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March 28, 2016

Ms. Nicole LeBoeuf, Chief
Marine Mammal and Sea Turtle Conservation Division
Office of Protected Resources
National Marine Fisheries Service
Attn: Acoustic Guidance
1315 East-West Highway
Silver Spring, MD 20910-3226

Re: NOAA-NMFS-2013-0177 Comments on proposed changes to the Draft Guidance For Assessing The Effects Of Anthropogenic Sound On Marine Mammal Hearing

Dear Ms. LeBoeuf,

We appreciate being given an opportunity to review the proposed changes on the NMFS-OPR Draft Acoustical Guidelines (hereinafter "Guidelines") although we were a bit chagrinned to find the format of the "Proposed Changes" document to be in a narrative, ancillary document rather than a revised and annotated version of the actual draft. This necessitated our doing your work by jumping between the July 2015 Draft and the proposed changes. As "homework" goes this would be awarded an "incomplete."

This format also does not allow us to make sure that the typographical errors we indicated in our September 22, 2015 critique (of which there were many) have been properly addressed. This may not have been so annoying had we been afforded more than fourteen days to review the proposed changes, but having to review across and between these documents was unnecessarily time consuming.

I assume that if they did not show up in the proposed changes, the many concerns we expressed in our critique had no bearing on the revisions. This is unfortunate because our proposals were both modest, and reflect the best and most current available science on the impacts of noise – particularly noise characteristics on marine mammals. So while the guidelines are an improvement over the legacy guidelines, they still fall short of where the science sits on noise characteristics and hearing compromise. It would be useful to

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know that the efforts we put into our September 22 critique were at least reviewed and addressed.

We continue to be concerned on how the LF Cetacean audiograms are derived. While the revised exposure threshold curves are more conservation-minded than the curves originally proposed in the July 2015 Guidelines, they are still more a product of assumptions and conventions than of any substantiating research or evidence. For example; given that a preponderance of blue whale vocalization occur below 19Hz[1] and humpback whales also vocalize below the f_1 of 200Hz,[2] there is no reason that the LF weighting function should roll off at 200Hz.[3] In the absence of any other compelling evidence, logic (and precaution) would dictate that the LF weighting function would not roll off at all in the low frequency end of the weighting curve.

We remain concerned that our critique for the Guidelines section 2.3.3.1 "Cumulative Sound Exposure Level" (SEL_{CUM}) Metric has not been addressed in the proposed revisions. Reiterating our concern; using a 24 hour accumulation window is only a convenience which only has meaning in terms of how we set our watches; exposed animals do not "clear the stack" after 24 hours and start anew. Accumulation of sound for the purposes of SEL_{CUM} should continue as long as the sound continues if the noise generated is above the "Effective Quiet" described in the Guidelines.[4] The question of "how much above" is a matter for further research, but if hearing acuity is continuously compromised by a relentless noise source in an animal's usual habitat, the distinction of whether the noise is "masking" or their hearing is neuro-mechanically compromised may only be academic.

This is particularly germane as the noises we are deploying in the ocean are increasingly becoming continuous – from the "around the clock" seismic surveys, the expanding fleet of acoustically-controlled autonomous vehicles, seafloor mounted processing equipment, and continuously operating communication and navigation beacons. Cumulative sound exposure in the Guidelines Section 2.3.3.1 are limited to evaluating single sounds sources – a point that is recognized in the section. But it is becoming increasingly germane that the noise levels of entire soundscapes be incorporated into a cumulative exposure metric because offshore industrial operations are typically deploying arrays of devices and fields of equipment all of which continuously generate noise.

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[1] David K. Mellinger, Christopher W. Clark, *Blue whale (*Balaenoptera musculus*) sounds from the North Atlantic* J. . Acoust. Soc. Am., Vol. 114, No. 2, August 2003

[2] James D. Darling *Low frequency, ca. 40 Hz, pulse trains recorded in the humpback whale assembly in Hawaii* J. Acoust. Soc. Am. 138 (5), November 2015

[3] Guidelines Table PC3 and Fig. PC3: *Summary of updated weighting function parameters (updates Main Document: Table 7; Appendix A: Table 8 from NOAA 2015a*.

[4] Guidelines Appendix C Section I:1.11

For example a common positioning beacon generates streams of navigation data at 205dB centered around 22kHz (e.g. Kongsberg positioning beacons[5]). At these frequencies a single beacon would only induce an MMPA Level A take within 12-15 meters of the device, but as these and other complimentary devices are being deployed in synchronized arrays of four to six units and are operating continuously with a designed effective range of 10km, the entire array of devices needs to be evaluated as a continuous source of noise, not as a four to six separate noise sources. This same would hold true for seafloor mounted processing equipment used in extraction industries (such as materials separators, reinjection pumps, and manifolds) which operate as a complimentary set of equipment, not an assortment of discrete pieces of gear.

