MARINE MAMMAL COMMISSION

4 November 2024

Naval Facilities Engineering Systems Command, Atlantic
Attn: AFTT EIS Project Managers, Code EV22SG
6506 Hampton Boulevard
Norfolk, VA 23508-1278

Dear Sir or Madam:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the U.S. Navy's (the Navy) Draft Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS) for training and research, development, test, and evaluation (testing) activities conducted within the Atlantic Fleet Training and Testing (AFTT) study area (Phase IV; 89 Fed. Reg. 77113). The DEIS addresses the impacts on marine mammals from conducting training and testing activities in the AFTT study area and is associated with the letter of authorization (LOA) application that the Navy submitted to the National Marine Fisheries Service (NMFS). The Navy previously analyzed the various impacts, first under the Tactical Training Theater Assessment and Planning DEISs (TAP I) and then under the Phase II and III DEISs.

Background

The Navy's AFTT study area is in the western Atlantic Ocean and encompasses the waters along the east coast of North America, the Gulf of Mexico, and portions of the Caribbean Sea, at Navy pierside locations and in port transit channels, near civilian ports and Coast Guard stations, and in bays, harbors, inland waters, and rivers. The activities would involve the use of low-, mid-, high- and very high-frequency active sonar, weapons systems, explosive and non-explosive practice munitions and ordnance, high-explosive underwater detonations (including ship shock trials), expended materials, vibratory and impact hammers, airguns, electromagnetic devices, high-energy lasers, vessels, underwater vehicles, and aircraft. Under the No Action Alternative, the Navy would not conduct training or testing activities. Alternative 1, the Preferred Alternative, includes a representative number of training and testing activities; whereas, Alternative 2 includes the maximum number of training and testing activities. In addition to some time-area closures, mitigation measures would include visual monitoring to implement delay and shut-down procedures.

Auditory thresholds

As the Commission has noted in letters related to NMFS's Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater and in-air criteria for onset of auditory injury and temporary threshold shifts (AINJ and TTS, respectively; NMFS 2024)[1], the Commission supports the weighting functions and associated thresholds as stipulated in Finneran (2024), which are the same as were used for Navy Phase IV activities (Department of Navy 2024a). However, new data are available since the Navy updated the weighting functions and thresholds. For example, Kastelein et al. (2024a) provided additional TTS data for harbor porpoises exposed to one-sixth octave band sound at 8 kHz. Although the Kastelein et al. (2024a) manuscript likely was 'in prep' at the time Finneran (2024) was drafted, it is unclear why the data were not included, as other data that were and still are part of 'in prep' manuscripts (i.e., Kastelein et al. in prep, Reichmuth et al. in prep) were incorporated in Finneran (2024)[2]. The Commission recommends that the Navy review the data from Kastelein et al. (2024a) and determine whether inclusion of the data would alter the weighting function and/or thresholds for very high-frequency[3] cetaceans and if so, whether those modifications are sufficient to warrant revision of the current weighting function and associated thresholds for non-impulsive sources as stipulated in Department of the Navy (2024a).

For mysticetes, more recent data were incorporated into the weighting function for Phase IV activities. The first hearing tests were conducted on minke whales in 2023 and showed that the whales were sensitive to frequencies much higher than expected—at least 45 kHz and potentially as high as 90 kHz (National Marine Mammal Foundation (NMMF) 2023, Houser et al. 2024[4]). As such, the Navy split the low-frequency (LF cetacean) functional hearing group into very low-frequency (VLF) and LF cetaceans[5], with the LF cetacean weighting function shifted to encompass higher frequencies. Since 2023, additional hearing data have been collected that showed minke whales were the most sensitive at 32 kHz for the frequencies that were tested in 2024[6]. Department of the Navy (2024a) based various VLF and LF parameters that inform the composite audiograms, weighting functions, and thresholds on the mean or median parameters of the other functional hearing groups. In its 31 August 2015 letter on NMFS's technical guidance and the Navy's original Phase III criteria and thresholds, the Commission recommended that the phocid (PCW) weighting and exposure function parameters be used to inform the LF weighting and exposure functions[7]. Recently, others[8] also have suggested that mysticete hearing appears to be more similar to that of phocids. Therefore, the Commission recommends that the Navy specify whether the LF weighting function has been shifted far enough to the higher frequencies to reflect that 32 kHz was the most sensitive frequency tested in minke whales, determine whether use of the PCW composite audiogram, weighting function, and threshold parameters are more representative of VLF and LF cetaceans than medians and means of the five other functional hearing groups, and revise the VLF and LF composite

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[1] The Commission appreciates that the Navy, and in turn NMFS, incorporated its recommendations in the 26 June 2023 letter to (1) include the California sea lion hearing threshold data from Kastelein et al. (2021, 2022a and b, and 2024b) in the derivation of the otariid composite audiogram and revise the weighting function accordingly and (2) fix the rounding issues for *K* to ensure that the impulsive AINJ thresholds were 15 dB greater than the TTS thresholds.
[2] As well as NMFS (2024) and Department of the Navy (2024a).
[3] VHF.
[4] Which is similarly part of an in prep manuscript.
[5] VLF cetaceans include right, bowhead, fin, and blue whales; whereas, LF cetaceans include minke, sei, Bryde's, Rice's, Omura's, humpback, gray, and pygmy right whales.
[6] Which is part of another in prep manuscript.
[7] Which incorporate the weighting functions and associated weighted thresholds.
[8] D. Houser during his presentation of minke whale hearing results at the Effects of Sound on Marine Mammals meeting.

audiograms, weighting functions, and thresholds as needed for impulsive and non-impulsive sources for the FEIS and LOA application.

Behavior thresholds for acoustic sources

To further define its behavior thresholds for acoustic sources (i.e., sonars and other transducers), the Navy developed multiple[9] Bayesian biphasic dose response functions[10] (Bayesian BRFs) for Phase IV activities. The Bayesian BRFs were a generalization of the monophasic functions previously developed[11] and applied to behavioral response data[12] (see Department of the Navy 2024a for specifics). The biphasic portions of the functions are intended to describe both level- and context-based responses as proposed in Ellison et al. (2011). At higher amplitudes, a level-based response relates the received sound level to the probability of a behavioral response; whereas, at lower amplitudes, sound can cue the presence, proximity, and approach of a sound source and stimulate a context-based response based on factors other than received sound level[13]. The Commission agrees that the general method by which Bayesian BRFs are derived is reasonable. The Commission, however, questions whether best available data were used to inform them.

