13 July 2018

Ms. Jolie Harrison, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3226

Dear Ms. Harrison:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the National Marine Fisheries Service's (NMFS) 26 June 2018 notice (83 Fed. Reg. 29872) and the letter of authorization (LOA) application submitted by the U.S. Navy (the Navy) seeking issuance of regulations under section 101(a)(5)(A) of the Marine Mammal Protection Act (the MMPA). The taking would be incidental to conducting training and research, development, test, and evaluation (testing) activities within the Hawaii-Southern California Training and Testing (HSTT) study area (Phase III activities). The Commission reviewed and provided recommendations in its 13 November 2017 letter on the Navy's Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS) for conducting training and testing activities in the HSTT study area, which underpins the Navy's LOA application. NMFS authorized the Navy to conduct similar activities first under the Tactical Training Theater Assessment and Planning (TAP I) LOA applications and second under Phase II LOA applications.

Background

The Navy's HSTT study area is in the Pacific Ocean and encompasses the waters along the coast of Southern California (SOCAL), around the Hawaiian Islands (including the Hawaii Range Complex (HRC)), and the associated transit corridor. The activities would involve the use of low- (LFA), mid- (MFA), high- (HFA) and very high-frequency active sonar, weapons systems, explosive and non-explosive practice munitions and ordnance, high-explosive underwater detonations, expended materials, vibratory and impact hammers, airguns, electromagnetic devices, high-energy lasers, vessels, underwater vehicles, and aircraft. The Navy would implement mitigation measures that consist of both procedural mitigation measures[1] and mitigation areas[2].

[1] Which primarily include visual monitoring to implement delay and shut-down procedures. Passive acoustic monitoring would be required only for sinking exercises and deployment of explosive sonobuoys and explosive torpedoes.
[2] Which include limiting or restricting the types and quantities of activities to be conducted in specific areas.

Density estimates

The Commission had recommended in previous letters regarding Navy Phase II activities that the Navy incorporate more refined data in its extrapolated density estimates, primarily with regard to cetaceans in regions that have not been surveyed and pinnipeds in general. For Phase III activities, the Navy used more refined density estimation methods for cetaceans and accounted for uncertainty in those densities and the group size estimates[3] that seeded its animat modeling. The Commission appreciates that the Navy incorporated uncertainty in both the density and group size estimates for cetaceans and expects that comparable methods will be used for the other Navy study areas. The Commission notes that 30 iterations or Monte Carlo simulations are low for general bootstrapping methods used in those models but understands that increasing the number of iterations in turn increases the computational time needed to run the models. Accordingly, the Commission suggests that the Navy consider increasing the iterations from 30 to at least 200 for activities that have yet to be modeled for Phase III and for all activities in Phase IV.

The Commission still has concerns regarding the Navy's pinniped density estimates. Given that a single density was provided for the respective areas and pinnipeds were assumed to occur at sea as individual animals, uncertainty does not appear to have been incorporated in the Navy's animat modeling for pinnipeds. The Navy primarily used sightings or abundance data, assuming certain correction factors, divided by an area to estimate pinniped densities. Many, if not all, of the abundance estimates had associated measures of uncertainty (i.e., coefficients of variation (CV)), standard deviation (SD), or standard error (SE)). Therefore, the Commission recommends that NMFS require the Navy to specify whether and how it incorporated uncertainty in the pinniped density estimates into its animat modeling and if it did not, require the Navy to use measures of uncertainty inherent in the abundance data (i.e., CV, SD, SE) similar to the methods used for cetaceans.

More specifically, the Commission has concerns regarding the various areas, abundance estimates, and correction factors that the Navy used for pinnipeds. In HSTT, the Navy used the following areas—

- for harbor seals and northern fur seals, the area was based on the NMFS SOCAL stratum[4] for its vessel-based surveys (i.e., Barlow 2010);
- for elephant seals, California sea lions, and Guadalupe fur seals, the area was based on the Navy SOCAL modeling area; and
- for monk seals, the area was based on the areas within the 200-m isobaths in both the Main and Northwest Hawaiian Islands (MHI and NWHI, respectively) and areas beyond the 200-m isobaths in the U.S. EEZ.

The only 'area' that is appropriate is that used for monk seals. Neither of the other two areas are based on the biology or ecology of the specific species. For example, the Navy indicated that, since harbor seals generally occur within 80 km of their haul-out sites, it *applied* the density estimates from the coast to 80-km offshore rather than deriving the density estimates based on that area. It would

[3] Using means and standard deviations that varied based on a lognormal distribution for densities and either a Poisson or lognormal distribution for group sizes.
[4] Extending to the extent of the U.S. exclusive economic zone (EEZ), 370 km from the coast.

have been more appropriate and logical for the Navy to take the approach it did for monk seals at HSTT and for harbor seals in the Northwest Training and Testing (NWTT) study area[5]—that is to use the area of occurrence to estimate the densities for harbor seals. For the other species, either the NMFS SOCAL stratum or the Navy SOCAL modeling area was used. However, none of the underlying abundance data are related to either of those areas, and it is unclear why two different areas were needed. Both are similar in extent, with the Navy SOCAL modeling area being approximately 13 percent larger than the NMFS SOCAL stratum.

In addition, some of the abundances used were not based on best available science. The Navy noted that its monk seal abundance was less than that reported by Baker et al. (2016), but that those more recent data were not available when the Navy's modeling process began. The Baker et al. (2016) data have been available for almost two years and should have been incorporated accordingly, particularly since the data would yield greater densities[6] and the species is endangered. For harbor seals, the Navy assumed that 22 percent of the stock occurred in SOCAL, citing Department of the Navy (2015). There are two concerns with this. First, one has to go to Department of the Navy (2015) to determine the original source of the information (Lowry et al. 2008; see Commission's 20 February 2014 letter on this matter). Second, Lowry et al. (2008) indicated that 23.3 percent of the harbor seal population occurred in SOCAL, not 22 percent[7] as used by the Navy.

For northern elephant seals in the California stock, the Navy assumed an annual growth rate of 1.7 percent for the last 10 years based on Lowry's (2002) field effort from 2001. Because it has been more than 15 years since those data were collected, the elephant seal abundance estimate for the California stock should have been based on at least 15 years of increasing trends. In addition, Lowry et al. (2014) indicated that the population was estimated to have grown 3.8 percent annually from 1988 to 2010. That growth rate is more applicable and should have been used. Further, it is unclear where the abundance estimate for elephant seals in Mexico originated. The Navy assumed that 68.5 percent of the seals[8] would occur in the SOCAL range complex. There were between 31,000 and 60,000 elephant seals estimated to occur in the Mexican population (Lowry et al. 2014), which would yield 21,235 to 41,100 seals, not 15,083 seals as proposed by the Navy. The elephant seal density for Mexico appears greatly underestimated based on the assumptions used. Deciphering the appropriateness of the California sea lion abundance estimates is even more difficult. The California population estimate was based on a personal communication and the Mexican population estimate was based on a Spanish-language document, which has not been translated and made available for public review. The use of both sources reduces transparency.

