3.3. Measurements of high-order explosions for disposal of Unexploded Ordnance in the North Sea

Sei-Him Cheong, NPL (National Physical Laboratory)

“Comparison of measured and modelled sound peak pressure and SEL for explosions at Moray East and NNG windfarm sites” presented by Sei-Him Cheong (NPL). Project Team: Stephen Robinson (NPL), Lian Wang (NPL), Paul Lepper (Loughborough University), John Hartley (Hartley Anderson).

BEIS funded project through Offshore Energy Strategic Environmental Assessment Programme. UXO (unexploded ordnance or munitions) dropped during World Wars must be cleared (normally through detonation by doping charge) prior to offshore development. First phase of project entailed controlled field trials to study benefit of new “low order” technique called deflagration. Reports written and papers published on potential to reduce UXO disposal acoustic impact by using this technique.

Large acoustic data set provided from offshore wind farm developers Moray East and NNG provided. A number of UXO targets identified in both sites. Bottom mounded noise recorders deployed for measurement. Modelled and measured data were in

relatively good agreement. Explosion of buried charge generates lower noise level than that on the seabed. Scare charges introduce higher level noise as they are in the middle of the water.

3.4. Deep ocean noise during COVID

Stephen Robinson, NPL (National Physical Laboratory), referencing **"**Investigation of COVID quietening in deep ocean noise during determined from the CTBTO hydroacoustic stations, by S P Robinson, P M Harris, S-H Cheong, L Wang, V Livinia (NPL), G Haralabus, M Zampolli, P Nielsen (CTBTO). Adapted from SNT2021 conference, Session T1.3, July 2021.

Noted that views of the authors are not necessarily the official views of the CTBTO.

CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organisation) have Hydroacoustic stations installed in all major oceans, consisting of triplets of hydrophones placed in the ocean's deep-sound-channel. Low frequency measurements taken.

Data taken from selected CTBTO stations, looking at both daily and weekly statistics at the 10^{th} percentile (data point for which 10% of data is quieter/lower in amplitude and 90% higher), divided into three frequency bands (10-40 Hz/low, 40-70 Hz/medium, 70-100 Hz/high). Data demonstrates seasonal fluctuations due to various factors (e.g. sea-surface temperature, biological sources, ice for some stations).

A Gaussian Process (GP) regression, a form of machine learning, used to model the data. Copying GP modelling used for atmospheric concentration of CO2 which has a similar seasonal variation that needs to be removed from the data. The GP regression allows us to see if any changes we observe are real and statistically significant. Seasonal and long-term used to generate predictions.

Analysis done for Ascension Island shows that decibel levels predicted by GP regression for first several months of 2020 higher than what was actually recorded, although towards end of year recorded data more in line with what was predicted. A statistically significant reduction in decibels during the first half of 2020 for Ascension Island. Similar reduction in decibel levels during first half of year for Wake Island and Diego Garcia with recovery in second half of year. Juan Fernandes showed reduction in decibel levels that persists throughout the year. No statistically significant reduction in Cape Leeuwin.

Reduction in Ascension Island the largest observed, and also correlated with reduction in ship traffic and geophysical surveys for oil and gas in that area.

Stephen Robinson happy to circulate link to paper.

3.5. EMB Future Science Brief: Addressing underwater noise in Europe

Sónia Mendes, JNCC

Sónia presenting today under the auspices of the Underwater Noise Expert Working Group of the European Marine Board set up in 2020, of which she is the co-chair along with Frank Thomsen.

In June 2008 the Marine Board – European Science Foundation published Position Paper 13 entitled "Effects of Anthropogenic Sound on Marine Mammals – A Research Strategy" by Boyd et al. Twelve years later, the EMB commissioned this new group and charged with updating the 2008 publication, broadening the scope from marine mammals to all marine organisms and highlighting the conflicts and solutions that exist with relation to underwater noise. Among other objectives, working group asked to highlight key actions related to research, monitoring, policy and management needs.