In its review of Department of the Navy (2024a), the Commission notes the following in regard to the BRFs—

- Justification was not provided regarding why the upper bound of the BRFs increased from 185 to 200 dB re 1 μPa for Phase IV.
  - None of the raw behavioral data include exposures above 185 dB re 1 μPa (see Table E-1 in Department of the Navy 2024a).
  - Although the upper bound was set by subject matter experts for Phase III (Department of the Navy 2017a), it appears arbitrary for Phase IV. Such a change would result in the Phase IV functions moving farther to the right toward higher received levels, the 50-percent probabilities occurring at higher received levels, the slopes of the functions being less steep, and the overall BRFs for odontocetes and mysticetes[14] being less precautionary as compared to Phase III (see Figure 42 in Department of the Navy 2024a and note the flat slope between 185 and 200 dB re 1 μPa on all BRFs for Phase III).
  - Additionally, the Department of the Navy (2024a) indicated that the 50 percent probability of a behavioral response was estimated to occur at 185 dB re 1 μPa for the mysticete BRF, 8 dB higher than the TTS threshold for LF or VLF cetaceans.
- None of the Southall et al. (2018, 2019, 2020, 2021, 2022, 2023) data for the Atlantic behavioral response study (BRS) involving beaked whales and other odontocetes were included. However, 'in prep' data were included for auditory thresholds, and data that were

[9] For sensitive species (beaked whales and harbor porpoises), odontocetes, mysticetes, and pinnipeds.
[10] Comprising two truncated cumulative normal distribution functions with separate mean and standard deviation values, as well as upper and lower bounds. The model was fitted to data using the Markov Chain Monte Carlo algorithm.
[11] By Antunes et al. (2014) and Miller et al. (2014).
[12] From both wild and captive animals.
[13] e.g., the animal's previous experience, separation distance between the sound source and the animal, sound source speed and heading, and behavioral state of the animal including feeding, traveling, etc.
[14] And less precautionary for sensitive species at higher received levels. The Phase IV pinniped BRF is more precautionary than the Phase III BRF, but would have been more so if the upper bound had been 185 dB re 1 μPa.

underlying but not specifically included in the publications were used for the BRFs[15]. This information may have been particularly useful to assess whether the less sensitive BRFs that were developed for Phase IV would have been supported by the Atlantic BRS data.

- The odontocete BRF incorporated 30 random samples from the dose-response function developed for just the *moderate and severe responses* of captive bottlenose dolphins (Houser et al. 2013b) to give equal weighting to the field and captive studies.
  - Houser et al. (2013b) included dose-response functions derived from all of the raw data. It is unclear why the Navy used only the moderate and severe responses to derive a new dose-response function for captive bottlenose dolphins, as this would skew the subsequent odontocete BRF to the right, particularly at the lower response probabilities and lower received levels, as seen in Figure 42 in Department of the Navy (2024a).
  - Further, there are more than 30 exposures for the field studies, so equal weighting of field to captive studies was not achieved as specified in Department of the Navy (2024a).
- The sensitive species BRF[16] incorporated 10 random samples from the generalized additive models (GAMs) that were developed from passive acoustic monitoring data in Moretti et al. (2014) and Jacobson et al. (2022)[17] and that ranged from 120 to 180 dB re 1 μPa[18].
  - Department of the Navy (2024a) did not specify how the 10 random samples were allocated between the GAMs nor did it specify how it handled the fact that the Jacobson et al. (2022) GAM went to only 165 dB re 1 μPa and was based on the decrease in the probability of a group vocal period (GVP; i.e., foraging dive), while the Moretti et al. (2014) GAM went to 180 dB re 1 μPa and included GAMs for both the decrease in the probability of a GVP and probability of disturbance[19].
  - Jacobson et al. (2022) specifically stated that they did not make an inference on sonar received levels above 165 dB re 1 μPa, because no GVPs were observed above this received level. Since the 10 random samples used for the BRFs were not included in Table 21 of Department of the Navy (2024a), it is unclear whether those samples could be causing the lesser sensitivity at the higher received levels in the sensitive species BRF as compared to the Phase III BRF.
  - It also is unclear why similar passive acoustic monitoring data were not used for beaked whales at the Southern California Acoustic Range and minke whales at PMRF, since those data have been collected and reported on as part of the Navy's Marine Species Monitoring Program for Phase III[20].
- For harbor porpoises, multiple received levels were noted for the same individual exposed to the same sound source (i.e., high-frequency active sonar (HFAS)) in Table E-1. Since the specific Kastelein et al. references were not provided, it is unclear whether the experimental scenarios differed enough that the data were considered independent or whether only the lowest received level for each individual should have been used.

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[15] i.e., data from Jacobson et al. (2022).

[16] Department of the Navy (2024a) indicated that, for harbor porpoises, a large enough aggregation of controlled exposure studies involving captive animals existed such that a risk function could be developed. The Commission understands that the Navy was referring to development of the actual BRF, not a separate harbor porpoise dose-response function that was used for other captive studies. This should be clarified in Department of the Navy (2024a).

[17] Moretti et al. (2014) included data from the range hydrophones at the Atlantic Undersea Test and Evaluation Center, and Jacobson et al. (2022) included data from the Pacific Missile Range Facility (PMRF).

[18] This range is indicated in the text, whereas, Table 21 specified the range was 100–180 dB re 1 μPa.

[19] i.e., whether they were considered a one-to-one comparison.

[20] https://www.navymarinespeciesmonitoring.us/reporting/pacific/. See DiMarzio et al. (2019) as one example.

- The pinniped BRF incorporated 15 random samples from the dose-response function developed for just the *moderate and severe responses* of captive California sea lions (Houser et al. 2013a).
  - It is unclear why the captive dose-response function from Houser et al. (2013a) that was derived from all of the raw data was not used for subsampling.
- The executive summary, Tables 21–24, Figures 43–45, and accompanying text, as well as Table E-1 in Department of the Navy (2024a) included contradictory information regarding the range of received levels for both exposures and responses, distances at which the responses occurred, and the number of significant responses (see the Addendum herein). Further, Table E-1 does not appear to include the Blainville's beaked whale information from Tyack et al. (2011), Moretti et al. (2014), and Jacobson et al. (2022). The table also appears to include only the raw data from Houser et al. (2013a, b), not the subsampled data from the re-derived dose-response functions that then were used for the BRFs. Absent consistent information, it is difficult to assess the appropriateness of the various BRFs and the Navy's cut-off distances.