Another concern is that the correction factors that were applied to the population estimates to account for seasonality are either unsubstantiated or incorrect. For Guadalupe fur seals, the references cited[9] refer to harbor seals and cetaceans, not Guadalupe fur seals. The references cited

---

[5] The area was based on Calambokidis et al. (2004) reporting that seals occur within 40 km of the coastline for the offshore area.
[6] The 2015 abundance estimate is 19 percent greater than what the Navy used.
[7] Which was based on a single year of data, the lower of the two years (24.59 percent in 2002 and 21.98 percent in 2004) rather than the mean of both years.
[8] Based on 27 percent of the post-breeding and 9.5 percent of the post-molt migration for adult females and 15 percent of the post-breeding and 17 percent of the post-molt migration for adult males. It is unclear what data the Navy used regarding movements of juveniles and pups to exclude those age classes and whether those assumptions are valid.
[9] Barlow (2010) and Yochem et al. (1987).

for seasonal correction factors for northern fur seals and northern elephant seals are applicable to the species, but none provided the seasonal at-sea correction factors. Thus, it is unclear what assumptions the Navy made and what the specific underlying data were for those correction factors. For California sea lions, Lowry and Forney (2005) stipulated that 44[10] not 47 percent of the sea lions would be at sea during the cold season and 48[11] not 53 percent would be at sea during the warm season. Similarly for harbor seals, Yochem et al. (1987) indicated that 59[12] not 39 percent would be at sea during the warm season. However, Harvey and Goley (2011) used updated methods and provided more extensive data than Yochem et al. (1987). They found that harbor seals spend 35 percent[13] of the time hauled out and 65 percent in the water. The Navy indicated the cold season correction factor for harbor seals originated from Eguchi (2015), but that particular reference involves sea turtles. Eguchi and Harvey (2005) was noted in the harbor seal density section, but it also did not include haul-out correction factors. Those authors provided dive data that are not comparable to haul-out correction factors[14]. Finally for monk seals, the issue of appropriate correction factors is related to the Navy's failure to use the best available science[15]. Baker et al. (2016) indicated that 63[16] not 61 percent would be at sea in the MHI and Harting et al. (2017) indicated that 69[17] not 61 percent would be at sea in the NWHI.

The Commission continues to believe that data regarding movements and dispersion of tagged pinnipeds could yield better approximations of densities than the methods the Navy currently uses. Furthermore, pinnipeds generally are found in greater densities and in groups of more than one closer to known haul-out sites and rookeries. This has not been addressed through the Navy's use of uniform densities. The Commission understands the difficulty of analyzing these data in time to be incorporated into the Navy's current estimates but that should not prevent the Navy from doing so in future analyses. Therefore, the Commission recommends that, at the very least, NMFS require the Navy to revise the pinniped density estimates[18] by—

(1) using the extent of the coastal range (e.g., from shore to 80 km offshore) of harbor seals as the applicable area, 23.3 percent of the California abundance estimate based on Lowry et al. (2008), and an at-sea correction factor of 65 percent based on Harvey and Goley (2011) for both seasons;
(2) using the 2015 monk seal abundance estimate from Baker et al. (2016) and an at-sea correction factor of 63 percent for the MHI based on Baker et al. (2016) and 69 percent for the NWHI based on Harting et al. (2017);

---

10 Based on a haul-out correction factor of 1.77 for December 1998 data, 56 percent of the population would be hauled out and 44 percent would be in the water.
11 Based on the average haul-out correction factor of 1.93 for May-June and September 1998 data and July 1999 data, 52 percent of the population would be hauled out and 48 percent would be in the water.
12 Based on 41 percent hauled out each day, 59 percent would be in the water.
13 Based on a haul-out correction factor of 2.86 for SOCAL, 35 percent of the population would be hauled out and 65 percent would be in the water.
14 Additionally, harbor seals do not exhibit such drastic at-sea differences between the warm and cold season as purported by the Navy (39 and 85.5 percent, respectively). Harbor seals haul out steadily throughout the year and leave their haul-out sites twice per day with the changing tides. They do not remain onshore throughout the breeding season or make extensive movements, as do otariids and other phocids.
15 Wilson et al. was based on unpublished data at the time.
16 Based on 37 percent of the population would be hauled out and 63 percent would be in the water.
17 Based on 31 percent of the population would be hauled out and 69 percent would be in the water.
18 Rather than remodeling, the take estimates could be scaled based on the revised density estimates.

(3) using the same representative area for elephant seals, northern fur seals, Guadalupe fur seals, and California sea lions;
(4) using an increasing trend of 3.8 percent annually for the last 15 years for elephant seals as part of the California population and at least 31,000 as representative of the Mexico population based on Lowry et al. (2014); and
(5) using an at-sea correction factor of 44 percent for the cold season and 48 percent for the warm season for California sea lions based on Lowry and Forney (2005).

In addition, the Commission recommends that NMFS require the Navy to (1) specify the assumptions made and the underlying data that were used for the at-sea correction factors for Guadalupe and northern fur seals and (2) consult with experts in academia and at the NMFS Science Centers to develop more refined pinniped density estimates that account for pinniped movements[19], distribution, at-sea correction factors, and density gradients associated with proximity to haul-out sites or rookeries.

Criteria and thresholds

Thresholds in general—As stated in letters related to "NMFS's Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater acoustic thresholds for onset of permanent and temporary threshold shifts" (PTS and TTS, respectively; NMFS 2016), the Commission supports the weighting functions and associated thresholds as stipulated in Finneran (2016), which are the same as those used for Navy Phase III activities (Department of the Navy 2017a). Multiple recent studies provide additional behavioral audiograms (e.g., Branstetter et al. 2017, Kastelein et al. 2017b) and information on TTS (e.g., Kastelein et al. 2017a, 2017c, Kastelein et al. 2018). The Commission appreciates that developing weighting functions and associated thresholds is an extensive process and that the Navy cannot amend them with each new published dataset. However, the Navy should provide a discussion of whether those new data corroborate the current weighting functions and associated thresholds.

Behavior thresholds for non-impulsive sources—To further define its behavior thresholds for non-impulsive sources[20], the Navy developed multiple[21] Bayesian biphasic dose response functions[22] (Bayesian BRFs) for Phase III activities. The Bayesian BRFs were a generalization of the monophasic functions previously developed[23] and applied to behavioral response data[24] (see Department of the Navy 2017a 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

[19] Including using telemetry data and Markov process methods to estimate habitat-use probability densities.
[20] Acoustic sources (i.e., sonars and other transducers).
[21] For odontocetes, mysticetes, beaked whales, and pinnipeds. The Navy used the 120-dB re 1 μPa unweighted, step-function threshold for harbor porpoises as it had done for Phase II activities.
[22] 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.
[23] By Antunes et al. (2014) and Miller et al. (2014).
[24] From both wild and captive animals.

stimulate a context-based response based on factors other than received sound level[25]. The Bayesian BRFs are reasonable and a much-needed improvement on the two dose response functions (BRFs)[26] that the Navy had used both for TAP I and Phase II activities.

The Commission is concerned however, that following the development of the BRFs, the Navy then implemented various cut-off distances beyond which it considered the potential for significant behavioral responses to be unlikely (Table 17 in the *Federal Register* notice and Table C.4 in Department of the Navy 2017a). The Navy indicated it was likely that the context of the exposure is more important than the amplitude at large distances[27] (Department of the Navy 2017a)—that is, the context-based response dominates the level-based response. The Commission agrees but contends that, although the distance between the animal and the sound source is an important contextual factor, such factors have already been included in the Bayesian BRFs. Including additional cut-off distances contradicts the data underlying those functions and negates the intent of the functions themselves.

