

Generally, the Draft Guidance notes that the proposed criteria are based upon research using very few marine mammals. To address limited data, the agency explains that it will choose the lowest threshold value if there are less than five relevant studies and that it will identify a median value if there are five or more studies. The Associations respectfully disagree with this approach and propose that NMFS consider the best available information, regardless of the number of available studies and, as required by the MMPA and the ESA, develop thresholds that most accurately reflect all of the available science rather than applying a conservative approach by choosing a low reported value to the exclusion of other available information.

#### **4. Equal Energy Hypothesis**

The use of  $SEL_{cum}$  is practical in the sense that it allows researchers and operators to compare sound events with various SPL and time durations. For transient sounds,  $SEL_{cum}$  is also practical as it expresses the total energy as opposed to the maximum energy. However,  $SEL_{cum}$  is used under the assumption that a low amplitude and long signal with an equal  $SEL_{cum}$  as a loud and short signal will have the same effects on the auditory system (the Equal Energy Hypothesis (“EEH”)). The EEH may be correct in certain conditions, but an increasing body of evidence indicates that the EEH does not hold true in most marine mammal sound exposures. As recognized in the Draft Guidance, the EEH is not supported by several studies. *See* Kastelein et al. (unpublished); Popov et al. (2011); Popov et al. (unpublished), Supin (Aug. 2013 Abstract); *see also* Mooney et al. (2009a); Finneran et al. (2010b); Kastak et al. (2005); Kastak et al. (2007); Mooney et al. (2009b); Finneran et al. (2010a); Kastelein et al. (2012a); Kastelein et al. (2012b). Therefore, the use of  $SEL_{cum}$  has some practical aspects, particularly in the absence of a complete data set. However, as more data become available, more analyses should be performed to determine what model or equation best fits the EEH, and how the  $SEL_{cum}$  criteria should be revised to more accurately reflect the potential for TTS changes with duration and amplitude.

#### **5. Marine Mammals’ Ability to Adjust Hearing**

There is a growing body of science regarding the ability of marine mammals to adjust their hearing when exposed to loud sounds. *See* Popov (Aug. 2013 Abstract); Nachtigall and Supin (2013). This research describes the ability of cetaceans to voluntarily reduce the level of incoming sound by up to 13 dB through the use of an active noise control system. However, these studies do not appear to have been considered in the Draft Guidance. Consistent with its obligation to use all of the best available science and the recognized need for flexibility, NMFS should address and consider these studies if presented by applicants during the permitting in process, and review and update the Guidance as necessary as this area of science becomes more fully developed.

#### **6. Recovery**

In general,  $SEL_{cum}$  is an appropriate way to measure transient sounds because it allows comparisons between sound exposures of different natures or durations. However, the proposed

threshold criteria assume no recovery between sound exposure events for intermittent and repeated exposures. Given the current knowledge of TTS, this assumption may be inaccurate. Existing studies indicate that recovery may occur in both terrestrial and marine mammals, and research suggests that marine mammals have other adaptive strategies that protect them from sound (Nachtigall and Supin 2013). We recommend that NMFS include a recovery function in the Draft Guidance, and incorporate the work of Finneran et al. (2010) and Finneran and Schlundt (2013). Although these studies are limited in scope, their validity is not in question.

### **7. Accumulation Periods**

The selection of one-hour and 24-hour accumulation periods are not biologically based, and we suggest that NMFS revise the Draft Guidance to expressly allow for the option of SEL<sub>cum</sub> modeling for the duration of the activity in addition to the one-hour and 24-hour options. We also request that NMFS provide additional information to footnote 15 on page 13 of the Draft Guidance. This footnote indicates that the SEL<sub>cum</sub> metric is not meant to accumulate sound exposure for multiple activities or for naturally occurring sounds, but very little supporting explanation is provided.

### **8. Continuous and Impulsive Sounds**

The Draft Guidance's definitions of continuous and impulsive sounds are vague and do not objectively distinguish these two types of sound. Impulsive sounds become increasingly continuous with distance, due to multipath arrivals and other factors, and may have continuous components even at short distances, due to reverberation. Accordingly, clear technical definitions of continuous (non-impulsive) and impulsive sounds from geophysical sources, based on the best available scientific literature, should be included in the Draft Guidance. *See* Southall et al. (2007). NMFS should also consider waveform data at the location of the receiver (i.e., the marine mammal) as one of the parameters to determine the impulsive nature of signals covered by these criteria.

### **9. Relevant Recent Research**

A substantial amount of information recently presented at scientific conferences should be considered in the Draft Guidance. *See* Abstracts from The Effects of Noise on Aquatic Life