<u>The Commission recommends</u> that the Navy revise Department of the Navy (2024a) to clarify and address all of these points. <u>The Commission further recommends</u> that the Navy use the dose-response functions that were developed from all of the raw data rather than those that were regenerated for only moderate and severe responses and refrain from extrapolating beyond the bounds of the underlying data when revising the BRFs.

To derive criteria and thresholds for auditory and behavioral impacts, new data are being collected and new methods to analyze existing data are continually being developed. The Navy currently implements the thresholds at the animat stage within the Navy Acoustic Effects MOdel (NAEMO; Department of the Navy 2024b) rather than at a true post-processing stage after the sound propagation and animat modeling has been conducted. This means that the Navy cannot re-query the animat dosimeters using different thresholds when thresholds change, instead it must rerun the animat portion of NAEMO using the new thresholds. This is not only inefficient, but it has caused the Navy and NMFS to rely on the same outdated thresholds for more than a decade. Criteria and thresholds usually are developed at least three years before a DEIS and proposed rule are finalized, and a final rule is valid for seven years[21]. When Navy-funded projects (e.g., Southall et al. 2018, 2019, 2020, 2021, 2022, 2023) are not able to provide the data to the Navy by a specific deadline, those data then are not able to be incorporated until the next Phase based on the current paradigm. Thus, the Navy is not able to benefit from the data that it has funded to be collected, sometimes for at least 15 years, by which time the thresholds are not considered best available. <u>The Commission recommends</u> that the Navy make a concerted effort to incorporate data that support criteria and threshold development more often than on a decadal cycle and revise NAEMO to implement the relevant criteria and thresholds at a true post-processing stage so that animat dosimeter data can be re-queried if thresholds change, rather than needing to remodel the animat-portion of NAEMO.

[21] The same criteria and thresholds also have been used for all DEISs and rulemakings under a given Phase, meaning that the Phase IV thresholds will be used for Navy activities until the Phase IV Gulf of Alaska rulemaking would expire in 2037.

Cut-off distances for behavior takes

The Commission remains concerned that, following the development of the BRFs and consistent with Phase III, the Navy implemented various cut-off distances beyond which it considered the potential for significant behavioral responses to be unlikely (Table 4 in Department of the Navy 2024a). The Navy previously indicated that the context of the exposure is likely more important than the amplitude at large distances (Department of the Navy 2017a)—that is, the context-based response dominates the level-based response. The Commission agrees with that notion but notes that the Bayesian BRFs specifically are intended to incorporate those factors. Thus, including additional cut-off distances would contradict the data underlying the Bayesian BRFs, negate the intent of the functions, and ultimately underestimate the numbers of takes.

For Phase IV activities, the Navy did add a condition that if a take were to occur beyond the relevant cut-off distance but above the 50 percent probability for a given BRF (e.g., a bottlenose dolphin exposed at 18 km and at a received level where the probability of response was 65 percent), it would be considered a significant response. That condition was further qualified based on the Navy assuming that animats would avoid a sound source between the response probabilities of 50 to 90 percent (avoidance is discussed further herein). Regardless of how the cut-off distances were qualified, they remain unsubstantiated and are less than what the Navy used for Phase III activities[22].

Department of the Navy (2024a) indicated that the models did not select range as a factor in the final BRFs, as it was too confounded with received level. The Navy also indicated that it was not surprising given that only 21 of 196 exposures that informed the four BRFs occurred at 10 km or greater from the sound source—19 animals had no response at all, one had a minor vocal response, and one had a strong avoidance response but it did not last for the full duration of the exposure. Delving into Department of the Navy (2024a), Table E-1 specified only 18 exposures occurred at 10 km or more from the sound source. Of those 18 exposures, one animal had minor vocal response, one had a strong avoidance response that lasted less time than the exposure, one stopped singing for as long as or longer than the duration of exposure, one had a strong avoidance response that was considered significant and lasted longer than the exposure, and another animal ceased its feeding, changed its dive and vocal behavior, and exhibited prolonged avoidance behavior. Thirteen animals exhibited no response at ranges of approximately 17 to 232 km from the source (Table E-1). Further, Figures 43–45 in Department of the Navy (2024a) are missing certain data that were specified in Table E-1 and in some instances have depicted the data incorrectly in terms of response, range, received level, and/or sample size relative to Table E-1. These inconsistencies make it difficult to assess the Navy's assumptions regarding cut-off distances similar to the BRFs.

Department of the Navy (2024a) however is correct in its statement that the probability of reaction at distances of 10 km and farther is not well represented. As such, it is unclear how the Navy can assert that those few data points provide support that beyond a certain distance, significant responses are unlikely to occur or that the source-receiver range must be included as a separate consideration to estimate likely significant behavioral reactions. Absence of data means just

[22] For Phase III, two different cut-off distances were used per behavioral group (one for moderate source level, single platform events and one for high source level or multiple platform events). For Phase IV, a single distance was used for all platforms and source levels for each behavioral group, but each of the four distances is less than the cut-off distance for high source level or multiple platform events from Phase III (see Table 4 in Department of the Navy 2024a).

that, there are no data to support including such cut-off distances or assumptions that a significant response is unlikely to occur beyond a certain distance.

The Navy specified that the probability of significant behavioral responses occurring beyond the cut-off distances at received levels above the 50 percent probability of response is unknown, but was included as a conservative assumption due to the paucity of data (Department of the Navy 2024a). Even with the scant data available it is clear that the cut-off distances do not encompass the significant behavioral responses that have been observed to occur and that inform the revised BRFs. Further, significant behavioral responses are occurring at received levels *below* the 50-percent probability of response. For example, the cut-off distance for mysticetes is 10 km and the received level for the 50-percent probability of response is 185 dB re 1 µPa (Table 4 in Department of the Navy 2024a). However, a humpback whale exhibited a significant behavioral response in which it stopped foraging, changed its dive and vocal behavior, and conducted prolonged avoidance behavior at a distance of 16.8 km from the source and a received level of 128 dB re 1 µPa (Table E-1 in Department of the Navy 2024a). This example calls into question the appropriateness of both the received level estimated to equate to the 50-percent probability of response and the cut-off distance.

As another example, a sperm whale stopped resting and had a moderate change in its dive profile that occurred for a shorter duration than the exposure. It is unclear how long the response lasted but it did occur nearly 38 km from the sound source and at a received level of approximately 114 dB re 1 µPa (Table E-1 in Department of the Navy 2024a)—the cut-off distance for odontocetes is 15 km and the received level for the 50-percent probability of response is 168 dB re 1 µPa. Although this animal was incorrectly denoted as having a significant behavioral response in Table E-1 of Department of the Navy (2024a) due to the length of response, it highlights that responses do occur at larger distances and lower received levels than the cut-off distances and 50-percent probability of response portray. For harbor porpoises and pinnipeds, there currently are no data on a wild animal's response and relative distance to Navy acoustic sound sources.