The actual cut-off distances used by the Navy also appear to be unsubstantiated. For example, the Navy indicated that data were not available regarding the response distances of harbor porpoises to sonar or other transducers, so it based the cut-off distances on harbor porpoise responses to pile-driving activities. The Commission disagrees with that choice, given that pile-driving activities are an impulsive rather than non-impulsive source and unrelated to the Bayesian BRFs. For pinnipeds, the Navy indicated there are limited data on pinniped behavioral responses in general, and a total lack of data beyond 3 km from the source. However, the Navy arbitrarily set the cut-off distance at 5 and 10 km depending on the source. In response to the Commission's comments regarding those cut-off distances, the Navy indicated that pinnipeds do not exhibit strong reactions to sound pressure levels up to 140 dB re 1 μPa based on Southall et al. (2007; 83 Fed. Reg. 65230). The Commission notes, as did the Navy, that those data were limited and were based on sources that did not have characteristics similar to MFA sonar[28]. Southall et al. (2007) additionally indicated that data did not exist regarding exposures at higher received levels at that time. Luckily, data on pinniped behavioral responses now exist for both sound sources similar to MFA sonar and at higher received levels. Those data ultimately were used by the Navy to develop the Bayesian BRF for pinnipeds (see Table 3-2 in Department of the Navy 2017a for specifics), while none of the data cited in Southall et al. (2007) were used. Some of the pinnipeds did in fact exhibit 'strong' reactions based on the Southall et al. (2007) severity scale[29] to received levels less than and equal to 140 dB re 1 μPa, and those data were used to inform the context portion of the Bayesian BRF.

---

[25] e.g., the animal's previous experience, separation distance between sound source and animal, and behavioral state including feeding, traveling, etc.

[26] One for odontocetes and pinnipeds and one for mysticetes.

[27] For example, the Navy indicated that the range to the basement level of 120 dB re 1 μPa for the BRFs from TAP I and Phase II sometimes extended to more than 150 km during activities involving the most powerful sonar sources (e.g., AN/SQS-53).

[28] Some sources emitted sound at much lower frequencies (the acoustic thermometry of the ocean climate (ATOC) sound source emitted signals at a center frequency of 75 Hz) and at a greater repetition rate than MFA sonar (Costa et al. 2003). Other sources emitted sound at higher frequencies (the Airmar™ acoustic harassment device (AHD) emitted signals at 10 kHz or higher and acoustic communication signals were emitted at 12 kHz with higher frequency harmonics) and at a greater repetition rate with shorter pulse durations (specifically the AHD) than MFA sonar (Jacobs and Terhune 2002, Kastelein et al. 2006).

[29] Equating to significant behavioral responses as specified by the Navy.

More concerning than how they were determined is the fact that, depending on the activity and species, the cut-off distances could effectively eliminate a large portion of the estimated numbers of takes. For sonar bin MF1 (the most powerful mid-frequency active sonars), the estimated numbers of takes would be reduced to zero for odontocetes beginning where the probability of response is 40 percent, for pinnipeds where the probability of response is 27 percent, and for beaked whales where the probability of response is 28 percent (Table 19 in the *Federal Register* notice and Table 6-10 in the LOA application). For mysticetes, takes would be eliminated for MF1 sources at a received level of 154 dB re 1 μPa equating to a probability of response of 17 percent. While that percentage may seem inconsequential, the received level is actually greater than the level at which actual context-based behavioral responses were observed for feeding blue whales (see Figure 3 in Goldbogen et al. 2013[30]). For all of these reasons, the Commission recommends that NMFS 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. Use of cut-off distances could be perceived as an attempt to reduce the numbers of takes. This is discussed in a subsequent section of this letter.

Behavior threshold for explosives—The Navy assumed a behavior threshold 5 dB less than the TTS thresholds for each functional hearing group for explosives. That value was derived from observed onset behavioral responses of captive bottlenose dolphins during non-impulsive TTS testing[31] (Schlundt et al. 2000). The justification for that threshold itself is a bit questionable, but more concerning is that the Navy continues to believe that marine mammals do not exhibit behavioral responses to single detonations (Department of the Navy 2017a)[32]. 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 if no further detonations followed. Although there are no data to substantiate that assertion, the Navy notes that the same reasoning was used in previous ship shock trial final rules in 1998, 2001, and 2008. Without such data, there is no reason to continue to ascribe validity to assumptions made 10 to 20 years ago. Larger single detonations (such as explosive torpedo testing[33]) would be expected to elicit 'significant behavioral responses'[34]. The Navy provided no evidence 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 more than 500 lbs. Therefore, the Commission recommends that NMFS estimate and ultimately authorize behavior takes of marine mammals during *all* explosive activities, including those that involve single detonations.

Mortality and injury thresholds for explosives—The Commission notes that the constants and exponents[35] associated with the impulse metrics for both onset mortality and onset slight lung injury have been amended from those used in TAP I and Phase II activities. The Navy did not explain why the

[30] Data that also were used to derive the Bayesian BRFs.
[31] Based on 1-sec tones.
[32] Including certain gunnery exercises that involve several detonations of small munitions within a few seconds.
[33] With net explosive weights of 500 to 650 lbs (Bin E11).
[34] Including the animals (1) altering their migration path, speed and heading, or diving behavior; (2) stopping or altering feeding, breeding, nursing, resting, or vocalization behavior; (3) avoiding the area near the source; or (4) displaying aggression or annoyance (e.g., tail slapping). These factors were described in Department of the Navy (2017a) and used by the Navy to differentiate behavioral response severity.
[35] The constants have increased and the exponents have decreased from 1/2 to 1/6.

constants and exponents have changed while the underlying data[36] remain the same. The modifications yield smaller zones[37] in some instances and larger zones in other instances[38]. These results are counterintuitive since the Navy presumably amended the impulse metrics to account for lung compression with depth, thus the zones would be expected to be smaller rather than larger the deeper the animal dives. The Commission recommends that NMFS require the Navy to (1) explain why the constants and exponents for onset mortality and onset slight lung injury thresholds[39] for Phase III have been amended, (2) ensure that the modified equations are correct, and (3) specify any additional assumptions that were made.

More importantly, the Navy only used the onset mortality and onset slight lung injury criteria to determine the range to effects[40], while it used the 50 percent mortality and 50 percent slight lung injury criteria to estimate the numbers of marine mammal takes[41]. That approach is inconsistent with the manner in which the Navy estimated the numbers of takes for PTS, TTS, and behavior for explosive activities. All of those takes have been and continue to be based on onset, not 50-percent values.

Although the effectiveness of the Navy's mitigation measures[42] has yet to be determined, the circumstances of the deaths of multiple common dolphins during one of the Navy's underwater detonation events in March 2011 (Danil and St. Leger 2011) indicate that the Navy's mitigation measures are not fully effective, especially for explosive activities. It would be more prudent for the Navy to estimate injuries and mortalities based on onset rather than a 50-percent incidence of occurrence. The Navy did indicate that it is reasonable to assume for its impact analysis—thus its take estimation process—that extensive lung hemorrhage[43] is a level of injury that would result in mortality for a wild animal (Department of the Navy 2017a). Thus, it is unclear why the Navy did not follow through with that premise. The Commission recommends that NMFS use onset mortality, onset slight lung injury, and onset GI tract injury thresholds to estimate both the numbers of marine mammal takes *and* the respective ranges to effect.