This argument on cumulative exposure intersects section 3.2.2 "Stationary Sources" description in the Guidelines under two conditions. The first condition is when the exposed animal may deliberately come within the "24-h Accumulated Isopleth" such as when pinnipeds remain in auditory "harm's way" if their incentive is feeding.[6] The cited situation refers to the "dinner bell" effect of acoustic harassment devices which are specifically designed to repel animals preying on fishing and aquaculture operations and thus subject to a different ethic than unintentional exposures. But this needs to be considered when an action proponent applies for a harassment authorization. The context of Acoustic Harassment Devices (AHDs) introduces the second condition where stationary sources that would otherwise subject animals to Level A takes but due to avoidance of the sources, the noises end up colonizing habitat and displacing animals that would otherwise inhabit the area.[7] While avoidance response falls under Level B "behavioral" takes, if a noise source is continuous and displaces an animal from critical feeding habitat it would also compromise survival success[8] which puts the noise along a continuum between Level A and Level B takes.

We remain concerned that given what is known about the greater impacts of high kurtosis signals with equal energy of low kurtosis signals that there is still no consideration for

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[5] Kongsberg Acoustic underwater positioning and navigation systems HiPAP and HPR

[6] Olesiuk, P. E., Nichol, L.M., Sowden, M. J., and Ford, J. K. B. (1995). *Effect of sounds generated by acoustic deterrent device on the abundance and distribution of harbor porpoise (Phocoena phocoena) in Retreat Passage, British Columbia*. Dept. of Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo BC V9R 5K6 Canada. 47pp. and Carretta, James V.; Barlow, Jay Source *Long-Term Effectiveness, Failure Rates, and "Dinner Bell" Properties of Acoustic Pingers in a Gillnet Fishery*: Marine Technology Society Journal, Volume 45, Number 5, September/October 2011, pp. 7-19(13)

[7] Alexandra B. Morton and Helena K. Symonds (2002) *Displacement of Orcinus orca (L.) by high amplitude sound in British Columbia, Canada* ICES Journal of Marine Science, 59: 71–80. doi:10.1006/jmsc.2001.1136

[8] Clinton D Francis, Catherine P Ortega, Alexander Cruz (2009) *Noise pollution changes avian communities and species interactions* J. Current Biology v. 19:6

this fact.[9] Perhaps this is where terminology is seeking a numeric standard. Hopefully the provisions in the guidelines for more frequent review and updating will accommodate this metric and this standard as it becomes codified in the literature.

Regarding some of the systematic changes in the revision document: we concur that the white-beaked dolphins are best moved from the MF cetacean to the high-frequency (HF) cetacean functional hearing group (Section 2 in the proposed changes) and that recent harbor porpoise data should be included in the HF cetacean audiograms (Section 3 in the proposed changes). It also makes sense that non-representative animals such as hearing compromised pinnipeds should be removed from the datasets (Section 4 in the proposed changes), although this does little to assuage our concerns that so few animals –all captive, are being used as a proxy for many more species of non-captive animals living in an unbounded acoustical environment.

We do concur that peak (PK) metrics are not relevant to continuous or non-impulsive sounds (Section 5 in the proposed changes).

While these new guidelines and proposed revisions are an improvement over the legacy guidelines, there remains room for improvement. We understand that the Kurtosis Exposure Metric has not been standardized yet, but given that NOAA has taken liberties in defining a SEL_{CUM} metric with a "reset" after 24 hours,[10] it would not be much of a reach to extend the Equal Energy Hypothesis used in the guidelines[11] to include a consideration for signal kurtosis using published – albeit not standardized kurtosis metric.[12]

In light of what is likely and possible at this juncture, our dominant recommendation would be to revise the LF low frequency weighting curve to extend flat to 0Hz to assure that low frequency noises from shipping, industry, seismic surveys, acoustic tomography, and any future anthropogenic communication or navigation signals does not compromise the low frequency communications, biological, or geological signals that LF cetaceans may need to survive and thrive.

It would be helpful in the final analysis to have an opportunity to review the actual document with the proposed changes integrated into the guidelines before adopting them. Even in light of the provisions for more frequent scientific review and updating we

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[9] Hamernik, R.P., W. Qiu, and B. Davis. 2003. *The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: The kurtosis metric.* J. of the Acoustical Society of America V.114:386-395.
[10] Guidelines: 2.3.3.1 Cumulative Sound Exposure Level (SEL_{cum}) Metric
[11] Ibid. *Equal Energy Hypothesis*
[12] Wei Qiu,a) Roger P. Hamernik, and Robert I. Davis. *The value of a kurtosis metric in estimating the hazard to hearing of complex industrial noise exposures* J. Acoust. Soc. Am. 133 (5), May 2013

suspect that future modifications run the risk of getting bogged down (as these very guidelines and revisions seemed to have suffered). Any typographical errors, oversights, or omissions may have a longer shelf life than would be desirable. Reviewing the final document, rather than having to cross-reference to a narrative, ancillary document would give us the assurance that at least for now we have a correct document representative of the most practicable acoustical exposure guidelines for “Level A Takes.”

Sincerely,

Michael Stocker
Director