Tyack and Thomas (2019) previously highlighted that the number of animals that are predicted to have a low probability of response may represent the dominant impact from a given sound source, as well as the shortcomings associated with assuming only a portion of the animals respond[23]. In addition to the Commission's ongoing concerns, use of cut-off distances has been criticized in public comments as an attempt to reduce the numbers of takes (85 Fed. Reg. 72326). Given the lack of data for certain behavioral groups in general and the fact that best available science was not used when data were available, <u>the Commission again recommends</u> that the Navy refrain from using cut-off distances in conjunction with the Bayesian BRFs and re-estimate the numbers of marine mammal takes based solely on the Bayesian BRFs for the FEIS and LOA application.

Behavior thresholds for explosives[24]

The Navy assumed a behavior threshold for explosives that was 5 dB less than the TTS threshold for each functional hearing group (Department of the Navy 2024a). The 5-dB value was

[23] Which corresponds to using various arbitrary cut-off distances.
[24] The Commission appreciates that the Navy incorporated the Commission's previous recommendations and used only the onset mortality, slight lung injury, and slight gastrointestinal tract injury thresholds for estimating the numbers of takes of marine mammals rather than the 50 percent thresholds that were used in Phase III.

derived from observed onset behavioral responses of captive bottlenose dolphins during non-impulsive TTS testing[25] (Schlundt et al. 2000). Aside from the issues associated with conducting behavioral response studies on trained animals and using a different metric than all other BRFs or behavior thresholds[26], there is no scientific basis for using data from 1-sec tones to replicate or be comparable to an animal's behavioral response to underwater detonations. The Navy itself in Department of the Navy (2017a) stated that, although data from Schlundt et al. (2000) were used to derive the TAP I/Phase II BRFs for *acoustic sources*, they were not used in the quantitative derivation of the Phase III BRFs (or Phase IV BRFs) because the study was a hearing study where animals were conditioned and reinforced to tolerate high noise levels. It is illogical that the Navy removed such data from the estimation of BRFs for acoustic sources, which are similar to the 1-sec tones used in Schlundt et al. (2000), but then continued to use the same inappropriate data for a completely different sound source—data that underestimate impacts.

Another concerning assumption is that the Navy continues to maintain that marine mammals do not exhibit behavioral responses to single detonations (Department of the Navy 2024a)[27]. The Navy has asserted that the most likely behavioral response would be a brief alerting or orienting response and significant behavioral reactions would not be expected to occur due to no further detonations following the initial detonation based on reasoning that it historically has applied to shock trials (Department of the Navy 2024a). It is irrelevant that the same reasoning goes back to 1998. There were no data then, and there are no data now to support the assumption that animals would not behaviorally respond to a single detonation that could have been up to 58,000 lbs in net explosive weight (NEW)[28].

Larger single detonations (such as explosive torpedo testing or ship shock trials[29]) are expected to elicit 'significant behavioral responses' as described in Department of the Navy (2024a). The Navy has yet to justify why it believes that an animal would exhibit a significant behavioral response to two 5-lb charges detonated within a few minutes of each other but would not exhibit a similar response for a single detonation of 50 lbs, let alone detonations of up to 14,500 lbs. In response to Commission comments on the AFTT Phase III DEIS, the Navy indicated that there is no evidence to support that animals have significant behavioral reactions to temporally and spatially isolated explosions and that it has been monitoring detonations since the 1990s and has not observed those types of reactions. Due to human safety concerns, the Navy has never stationed personnel at the target site to monitor marine mammal responses during large single detonations. In other instances (i.e., bombs dropped from aircraft), lookouts are tasked with clearing the mitigation zone, not documenting an animal's behavioral response to the activity.

Although neither the Navy nor NMFS is aware of evidence to support the assertion that animals will have significant behavioral responses to temporally or spatially isolated explosions at

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25 Based on 1-sec tones.

26 Department of the Navy (2024a) used the cumulative sound exposure level (SEL_{cum}) metric for behavior thresholds for explosives rather than the root-mean-square sound pressure level (SPL_{rms}), which is used for behavior thresholds for all other sources. NMFS's behavior thresholds also are based on SPL_{rms} for all other sources.

27 Including certain gunnery exercises that have several detonations of small munitions occurring within a few seconds.

28 Takes for which were authorized under AFTT Phase III compliance documents, and ship shock trial activities for which the Navy conducted.

29 With net explosive weights of 500 to 650 lbs (Bin E11) and 7,250 to 14,500 lbs (Bins E16), respectively, for Phase IV activities.

received levels below the TTS threshold (85 Fed. Reg. 72325), a lack of evidence, particularly when concerted monitoring has not occurred in the Level B harassment zones during detonations, does not mean that takes have not occurred. Behavior takes from numerous types of activities have not been documented, but the Navy and in turn NMFS presumes that they could occur—essentially for all Navy acoustic sources but low- and mid-frequency active sonar. Given the lack of justification for continuing to ascribe validity to assumptions that clearly are not based on best available science, the Commission recommends that the Navy include behavior takes of marine mammals during *all* explosive activities, including those that involve single detonations and gunnery exercises that have several detonations occurring within a few seconds, in the FEIS and its LOA application and invest additional resources in conducting behavioral response studies on marine mammals' responses[30], including pinnipeds, to underwater detonations for the derivation of explosive BRFs.

Avoidance and other NAEMO limitations

Avoidance—NAEMO does not use moving animats for estimating avoidance, as it does moving sound sources for the propagation model (Department of the Navy 2024b). NAEMO simply simulates an animat moving away from a sound source by mathematically reducing the received SPLs of individual exposures based on a spherical spreading calculation for the source(s) present on each unique platform. Avoidance speeds and durations were informed by a review of available exposure and baseline data (Department of the Navy 2024b). In prior Phases, avoidance was not modeled in NAEMO. Instead, 95 percent of the takes for permanent threshold shift (PTS), now referred to as AINJ, predicted by NAEMO were assumed to be reduced to TTS due to avoidance (Department of the Navy 2017b). This reduction was based on the assumption that an animal avoided the AINJ zone of a moving MF1 source (i.e., a hull-mounted surface ship sonar as defined in NAEMO).