Procedural mitigation measures

Mitigation effectiveness—The Navy's proposed mitigation zones are similar to the zones[44] previously used during Phase II activities and are intended, based on the Phase III DEIS, to avoid the potential for marine mammals to be exposed to levels of sound that could result in injury (i.e., PTS). However, the Phase III proposed mitigation zones would not protect various functional hearing groups[45] from PTS. For example, the mitigation zone for an explosive sonobuoy is 549 m but the

---

[36] Based on Richmond et al. (1973), Yelverton et al. (1973), Yelverton and Richmond (1981), and Goertner (1982).
[37] When animals occur at depths between the surface and 8 m, yielding higher absolute thresholds.
[38] When animals occur at depths deeper than 8 m, yielding lower absolute thresholds.
[39] Equations 11 and 12 in Department of the Navy (2017a).
[40] To inform the mitigation zones.
[41] A similar approach was taken for gastrointestinal (GI) tract injuries.
[42] Which is discussed further herein.
[43] i.e., onset mortality; see Table 4-1 in Department of the Navy (2017a).
[44] The Commission appreciates that the Navy has provided estimated mean, minimum, and maximum distances for all impact criteria (i.e., behavior, TTS, PTS, onset slight lung injury, onset slight gastrointestinal injury, and onset mortality) for the various proposed activity types and for all functional hearing groups of marine mammals. That approach is consistent with the Commission's recommendations on Phase II activities.
[45] Primarily high- and low-frequency (HF and LF, respectively) cetaceans and phocids (PW).

mean PTS zones range from 2,113–3,682 m for HF[46]. Similarly, the mitigation zone for an explosive torpedo is 1,920 m but the mean PTS zones range from 7,635–10,062 m for HF, 1,969–4,315 m for LF, and 3,053–3,311 for PW[47]. The appropriateness of such zones is further complicated by platforms firing munitions (e.g., for missiles and rockets) at targets that are 28 to 139 km away from the firing platform. An aircraft would clear the target area well before it positions itself at the launch location and launches the missile or rocket. Ships, on the other hand, do not clear the target area before launching the missile or rocket. In either case, marine mammals could be present in the target area unbeknownst to the Navy at the time of the launch.

In addition, the Navy indicated in the DEIS that lookouts would not be 100 percent effective at detecting all species of marine mammals for every activity because of the inherent limitations of observing marine species and because the likelihood of sighting individual animals is largely dependent on observation conditions (e.g., time of day, sea state, mitigation zone size, observation platform). The Commission agrees and has made repeated recommendations to the Navy regarding the effectiveness of visual monitoring. Since 2010, the Navy has been collaborating with researchers at the University of St. Andrews to study Navy lookout effectiveness. The Navy does not appear to have mentioned that study in its DEIS for Phase III. For its Phase II DEISs, the Navy noted that data collected in that study were insufficient to yield statistically significant results. Nevertheless, the Commission continues to consider the basic information provided by the studies to be useful. In one instance, the marine mammal observers (MMOs) sighted at least three marine mammals at distances of less than 914 m (i.e., within the mitigation zone for mid-frequency active sonar for cetaceans), which were not sighted by Navy lookouts (Department of the Navy 2012). In other instances, MMOs sighted a group of approximately three dolphins at a distance of 732 m (Department of the Navy 2014a), a group of approximately 20 dolphins at a distance of 759 m (Department of the Navy 2014c), a group of approximately 9 pilot whales at a distance of 383 m (Department of the Navy 2014b), and a small unidentified marine mammal at 733 m (Department of the Navy 2014b)—none of which were documented as having been sighted by the Navy lookouts. Further, MMOs have reported marine mammal sightings not observed by Navy lookouts to the Officer of the Deck, presumably to implement mitigation measures (Department of the Navy 2010). Neither the details regarding those reports nor the raw sightings data were provided to confirm this. The Commission is not aware of any additional data that have been made available since 2014 but understands that any data that have been collected since then would not be sufficient to conduct a statistical analysis.

The Commission anticipates that the lookout effectiveness study will be very informative once completed, but notes that in the interim, the preliminary data *do* provide an adequate basis for taking a precautionary approach. The Commission continues to believe that, rather than simply reducing the size of the zones it plans to monitor, the Navy should supplement its visual monitoring efforts with other monitoring measures including passive acoustic monitoring. The Navy did propose to supplement visual monitoring with passive acoustic monitoring during three explosive activity types but not during the remaining explosive activities or during LFA, MFA, and HFA sonar activities. The Navy uses visual, passive acoustic, and active acoustic monitoring (via HF/M3) during

---

[46] The maximum range extends to 7,025 m for HF (Table 9-44) based on varying propagation environments as presented in Navy (2017b).
[47] The maximum ranges extend to 31,025 m for HF (Table 9-44), 8,025 m for LF (Table 9-45), and 8,275 m for PW (Table 9-52) based on varying propagation environments as presented in Department of the Navy (2017b).

SURTASS LFA sonar activities to augment its mitigation efforts over large areas. But, it indicated in its Phase III DEIS that it is not able to use HF/M3 during training and testing activities due to limitations regarding space, personnel, and the resources needed to design, build, install, and maintain the devices. The Navy, however, did not specify the limitations that prevent it from being able to use passive acoustic capabilities (devices and other assets) to monitor more than the three explosive activity types. As an example of how the presumed difficulties might be overcome, the Commission suggests that sonobuoys could be deployed with the target in the various target areas prior to the activity. This approach would allow the Navy to better determine whether the target area is clear and remains clear until the munition is launched.

The Navy indicated in the DEIS that it had capabilities to monitor instrumented ranges in real time or through data recorded by hydrophones at both the Southern California Offshore Range (SCORE) and the Pacific Missile Range Facility (PMRF) off Kauai, both of which are within the HSTT study area. The Commission also understands that the Navy is quite adept at detecting, classifying, and localizing individual marine mammals[48]. For example, Helble et al. (2015) were able to track multiple animals on PMRF hydrophones in real time, including humpback whales, a species that can be problematic to localize. Multiple animals were localized simultaneously with a localization error rate of 2 percent or less. Similar methods can be used for other species. Baird et al. (2015) also indicated that the PMRF hydrophones allow the PAM analyst to isolate animal vocalizations on the range, confirm species classification, and localize groups of animals in real time. Multiple detectors can be used for sperm whales, delphinids, beaked whales, and baleen whales. Similar to Helble et al. (2015), Baird et al. (2015) indicated that localization algorithms could determine an animal's position. In the case of bottlenose dolphins, that location was within approximately 100 m of the vocalizing animal. Similar localizations have been used to direct researchers to groups of vocalizing odontocetes to deploy satellite-linked tags as well[49] (Baird et al. 2014).

Although the Navy indicated that it was continuing to improve its capabilities for using range instrumentation to aid in the passive acoustic detection of marine mammals, it also stated that it didn't have the capability or resources to monitor instrumented ranges in real time for the purpose of mitigation. That capability clearly exists. While available resources could be a limiting factor, the Commission notes that personnel who monitor the hydrophones on the operational side do have the ability to monitor for marine mammals as well[50]. The Commission has supported the use of the instrumented ranges to fulfill mitigation implementation for quite some time (see the Commission's most recent 13 November 2017 letter) and contends that localizing certain species (or genera) provides more effective mitigation than localizing none at all.

Given that the effectiveness of Navy lookouts conducting visual monitoring has yet to be determined, the Commission believes that passive or active acoustic monitoring should be used to supplement visual monitoring, especially for activities that could injure or kill marine mammals. Therefore, <u>the Commission again recommends</u> that NMFS require the Navy to use passive and active acoustic monitoring, whenever practicable, to supplement visual monitoring during the

---

[48] Via the Marine Mammal Monitoring on Navy Ranges (M3R) program at SCORE and PMRF.
[49] Which also occurs on SCORE.
[50] For example, the engineer monitoring the hydrophones during a U.S. Air Force (USAF) activity at PMRF also listened for any signs of marine mammal life post [aerial clearance] survey and leading up to weapon impact (USAF 2016).

implementation of its mitigation measures for *all* activities that have the potential to cause injury or mortality beyond those explosive activities for which passive acoustic monitoring already was proposed, including those activities that would occur on the SCORE and PMRF ranges.

