PROPOSED OUTLINE FOR ACOUSTIC IMPACT WORKSHOP

Wednesday, 9 November 2016

Registration: 07:30

1. **8:00 – 8:15 - Opening Remarks and Introduction**

2. **8:15 – 09:45 - Module 1: Acoustic Fundamentals.**
    a. Source / Medium / Receiver model
    b. Decibels, reference pressure
    c. Acoustic metrics – peak SPL, rms SPL, SEL, cSEL, time, frequency dependence, decade, octave, 1/3 octave bands, including how and when it is appropriate to convert between measurements.
    d. Sound in water vs sound in air, how loud is loud?
    e. Impulsive versus continuous sounds
    f. Particle velocity, particle acceleration, and pressure

09:45 – 10:00 - Health Break

3. **10:00 – 11:00 – Module 2: Sound Sources.**
    a. What is ambient sound? When are anthropogenic sounds background sounds? Are those ambient?
    b. Geologic sound sources – wind, waves, seismic activity, thunder, rain etc.
    c. Anthropogenic sound sources – shipping, sonars, seismic arrays, pile driving, marine construction, drilling, echo sounders, multi-beam, boomers, pingers, side-scan etc.
    d. Biologic sound sources – marine mammals, fish, crustaceans.
    e. Sound examples

4. **11:00 – 12:00 – Module 3: Introduction to Acoustic Propagation Modelling.**
    a. Ocean properties & effects on sound speed – refraction / reflection
    b. Ways to model – geometric spreading, practical spreading, and numerical modeling
    c. Converting model outputs to metrics that matter
    d. Factors affecting modelling – bottom properties, daily changes in sound speed profiles, sound channels.
    e. Importance of sound source verifications.

12:00 – 13:00 – LUNCH

5. **13:00 – 15:00 – Module 4: Potential Consequences of Sound Exposure on Marine Life**
    a. Uses of sound by marine life – communication, foraging, navigation, predator avoidance.
    b. Basics of hearing in marine life – ear structures, sensitivities, audiograms, critical ratios and perception.

c. Effects of noise on hearing in marine life: Acoustic Trauma, Temporary Threshold and Permanent Threshold Shifts (TTS and PTS)
d. Other effects of noise on marine life: non-acoustic injury, stress and other health problems, masking of important acoustic information, changes in acoustic perception and behavioural disturbance – theory and evidence of actual effects.
e. Methods employed by mammals to manage exposure to intense sounds
f. Indirect effects – e.g. habitat degradation, effects of noise on prey species.

15:00 – 15:30 - Health Break

6. **15:30 – 17:00 Module 5: Introduction to Modeling of Acoustic Impacts on Marine Life**
    a. Acoustic propagation modelling revisited
    b. Exposure modelling approaches
    c. Simulated animal movement (Animat) modelling
    d. Estimate exposure rates of animats sampling the sound field
    e. Adjust animat density with real world animal density and determine injury and disturbance rates of individuals using risk metrics
    f. Discussion of use of animat modelling and how 'Take' (effect) estimates are done.
    g. Case study – Apply exposure modelling directly bowhead migration Beaufort Sea
    h. Trade-offs in different approaches to take estimation
    i. Assessing Risk of Harm to Marine Animal Populations
        i. PBR based approach using animat model
        ii. Boyd et al 2008 Criteria for Disturbance
        iii. PCAD and PCod
        iv. Example of Application of PCoD

7. **17:00 – 17:30 Open Discussion**

Thursday, 10 November 2016

8. **8:15 – 8:45 - Review of Modules from Day 1**

9. **8:45 – 10:45 - Module 6: Scientific Base of Regulatory Frameworks of Injury and Disturbance Risk Assessment.**
    a. Purpose of using sound exposure thresholds
    b. Types of thresholds
    c. Impact assessment criteria for fishes
        i. FHWG 2008
        ii. Popper et al 2014/2015
    d. Impact assessment criteria for marine mammals
        i. MMPA (U.S.) 1972/1992
        ii. Southall et al 2007, Finneran and Jenkins 2012, Finneran 2015,
        iii. Critique by Tougaard et al 2014
        iv. NOAA/NMFS acoustic guidelines; Drafts and Final Version 2013-2016

v. Masking and Behavioural Response Criteria: Wood et al. 2012, Erbe 2016

e. Overview of regulatory guidelines from other jurisdictions around the world

10. 10:45 – 11:00 - Health Break

11. 11:00 – 12:00 - Module 7: Noise Mitigation

a. Regulatory requirements (SARA, Fisheries Act, SCOP)
b. Methodology
    i. Visual and acoustic monitoring of animal exclusion zones
    ii. Ramp-up/soft start/shut down/slow down procedures
    iii. Post operation and intermittent data analysis and review
    iv. Methods to mitigate pile driving noise

12:00 – 13:00 Lunch

12. 13:00 – 14:30 – Module 8: Acoustic Monitoring Programs

a. Types of Acoustic Monitoring Programs:
    i. Sound Source Characterizations – removing uncertainties from SL, TL, and exclusion zones
    ii. Acoustic Baseline monitoring of ambient sound levels, anthropogenic activity, and biological activity
    iii. Passive Acoustic Monitoring for exclusion zones and compliance monitoring around anthropogenic activities.
b. Acoustic monitoring equipment
c. Specifying acoustic recorders – sensitivity, frequency range, recording duration, clock alignment, dynamic range, duty cycling, multi channels
d. Commonly available acoustic recorders

14:30 – 14:45 - Health Break

13. 14:45 – 17:00 – Module 9: Shipping – A review and discussion of the methodology and tools used to assess shipping noise impact

This review includes discussions of the following questions regarding:

a. Monitoring:
    i. What species could be affected by shipping and how, ie. behavioural disturbance, masking, displacement?
    ii. What are the current levels of noise generated by shipping?
    iii. What type of monitoring is appropriate?
    iv. How to assess monitoring results in the context of impact?
b. Modelling Assessment:
    i. How should the impact be modelled?
    ii. Assessing the need for animat based impact modeling?
    iii. Assessing the need for population consequence modelling?

iv. Assessing the need for habitat degradation assessment/modelling?
v. What issues will cause uncertainty in the models?
vi. What are recommended mitigation measures?
vii. How to assess the utility and effectiveness of mitigation measures?

17:00 – 17:30: Open Discussion

All modules will be presented in seminar style, allowing plenty of discussion and topic number 9 will be a directed discussion session where participants are asked to come up with answers to the above questions based on what they have learned from the previous modules