Working group first met in 2020 online, and in October 2021 published "Addressing Underwater Noise in Europe: Current State of Knowledge and Future Priorities." It is a science brief for regulators and policy makers. Chapter four includes an infographic timeline of legal developments, projects, initiatives and key publications in underwater noise since UNCLOS was adopted in 1982. In 2008, significant shift as first time a European regulation explicitly mentioned underwater noise in its EU Marine Strategy Framework Directive. October 2021 publication identifies thirteen priority actions.

3.6. Measuring Ambient Noise (PAM) from Autonomous Platforms
John Maloney, JASCO Applied Sciences Canada (Ltd)

JASCO has approximately 110 staff across Canada, USA, UK, Germany and Australia, and provides acoustic modelling, measurement, monitoring and data analytics for oil & gas, marine construction, ocean renewable energy, government, academia and defence & military sectors. They have a huge database from which they can compares data and develop models. Starting to move from analysing historical data to performing analytics related to gathering real time data.
AMAR G4 is their standard autonomous recorder device. A fleet of bottom landers deployed as part of ADEON programme. ADEON = Atlantic Deepwater Ecosystem Observation Network. A basin-wide ambient noise measurement programme of US Eastern Seaboard. Consortium led by the University of New Hampshire. Trying to apply findings to robotic platforms so real time measurements can be done.

JASCO working with Teledyne Webb Research (TWR) and their Slocum Gliders on PAM (Passive Acoustic Monitoring) System, called OceanObserver System. JASCO provides the payload and back office system to receive information from these robots. Analysts can then go in and do real time validation of measurements and detections occurring out at sea, although bandwidth limitations constrain amount of information can be transmitted back to shore in real time. An algorithm determines what is relevant information to transmit to shore stakeholders while vessel in the sea. Raw data also brought back for post-mission analysis and reporting.

Current trial taking place as part of Marine Mammal Mitigation Service supported by Innovation Solutions Canada and in collaboration with Open Ocean Robotics.

See Journal Publications | JASCO Applied Sciences for peer-reviewed articles by JASCO scientists.

4. Update on International Standards: Stephen Robinson, NPL

ISO TC43 SC3 Underwater Acoustics
Chaired by Stephen Robson, with Secretariat of ANSI/ASA in the USA

- Had online (instead of in Paris) meeting in October 2021. Next meeting to take place in Montreal (May 2023). Added a fifth working group on Monitoring ambient sound.
- Active work streams include:
    - ISO 17208-3: Ship noise – shallow water measurements
    - ISO 7447: in-situ determination of the insertion loss of barrier control measurement for underwater pile driving
    - ISO 7605: measurement of underwater ambient sound
    - ISO 20073: Standard-target method of calibrating active sonars for imaging and measuring scattering
- Looking for participants to support standards on sound particle motion and seabed vibration
- Other relevant activity:
    - IEC TC87 (WG15)
        - IEC TC87 covering “ultrasound,” with WG15 covering calibration of underwater electroacoustic devices (meeting Oct 2022 in San Francisco)
        - IEC 63305: calibration of vector sensors (committee draft stage)
        - NWIP: calibration of recorders and digital hydrophones
            - Future joint work with ISOTC43 SC3 starting soon
    - IEC TC25 (ISO TC12)
        - Committee maintains ISO 80000 series of standards. Part 8: Acoustics published in 2019.
        - IEC 80000 Part 15: Logarithmic and related quantities (committee draft stage) to cover definitions of units such as the decibel, neper, octave, etc.
- To become more involved in British Standards Institution (BSI) BSI EH1/7 Underwater acoustics work contact Stephen Robinson (Chair) or Joanna Macnamara (Secretary).

5. Any Other Business

- Stephen Robinson promoting 2nd Underwater Acoustics PhD Symposium Day
- Peter Liss looking for presenters for next meeting in six months time.