Department of the Navy (2024b) did not justify why spherical spreading was used rather than the propagation loss resulting from NAEMO modeling for each individual event. The Navy did however specify swim speeds that were used for the various groups for avoidance (see Table 5 in Department of the Navy 2024b). Some of the assumed avoidance speeds are greater than were noted in the underlying references. For example, Table 8 specified that Kastelein et al. (2018) was one of the references for harbor porpoise avoidance speeds. Even though Table 8 did not specify the speed, Kastelein et al. (2018) indicated that the highest sustainable swim speed for a harbor porpoise responding to pile-driving activities was 7.1 km/hr (or 1.97 m/s). The other harbor porpoise swim speeds mentioned were not sustainable for the duration of a Navy acoustic activity, while the baseline speed specified was 1.5 m/s (Table 8 in Department of the Navy 2024b). As such, it is unclear how a sustained swim speed of 3 m/s can be justified for harbor porpoises. Further, the baseline swim speed in Table 8 for otariids was 0.8 m/s, 0.4 m/s for harbor seals, and less than 1.7 m/s for northern elephant seals. No swim speeds were available for avoiding sound sources. Given that harbor seals comprise the vast majority of the phocid takes and swim speeds for a given group should be based on the slower species, pinniped swim speeds should have been no more than 1 m/s. For these reasons, the Commission recommends that the Navy use an avoidance swim speed of no more than 2 m/s for harbor porpoises and 1 m/s for pinnipeds and revise the NAEMO modeling and take estimates appropriately for the FEIS and LOA application.

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[30] Living Marine Resources has provided funding for a few opportunistic studies involving behavioral response of cetaceans exposed to underwater detonations (Falcone et al. 2024).

Moving animats, as well as animat-based avoidance behavior, has been modeled for quite some time. The Navy funded the development of the publicly-available Marine Mammal Movement and Behavior (3MB)[31] model 25 years ago (Houser and Cross 1999, Houser 2006) that incorporated moving animats and avoidance behavior. Although never included in NAEMO, 3MB has been modified over the years to be used for geophysical surveys (Zeddies 2015) and is currently used as the basis for animat modeling that is conducted for offshore wind activities (e.g., Denes et al. 2020, Küsel et al. 2022). Since NAEMO's current animat modeling and avoidance processes are not considered best available science, the Commission recommends that the Navy incorporate moving animats that can actively avoid sound sources based on species-specific dive profiles and swim speeds for Phase V activities and, if that is not feasible, incorporate species-specific swim speeds and the actual modeled sound propagation to simulate avoidance for a given event into NAEMO.

Repeated exposures—For Phase IV activities, the Navy has again used relative proportions or percentages of the stock to estimate impacts on individuals from repeated exposures and population-level consequences, which ultimately inform negligible impact determinations[32] under the Marine Mammal Protection Act (Department of the Navy 2024b). It is unclear why the Navy has not used NAEMO to model multi-day events or multiple single-day events that would provide information regarding repeated exposures of individuals by querying the animat dosimeters. This seems fairly basic, with something similar having been conducted for geophysical and geological activities in the Gulf of Mexico in 2015 (Zeddies et al. 2015 and 2017). To better assess repeated exposures of individuals and population-level consequences, the Commission recommends that the Navy use NAEMO to conduct modeling of both multi-day events and multiple single-day events to estimate the number of repeated exposures an individual is expected to incur.

Explosive propagation modeling—For Phase II activities, the Navy used its Refraction in Multilayered Ocean/Ocean Bottoms with Shear Wave Effects (REFMS) model to estimate sound propagation associated with underwater detonations. However, the Navy has since used Comprehensive Acoustic Simulation System/Gaussian Ray Bundle (CASS/GRAB) and a similitude equation to model underwater detonations for Phase III and IV activities (Department of the Navy 2017b, Department of the Navy 2024b). The Navy indicated that CASS/GRAB was approved by the Ocean and Atmospheric Master Library (OAML)[33], could vary environmental parameters with range, had a built-in absorption model, and was more numerically stable than REFMS (Department of the Navy 2017b). Although those assertions may be correct, the Navy also has used its Range-Dependent Acoustic Model (RAM) and the Navy's Standard Parabolic Equation (PE) model for non-impulsive sources with frequencies of less than 100 Hz[34] and for water depths of less than 50 m (Department of the Navy 2024b). It is unclear why RAM/PE was not used for underwater detonations that would occur in waters 50 m or less, where CASS/GRAB generally is not used. Further, Department of the Navy (2024b) specified that the similitude equation is valid only over a range of pressures equating to a NEW of up to 28.8 lbs.

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[31] http://oalib.hlsresearch.com/Sound%20and%20Marine%20Mammals/3MB%20HTML.htm.
[32] As well as small numbers determinations for construction activities conducted by the Navy.
[33] The Commission notes that CASS/GRAB is OAML-approved only for frequencies higher than 100 Hz per Department of the Navy (2017b). The Navy just uses it down to 25 Hz for impulsive sources.
[34] The main portion of an underwater detonation's energy occurs at frequencies less than 100 Hz.

Department of the Navy (2017b and 2024b) did indicate that the CASS/GRAB modeling process compared favorably with in-situ data, but the data were for small explosives at short ranges (i.e., no larger than 15-lb charges in less than 5 m of water at a range of hundreds of meters[35]; Deavenport and Gilchrest 2015). Department of the Navy (2017b) specified that data for large explosions *and* at long ranges were needed to fully validate the model. During the most recent ship shock trials off the east coast of Florida in 2021, some such data were collected. Seger et al. (2023) collected in-situ measurements of the three individual shots of a NEW of up to 58,000 lbs fired near the USS Gerald R. Ford for the purpose of validating NAEMO propagation models. The researchers conducted their own modeling using the Peregrine version of RAM/PE for optimal placement of the acoustic recorders and to compare with the in-situ measurements.