Pre- and post-activity monitoring—Based on the limitations noted for implementing mitigation measures during explosive activities, the Commission believes additional pre- and post-activity monitoring should be required. Although the Navy likely could not provide additional assets to clear an area prior to an activity, the existing assets (primarily for aircraft[51]) could conduct additional flyovers of the mitigation zone before expending any ordnance. Therefore, the Commission recommends that NMFS require the Navy to conduct additional pre-activity overflights before conducting any activities involving detonations barring any safety issues (e.g., low fuel).

In addition, NMFS would require the Navy to conduct post-activity monitoring for certain, but not all, activities involving underwater detonations. Specifically, post-activity monitoring would not be required after activities involving medium- and large-caliber projectiles, missiles and rockets, or bombs. Based on the uncertain effectiveness of the Navy's proposed mitigation measures, the Commission believes it would be prudent to require post-activity monitoring for these activities as well. That monitoring could occur immediately after the activity with additional surveys by activity aircraft as previously specified or vessels or when personnel retrieve the targets. The Commission recommends that NMFS require the Navy to conduct post-activity monitoring for activities involving medium- and large-caliber projectiles, missiles, rockets, and bombs.

Range to TTS—On the topic of TTS, the ranges to effect provided in Table 25 of the *Federal Register* notice and Table 6-4 of the LOA application appear to be incorrect. The ranges for LF cetaceans should increase with increasing sonar emission time. Therefore, the Commission recommends that NMFS determine what the appropriate ranges to TTS for bin LF5 should be and amend the ranges for the various functional hearing groups in the tables accordingly.

Least practicable adverse impact standard

In its 30 May 2017 letter regarding the SURTASS LFA sonar proposed rule, the Commission provided several recommendations concerning the least practicable adverse impact standard. The Commission recommended that NMFS adopt a two-step approach when applying the least practicable adverse impact standard. First, it should identify the criteria it will use to determine whether adverse impacts on marine mammal species or stocks or their habitat are anticipated. If adverse impacts are identified, the second step should be to determine whether measures designed to reduce those impacts are available and practicable. In the HSTT proposed rule, NMFS applied a two-step analysis, but one that differs from the approach recommended by the Commission. Rather than assessing whether the proposed activities have the potential to have adverse impacts on marine mammal species or stocks, the first factor in NMFS's analysis was "the manner in which, and the degree to which, implementation of potential [mitigation] measure(s) is expected to reduce adverse impacts to marine mammal species or stocks, their habitat, and their availability for subsistence uses (where relevant)." In applying its analysis, NMFS considered "such things as the nature of the potential adverse impact (such as likelihood, scope, and range), the likelihood that the measure will be effective if implemented, and the likelihood of successful implementation."

[51] Particularly in cases when aircraft routinely have extra fuel available, as some aircraft dump their fuel prior to landing.

The Commission agrees with some, but not all of NMFS's proposed steps for applying the least practicable adverse impact standard. The Commission agrees with NMFS (and the courts that have ruled on the matter) that the least practicable adverse impact standard is separate from, and in addition to, the negligible impact standard. A key threshold that must be met before an incidental take authorization can be issued is whether the anticipated taking will have no more than a negligible impact on the affected marine mammal species and stocks. However, even if the impacts are considered negligible, NMFS has an obligation to prevent or reduce further any remaining adverse impacts if it is practicable to do so.

The Commission also agrees that, as is the case with the negligible impact standard, the least practicable adverse impact standard is to be implemented at the level of marine mammal species and stocks. And, as NMFS recognized in its discussion in the preamble to the proposed rule, population-level effects accrue through effects on individuals, such that evaluation of potential impacts and mitigation measures needs to focus on individual animals, as well as, at the species or stock level. The Commission further posits that marine mammal moralities and serious injuries[52] that occur pursuant to activities conducted under an incidental taking authorization, while perhaps negligible to the overall health and productivity of the species or stock and of little consequence at that level, nevertheless are clearly adverse to the individuals involved and result in some quantifiable (though negligible) adverse impact on the population; it reduces the population to some degree. Under the least practicable adverse impact requirement, and more generally under the purposes and policies of the MMPA, Congress embraced a policy that minimizes, whenever it is practicable, the risk of killing or seriously injuring a marine mammal incidental to an activity subject to section 101(a)(5)(A), including taking measures in an authorization to eliminate or reduce the likelihood of lethal taking. <u>The Commission recommends</u> that NMFS address this point explicitly in its analysis and clarify whether it agrees that an incidental mortality or serious injury always should be considered an adverse impact for purposes of applying the least practicable adverse impact standard.[53]

<u>The Commission further recommends</u> that NMFS address the habitat component of the least practicable adverse impact provision in greater detail. The language in the MMPA strongly suggests that Congress believed that activities that compromise the value of important habitat (e.g., rookeries, mating grounds, and areas of similar significance) would always constitute an adverse impact and should be avoided or minimized whenever practicable. In light of this focus on habitat in the statutory provision, it is curious that NMFS's discussion of critical habitat, marine sanctuaries, and biologically important areas in the proposed rule is not integrated with the discussion of the least practicable adverse impact standard. It would seem that, under the least practicable adverse impact provision, adverse impacts on important habitat should be avoided whenever practicable. Therefore, to the extent that activities would be allowed to proceed in these areas, NMFS should explain why it is not practicable to constrain them further.

Because NMFS's proposed criteria for applying the least practicable adverse impact standard comingle elements related to whether impacts are adverse and whether potential mitigation measures

[52] NMFS has defined serious injury as "any injury that will likely result in mortality" (50 C.F.R. § 229.2) so, for purposes of this analysis, the Commission is treating serious injuries as lethal taking.
[53] In making this recommendation, the Commission recognizes that there may be situations when directed killing of a marine mammal benefits the population (e.g., the removal of a rogue male monk seal that is killing pups or females or sacrificing an animal to help find a cure for a disease that is decimating a population), but the Commission does not think that the incidental, unintentional taking allowed under section 101(a)(5)(A) constitutes such a situation.

are likely to be effective, NMFS's analysis is not as clear as it should be. For example, it is not readily apparent how the status of a species or stock is relevant to determining whether a proposed mitigation measure will be effective in reducing impacts or in evaluating the appropriateness of certain mitigation measures. While the Commission believes that a mortality should always be considered adverse, it agrees that the status of a stock is relevant in determining whether sub-lethal impacts (e.g., those from disturbance) are considered adverse to the affected marine mammal species or stock. That is, an impact that is unlikely to lead directly to the death of a marine mammal might be considered adverse to a depleted and declining stock but not to a healthy, thriving one. However, once a determination has been made that an impact would be adverse, the only question remaining is whether it is practicable to eliminate or reduce that impact. The Commission recommends that NMFS rework is evaluation criteria for applying the least practicable adverse impact standard to separate the factors used to determine whether a potential impact on marine mammals or their habitat is adverse and whether possible mitigation measures would be effective. In this regard, it seems as though the proposed "effectiveness" criterion more appropriately fits as an element of practicability and should be addressed under that prong of the analysis the Commission has recommended. In other words, a measure not expected to be effective should not be considered a practicable means of reducing impacts.

