G. The Cumulative Effects Analysis in Appendix K Should Be Eliminated

Appendix K contains novel concepts that are inconsistent with a substantial amount of scientific literature addressing the topics of hearing masking and chronic effects of sound. For example, Appendix K presents new concepts, such as "lost listening area," which have no scientific precedent. Additionally, Appendix K introduces novel risk metrics like annual cumulative SEL and equivalent continuous sound level ("L_{eq}") that are not biologically realistic concepts (pages K-22 and K-24), and other ideas that have no apparent basis, such as the Cumulative and Chronic Exposure metric (page K-10). Equally concerning, the novel analysis in Appendix K is introduced, for this first time, without any serious peer-review or expert evaluation.

Appendix K presents a hypothetical analysis of "lost communication space" for Bryde's whales (pages K-32 to K-41) without any evidence to support an actual (not hypothetical) baseline for this or any related species. Communication space is considered to be the maximum detectable range of a sound, which far exceeds the actual communication space for any species, terrestrial or marine. Another omission in Appendix K is the lack of reference to a recent and very thorough review of the subject of hearing masking (Erbe et al. 2015). Instead, Appendix K primarily references Clark et al. (2009) for masking, even though it has been demonstrated to be an incomplete model that overestimates the risk of masking.

In addition, the Appendix K analysis is based on assumptions about hearing and hearing masking that are clearly incomplete and overly conservative, such as assuming that the animal requires signal excess of 10 dB to detect a conspecific call (page K-17), when the standard in the literature is detection at -3 to -6 dB below ambient. Appendix K treats received sound as being the same at all depths (2D "disk" model of masking, page K-17), and no directional release from masking is provided—not because the animals cannot use the 3 to 12 dB of gain they get from directionality, but because the analysis suggests that the survey tracks are "randomly oriented" (page K-19). This inability to determine the angular resolution between receiver, conspecific caller, and the seismic source is puzzling because the Phase I and Phase II exposure models provide very specific direction-dependent transmission loss model data and are dynamic 4D models that should easily yield the necessary information to insert spatial release from masking in the communication space equation. Instead, a generic "signal processing gain" term is used to account for the various features of a signal that enable the receiver to pick it out of sound. Finally, Appendix K uses an unrealistic and simplistic formula (Sirovic et al. 2014) for determining the bandwidth of the signal (to the human, not the whale listener) and call length (without redundance or signal variance and periodicity), ignoring substantial literature on this topic for humans and other species (page K-20).

In sum, Appendix K is premature, inappropriate, and not consistent with the best available science. Moreover, its relevance to the DPEIS is not explained by BOEM. Because of its many defects, Appendix K should be removed from the DPEIS.

H. The Analysis of Potential Effects of Seismic Activities on Sea Turtles Can Be Improved

The DPEIS adequately reviews the literature regarding sea turtle hearing and accurately assesses what is known about the frequency range of turtle hearing based on the best available science. However, the DPEIS's sea turtle effects analysis (Section 4.3) fails to sufficiently address sea turtle hearing thresholds at best sensitivity as reported in the scientific literature. These values, which range from 93 to 117 dB at the most sensitive frequencies, are reported in Appendix E but there is no discussion of the meaning of those values. Although the data on sea turtle hearing "are too limited to be definitive because of the low numbers of individuals tested," the best available science demonstrates that sea turtle hearing is substantially less sensitive than marine mammal and fish hearing. By comparison, peak sensitivity thresholds of approximately 30 or 40 dB are the most sensitive frequencies in some odontocetes, and peak sensitivity thresholds of approximately 50 dB are most sensitive frequencies observed in some fish species. *See* Popper et al. (2014) at 9 (*see* audiograms). The DPEIS should include a more detailed assessment of sea turtle hearing thresholds at best sensitivity as part of the effects analysis.

I. The Potential Effects of Seismic Activities on Fish and Fish Resources Are Insignificant

Seismic survey activities do not result in any significant adverse effects to fish populations or to fisheries. Marine seismic surveys have been conducted since the 1950s and experience demonstrates that fisheries and seismic activities can and do coexist. There has been no observation of direct physical injury or death to free-ranging fish caused by seismic survey activity, and there is no conclusive evidence showing long-term or permanent displacement of fish. Any impacts to fish from seismic surveys are short term, localized, and not expected to lead to significant impacts on a population scale.[38]

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[38] *See Science for Environment Policy, Future Brief: Underwater Noise, European Commission*, June 2013: http://ec.europa.eu/environment/integration/research/newsalert/pdf/FB7_en.pdf; *Stocks at a Glance Status of Stocks*, 2011, U.S. Department of Commerce, NOAA: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/archive/2011/2011_status_of_stocks_fact_sheet.pdf; Boeger, W.A., Pie, M.R., Ostrensky, A., Cardoso, M.F., 2006. *The Effect of Exposure to Seismic Prospecting on Coral Reef Fishes; Brazil. J. Oceanogr.* 54, 235-239; 3D marine seismic survey, no measurable effects on species richness or abundance of a coral reef associated fish community. Mar. Pollut. Bull. (2013), http://dx.doi.org/10.1016/j.marpolbul.2013.10.031; Hassel, A., Knutsen, T., Dalen, J., Skaar, K., Lokkeborg, S., Misund, O.A., Osten, O., Fonn, M., Haugland, E.K., 2004. *Influence of seismic shooting on the lesser sand eel*. ICES J. Mar. Sci. 61, 1165-1173; Pena, H., Handegard, N.O. and Ona, E. 2013. *Feeding herring schools do not react to seismic air gun surveys*. ICES J. Mar. Sci., http://icesjms.oxfordjournals.org/content/70/6/1174.short?rss_1; Saetre, R. and E.

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