The measured sound levels exceeded what the Navy had estimated for Phase III modeling for the ship shock trials (Bin E17 in Tables 9-15 to 9-22 in Department of the Navy 2017b) by orders of magnitude[36]. For example, the maximum volume modeled out to a radius of 201 km was exceeded for both the SPL_{peak} and SEL_{cum} metrics for PTS and TTS for LF cetaceans[37] (Table 12 in Seger et al. 2023), the largest range of which was estimated by NAEMO to be 47 km. Since the Navy has yet to conduct a rigorous comparison between the radii provided by NAEMO and those measured in-situ, the total amount NAEMO had underestimated the zones is unknown. However, Seger et al. (2023) noted in Table 12 that the impact volumes for PTS and TTS were 16.5 times as large as the Grand Canyon and 1/40th the size of the Gulf of Mexico[38]. The researchers also noted that the sound energy from the 2016 ship shock trial of only 10–11,000 lbs reached Ascension Island[39] nearly 8,200 km away at received levels of 135 dB re 1 μPa, thus the far field was a relatively very far distance in that context. For the USS Ford ship shock trial, the maximum received level at the Ascension Island hydrophones was 157 dB re 1 μPa (Seger et al. 2023). The Commission recommends that the Navy conduct a rigorous comparison of CASS/GRAB and the similitude equation and the in situ measurements of the USS Ford ship shock trial from Seger et al. (2023) to fulfill the intent of the project. Given the comparability of the modeled zones from the Peregrine version of RAM/PE to the measured values and that RAM/PE is already used by the Navy for modeling non-impulsive sources that operate at less than 100 Hz and in shallow water, the Commission further recommends that the Navy use RAM/PE to model all underwater detonations for Phase IV activities for which modeling has not been completed and for all Phase V activities, until such time that CASS/GRAB and the similitude equation have been validated for the range of detonation sizes and environmental parameters (water depth and receiver range) in which it would be used.

Seger et al. (2023) also were tasked with determining whether vocal activity of odontocetes and mysticetes differed before and after each shot of the ship shock trial. Odontocete vocal activity decreased at four recorders, increased at two recorders, and remained the same at seven recorders.

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[35] Parameters which are exceeded by modeled scenarios for even the smallest detonations, Bin E1 (i.e., see Table 2.5-9 in Appendix E of the DEIS).

[36] The Peregrine modeled received levels at the various monitoring device locations were comparable to measured values (Seger et al. 2023).

[37] For unknown reasons, Seger et al. (2023) used the 160 dB re 1 uPa threshold as the behavior threshold. The Navy has never used that threshold to estimate the range to behavioral response for underwater detonations.

[38] For reference, Department of Navy (2017b) estimated that the TTS zone for the SEL_{cum} threshold was 3.7 km for MF cetaceans.

[39] Where Comprehensive Nuclear-Test-Ban Treaty Organization hydrophones are installed.

Mysticete vocal activity decreased at eight recorders, increased at one recorder, and remained the same at four recorders. Certain vocal activity changes were statistically significant. Although Seger et al. (2023) did not provide ranges from each of the detonations to the recorders, some recorders were very likely beyond the range of TTS for LF cetaceans and most definitely beyond the range of TTS for MF cetaceans (47.4 km and 6 km, respectively; Department of the Navy 2017b). Thus, contrary to the Navy and NMFS's continued presumption, behavioral responses do in fact occur at ranges beyond TTS for single detonations.

Pile-driving calculations—The Navy indicated that, based on the best available science regarding animal reactions to sound, selecting a reasonable accumulation period was necessary to accurately reflect the period that an animal is likely to be exposed to the sound (Department of the Navy 2024b). The Navy chose a 5-minute accumulation time for the SEL_{cum} thresholds for AINJ and TTS, because most marine mammals should be able to easily move away from the expanding AINJ and TTS zones within that timeframe, especially considering that soft-start procedures may warn the animals. The Navy also suggested that the animal could avoid the zone altogether if it is outside the immediate area when pile driving begins. Those assumptions may hold if an animal avoids pile-driving activities, but many times, certain species such as pinnipeds and bottlenose dolphins do not avoid the activities. As such, the assumed 5-min accumulation time would be insufficient. Since the Navy currently has 13 active incidental take authorizations for construction activities and has had at least 35 incidental take authorizations issued in the last 10 years, it should be able to review its monitoring data to determine whether a 5-minute accumulation time is sufficient for species that are known to remain near pile-driving activities. The Commission recommends that the Navy review its previous monitoring reports for both construction activities and any pile-driving activities associated with AFTT Phase I, II, or III FEISs to estimate the mean time an animal is expected to remain near a pile-driving activity and revise the accumulation time, range to effects, and numbers of takes accordingly for the FEIS and LOA application.

Mitigation measures

Mitigation Areas—Various mitigation areas in the AFTT study area were informed by biologically important areas (BIAs), critical habitat, important habitat, etc. for Phase III activities. BIAs in particular are of known importance for reproduction, feeding, or migration or are areas where small and resident populations are known to occur (see Harrison et al. 2023 for details). The BIAs for the Atlantic Ocean and Gulf of Mexico currently are in draft form and have not yet been incorporated into Navy compliance documents for Phase IV activities. However, the draft BIAs specifically for North Atlantic right whales and Rice's whales have been provided to the Navy and NMFS. Those draft BIAs vary from, and in some cases are larger than, the various North Atlantic Right Whale Mitigation Areas (LaBrecque et al. in prep) and the Gulf of Mexico Rice's Whale Mitigation Area (LaBrecque et al. in prep). The Commission understands that the other draft BIAs will be provided to the Navy and NMFS in the coming months. The Commission recommends that, in the FEIS and LOA application, the Navy (1) ensure that the Gulf of Mexico Rice's Whale Mitigation Area encompasses the Rice's whale parent BIA, (2) consider the new delineations for the North Atlantic right whale feeding, migrating, and most importantly reproductive BIAs and expand the various North Atlantic Right Whale Mitigation Areas as needed, (3) ensure that the Ship Shock Trial Mitigation Areas are at least 5 nmi beyond the boundaries of the Rice's whale parent and child BIAs and all of the North Atlantic right whale BIAs, and (4) evaluate whether any of the draft BIAs for the other marine mammal species should inform expansion of or additional mitigation areas.

Passive acoustic monitoring—The Navy proposed to use information from passive acoustic detections (presumably from instrumented ranges, sonobuoys, etc.) to inform visual observations of lookouts when passive acoustic devices are already being used in events involving active acoustic sources (Table 5.6-1 in the DEIS). Given that visual observations by Navy lookouts have proven to be ineffective (Oedekoven and Thomas 2022)—such that the Navy has removed any 'credit' for mitigation implementation from the Phase IV DEIS and other compliance documents—the Navy's currently proposed mitigation measure that still relies on a lookout's visual observations is insufficient. Passive acoustic monitoring via range instrumentation, and sonobuoys, has reached the level of performance needed for use during military readiness activities (e.g., Department of the Navy 2013 and 2014, U.S. Air Force (USAF) 2016), contrary to the Navy's stance that they have not. The Navy's mitigation measures have yet to be supplemented from a technology standpoint[40] beyond those measures proposed for TAP I activities more than 15 years ago. Although the DEIS indicated that many of the technologies have yet to reach the level of performance needed for deployment during military readiness activities, many are and have been used by the Department of National Defence (DND) in Canada[41] to supplement detections when there are visual monitoring limitations (Binder et al. 2021, Thomson and Binder 2021, Binder et al. 2024). Therefore, the Commission remains skeptical of the Navy's insistence in the DEIS that use of passive acoustic monitoring is impractical as a precise real-time indicator of a marine mammal's location for mitigation implementation absent a confirmed visual sighting. The Commission recommends that the Navy use its instrumented ranges and sonobuoys to localize marine mammals and implement the relevant mitigation measures during active acoustic events for Phase IV activities, take a harder look at the technologies that the Canadian DND use during its at-sea activities, and incorporate accordingly for other Phase IV DEISs.