The most concerning element of NMFS's implementation of the least practicable adverse impact standard is its suggestion that the mitigation measures proposed by the Navy will "sufficiently reduce impacts on the affected mammal species and stocks and their habitats" (83 Fed. Reg. 11045). That phrase suggests that NMFS is applying a "good-enough" standard to the Navy's activities. Under the statutory criteria, however, those proposed measures are "sufficient" only if they have either (1) eliminated all adverse impacts on marine mammal species and stocks and their habitat or (2) if adverse impacts remain, it is impracticable to reduce them further. The Commission recommends that NMFS recast its conclusions to address these specific points and to provide sufficient detail as to why additional measures either are not needed (i.e., there are no remaining adverse impacts) or would not be practicable to implement.

Additionally, in its comments on the Navy's SURTASS LFA sonar proposed rule, the Commission sought clarification as to whether NMFS intended the discussion of least practicable adverse impact in that rule to provide the "formal interpretation" of that standard called for by the Ninth Circuit Court of Appeals in *NRDC* v. *Pritzker*. The Commission noted that such general guidance normally would be provided in an agency policy statement or in broader regulations implementing section 101(a)(5) of the MMPA, rather than in regulations specific to a particular authorization. The Commission again is concerned that NMFS is seeking to adopt generally applicable policy statements in this specific proposed rule rather than through a generally applicable regulation or policy directive, particularly if this is going to be an iterative process spanning multiple proposed rules, as now appears to be the case. The Commission therefore recommends that any "formal interpretation" of the least practicable adverse impact standard by NMFS be issued in a stand-alone, generally applicable rulemaking (e.g., in amendments to 50 C.F.R. § 216.103 or § 216.105) or in a separate policy directive, rather than in the preambles to individual proposed rules.

Level A harassment and mortality takes

The Navy used various post-model analyses for estimating the numbers of marine mammal takes during acoustic and explosive activities that are similar to methods used in its Phase II DEISs. Those analyses effectively reduced the model-estimated numbers of Level A harassment (i.e., PTS) and mortality takes. The analyses were based on (1) animal avoidance, (2) mitigation effectiveness, and (3) cut-off distances. The Commission has discussed the first two aspects at length in letters regarding Phase II activities. That information is not repeated herein but should be reviewed in conjunction with this letter (see the Commission's most recent 15 September 2014 letter). The Commission has a few additional comments on those analyses.

For avoidance, the Navy assumed that animals present beyond the range to onset PTS for the first three to four pings avoid any additional exposures at levels that could cause PTS (Department of the Navy 2017a). That equated to approximately 5 percent of the total pings or 5 percent of the overall time active; therefore, 95 percent of marine mammals predicted to experience PTS due to sonar and other transducers were instead assumed to experience TTS (Department of the Navy 2017a). That assumption has no scientific basis. Given that sound sources are moving, it may not be until later during an activity that the animal is close enough to experience PTS and it is those few close pings that contribute to the potential to experience PTS. The fact of an animal being beyond the PTS zone initially has no bearing on whether it will come within close range later during an activity since both sources and animals are moving. In addition, Navy vessels may move faster than the ability of the animals to evacuate the area. The Navy should have been able to query the dosimeters of the animats to verify whether its 5-percent assumption was valid.

Regarding mitigation effectiveness, the Commission notes that the specific mitigation effectiveness scores for the various activities were provided for Phase II but not for Phase III activities. For Phase III, the Navy included more detail regarding how the scores were determined (including species sightability, observation area extent, visibility factors, and whether sound sources were under positive control) but did not specify what the actual scores were for those four factors or the mitigation scores as a whole. The Navy also apparently did not include model-estimated numbers of takes. The lack of information makes it difficult for the Commission and the public to assess the appropriateness of the mitigation scores or their effect on the overall numbers of marine mammal takes. And, although the Navy did not reduce the numbers of injury (slight lung and GI tract) and PTS takes for explosive activities as it had for Phase II analyses, it still assumed its model-estimated mortality takes would not occur and zeroed out those takes to be enumerated as injury takes. Since the Navy has yet to determine the effectiveness of its mitigation measures, it is premature to include *any* related assumptions to reduce the numbers of marine mammal takes.

The flaws of the cut-off distances, which reduced the numbers of takes, were articulated in a previous section of this letter and it seems apparent that the post-analyses as a whole would underestimate the various numbers of takes. Therefore, the Commission again recommends that NMFS (1) authorize the total numbers of model-estimated Level A harassment (PTS) and mortality takes rather than reduce the estimated numbers of takes based on the Navy's post-model analyses and (2) use those numbers, in addition to the revised Level B harassment takes[54], to inform its negligible impact determination analyses.

[54] Based on the Bayesian BRFs only, not including the cut-off distances.

Pile-driving activities

The Navy did not indicate which method it used, the Navy Acoustic Effects Model (NAEMO) or NMFS's user spreadsheet, to estimate the ranges to effects during pile-driving activities, and ultimately the numbers of marine mammal takes. Based on the estimated extents of the PTS zones[55], the Navy does not appear to have used NMFS's user spreadsheet. That tool would yield PTS zones[56] for impact pile driving that range from 55 to 1,343 m for the various functional hearing groups. If the Navy incorporated the relevant source spectra and actual weighting functions, those zones would be smaller but not as small as reported by the Navy. The Navy apparently did not accumulate the energy over the entire day of activities, which is standard practice for all pile-driving activities, including those the Navy conducts (e.g., 83 Fed. Reg. 9366 and 10689). Rather, the Navy appears to have used approximately 1 minute[57] of impact pile driving[58] to inform the various zones rather than the full 90 minutes of activities proposed. The ranges to PTS and TTS for vibratory pile driving[59] similarly are non-reproducible from the information provided in the *Federal Register* notice and LOA application. It also is unclear whether the Navy included as assumed swim speed and/or turnover rate of the animals. Specifics on those parameters should have been provided, especially given that the various odontocetes and pinnipeds that could occur in the area exhibit much different swim speeds and residency patterns (i.e., traveling through the area vs. feeding and milling).

In addition, the PTS and TTS zones for LF and HF cetaceans are estimated to be the same during impact pile-driving activities (Table 39 in the *Federal Register* notice and Table 6-36 in the LOA application). Neither NAEMO (based on results for the other broadband sources) nor NMFS's user spreadsheet would yield the exact same ranges for LF and HF cetaceans. Therefore, the Commission recommends that NMFS require the Navy to (1) specify what modeling method and underlying assumptions, including any relevant source spectra and assumed animal swim speeds and turnover rates, were used to estimate the ranges to PTS and TTS for impact *and* vibratory pile-driving activities, (2) accumulate the energy for the entire day of proposed activities to determine the ranges to PTS and TTS for impact *and* vibratory pile-driving activities, and (3) clarify why the PTS and TTS ranges were estimated to be the same for LF and HF cetaceans during impact pile driving.

---

[55] Ranging from 2 to 65 m for the various functional hearing groups in Table 39 of the *Federal Register* notice and Table 6-36 of the LOA application.

[56] Assuming six piles would be driven per day with 35 strikes per minute for a total of 15 minutes per pile, a source level of 182 dB re 1 μPa^2-sec, transmission loss of 16.5 (Sections 1.4.1.3 and 6.4.4.3.1 of the LOA application), and a weighting factor adjustment of 2 kHz. The Commission further notes that Table 1-4 in the LOA application incorrectly indicated that the source level metric for impact pile driving is a peak sound pressure level. The 192-dB re 1 μPa source level is based on root-mean-square (rms, as referenced in Table 2 of the *Federal Register* notice), not peak. The peak value would be approximately 15 dB greater than the rms value.

[57] If this is in fact the case, the Navy would have assumed that animals would only be exposed during the first minute (or two) of pile-driving activities consistent with its assumptions for its acoustic sources discussed previously herein. Although consistent with those assumptions, it is not consistent with real-world conditions.

