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ADVISORY NOTE: FURTHER GUIDANCE ON INDEPENDENT, SCIENTIFIC MODELLING OF NOISE PROPAGATION

(Prepared by OceanCare)

Summary:

The CMS Family Noise EIA Guidelines are accompanied by expert-authored Technical Support Information, which was presented to COP12 as UNEP/CMS/COP12/Inf.1, and welcomed in Resolution 12.14.

When promoting these Guidelines, it has become apparent that there are some difficulties with interpretation of the guidance related to noise modelling. OceanCare contracted the lead author of the Guidelines to draft an additional advisory note specifically on this topic.

UNEP/CMS/COP13/Doc.26.2.2 recommends that this Advisory Note be added to the Technical Support Information provided online.

Advisory Note: **Further guidance on independent, scientific modelling of noise propagation**

Geoff Prideaux
June 6, 2019

It is evident, after a period of two years since the *CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities* (CMS Noise EIA Guidelines) were endorsed by CMS COP12, further clarity about **independent, scientific modelling** is required.

The precision of acoustic modelling depends on accurate parameters defining the sound propagation environment. This takes both skill and the choice of the appropriate scientific model/s for each sound generating activity and proposal.

The model/s should reflect: the activity to be modelled, location, environmental conditions, biological relevance, topographic/bathymetric features (underwater canyons and seafloor composition), Sound Speed Profiles that are seasonally relevant factoring temperature, salinity and depth. There is no single model capable of accommodating all noise generating activities in all circumstances.

Using a reputable model is not enough. Modellers need expert knowledge and experience of the model/s they are using. This requires understanding of the physics of underwater acoustic propagation, knowledge to select the right model/s, and to choose the appropriate input parameters and adjust them accordingly, so that the outcome of the modeling process makes physical sense. Finally, time investment in ground-truthing feedback is necessary to confirm the validity of the model.

The following table elaborates important detail about the CMS Noise EIA Guidelines advice on **independent, scientific modelling** (column 2) and is complimented by additional details from the New Zealand *'Sound Propagation and Cumulative Exposure Models Technical Working Group'* report (column 3). This Technical Working Group advised the Department of Conservation for the revision of the NZ Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations (2015-2016).

At all stages, the information provided below is intentionally conservative and does not embellish or add to the information from within each document.

	CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities	**Sound Propagation and Cumulative Exposure Models Technical Working Group**
1. Independent, scientific modelling of noise propagation should be impartially conducted	a) Models chosen should be peer-reviewed, scientific source models (as opposed to industry black box models) b) Modelers should have enough knowledge of, and experience with, the models they are using. Modellers should understand the physics of underwater noise propagation to ensure the correct models are used and that the results are accurate and make physical sense. c) Modelling results should be reviewed by subject matter experts, and experienced modellers with a strong theoretical understanding of underwater acoustics.	
2. Propagation models should be:	a) based on accurate input data, and for seismic surveys specifically the	c) specific to the source, region and environmental conditions.

	official calibration figures supplied by the survey vessel to be charted. b) able to accommodate the activity noise frequencies, the water depth, seabed topography, temperature and salinity, and spatial variations in the environment. Model methodology/s used should be stated.	d) based on accurate input data including seismic source data and environmental data, such as: - geo-acoustic properties including bottom sediment types and their layer depths for the region to be modelled, ideally down to several hundred metres into the bottom. - bathymetry mapping grid resolution greater than 450m - seasonally relevant Sound Speed Profiles (SSPs), salinity, temperature and depth data (in tabulated form). e) chosen based on the treatment of environmental conditions, with an appropriate rationale for the modelling choice provided in the modelling report. f) given special consideration for fiords and deep-water canyons and may require high-resolution 3D models. g) biologically relevant and able to handle a wide range of frequencies, including very high and very low frequencies, regardless of the proponent's frequency focus. The computational difficulty of modelling very high frequencies is not a reason for disregard.
3. Propagation modelling should include:	a) the received sound levels at given distances from the noise source to determine propagation loss. b) full frequency bandwidth of a proposed anthropogenic noise source. c) the intensity/pressure/energy output within that full range.	f) sound propagation and cumulative exposure data that is appropriate to the full range of concurrent noise-generating activities. These should include separate modelling of each noise-generating activity (ie. shipping, support vessels, sonar, seismic surveys), as well as a cumulative model

	d) the principal or mean/median operating frequency of the source(s). e) the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics).	of all these activities combined. g) appropriate single shot modelling that is correctly reprehensive of the survey region. Biologically important sub-regions may require additional focus. h) representation of cumulative exposure over time (ie 24 hours) i) acoustic ground-truthing of the chosen model (to ensure model credibility).
4. Propagation modelling reports should demonstrate:	a) propagation from point source out to a radius where the noise levels generated are close to natural ambient sound levels[1] b) particle motion propagation[2] to assess the impact on invertebrates, and fish species. c) proposed exclusion zones designed for the protection of specific species and/or populations should be identified and mapped and should demonstrate how noise will not propagate into these areas, taking into consideration the local propagation features.	d) border thresholds will not be breached for exclusions zones and biologically important areas. e) that all modelling assumptions are clearly stipulated and comprehensively justified.

References

DOC (ed). 2016. ‘Report of the Sound Propagation and Cumulative Exposure Models Technical Working Group’. (Wellington: Marine Species and Threats, Department of Conservation).

Etter PC. 2013. ‘Underwater acoustic modelling and simulation’ (Boca Raton: CRC Press, Taylor and Francis Group)

Prideaux G. 2017. ‘Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities’, (Bonn: Convention on Migratory Species of Wild Animals).

Urick RJ. 1983. ‘Principles of Underwater Sound’ (New York: McGraw-Hill Co).

[1] ISO 18405 refers to ambient sound as “*sound that would be present in the absence of a specified activity*” and “*is location-specific and time-specific*”. The CMS Noise EIA Guidelines more specifically define ambient sound as the average ambient (non-anthropogenic) sound levels from biological (marine animals) and physical processes (earthquakes, wind, ice and rain etc) of a given area. It should be measured (including daily and seasonal variations of frequency bands), for each component of an activity, prior to an Environmental Impact Assessment (EIA) being developed and presented

[2] The detection of particle motion or particle displacement requires different types of sensors than those utilized by a conventional hydrophone. These sensors must specify the particle motion in terms of the particle displacement, or its time derivatives (particle velocity or particle acceleration).