The Navy also proposed to use passive acoustic detections to inform lookouts prior to the initiating detonations only if the passive acoustic devices are already being used during the event. Passive acoustic monitoring was required for explosive sonobuoys, explosive torpedoes, and sinking exercises for Phase III and prior activities, including in NMFS's final rules. The effectiveness of passive acoustic devices has not diminished nor has use of the devices become impracticable. Thus, requirements to use passive acoustic devices should be included for Phase IV explosive sonobuoys, explosive torpedoes, and sinking exercises as well. It is unclear why passive acoustic monitoring, particularly the use of expendable sonobuoys, has not been a requirement before for ship shock trials. The Commission recommends that the Navy include the use of passive acoustic monitoring prior to and during activities involving explosive sonobuoys, explosive torpedoes, sinking exercises, and ship shock trials for Phase IV activities in the FEIS and its LOA application.

Further, since passive acoustic monitoring is not required for surface detonations[42] (i.e., air-to-surface explosive bombs, missiles, rockets), multiple sonobuoys could be deployed with a surface target prior to an activity to better determine whether the target area is clear and remains clear until the munition is launched. This would supplement any pre-activity visual observations for air-to-

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[40] In fact, over the years some mitigation measures have been removed (i.e., surface-to-surface projectiles, passive acoustic monitoring requirements for certain explosive activities) and some of the mitigation zones have been reduced in size (i.e., explosive mine neutralization exercises not involving positive control).
[41] i.e., automated passive acoustic monitoring via fixed hydrophones, mobile autonomous systems, and sonobuoys; detection and tracking capabilities using bottom-mounted hydrophones on instrumented ranges; electro-optical, infrared, and space-based detection methods to supplement naked-eye monitoring.
[42] Mitigation is not required to be implemented at all for surface-to-surface detonations.

surface exercises and would serve as the only mitigation measure for surface-to-surface detonations[43]. Specifically, Directional Frequency Analysis and Recording (DIFAR) sonobuoys[44] provide both range and bearing to vocalizing animals, can determine an animal's location and confirm its presence in a mitigation zone, and are routinely used by the Navy.

The Navy itself has drawn attention to the success of using sonobuoys to detect bottlenose dolphins in real-time during mine exercises, provides sonobuoys to researchers for the same purpose of detecting and localizing marine mammals[45], and has highlighted numerous instances of various types of sonobuoys being used to detect and localize baleen whales, delphinids, and beaked whales[67]. A broadband repertoire of frequencies, as well as narrow-band frequencies, can be monitored by sonobuoys. For these reasons, the Commission again recommends that the Navy include the use of passive acoustic devices (i.e., DIFAR and other types of passive sonobuoys, operational hydrophones) prior to air-to-surface and surface-to-surface explosive bomb, missile, and rocket exercises to detect marine mammals and implement the necessary mitigation measures in the FEIS and LOA application and, when sonobuoys are used, deploy them at the same time as the surface target.

Other mitigation measures—The Commission notes that mitigation measures for air-to-surface explosive large-caliber gunnery exercises[46] are lacking for Phase IV activities. Mitigation measures also are lacking for surface-to-surface activities involving explosive medium-caliber projectiles. The mitigation measures are similar to those included for explosive gunnery exercises for air-to-surface medium-caliber projectiles in Table 5.6-2 of the DEIS, except the mitigation zones were 600 yards for surface-to-surface activities using explosive medium-caliber projectiles and 1,000 yards for surface-to-surface activities using explosive large-caliber projectiles for Phase III activities. The Navy eliminated mitigation measures for surface-to-surface missiles and rockets (see Table 5.9-1 in the DEIS), but those measures should not have been eliminated for surface-to-surface explosive medium- and large-caliber projectiles. Given that the measures have been deemed practicable for Phase III and previous activities, the Commission recommends that the Navy include a 600-yard and 1,000-yard mitigation zone for surface-to-surface activities using explosive medium- and large-caliber projectiles, respectively, in the FEIS and its LOA application.

For Phase III and previous activities, the Navy would delay and/or move activities if floating vegetation or jellyfish[47] were observed in the relevant mitigation zone for active acoustic sources, pile driving, airguns, and explosive activities. Chapter 5 in the DEIS makes note of floating vegetation and jellyfish but does not specify what measures, if any, would be implemented if either

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[43] The Navy indicated in the DEIS that mitigation would not be effective for vessel-deployed missiles and rockets because of the distance between the firing platform and target location and it would not be possible for vessels to conduct close-range observations due to the length of time (and associated operational costs and exercise delays) it would take to complete observations and then transit back to the firing position (typically 28 to 139 km each way).
[44] And other types of passive (e.g., Vertical Line Array Directional Frequency Analysis and Recording (VLAD)) and active (Directional Command Active Sonobuoy System (DICASS) and the Multistatic Active Coherent (MAC) system and Air Deployed Active Receiver (ADAR)) sonobuoys.
[45] Including DIFAR sonobuoys, which have an upper frequency cutoff of 2.4 kHz, and other types of sonobuoys, including omnidirectional sonobuoys that have a higher frequency cutoff.
https://www.navymarinespeciesmonitoring.us/files/4714/0069/6940/Spr14_Sonobuoys_Reasearch_Monitoring.pdf.
[46] For the projectiles themselves. Mitigation measures for explosive and non-explosive large-caliber gunnery firing noise is included in Table 5.6-2 of the DEIS.
[47] That the Navy has historically used as a proxy for the potential presence of marine mammals.

were to be observed during a given activity. The Commission recommends that the Navy include the requirement to delay, relocate, or cease activities if floating vegetation or jellyfish are observed in the mitigation zone during activities involving active acoustic sources, pile driving, airguns, and explosives consistent with Phase III mitigation measures in the FEIS and LOA application.