[58] Which would yield zones ranging from 3 to 68 m based on the assumptions in the previous footnote and 30 strikes.

[59] In addition, the source levels based on SPL_{rms} and SEL should be the same value. However, the SEL-based source level is 1 dB less than the SPL_{rms}-based source level as reported in Table 2 of the *Federal Register* notice.

Negligible impact determination

NMFS applied both qualitative and quantitative analyses to inform its negligible impact determination. In general, NMFS has based negligible impact determinations[60] associated with incidental take authorizations on abundance estimates provided either in its stock assessment reports (SARs) or other more recent published literature. For the HSTT proposed rule, NMFS used the abundance estimate as determined by the Navy's underlying density estimates rather than abundance estimates from either the SARs or published literature. NMFS also did not specify how it determined the actual abundance given that many of the densities differ on orders of kilometers[61]. Interpolation or smoothing, and potentially extrapolation, of data likely would be necessary to achieve NMFS's intended goal—it is unclear whether any such methods were implemented. In addition, it is unclear whether NMFS estimated the abundances in the same manner beyond the EEZ as it did within the EEZ for HRC and why it did not compare takes within the EEZ and beyond the EEZ for SOCAL, given that a larger proportion of the Navy's SOCAL action area is beyond the EEZ than HRC. Furthermore, NMFS did not specify how it determined the proportion of total takes that would occur beyond the EEZ. Presumably, that was based on modeling assumptions and model-estimated takes provided by the Navy, but this is not certain.

Moreover, the 'instances' of the specific types of taking (i.e., mortality, Level A and B harassment) do not match the total takes 'inside and outside the EEZ' in Tables 69–81 (where applicable) or those take estimates in Tables 41–42 and 67–68[62]. It also appears the 'instances' of take columns were based on only those takes in the EEZ for HRC rather than the area within and beyond the EEZ. For example, 2,849 takes of pantropical spotted dolphins (pelagic stock) presumably would occur outside the EEZ and were not enumerated in the 'instances' of take columns. Thus, it is unclear what types of takes those constitute and whether they were simply ignored. It further is unclear why takes were not apportioned within and beyond the EEZ for SOCAL. Given that the negligible impact determination is based on the total taking in the entire study area, NMFS should have partitioned the takes in the 'instances' of take columns in Tables 69–81 for all activities that occur within *and* beyond the EEZ.

In short, NMFS's analytical approach for negligible impact determination is not transparent. The methods and resulting data cannot be substantiated with the information provided. Quantitative analyses are preferred over qualitative analyses but only if those quantitative analyses are appropriate and well informed. Until such time that NMFS provides the relevant information, the Commission and the public cannot comment on NMFS's quantitative analysis for its negligible impact determination.

[60] And small numbers determination, which is not applicable to military readiness activities.
[61] Resolution is at a scale of 10 km.
[62] Mortalities are missing altogether for mysticetes and sperm whales in Tables 69–72. The Commission also notes that for short-beaked common dolphins and California sea lions, the mortalities were increased to the next whole number from 1.2 to 2 and 0.8 to 1, respectively. The same tack should be taken for mysticetes and sperm whales.

The Commission appreciates the effort and analyses put into development of the LOA application submitted by the Navy. Please contact me if you have questions concerning the Commission's recommendations or rationale.

Sincerely,

Peter O. Thomas, Ph.D.,
Executive Director

References

Antunes, R., P.H. Kvadsheim, F.P. Lam, P.L. Tyack, L. Thomas, P.J. Wensveen, and P.J. Miller. 2014. High thresholds for avoidance of sonar by free-ranging long-finned pilot whales (*Globicephala melas*). Marine Pollution Bulletin 83(1):165–180.

Baird, R.W., S.W. Martin, D.L. Webster, and B.L. Southall. 2014. Assessment of modeled received sound pressure levels and movements of satellite-tagged odontocetes exposed to mid-frequency active sonar at the Pacific Missile Range Facility: February 2011 through February 2013. Prepared for U.S. Pacific Fleet. 26 pages.

Baird, R.W., A.N. Dilley, D.L. Webster, R. Morrissey, B.K. Rone, S.M. Jarvis, S.D. Mahaffy, A.M. Gorgone, and D.J. Moretti. 2015. Odontocete studies on the Pacific Missile Range Facility in February 2014: Satellite-tagging, photo-identification, and passive acoustic monitoring. Prepared for Commander, U.S. Pacific Fleet. 44 pages.

Baker, J.D., A.L. Harting, T.C. Johanos, and C.L. Littnan. 2016. Estimating Hawaiian monk seal range-wide abundance and associated uncertainty. Endangered Species Research 31:317–324.

Barlow, J. 2010. Cetacean abundance in the California Current estimated from a 2008 ship-based line-transect survey. NOAA Technical Memorandum NMFS-SWFSC-456. Southwest Fisheries Science Center, La Jolla, California. 24 pages.

Branstetter, B.K., J. St. Leger, D. Acton, J. Stewart, D. Houser, J.J. Finneran, and K. Jenkins. 2017. Killer whale (*Orcinus orca*) behavioral audiograms. The Journal of the Acoustical Society of America 141:2387–2398. http://dx.doi.org/10.1121/1.4979116.

Calambokidis, J., G.H. Steiger, D.K. Ellifrit, B.L. Troutman, and C.E. Bowlby. 2004. Distribution and abundance of humpback whales (*Megaptera novaeangliae*) and other marine mammals off the northern Washington coast. Fishery Bulletin 102:563–580.

Costa, D.P., D.E. Crocker, J. Gedamke, P.M. Webb, D.S. Houser, S.B. Blackwell, D. Waples, S.A. Hayes, and B.J. Le Boeuf. 2003. The effect of a low-frequency sound source (Acoustic Thermometry of Ocean Climate) on the diving behavior of juvenile northern elephant seals, *Mirounga angustirostris*. Journal of the Acoustical Society of America 113:1155–1165.

Danil, K., and J.A. St. Ledger. 2011. Seabird and dolphin mortality associated with underwater detonation exercises. Marine Technology Society Journal 45(6):63–87.

Department of the Navy. 2010. Appendix C–Cruise report, marine species monitoring and lookout effectiveness study: Submarine Commanders Course, February 2010, Hawaii Range Complex. *in* Marine mammal monitoring for the U.S. Navy's Hawaii Range Complex and Southern California Range Complex Annual Report 2010. Department of the Navy, U.S. Pacific Fleet. 31 pages.

Department of the Navy. 2012. Cruise report, marine species monitoring and lookout effectiveness study: Koa Kai, November 2011, Hawaii Range Complex. *in* Marine species monitoring for the U.S. Navy's Hawaii Range Complex 2012 Annual Report. Department of the Navy, U.S. Pacific Fleet, Honolulu, Hawaii. 12 pages.

Department of the Navy. 2014a. Final cruise report, marine species monitoring and lookout effectiveness study: Koa Kai, January 2014, Hawaii Range Complex. Department of the Navy, U.S. Pacific Fleet, Honolulu, Hawaii. 29 pages.

Department of the Navy. 2014b. Final cruise report, marine species monitoring and lookout effectiveness study: Submarine Commanders Course, August 2013, Hawaii Range Complex. Department of the Navy, U.S. Pacific Fleet, Honolulu, Hawaii. 18 pages.

Department of the Navy. 2014c. Final cruise report, marine species monitoring and lookout effectiveness study: Submarine Commanders Course, February 2014, Hawaii Range Complex. Department of the Navy, U.S. Pacific Fleet, Honolulu, Hawaii. 12 pages.