In addition, the Navy removed the requirement for lookouts to wear polarized sunglasses in the Inshore Manatee and Sea Turtle Mitigation Areas (Table 5.8-1 in the DEIS). The Navy instead will *encourage* lookouts to use polarized sunglasses. Polarized sunglasses are more effective at observing submerged manatees and sea turtles than non-polarized sunglasses and are clearly practicable and not cost-prohibitive. It seems a bit absurd that such a minor 'technology' has been proposed to be removed as a requirement. The Commission recommends that the Navy include the requirement that lookouts wear polarized sunglasses in the Inshore Manatee and Sea Turtle Mitigation Areas to better implement the required mitigation measures in the FEIS and Biological Assessment submitted under the Endangered Species Act.

For ship shock trials, the Navy indicated that, if an incident involving a marine mammal is observed after an individual detonation, it would follow established incident reporting procedures and halt any remaining detonations until the Navy can consult with NMFS and review or adapt the mitigation plan. It is unclear why such a measure would not apply to all activities. The Commission recommends that the Navy cease any active acoustic, explosive, pile driving, or airgun activity if a marine mammal is observed to be injured or killed during or immediately after the activity and consult with NMFS to review or adapt the mitigation measures, as necessary.

The Commission appreciates the opportunity to provide comments on the Navy's DEIS for training and testing activities conducted within the AFTT study area. Most, if not all, of the Commission's recommendations would apply to the Navy's LOA application as well and should be considered as such. Please contact me if you have questions concerning the Commission's recommendations or rationale.

Sincerely,

Peter O. Thomas

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Addendum

The following are some of the errors, inconsistencies, or missing information observed in Tables 21–24, Figures 43–45, and Table E-1 of Department of the Navy (2024a). These issues should be addressed and the various tables, figures, and accompanying text should be revised accordingly.

Table 21—

- The range of response received levels (RLs) for bottlenose whales was 117–130 dB re 1 μPa in Table 21, while Table E-1 noted RLs of 127.2–128 dB re 1 μPa in Table E-1.
- The range of exposure RLs in Table 21 for Cuvier's and Baird's beaked whales from the Southern California Behavioral Response Study (SOCAL BRS) was 91–43 dB re 1 μPa, which is not an appropriate range. Table E-1 noted 138 dB re 1 μPa as the highest exposure RL for Cuvier's and Baird's beaked whales from the SOCAL BRS.
- Table 21 indicated that 9 significant responses occurred for harbor porpoises, while Table E-1 specified only 8 significant responses.
- Table 21 and the executive summary indicated that the response RLs for all species ranged from 95–138.4 dB re 1 μPa, while Table E-1 indicated a range of 98–138 dB re 1 μPa.

Table 22—

- The range of response RLs for killer whales was 94–164 dB re 1 μPa in Table 22, while Table E-1 noted a range of 94–161 dB re 1 μPa. The distances of responses for killer whales were 0.4–2.5 km in Table 22, while the distances at a response were 0.7–8.9 km in Table E-1.
- The number of significant exposures for sperm whales was 15 in Table 22, while only 14 are noted in Table E-1[48]. The distances of responses for sperm whales were 0.65–12.3 km in Table 22, while the distances at a response were 1.8–12.3 km in Table E-1.
- The range of response RLs for pilot whales was 115–159 dB re 1 μPa in Table 22, while Table E-1 noted a range of 114–152 dB re 1 μPa. The distances of responses for pilot whales were 0.08–0.3 km in Table 22, while the distances at a response were 0.09–6.2 km in Table E-1.

Table 23—

- The number of significant exposures for hooded seals was 12 in Table 23, while only 4 are noted in Table E-1. The range of response RLs for hooded seals was 161–170 dB re 1 μPa in Table 23, while Table E-1 noted a range of 165–170 dB re 1 μPa.

Table 24—

- The range of response RLs for blue whales from the SOCAL BRS was 105–143 dB re 1 μPa in Table 24, while Table E-1 noted a range of 111–146 dB re 1 μPa.
- The range of exposure RLs for fin whales from the SOCAL BRS was 110–161 dB re 1 μPa in Table 24, while Table E-1 noted a range of 104–156 dB re 1 μPa.
- The response RL for minke whales from the 3S project was 146 dB re 1 μPa at 4.5 km in Table 42, while Table E-1 noted a response RL of 138 dB re 1 μPa at less than 8 km.

[48] Since the Navy confirmed that it did not consider Sw_17_182a exposed to low LFAS to have exhibited a significant response.

- The number of significant exposures for humpback whales from the 3S project was 4 in Table 24, while 5 exposures are noted in Table E-1. The distances of responses for humpback whales were 0.1–0.4 km in Table 24, while the distances at a response were 0.81–0.98 km in Table E-1.

Figure 43—
- Although nine exposure RLs with accompanying distances were included in the figure, of the nine exposures in Table E-1 three of the Cuvier's beaked whale exposures do not have distances denoted. Also, animals Ha12_176a and bb12_214a were not included in the figure, and it is unclear where the exposures from 140–155 dB re 1 μPa originated because the RLs in Table E-1 are all less than or equal to 138 dB re 1 μPa. Further, no data in Table E-1 represent distances at or around 60 km, as denoted in the figure.

Figure 44—
- The figure specified that 101 exposures were included, whereas only 97 exposures were included in Table E-1. Given the number of exposures included in the figure, its accuracy based on Table E-1 cannot be assessed.

Figure 45—
- The figure specified that 85 exposures were included, whereas only 79 exposures were included in Table E-1.
- Animal bw_193a was not included in the figure, and Animal bp_075a was incorrectly denoted at 47 rather than 57 km.

Table E-1—
- The relevant data on Blainville's beaked whales from Tyack et al. (2011), Moretti et al. (2014) and Jacobson et al. (2022) were not included in the table. At a minimum, the 10 data points that were randomly subsampled from the Moretti et al. (2014) and Jacobson et al. (2022) dose response functions should have been included in the table.
- Data from the minke whale from the SOCAL BRS from Kvadsheim et al. (2017) was not included in the table.
- The distances at a response are included as '?' for Cuvier's and Baird's beaked whales from the SOCAL BRS, while 2–5 km is provided in Table 21 for the distances of responses.
- The raw data were included in the table for bottlenose dolphins and California sea lions from Houser et al. (2013a, b) rather than the subsampled data from the dose response functions that the Navy derived specifically from the moderate and severe responses of the dolphins and sea lions.

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