Department of the Navy. 2017a. Technical report: Criteria and thresholds for U.S. Navy acoustic and explosive effects analysis (Phase III). SSC Pacific, San Diego, California. 194 pages.

Department of the Navy. 2017b. Quantifying acoustic impacts on marine mammals and sea turtles: Methods and analytical approach for Phase III Training and Testing. Space and Naval Warfare Systems Center Pacific, San Diego and Naval Undersea Warfare Center, Newport. 91 pages.

Eguchi, T. 2015. SOCAL sea turtle abundance. Personal communication between Tomoharu Eguchi (NMFS SWFSC) and Mike Zickel (ManTech) via email.

Eguchi, T., and J.T. Harvey. 2005. Diving behavior of the Pacific harbor seal (*Phoca vitulina richardii*) in Monterey Bay, California. Marine Mammal Science 21(2):283–295.

Ellison, W.T., B.L. Southall, C.W. Clark, and A.S. Frankel. 2011. A new context-based approach to assess marine mammal behavioral responses to anthropogenic sounds. Conservation Biology 26(1):21–28.

Finneran, J.J. 2016. Auditory weighting functions and TTS/PTS exposure functions for cetaceans and marine carnivores. May 2016. SSC Pacific, San Diego, California. 73 pages.

Goertner, J.F. 1982. Prediction of underwater explosion safe ranges for sea mammals. Naval Surface Weapons Center, Dahlgren, Virginia. 31 pages.

Goldbogen, J.A., B.L. Southall, S.L. DeRuiter, J. Calambokidis, A.S. Friedlaender, E.L. Hazen, E.A. Falcone, G.S. Schorr, A. Douglas, D.J. Moretti, C. Kyburg, M.F. McKenna, and P.L. Tyack. 2013. Blue whales respond to simulated mid-frequency military sonar. Proceedings of the Royal Society B 280(1765):20130657.

Harting, A.L., J.D. Baker, and T.C. Johanos. 2017. Estimating population size for Hawaiian monk seals using haulout data. Journal of Wildlife Management 81:1202-1209.

Harvey, J.T., and D. Goley. 2011. Determining a correction factor for aerial surveys of harbor seals in California. Marine Mammal Science 27(4):719–735.

Helble, T.A., G.R. Ierley, G.L. D'Spain, and S.W. Martin. 2015. Automated acoustic localization and call associations for vocalizing humpback whales on the Navy's Pacific Missile Range Facility. Journal of the Acoustic Society of America 137:11–21.

Jacobs, S.R., and J.M. Terhune. 2002. The effectiveness of acoustic harassment devices in the Bay of Fundy, Canada: Seal reactions and a noise exposure model. Aquatic Mammals 28:147–158.

Lowry, M.S. 2002. Counts of northern elephant seals at rookeries in the Southern California Bight: 1981–2001.NOAA Technical Memorandum NMFS-SWFSC-345. Southwest Fisheries Science Center, La Jolla, California. 68 pages.

Lowry, M.S., and K. A. Forney. 2005. Abundance and distribution of California sea lions (*Zalophus californianus*) in central and northern California during 1998 and summer 1999. Fishery Bulletin 103(2):331–343.

Lowry, M.S., J.V. Carretta, and K.A. Forney. 2008. Pacific harbor seal census in California during May–July 2002 and 2004. California Fish and Game 94(4):180–193.

Lowry, M.S., R. Condit, B. Hatfield, S.G. Allen, R. Berger, P.A. Morris, B.J. Le Boeuf, and J. Reiter. 2014. Abundance, distribution, and population growth of the northern elephant seal (*Mirounga angustirostris*) in the United States from 1991 to 2010. Aquatic Mammals 40(1):20–31.

Kastelein, R.A., S. van der Heul, W.C. Verboom, R.V.J. Triesscheijn, and N.V. Jennings. 2006. The influence of underwater data transmission sounds on the displacement behaviour of captive harbor seals (*Phoca vitulina*). Marine Environmental Research 61:19–39.

Kastelein, R.A., L. Helder-Hoek, and S. Van de Voorde. 2017a. Effects of exposure to sonar playback sounds (3.5–4.1 kHz) on harbor porpoise (*Phocoena phocoena*) hearing. The Journal of the Acoustical Society of America 142(4):1965–1975. https://doi.org/10.1121/1.5005613.

Kastelein, R.A., L. Helder-Hoek, and S. Van de Voorde. 2017b. Hearing thresholds of a male and a female harbor porpoise (*Phocoena phocoena*). The Journal of the Acoustical Society of America 142(2):1006–1010. http://dx.doi.org/10.1121/1.4997907.

Kastelein, R.A., L. Helder-Hoek, S. Van de Voorde, A.M. von Benda-Beckmann, F.-P. A. Lam, E. Jansen, C.A.F. de Jong, and M.A. Ainslie. 2017c. Temporary hearing threshold shift in a harbor porpoise (*Phocoena phocoena*) after exposure to multiple airgun sounds. The Journal of the Acoustical Society of America 142(4):2430–2442. https://doi.org/10.1121/1.5007720.

Kastelein, R.A., L. Helder-Hoek, A. Kommeren, J. Covi, and R. Gransier. 2018. Effect of pile-driving sounds on harbor seal (*Phoca vitulina*) hearing. The Journal of the Acoustical Society of America 143(6):3583–3594. https://doi.org/10.1121/1.5040493.

Miller, P.J., R.N. Antunes, P.J. Wensveen, F.I. Samarra, A.C. Alves, P.L. Tyack, P.H. Kvadsheim, L. Kleivane, F.P. Lam, M.A. Ainslie, and L. Thomas. 2014. Dose-response relationships for the onset of avoidance of sonar by free-ranging killer whales. The Journal of Acoustical Society of America 135(2):975–993.

NMFS. 2016. Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing: Underwater acoustic thresholds for onset of permanent and temporary threshold shifts. Office of Protected Resources, NMFS, Silver Spring, Maryland. NOAA Technical Memorandum NMFS-OPR-55. 178 pages.

Richmond, D.R., J.T. Yelverton, and E.R. Fletcher. 1973. Far-field underwater-blast injuries produced by small charges. Lovelace Foundation for Medical Education and Research, Defense Nuclear Agency, Washington DC. 95 pages.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins, *Tursiops truncatus*, and white whales, *Delphinapterus leucas*, after exposure to intense tones. The Journal of Acoustical Society of America 107(6):3496–3508.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendation. Aquatic Mammals 33:411–521.

USAF. 2016. Protected species monitoring and mitigation results for 2016 Long Range Strike Weapon System Evaluation Program operational testing: Pacific Missile Range Facility, Kaua'i, HI. Department of the Air Force, Eglin Air Force Base, Florida. 8 pages.

Yelverton, J.T., and D.R. Richmond. 1981. Underwater explosion damage risk criteria for fish, birds, and mammals. Paper presented at the 102nd Meeting of the Acoustical Society of America, Miami Beach, Florida. 35 pages.

Yelverton, J.T., D.R. Richmond, E.R. Fletcher, and R.K. Jones. 1973. Safe distances from underwater explosions for mammals and birds. Lovelace Foundation for Medical Education and Research, Albuquerque, New Mexico. 64 pages.

Yochem, P.K., B.S. Stewart, R.L. DeLong, and D.P. DeMaster. 1987. Diel haul-out patterns and site fidelity of harbor seals (*Phoca vitulina richardsi*) on San Miguel Island, California, in autumn. Marine Mammal Science 3(4):323–332.